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On the cover: Gary Smith and his son, Blaine, bolt an extension to a lead section while installing helical piers for a house under construction in Arnold, Md. See the story on page 35. Photo by Chad Smith.

FEATURES

DEPARTMENTS

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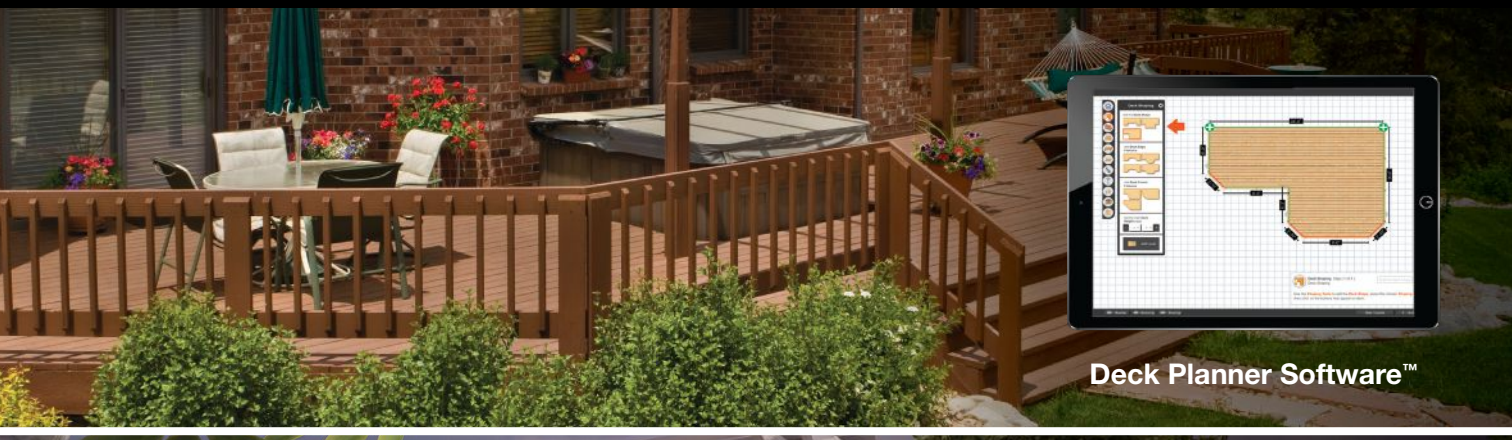

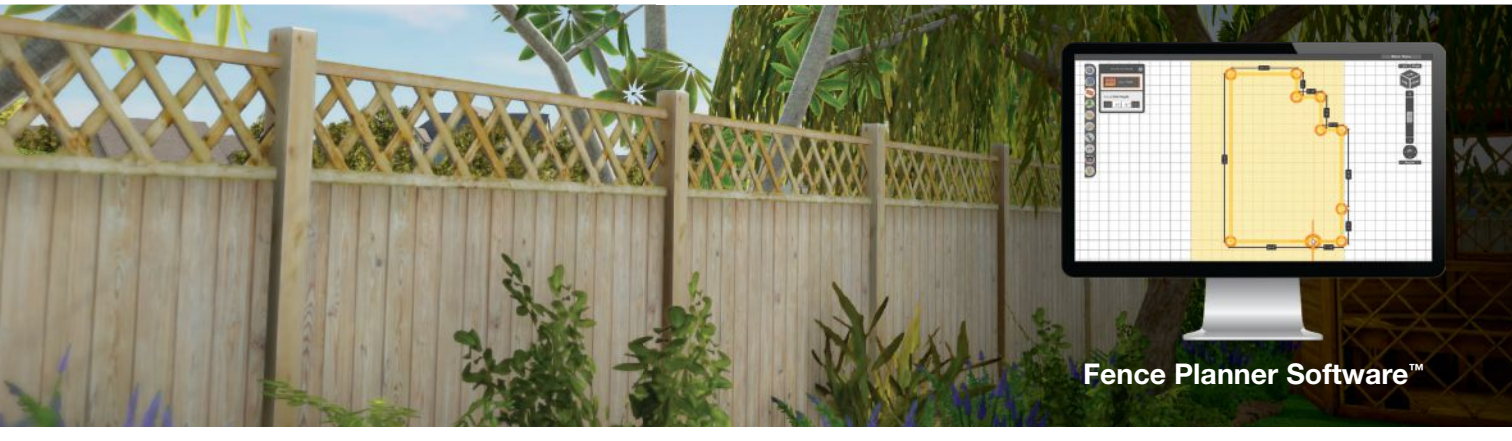

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"UNTANGLING THE SKILLED LABOR KNOT" (APR/23)

I take this problem seriously as it affects my business significantly. When I joined the trades 25 years ago, I did it because I wanted to be a carpenter; when I made this decision, I did everything in my power to learn the trade—books, trial and error, always asking questions. I learned from the older carpenters that you can build a whole house by learning a framing square and also learned the importance of details and craftsmanship, as well as math and building science.

I have been out on my own for 21 years and built a successful business as a custom home builder in Wyoming based on a firm foundation of quality and a firm grasp on "how" to build a home that lasts.

In my opinion, most of the new breed of worker do not want to learn the ins and outs of the trade. I've had several guys who have worked for a few years, picked up the basics, and then gone out on their own. It is easier for this new breed to work 25 to 30 hours per week, make their own schedule, and charge a rate higher than the wage they were making as a payroll employee. These glorified handymen are filling a necessary gap in the workforce, but what inevitably happens is these guys will eventually take on a big job that is above their skill level, and they'll fail in business.

What we get left with is reputable, aging, skilled contractors having no one to train and pass down their skills to. On the flip side, unsuspecting customers are hiring inexperienced tradesmen at the very same rates as the older qualified contractors who are struggling to find field employees. I often hear stories about these inexperienced tradesmen doing a poor job and charging high rates. Oftentimes, the people are so desperate to get their windows replaced or a deck built that they settle for these less experienced tradesmen, which is bad for the industry.

I am not one for regulations, but the carpentry trade needs some form of universal degree or certificate, similar to that of a journeyman or master plumber, that truly reflects one's skill set. Instead, in our area, all you need is a hammer, and you can go out and work on someone's home.

I wish construction and carpentry would be taught as a degree in our colleges, so that young people could have the experience and esteem of getting a degree but also be a part of our workforce.

I'm not sure how we achieve that, but I would love to be part of the dialogue and the solution. I want to keep going and pass my skills to someone who shares the same zest for the trade that I do. What I do know is that we are in big trouble, especially in our rural communities. The good ones are getting older and burning out, while those coming up seem less and less competent. Can we leave this necessary trade in their hands?—*Luke Magargal, Cody, Wyo.*

Nice job on your article about the trades. I would add to your list that we need to improve the culture at the jobsite to make it more accepting of new and young people, and less hostile. The old methods of shaming or teasing someone who has limited training so they won't make the same mistakes again are not appealing to current prospects.

Another point: On-the-job training conducted by those who were also trained only at the jobsite limits the skills and knowledge of the potential workforce. I believe that on-the-job training should be supported by and support technical education related to whatever trade one pursues. In fact, seasoned workers who learned only through on-the-job experience would benefit greatly from the knowledge of a younger worker who has had the technical training. —*Shawn McCadden, Brookline, N.H.*

Thank you for the article on our ongoing skilled labor problems. We used to consider hiring only carpenters who had their own tools, and the inspection of their toolbox (including my father running his thumb across the end of a prospective hire's chisels) was an essential step before we would ever consider hiring someone.

My, how things have changed! These days, we don't bother. We are happy to have anyone who projects a positive attitude and shows up on time for the interview. The hires who have worked out best tend to have some of their own tools already, though it's rare that someone young has a complete set of hand and power tools. We have acquired several extra saws and drill/drivers and keep a few lightly loaded toolbelts on hand to "lend" to new hires. We encourage employees to buy their own tools and will cover half the cost of many tools if they get advance approval, which gives us an opportunity to make recommendations and steer them toward tools we think will serve them well over time (red, dark green, yellow, and turquoise blue tools, not orange, light green, or navy blue). We add this cost to our overhead and we have only three full-time carpenters, so it's not a big expense. But it does seem to inspire new, young carpenters and helps them begin to build interest in their work. —*Tom Brice, Albuquerque, N.M.*

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CLAYTON DEKORNE WITH RICK MILLS, JEREMY KASSEL, AND MIKE WHALEN

Jobsite Etiquette

JLC sat down with Rick Mills, Jeremy Kassel, and Mike Whalen in this first of a series of articles exploring the roles and responsibilities of project managers. Each of these individuals works under a slightly different business model that together nicely span the range of businesses of many JLC readers: Rick is senior project manager for Jackson Andrews Building + Design, a custom builder based in Virginia Beach, Va.; Jeremy operates as a "bags on" general contractor and assumes the role of project manager on renovation projects in and around Albany, N.Y.; and Mike Whalen is a lead carpenter at DBS Remodel, a design-build residential remodeling company based in Poughkeepsie, N.Y.

This first article springs from a presentation Jeremy did at the 2023 JLC Live conference on "Jobsite Etiquette"—a topic that Rick and Mike had each talked with JLC about previously as a possible subject for an article. "Etiquette" seems a fancy word to describe the necessary decorum that project managers must adopt to be effective communicators with clients, trade partners, and co-workers, but it is appropriate to the skillful maneuvering with people that is necessary in the service roles project managers assume. In his JLC Live presentation, Jeremy organized the discussion around the different parties that project managers interact with—clients, employees, subcontractors, and vendors. We started from this premise, focusing on the client-project manager relationship first. —Clayton DeKorne

Jeremy Kassel: When most people think of the term "jobsite etiquette," they probably think of behavior, but it's more than this. It's more than good manners, more than "please and thank you" and taking off your shoes at the door. It includes those, but it is more about (I don't want to say "personality" management, because I think that has a different connotation) how we work effectively with people on the job. This requires certain skills—we call them "soft skills"—but it's also an approach, which is hard to pin down, because there is so much variability in the perspectives of the people involved. While some of these things you can teach, or at least build awareness around, some of them come only with experience. I have somebody working for me who's 24 years old, and he's going to handle things very differently from somebody who's my age (I'm 44).

***JLC*:** If we don't have that experience, can we build that awareness? What are some ground rules, or tools and procedures for working with clients you can pass along to other project managers?

KEY ELEMENTS

Mike Whalen: When it comes to serving the client, I think the key elements we depend on, or build a relationship around, are the project design that we have agreed on with the client, along with the contract that defines the scope of work—the service that we will provide. Once they have been presented to the client, we have a foundation and can walk onto the job confident about what our company needs to provide. They set the tone. The clients trust that we're going to fulfill that contract, and if we go off contract, we have to complete a change order right away, so we make it clear we are doing something different from the contract.

Most of the issues that arise come from the client either not understanding the design documents or having a different idea of the job scope. It's on us—me as a project manager, especially—to make sure we are on the same page about these documents. When something comes up, we have to address it right away. If we don't, and the client holds on [to their misinformed point of view] too long, the harder it is to resolve a problem. As a project manager, I have to protect our company from that occurring.

Most of the issues that arise come from the client either not understanding the design documents or having a different idea of the job scope.

But there are times when it becomes more difficult. For example, we had a situation in which the client didn't like the tile installation. I think they were within reason. I had been policing the installer [a subcontractor] on the quality of the tile work and understood where the client was coming from, so I made the call and said, "OK, everything comes out. We will do it over." It's tough sometimes being able to deliver on what's promised and meet the expectations of the client. But we have to stand by our work.

In this case, I put myself in the client's position, and it was clear we had to redo the tile, as difficult as that was to the schedule and our margins. This is the challenging part because it's not straightforward. It was a very fine line. It wasn't a botched job that was horrible, that anyone walking in would say, "Clearly, this has to be redone." Some clients would be willing to accept the installation. We wouldn't want to take advantage of that and deliver shoddy work. But at the same time, some clients can be so picky, and you have to draw a line, so they don't take advantage of us.

In this particular example, my decision ate into the company's profit. Maybe 10 or 15 years ago, I would have been in a panic, thinking, "Now we're going to lose time and money on this job." But I see it differently now: It came down to the bigger value. I saw this as an opportunity for the company. At the end of the day, the customer will remember how we handled the problem. They're going to say, "We weren't happy with the tile. But they came in, and they took all of it out and redid everything to make sure we were happy." While it's a loss now, in the long run it's a marketing win. Not that we're looking for that, but in the moment, you have look at the big picture, and it helps to understand these situations as opportunities.

CLEAR LINES OF COMMUNICATION

Rick Mills: In our company, Jackson [the company owner] is our main salesperson, so obviously the clients have built a relationship with him early on. He needs to clearly turn the project over to the project manager and establish that this person is the main point of contact. We do this by scheduling a preconstruction meeting, and it's important for me to go in there and build rapport with the client right away.

I've been with Jackson about 10 years, so there's a lot of built-up trust between us. I usually handle the preconstruction meetings alone, so my role is usually clear to the client at the beginning. Jackson will come if I ask him, and maybe he'll check in with the client once a month. But it's always clear that I am taking the lead communicating with the client.

That's first—a good handoff from sales to the project manager to build trust with the client so that there's no "Hey, we need to call Jackson and see what he thinks." We definitely don't want a situation where the homeowner wants to speak to the owner all the time about job details the project manager is handling. I see my role here is to protect Jackson from this sort of thing occurring. The job of the project manager is taking that off the company owner's plate, so there is one less thing for them to worry about.

The main goal of the preconstruction meeting is to go over the scope of work. Like Mike said, this is where we need to be very clear. Problems are most likely to come up when a client doesn't fully grasp the scope of the job or thinks something is in that scope of work that isn't actually documented and budgeted.

Of course, we start with the scope of work, but it's always developing. Clients constantly want to do more, and so managing those changes is a big part of the process—getting them priced, drafting a change order, and getting signoff from the client and making sure they are recognizing the changes to the budget.

MW: We have a similar process. We conduct a preconstruction meeting where I'll meet the clients and go over the job scope. The company owner, Brian, used to be the main salesperson, but he has hired on sales consultants, and that has allowed him to take a step back to concentrate on bigger-picture concerns for the company. He may stop by. It depends on the size of the job; it could be every two weeks. It could be once a month. Same kind of thing, though: My role is to make sure that clients aren't calling him all the time about the job.

We use Builder Trend, which I update every day, and he will track the progress of jobs through this. But it's on me to make decisions in the course of the job, even when it has an impact on the bottom line, like the tile decision. A company owner has to have project managers he trusts. He needs to know you have the best in mind for the company. Every project manager is going to have a track record of how their jobs come in and if they're profitable based on the decisions that project manager makes.

At the end of every job, we do a job analysis—an autopsy of how I did. That's something that everyone can look back on. It includes a look at how I did ordering materials. We don't use purchase orders that need to be approved, because that can really slow things down. But I'm accountable for material orders, and I have to stay conscious of what's in the budget. How well I do will come to light at the end of the project. This system gives me a lot of independence but also makes me accountable. I think it shows a lot of respect for my abilities, and it relies on the respect I have for the company's goals.

DON'T WAIT TO ADDRESS ISSUES

RM: While I do try to protect Jackson, the owner, it's also important to recognize when I need to call him in to help resolve an issue. Of course, we all want to handle those issues ourselves. And the way to do that is to jump on them as soon as they arise and make sure things never escalate to an extreme level. Recognizing when a communication problem arises between you and a client, or when a client is uncomfortable with a decision, or even when you see something go wrong on the job—the wrong delivery, something damaged, or a mistake by a subcontractor, or anything that might have financial consequences—you need to step in and let the client know right away that you see the problem and are working on it. It's so much worse if the client discovers it for themselves. I'm also going to reach out to Jackson and fill him in. He may not need to step in, but he needs to know what's happening.

Yes, you have to be responsive and not let things wait. But of course, there are going to be people who you just know you're never going to please. Hopefully, our sales process has weeded out those clients who may be really difficult or who can't make a decision, the husband or wife who can't agree, most of the problem clients. We do have to say "no" and not take on some jobs. Of course, it helps that we're still in a market right now where there's plenty of work and we can pick and choose the jobs we want to take on.

So, yeah, it's being selective with your clients, but honestly, most of them we have a blast with. There are ups and downs over the course of any job, and we work through them, but everybody gets along fine, and I think that comes not just from us being selective about clients but from clients being selective about who they want to work with as a builder.

MW: Early on when I was project managing, I think it was just more of a pride thing: I felt like I needed to take care of as much as possible on my own. I felt that if I didn't, Brian would think I couldn't handle it. It took me awhile to learn when and where it's

necessary to get him involved. I agree, the owner needs to be kept informed when things go awry. At the same time, there are a lot of hard decisions he's not going to be the best to handle. He's not in the mix. As he should, he's delegated everything to others, so he may not have all the answers. I have a better grasp on the details because I'm on site all the time.

AWARENESS OF OTHER PEOPLE'S DOMAIN

***JLC*:** Ideally, a contract would include some sort of rules of the road for how you communicate with clients and how they communicate with you. But these are going to be broad: They might spell out the process for conducting a preconstruction meeting and will reference the scope of work and hopefully set some boundaries on when clients can call and who they should call with questions. But there are a lot of little things that the contract doesn't cover. To help us with these, are there any guidelines you can offer on how project mangers should conduct themselves going into a new job, especially in remodeling situations where you are literally living in their home for a time?

JK: In my JLC Live session, I touched on some contractor do's and don'ts for the first meeting and when doing a walk-through of the home with a client. For example, I don't open any doors in any client's house without asking first. It doesn't matter if it's a cabinet door, closet door, entry door, pantry door. You're in someone's home, so you have to keep reminding yourself that this is their space and you have to abide by their rules. Like I always ask if they want me take off my boots and put on a pair of house shoes.

Other things are much less clear, though. What if somebody offers you a glass of wine or beer at a meeting? Is that OK? Or I had one incident when doing a walk-through and measuring for a window replacement job. Taking out my tape measure in the dining room, I set my aluminum, flip-top clipboard on the dining room table. The client looked at me and said something to the effect, and I'll paraphrase, "If you don't take that clipboard off my table, you will not be hired for this job." I was taken aback. It never even crossed my mind that this wouldn't be OK, because the dining room table that I grew up with was not an heirloom. Any protection we put on our dining room table was decorative; you know, if there was a holiday or a party, we put a nice tablecloth on it but not to protect the table necessarily.

As it turned out, that response, the way he said it, was a bit of a red flag, because he was a difficult client to work for. We did end up doing the work, and all in all, we did a good job, and he was happy with it, though not without vocalizing what he was unhappy about along the way and being very particular about a lot of things. This first experience with him, however, was the point at which I thought to myself, "OK, not everybody's built the same." Not everybody has the same mindset as I do. And you need to always remember that you're in somebody else's domain. The awareness of these two things—people's different perspectives and that you're meeting them on their turf—demands that I ask a whole host of questions: Things like which sink should I be washing my hands in, and even which towel should I be drying my hands on. It's their home. They're going to be particular about certain things that are impossible to foresee. All clients, all human beings, whether they're the building owner or even a tenant, are going to be particular about certain things. It could be a clipboard, it could be shoes, it could be where you park your vehicle. The list goes on and on and on when you're working in someone's home.

Not everybody's built the same … All clients, all human beings, whether they're the building owner or even a tenant, are going to be particular about certain things.

***JLC*:** That constant awareness about being in another person's domain you speak of is paramount. Maintaining that awareness takes practice, I think: Being aware and acting on that awareness, choosing to ask rather than assume, is key. It seems like that is an important stand-in for experience. Because experience is the other key, right? You [Jeremy] and Mike both touched on the importance of that. For you, Jeremy, these learning moments—the clipboard, the hand towels—were eye opening when you first encountered them. They gave you that insight, and the next time you were in a client's home you were reminded and knew what not to do and knew to ask first. And that's exactly how our experience grows. As experienced project managers, you have all developed a natural way of working in a person's home. But until project managers gain that experience, they have to learn to maintain an awareness, an alertness to how others have different perspectives, which they need to respect.

I want to ask, Rick, I know a lot of the jobs you do now are the bigger projects, mostly new construction and not necessarily living with the client during the workday. What are the little client issues you deal with on a new build that aren't necessarily spelled out in the contract?

GRAY AREAS IN THE CONTRACT AND SCOPE OF WORK

RM: Certainly, there are communication issues. Most relate back to the scope of work and the contract, as Mike pointed out. Even in new construction, it's common to find some gray areas that weren't spelled out specifically in the contract or scope of work. If it's something we missed, like the shower door, then we're just going to take care of it. But other times, the client will misremember what was in the scope of work, or they had one thing in mind that didn't really get expressed at the design phase.

Here's one example: We had one-piece crown scoped in, but the client was expecting a larger, three-piece crown. That can create some frustration for them. I wasn't in those meetings, so it's hard for me to speak to what happened to help that frustration.

It's important for me not to make any judgments or speculate in any way on how that might have happened. Speaking from a place you're not certain about can go sideways, and I try to avoid that. What I can do is be clear that the job wasn't priced for one-piece crown and show them what it will cost to change it. That doesn't take away the frustration, but it shifts the focus away from why it happened and toward how we move forward. There's no perfect solution, but if you can move on effectively, they'll usually get over it and be like, "Yeah, that's fine. Let's get the price for the three-piece crown."

LEARNING HOW TO READ PEOPLE AND SHIFT PERSPECTIVE

***JLC*:** There's a lot of finesse involved when the client is not OK with paying more or with not getting what they think they now want, like the three-piece crown. You have to be super-diplomatic to keep the client's emotions from taking over. I used to have to remind myself I was in a service position with clients. It's a fine line because you don't want to grovel or show too much weakness because some people may take advantage of that, as Mike mentioned earlier. I think this stems sometimes not so much from their greediness, necessarily, but more from emotions around asserting what they want, which might spiral out of control. But at the same time, you want to be respectful and be there to serve. That's a fine line to strike. Any tips on how to finesse this?

RM: That's something we've learned over the years. From early on, Jackson has done a really good job of protecting our reputation. Like with Mike's tile example, there have been plenty of times where we have done something that we had to pay for to make sure the client felt satisfied in the end. We did that knowing the client will remember and tell their friends that we made it right even though we had to eat that. That's what gets you a good reputation and gets you good jobs in the future. But you're right, we have faced certain personalities that get carried away with their emotions.

MW: There's a skill in being able to read people that can help you avoid getting taken advantage of. But it's hard to teach. It's an awareness. And there is a whole range of personalities that force you to adapt how you communicate. For example, if someone starts out very nervous, concerned, asking a lot of questions. You need to read that and shift to that. I'm working for a client like that right now who just left for the city where she has another place. I have to send her lots of pictures. I have to do a lot more back and forth with her.

In our company, we spend a lot of training time on EQ, emotional intelligence, by working through different role plays to help talk with people in certain difficult or unfamiliar situations on the job. A lot of it has to do with being able to shift your perspective. We've had project managers in the past that couldn't make this shift. They weren't able to deal effectively with, for example, employees who made mistakes or with vendors when a delivery got messed up. Issues with deliveries and material orders come up a lot: It isn't going to be delivered on time; the truck broke down; it's not going to be here until next week. It's sometimes difficult to be understanding, especially when we're on a schedule. But it's going to pay off if you treat them well and can be understanding. The pay off is that when you need them, they're going to go out of their way and remember how you treated them when things got tight. There's also a payoff in being able to work with a tough client. It can help you retain employees and just have good working relationships with trade partners and vendors.

There is a whole range of personalities that force you to adapt how you communicate.

RM: I would say with all of our trade partners and vendors, we really like to be the intermediary and be the only person who interfaces with the client. Occasionally, it might be necessary to bring a trade partner into the discussion to discuss a certain detail we might not have knowledge about. But as a rule, we always want to assume that lead role communicating with the client.

I think this makes it easier on the client. You're the only person they need to worry about communicating with. It's the project manager's job to go to the different people from there. It's also nice for the trade partners and vendors.

When you're talking to a trade partner or vendor, it's often best to shoot straight—get right to the point and not tiptoe around certain things. And they shouldn't have to worry too much about how they speak. It's our job as project mangers to work out what they mean and what course of action to take from their observations or opinions. But you don't want that trade partner speaking that direct [unfiltered] to the client. It's better if we interpret those remarks and say it to the client in a way they can hear it best.

JK: I agree that it's important to protect trade partners and vendors. It's also important that we maintain a healthy separation between vendors and trade partners and the client. I learned this early in my career when speaking with the client about a door I was installing. I referred several times to the name of the person at the lumberyard, Butch, who supplied the door. Well, then the client had a problem with the door and called the lumberyard, asking for Butch. The client should have come to me with that issue. Clearly, it was my responsibility. The whole thing snowballed, because then I had Butch asking, "Why is your client calling me to handle this? Why aren't you handling it?" So, yes, we need to establish that single line of communication with the client but also stay conscious of how we maintain it.

***JLC*:** There's a lot to digest here and we have only begun to scratch the surface. Let's pick this up in the next session, looking more at the project manager's etiquette with trade partners as well as with employees.

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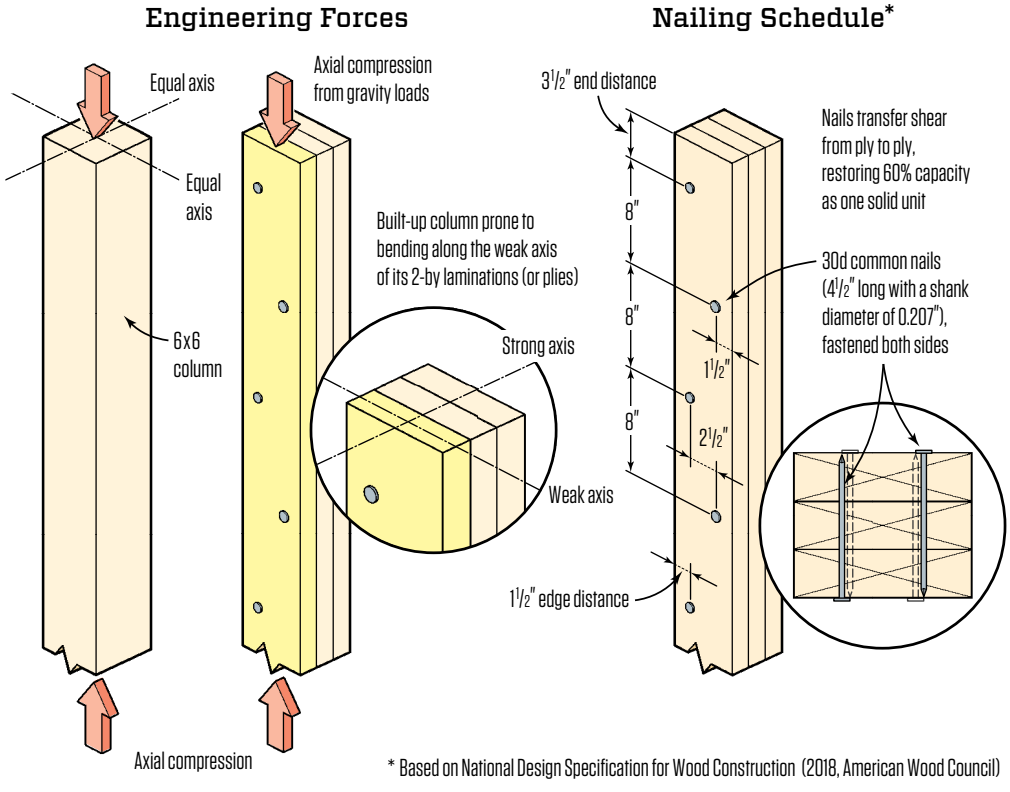
Q Is a site-built column made with three pressure-treated No. 2 southern pine 2x6s and 1/2-inch plywood spacers added to produce a 5 1/2-by-5 1/2-inch cross-section the structural equivalent of a solid-sawn 6x6 post made of the same material? If not, will laminating the layers together with construction adhesive make the column stronger?

A *Frank Woeste, P.E., professor emeritus at Virginia Tech, responds:* The short answer to the first question is no; a solid-sawn column will always be stronger than a free-standing, built-up column made with graded dimensional stock of the same lumber species. But it's possible that the column can be built so that it is strong enough to function as a structural alternative. Don't rely on glue, though; while it might help and certainly can't hurt, there's no way to determine the structural benefit and assign any meaningful values for a field-glued assembly.

Columns are subject to axial compression from gravity loads (and tension from wind uplift). To find the compressive strength of a built-up column made up of three 2x6s, you can't just look up the compressive strength of one of the 2x6s and multiply it by three. Instead, there's a formula in the NDS (National Design Specification for Wood Construction) that can be used to find the column's allowable compression stress. If the 2x6s are nailed together per the rules (see illustration, below), the reduction factor is 0.6, or a 40% reduction in allowable axial stress. It matters what material you use to build the columns. Fortunately, compared with some species, the design properties of 2x6 southern pine are very good.



Axial loads on a built-up column tend to act on the weak axis of each member, rather than on the whole assembly as they would with a solid-sawn column (far left). Even when the plies are fastened together per NDS specifications (left), the bending strength of a post assembled from three 2x6s is about 60% that of a solid-sawn 6x6 post.

Illustrations by Tim Healey

In addition to proper placement, the size and quality of the nails are important. The NDS specifies quality 30d common nails, which have a shank diameter of 0.207 inch and are 4 1/2 inches long, and so will penetrate through all three laminations. As tested, there are no gaps between the 2x6 members of the columns, so any plywood or OSB spacers should be added to the outside of the assembly after the plies are nailed together. It may be possible to fasten the plies together with structural screws, though you would need to determine (likely from their manufacturer) the size and number of screws needed to equal the NDS-required nailing schedule.

The purpose of the nails or screws is to transfer shear from ply to ply, as the column is prone to bend about the weak axis. The fastener's task is to make the plies behave as one solid unit in an attempt to restore some of the bending stiffness and strength that is lost by not using a solid-sawn column.

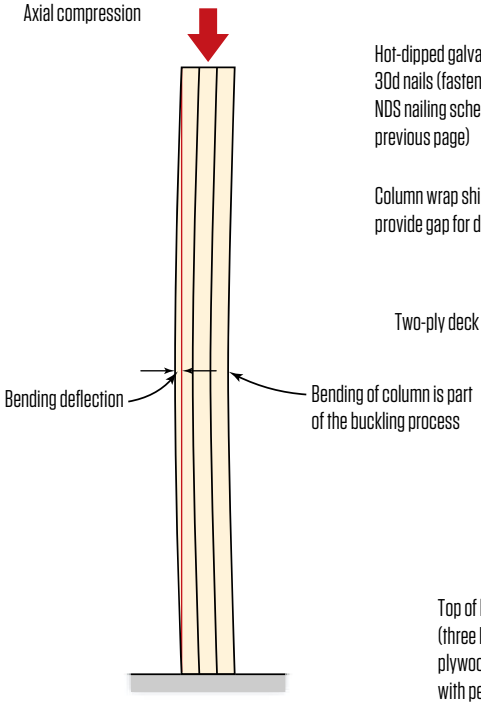
The overriding principle is "column buckling," which is the result of "column bending." "Bending deflection" is the devil. Once an unbraced column starts to bend—let's call the amount Δ—under an axial load P, a bending moment (P x Δ) is created. This in turn creates more Δ, which creates more bending moment from the same P until eventually the column fails ... it's a runaway process.

In short, there is nothing simple about substituting a three-ply column for a solid-sawn column. Some of the lumber that is now available is much weaker and has lower density, or nail strength, and less stiffness, or modulus of elasticity (E), than southern pine. Along with the design details discussed above, E and compression strength parallel-to-grain are the most important variables for column strength.

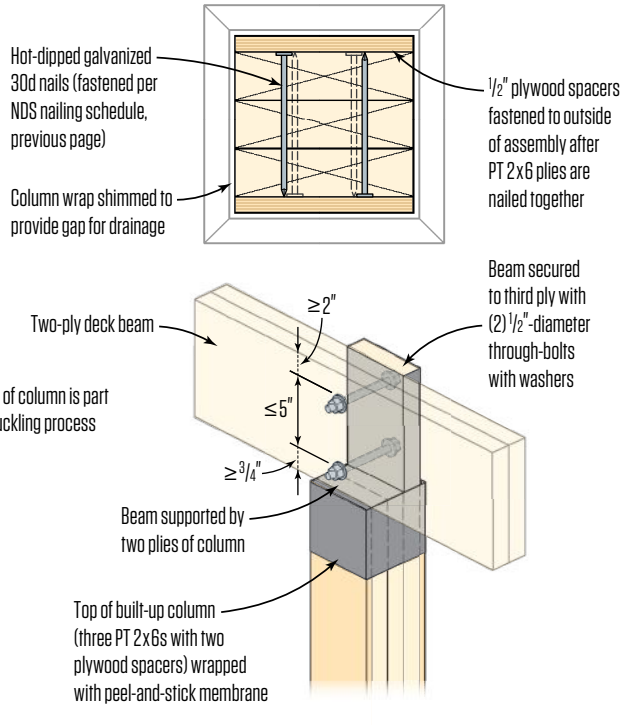
Another concern is water protection, say, if a PVC column wrap is used. Can wind blow water into the wrap, or is it a square sleeve? How can these columns be inspected in service if covered by a sleeve?

The pathway to using nail-laminated posts is for the contractor to decide on the species, the required preservative treatment (note that because the posts fall under the definition of "critical structural elements," the lumber used to build them should be "ground contact" preservative treated per AWPA Use Category 4A), the post height, the tributary loading, the snow load if applicable (more than 40 psf), and the method of connecting the plies. Then an engineer could come up with a go or no-go answer. If the answer is go, then the engineer can say using a certain species, you can replace the nails (which must be hot-dipped galvanized) with certain structural screws (which must also be hot-dipped galvanized or the equivalent) based on the manufacturer's rating and the properties of the nails as specified by the NDS.

Bending Deflection



Example: Wrapped Exterior Column



Under load, each ply in a built-up column deflects along its weak axis (far left). Proper nailing helps to transfer shear from ply to ply and strengthen the assembly, while a column wrap can help prevent water from penetrating the plies (top left). For better water protection, the author recommends wrapping the top or beam pocket, along with the rest of the column, with a flashing membrane (bottom left) and providing a drainage gap between the column wrap and the outside plywood spacers, which should be only lightly nailed to the assembly.

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Photos by Gary Striegler

A Framing Trick for Retrofitting a Wide Door

BY GARY STRIEGLER

As a young carpenter working on a condo project, I gained a good bit of experience installing 6-foot-wide sliding glass doors. The builder-grade units came fully assembled, and once we got past the hurdle of hauling them to the right room, installation was just a matter of laying down a bead of silicone on the floor, lifting the door into position, cross-taping it to make sure it was square, and screwing the nailing flanges to the wall sheathing. The doors functioned well when they were new, but years later, I noticed on a return trip for a remodeling project that many had been replaced with hinged units.

Recently, we installed a much larger sliding glass door unit as part of a kitchen remodel and patio addition. The client was opening up the interior floor plan, replacing the kitchen cabinets, and adding a roof over a large patio off the kitchen, but a major part of the project was replacing the existing windows and a door separating the kitchen from the patio with a 16-foot-wide-by-8-foot-tall sliding glass door. Sliding the two 4-foot-wide center operating panels open created an almost 8-foot-by-8-foot opening that extended the kitchen space outdoors.

Complicating the project, a large beam—installed as part of a previous remodel and carrying considerable roof and ceiling loads—was buried in the bearing wall that we needed to remove to install the new door unit. Supporting the exterior roof loads and the interior beam while we made a 16-foot-wide rough opening was going to be a tall order. Since we needed engineering to size the new header, I looked for a simpler solution.

Applied beam. Working together with the engineer we had hired to come on site to calculate loads and help with beam sizing, we came up with a plan to glue and lag-bolt a new, long beam capable of supporting those loads to the inside of the wall before we opened it up for the new door. After supporting the beam and framing the new rough opening with a new 2x4 wall inside the old wall, we would be able to tear out the existing wall to complete the rough opening. Not having to tear out the old wiring to get the new header in place was a bonus. My client was fine with losing about 5 inches out of

To frame the opening for a new 16-foot-wide door, the author stripped the drywall from the existing wall and applied construction adhesive to the framing where a new, 16-inch-wide LVL beam would be located **(1)**. Workers used a 3-ton trolley jack and a series of supports in graduated lengths to slowly lift the heavy beam into position **(2, 3)**.


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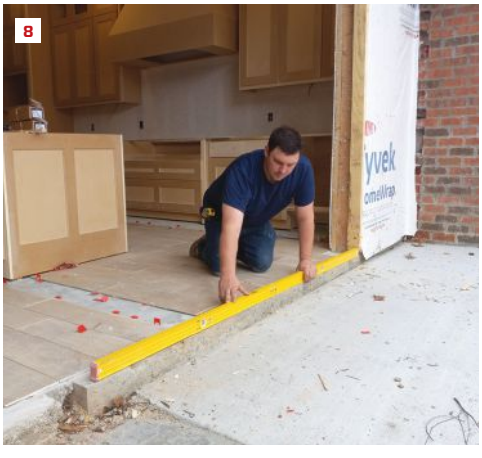
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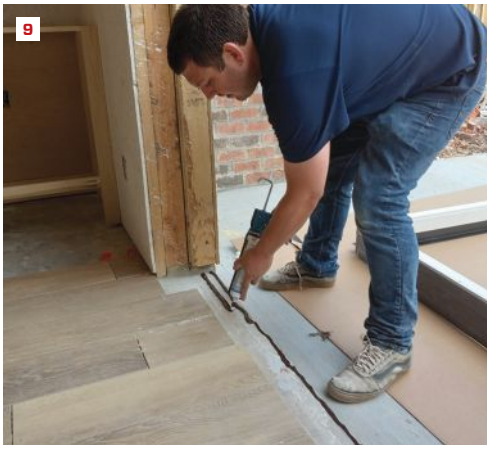
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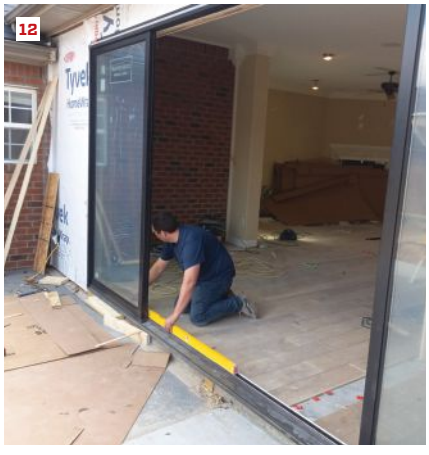
Once the 1 3/4-inch-wide LVL was fastened to the framing with LedgerLok structural screws, alternating layers of 3/4-inch and 1/2-inch plywood ripped to width were added to the assembly with glue and screws until the beam measured 3 1/2 inches thick **(4)**. With the rough framing and wiring completed and new drywall installed, workers closed in the opening with a temporary wall **(5)**. The new door arrived disassembled, so the frame had to be screwed together prior to installation, and part of the new tile floor had to be trimmed back to accommodate the door frame **(6)**. A chisel was needed to remove dried construction adhesive that had been used to glue the old wall plates to the concrete slab floor **(7)**. After checking for dips and high spots **(8)**, a worker applied a couple of beads of 100% silicone sealant to the slab for bedding the sill **(9)**.

the large kitchen if it saved her time and money on the framing.

Getting the 20-foot-plus-long-by-16-inch-deep LVL in place wasn't much fun, but it would have been a lot harder going into the exterior wall with temporary supports everywhere. After the LVL was installed, the engineer's design called for building up the beam thickness with layers of plywood glued and screwed to the LVL to match the 3 1/2-inch-wide wall framing.

As soon as the beam was complete, we removed the original

Sealant was also applied to the door frame before the outside panels were installed and screwed to the frame **(10)**. Workers used a 2x4 to lever the heavy door into position and lower it onto the sealant **(11)**. The crew checked that the door sill was level **(12)** and that the jambs were plumb **(13)**, then measured the diagonals to make sure that the frame was square **(14)**.



windows and door, framed in the new rough opening, and called in the electrician. Because we were over a month out on delivery of the door, we filled in the hole with a temporary wall as soon as the electrician was finished.

Door installation. The door arrived as four panels and a carton full of frame and track pieces. I waited for a warm, dry day and headed to the job with part of my crew to remove the temporary wall. Our next step was to screw the frame together (pro tip: make sure you use all the parts included for joining the frame). Since the project included a new, 14-foot-deep roof over the patio off the kitchen, we weren't too concerned about long-term waterproofing, but I did need to make sure the installation was airtight. We carefully scraped all the old caulking off the slab and checked for high spots with a level before carrying the frame outside.

To prevent any air leaks under the sill, we prepped the opening by laying down a heavy double bead of silicone sealant on the slab floor and partway up each wall. We also applied sealant to the frame before screwing the two outside panels into place, then lifted the assembly. That made the door frame a lot heavier and harder to lift in place, but the result was a better installation (the right way usually is harder). To make the job easier, we used a 2x4 as a lever to lift each end up and over the sealant before bedding it down.

For sliding doors to fit and operate properly, the frame has to be perfectly both plumb and square. We started by carefully plumbing the door jambs, putting a few screws in the corners to hold them in place. Next, we used an 8-foot level to check for high spots in the bottom track, then cross-taped to check the diagonals for square.

The last step in setting the frame was to make sure the top was straight. To do this, we used the 8-foot level again but also double-checked by climbing up a ladder to sight along the whole top before running screws through the top flange. While doing this, we noticed that lifting the frame in place had caused one of the fixed panels to shift a little, which we fixed by wedging a 2x4 against the other fixed panel and applying a little pressure.

Rollers on the bottom of each operating panel allow them to glide along the bottom track, but the tops of the panels are held in place with removable guides. To set an operating panel, you start at the bottom then stand the panel up, slide the upper guide in place, and mount it with screws, repeating the process for the second panel.

On our installation, both panels rolled very smoothly, but it's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After checking the head jamb to make sure it was straight and level and screwing the door's nailing flange to the sheathing, a worker sets one of the removable panels onto the bottom track and installs the upper guide, which holds the panel in place **(15)**. Then he inserts shims between the door frame and the header to ensure that the upper track is straight **(16)**. Rubber bumpers that snap down over the lower track keep the sliding panels from hitting the jambs **(17)**, while small L-brackets help to fasten the fixed panels to the frame **(18)**. To finish up the door installation, the worker installs a wooden trim strip that covers the upper track **(19)**. The installed door is now ready for extension jambs and trim. The author will wait to install the door hardware until after the paint crew finishes their work **(20)**.

possible to make adjustments if necessary by tweaking the rollers, which are independently adjustable, under each end of the doors. We added a few shims to make sure the inside edge of our track was straight, then angle brackets to secure the fixed panels to the frame before installing the bumpers. We finished up the installation with a wood trim strip screwed in place to cover the upper track.

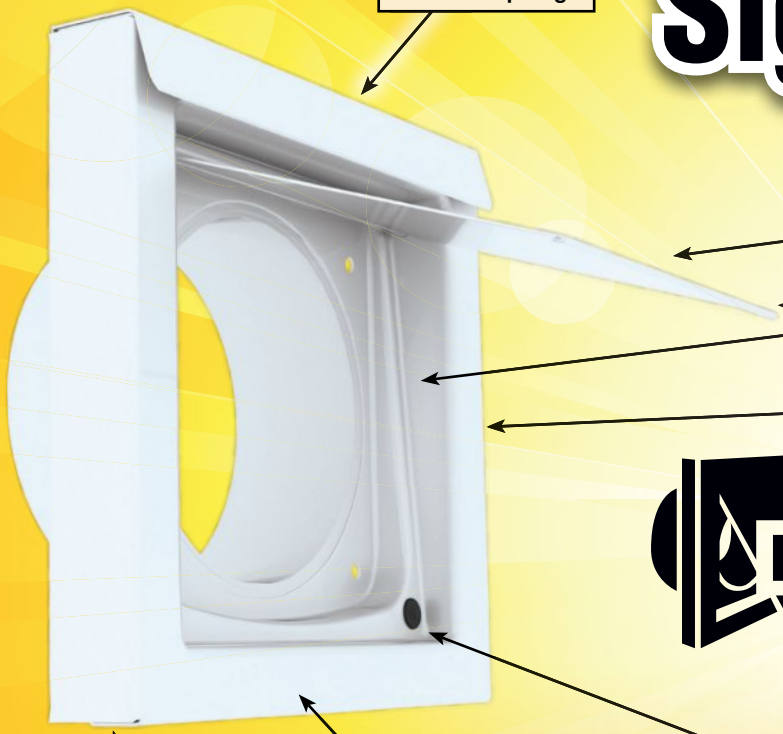
I didn't want to install any lock hardware until the painters finished, so we went old school and just cut 2x4s to drop in the track for a lock. About a week later, we returned and foamed around the frame with low-expansion foam. Then we added jamb extensions to make up for the added wall thickness and added casing trim.

Back in the day, we could have installed five smaller door units in the amount of time it took to complete this one extra-large one, but I am pretty sure if I come back to remodel this house in 20 years, the XL door will still be there and sliding as well as it does today.

Gary Striegler, a JLC contributing editor, owns Craftsman Builders, in Fayetteville, Ark., and teaches workshops at the Marc Adams School of Woodworking. Follow him on Instagram at @craftsmanbuilders or visit his website at craftsmanbuildersnwa.com.

Upon Closer Inspection Excellence Stands Out

Sight To See



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BY BRIAN ALTMANN

Becoming the Company Your Clients Want

I've been in the remodeling business for 37 years. I own and operate a design-build company with 23 full-time employees. We mostly do kitchens, bathrooms, and finished-basement remodeling work and typically have seven to 10 jobs running simultaneously. When it comes to running a remodeling business, I'm pretty much self-taught, but I don't think that's an admirable trait. I wasn't smart enough to seek business coaching along the way, so I learned just by my mistakes—the school of hard knocks, as they say.

Recently, it dawned on me that over those 37 years, my business has morphed into the company my clients wanted it to be rather than the company that I initially thought it would be (particularly over the past 10 to 15 years as we have increasingly incorporated client feedback into our business operations). Feedback, both from clients and other sources, such as employees and trade partners, has led to changes in how we approach customer service. We've learned to change the way we treat our clients, how to show more gratitude toward them, and how to ask them more (and better) questions.

Simply put, properly incorporating feedback from our clients has led to improvements in our customer service. Better customer service has led to greater value, and greater value has boosted our bottom line, allowing us to afford our valuable employees, our company trucks and trailers, worker's comp and liability coverage, Chief Architect software, Timberline estimating software, excavators, jackhammers, seven tile saws ... the list goes on and on. And it's getting more and more expensive to be in this business and somebody's got to pay for that—somebody being our clients; they pay for it.

So we need to be able to build great value in our companies, and the secret of accomplishing this is learning what's truly valuable. We are in the people-pleasing business, and we need to stop thinking we know what clients desire and start mining for feedback to learn the truth.

FEEDBACK: THE STRAW THAT STIRS THE DRINK

We have to build great value in our companies because we have to be able to close that gap between the number that we want to sell a project for and the number our clients want to pay. We can't just say, "We're the best builder. Or my crown molding is better than anybody's. We set cabinets like nobody's business." That's great. But that's what's not going to keep your company together. That's not what's going to get you to 10% net profit at the end of the year. That's not what's going to allow you to scale to a $2 million or $5 million or $10 million company, not by itself anyway.

We need to do everything that we can to close that gap. We build value because we need to be able to sell for the right price—that 67% markup, that 40% gross margin—which will hopefully give us a 10% net profit. (Of course, the number depends on how your business is structured. For some, it's more than 40%, for some it's less. Our business needs around a 40% margin.) We can close that gap through obtaining client feedback, taking the resulting data, and doing something with it. Feedback, as the saying goes, is the straw that stirs the drink. It should be the most valuable resource of your company, but for most remodeling businesses, I wager, it largely goes untapped.

"We have to build great value in our companies because we have to be able to close that gap between the number that you want to sell a project for and the number your clients what want to pay ... incorporating client feedback helps achieve this."

We must grow to survive. We need to create raving fans in this business. I don't think there's any other way to achieve our margins. When all things are equal, most clients will say, "I'm just going to choose the other guy because he's cheaper." But, the client may not be willing to pass up some incredible value that you put in your estimate. Build value that makes them say, "I want everything your company stands for. You've shown that you also don't want me to have regrets five years from now. I'm willing to spend more for a worthwhile investment." We have to be able to build that value. We want our homeowners to be raving fans.

The business maxim "If you're not growing, you're dying" is true. As remodelers, we're not excused from it. You can't go around thinking, "I'm a great remodeler. I know my stuff. I don't really need to grow. I don't need to get better." You are now in business, you are no longer just a carpenter. You have people who work for you. You have responsibilities for other people's lives. You have to be willing to change and grow. I know a lot of us didn't sign up for that initially, but in business, this is what we have to do. We're not just carpenters any more.

The best companies, organizations, and athletes in the world have to be open to growth. The Kansas City Chiefs won the Super Bowl this year; does the team have to improve to avoid irrelevance going into next year? You bet it does, and it has to start the day after the Super Bowl. Would you continue to buy tools from Hilti if it had made no improvements in five years? Probably not. Pepsi is in a battle against everybody else in its business; does it have to change to stay relevant? Mikaela Shiffrin has the most World Cup wins of any alpine skier in history and two Olympic gold medals. She is probably looking to shave two seconds off her giant slalom time.

So, what are we going to do to make our companies better? I think we all need to embrace change and constantly push the envelope as we critique every facet of our business in perpetuity. Inherit the desire to constantly make adjustments. These small, incremental improvements may not only save your business but create a windfall of profit as well.

Change for the good (Kaizen). The Japanese business philosophy "Kaizen" is a wonderful concept. It is an approach to creating continuous improvement based on the idea that small, ongoing positive changes can reap significant improvements. This is how you build a better company and how you're able to scale.

"Over the years, we've instilled a set of core values for our company. We live by them. We hire by them. We fire by them. They are thoughtfulness, discipline, passion, family, integrity, and growth. Growth has to be a part of all of our companies. It should be front and center."

We use the Kaizen approach in every part of our business; our showroom, intro appointments, job scoping, estimating, marketing, performance reviews, sales, training, exit interviews, lead qualifying, warranty, meetings, and systems and processes. For instance, we are continuously improving our intro appointments; we're never satisfied with them. We think of new questions to ask. We write down every idea, like creating a new training class just on conducting an intro appointment. Or, we are always improving our estimating. I would never use a job scope I wrote four years ago; I would be too vulnerable (even though that scope was really good and was based on 33 years of experience). Since then, I have learned more things. I've been burned more times. I have a couple of scars from when somebody said, "Nope. I don't see it anywhere in the scope." I had to make my job scope a little bit better. I tweaked it, and I keep tweaking it.

We try to improve every part of our business as time goes on. It's important. We have a book club, and employees will read a book about Kaizen and then get together with a volunteer employee moderator to discuss it. We discuss what we learned, how we would apply it to work, and how we might apply it in our personal lives, too. We're always keeping growth in our foremost thoughts.

Core values. Over the years, we've instilled a set of core values for our company. We live by them. We hire by them. We fire by them. They are thoughtfulness, discipline, passion, family, integrity, and growth. Growth has to be a part of all of our companies. It should be front and center. I can argue that every company needs growth as a core value.

It is imperative, as a team, to identify your core values. Write them down. Write them on the wall. Have your staff discuss them in meetings, including how the values relate to them personally. Keep your core values alive in your company. If you don't have this list of values, where's your beacon? Who's guiding all these people? Who's keeping people in check at the office and in the field? Are your employees like family? Are they disciplined? Are they thoughtful?

Thoughtfulness. When we're talking about customer service and we're talking about creating greater fans, we need to be genuinely thoughtful. This is where the money is.

Be thoughtful when you leave a job and when you sign a job. Be thoughtful in the comments you make to the client. When they sign a contract, I say, "Mrs. Jones, I just want to thank you from the bottom of my heart for giving me this opportunity to work for you." That's being thoughtful. That is going to get us more business down the road. She's going to tell her friend, "This is the nicest company. They really care. Yes, I'm spending a little bit more, but I feel like it's right for me." That's because we're being thoughtful with clients. We're being genuine with them.

Invest some time to think about why you should be thoughtful and show gratitude. It's because they just signed your contract. What would you do if they hadn't signed it? Nothing. How happy should you be when somebody signs on the dotted line? Are you over the moon with every client that you sign a contract with? Share with them why you have this immense amount of gratitude. Why wouldn't you? We need to do this at every step with them. Maybe everybody who goes to the jobsite would say something like, "Thank you again. We're very grateful for your business. We love working with your family. How's everything going with you? Are the dogs comfortable? I know it was a big concern that they not be let out. This is great being a guest in your home, and we're having a wonderful time working for you. You've been kind saying you appreciate everything we're doing, but really, the 'Thanks' goes back to you. If you didn't choose us to be here, I'm not sure that we would have a place to go. Folks like you allow us to keep our business going, support our people, and feed our families." You should be thinking about that.

When a job is done, are you showing immense gratitude toward your client? Are you letting the client know how much you appreciated this job? They just did a $200,000 job with you and allowed you the privilege of being a guest in their home. This is a time to pause and think about how lucky we are. Bring some flowers and a dinner gift certificate to a job-ending exit interview to say thank

you for your business. Having gratitude and thoughtfulness for those we serve … that's classic customer service.

FEEDBACK: THE PATH TO GROWTH

So, how do we grow as a company and as people? Start by being humble and admitting our shortcomings. If you think you know everything about this business, that is a clear indicator you are heading down the back side. We want an upward trajectory when it comes to growth, and the best way to accomplish this is to be humble.

Ask great questions and listen well. This is the foundation of obtaining feedback. For instance, during an intro appointment, the first appointment when we go out visit somebody's home, I don't necessarily care about what kind of kitchen they want or whether they want maple cabinets. I care about what kind of remodeler they are looking for. I'll ask, what kind of qualities are you looking for in a contractor? And they're going to think, "That's a weird question. Why would a contractor ask me that? That's not typical language from a contractor." But, it's going to be effective. It'll make them think, "Maybe there is something here. They asked some pretty thoughtful questions. I feel comfortable with this company." So, we're already off to a great start. I'll delve into this topic in more depth in a future story.

Being disciplined. Properly incorporating client feedback into your business takes discipline. As we mine for suggestions and ideas (from those we serve) on how to improve our company, it becomes challenging to then implement. All of this takes time, money, and a willingness to grow. We can't accomplish this without discipline!

Implement training programs. I didn't officially start training employees until I was 30 years in business. Now, training is so important in our company. I understand if you're reading this, and you think you don't need to implement training, but we need training because today's youth are not getting into this business. There aren't a lot of carpenters out there at our fingertips, are there? Training takes time, but that's how we grow, and it's tough because it's just one more thing to do. (See "Creating an In-House Training Program," Jan/Feb/23, for information on how the author's company approaches training.)

Hiring people smarter than you. I mentioned previously that we have 23 employees in our company. I have an operations manager, operations support manager, a full-time marketing director, a few salespeople, and seven lead carpenters out in the field who run the jobs. They're all capable and amazing employees. I mention this because hiring smart people is how you build better companies. This is how we're able to scale. This is why I can take off January and August, which is a privilege for me. The office doesn't call me and I don't call them, I do other things. This is possible because I have the best people working for me.

Know your numbers. Do postmortems on projects and learn from your mistakes, so maybe the next time you won't get burned. Evaluate actual hours versus estimated. Look at materials and subcontracting costs versus estimated and look for meaningful data that will help with accuracy on future projects. This scrutiny will no doubt encourage you to raise your prices. The only way to raise prices and successfully sell is to build tremendous value. If you properly implement feedback and continue to grow, your mission will be accomplished.

"We need to be coachable to discover better ways of running our businesses. And, we need to be open to constructive criticism and to be humble … We're going to get the best coaching from those that we serve."

Be open to change. I can't afford to work with people who do not embrace change. Many people in our company are getting better at accepting change, and we're all moving in the right direction, which is great. But if you have employees who are fighting you on this, I would say get them to change or, as the saying goes, free up their future. One of our six core values is growth. We are working very hard to emphasize the necessity to grow. All of our meetings start with everyone choosing a core value and describing an example of how that core value is in play. I love hearing examples of growth in our company.

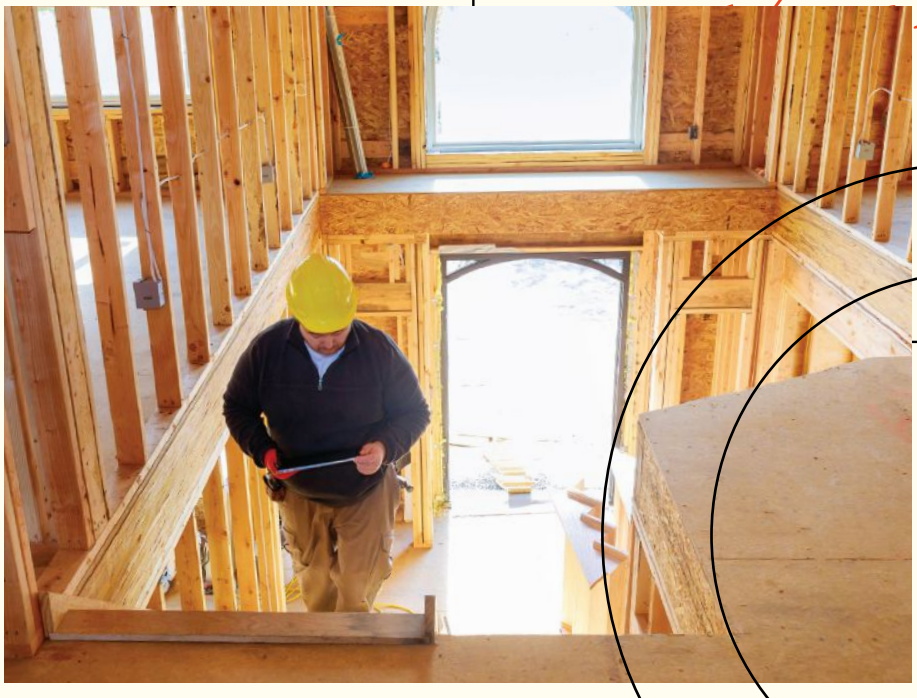
Improve through feedback and be coachable. We need to be coachable to discover better ways of running our businesses than we're now using. We need to be open to constructive criticism and to be humble, as I mentioned before. We have experts out there who are ready to offer us free coaching—it is all of our prospects as well as our clients. You may want to hire a business coach to get your financials in order. However, if you want to learn a thing or two about customer service … ask those you serve; they will give you the best advice! We are in the people-pleasing business and we need to stop thinking we know what clients desire and start mining for feedback to learn the truth.

Morphing. Again, when we started out in this business, we didn't talk about delivering gratitude with sincerity. We were carpenters. We didn't worry about in-house training or Kaizen. But, the times have changed, and it's gotten tougher to be remodelers and builders. So, my advice is to diligently pursue feedback from those you serve, and incorporate it into your business. Be thoughtful, genuine, and honest—people are attracted to these qualities. Always be growing. Be the company your clients want it to be.

In an upcoming article, I'll dive deeper into how to obtain feedback, how to process it, and how to use it to boost your bottom line.

Brian Altmann, CAPS, is president of DBS Remodel, a design-build residential remodeling company based in Poughkeepsie, N.Y. He is also a private consultant for other remodeling companies related to business advice. You can reach him at brian@dbsremodel.com.

JLC



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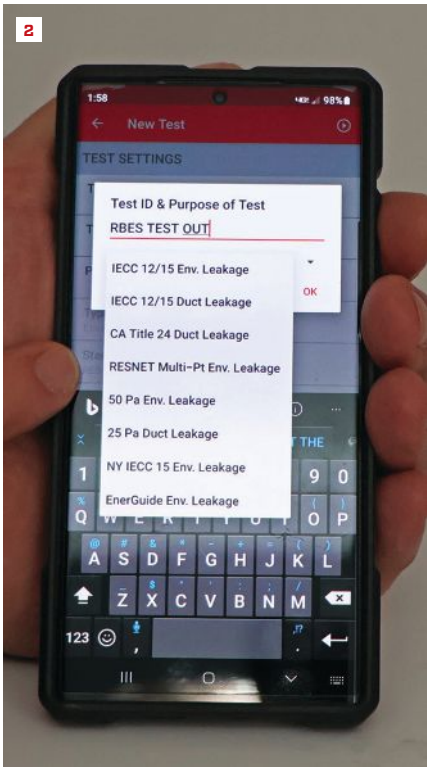
BY JIM BRADLEY

Multi-Point Testing Using TEC Auto Test


1



2

While testing a new house, the author uses the TEC Auto Test app on his smartphone to connect to his TEC DG-1000 manometer **(1)**. The program first sends the user through a series of prompts (such as location via GPS, the year the building was built, and the client's name, etc.), then a test can be created. TEC's Auto Test offers eight different tests **(2)**. The author uses the RESNET multi-point test, which collects the airflow data at five different pressure points, starting with 60 pascals and going down to 48, 35, 23, and 10 pascals. Multi-point testing is more accurate for predicting building leakage at lower pressures, which are more common during normal operating conditions of a home.

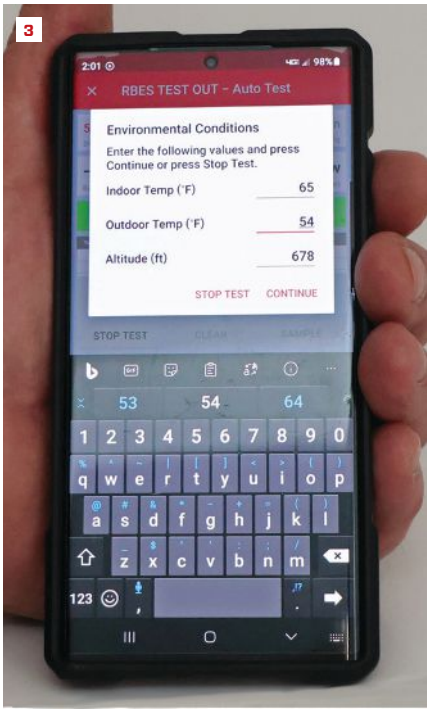
I've been a BPI-certified home-performance contractor for 18 years, and over that time, I've mostly performed single-point blower door tests. The state of Vermont, where I work, doesn't require multi-point blower door testing, nor does the Building Performance Institute (BPI). However, my views on testing methods began to change after reading an article in *JLC* last fall that discussed multi-point testing (see "Single-Point vs. Multi-Point Blower Door Testing," Sept/Oct/22). In it, the author explained that multi-point tests are more accurate for predicting building leakage at lower pressures, which are more common during normal operating conditions of a home. Multi-point tests collect the airflow data (in cfm) at five different pressure levels between 10 pascals and 60 pascals, while single-point blower door tests collect the airflow data (in cfm) at only one pressure level, typically 50 pascals.

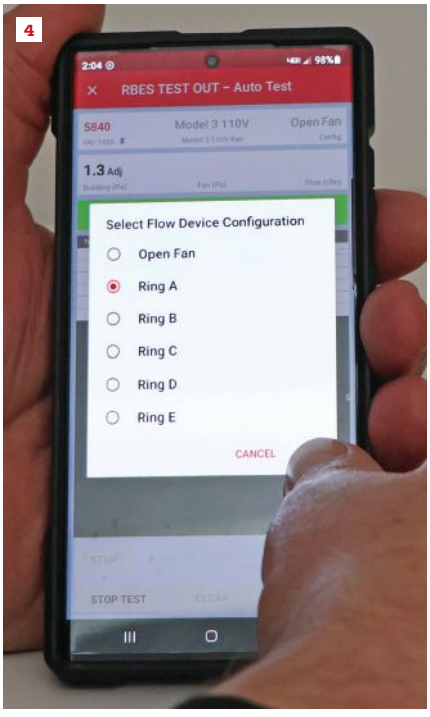
Coincidently, I was going through the RESNET HERS Rater training shortly after reading the article, and the instructors explained that you have to take a 10% penalty for air leakage when performing single-point tests—something I hadn't known about. This revelation prompted me to do a little online research, which led me to the latest version of The Energy Conservatory's Auto Test software. The software appeared to have several testing options for various industry standards, so I downloaded the TEC Auto Test app, started tinkering with it, and right away thought, "Why haven't I been using this all along?"

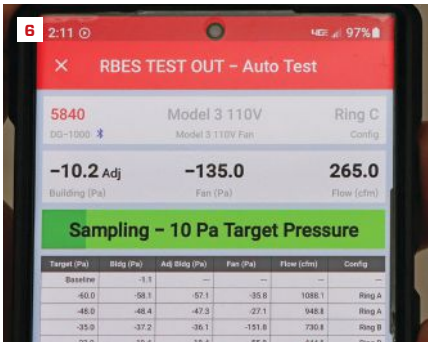
First off, Auto Test is free and supports single-point and multi-point testing along with allowing you to set up custom metrics. It was released in 2017 (not long after the TEC DG-1000 manometer) and has been through multiple software updates, which continually improved on how Auto Test operates and connects to the gauge. It comes with helpful features like a one-time report set-up to allow you to add your company information and credentials into every report and the ability to build templates for different clients. It has Bluetooth connectivity to your gauge, GPS location, and "Wind Assistant," which detects if it is too windy for accurate readings and adjusts your data collection time and fan control to get better data in rough weather conditions.

A feature I particularly like is it provides data at the end of your test in easy-to-share formats, so you can

Graphics by Jim Bradley; photos by Tim Healey







Indoor and outdoor temperatures need to be manually entered, while the home's altitude auto-fills from the GPS **(3)**. To start a baseline test, the ring size needs to be selected **(4)**. The program will also prompt the user to change the ring size as necessary while collecting airflow data from 60 pascals **(5)** down to 10 pascals. A chart infills with data as the test progresses **(6)**.

have your report done and sent before you leave the site. These include a PDF that can be attached to an email or text, as well as data in a JSON file type, which can be used to re-create the report or share the raw data. Though I would normally provide our clients with reports that include substantial information, this additional data raises the bar on what I have offered. The data can be stored to any location you like, such as iCloud, Google Drive, Dropbox, etc.

USING THE AUTO TEST APP FOR MULTI-POINT TESTING

After calculating the volume of the house, I start by selecting the TEC Auto Test app on my smartphone **(1)**. You can select a new project or access a list of past projects, which auto-fills the data and helps speed up the process. This is helpful because I perform blower door tests for a lot of the same construction companies. It then sends you through a series of prompts: determine location (which locates the home via Google Maps GPS); the year the building was built; the customer's name, address, phone, and email, along with the project ID name. You then create a test.

Under test settings, the app offers a selection of eight different tests, though I prefer to use the RESNET multi-point test because of its accuracy **(2)**. It takes into account a home's altitude and indoor and outdoor temperature, and collects airflow data at different pressures, so it gives you a better average than just a single-point test (again, for RESNET, if you do a single-point test, you have to take a 10% penalty for air leakage). Enter building volume, then hit "connect" to sync to the DG-1000 (as soon as it's connected, it shows the serial number of the manometer, so it knows which one you're using). It'll start monitoring, then ask for the environmental conditions, and you enter in the indoor and outdoor temperatures (the altitude of residence auto-fills from the GPS) **(3)**. Factoring in the altitude was new to me, which I learned about in RESNET training. You start to see a difference in the testing data at 600 feet above sea level, and many of the homes I test are above that.

I also test homes on Lake Champlain and the surrounding mountainous area where it tends to be breezy. Auto Test's "Wind Assistant" will sense if it's too windy and suggest when to use it. In Wind Assistant mode, it will take a lot more samples than normal to determine a better average of the building air leakage.

It'll then ask to start the baseline test. After that, you enter the ring size configuration, and it starts running the fan unit **(4)**. Should you need to change the ring size on the fan to obtain the measurements, it tells you to do so (you don't have to tell the program that you changed it; the app knows automatically). The software also can detect when the equipment is not set up correctly, and it tells you so. For instance, my sons work with me because I'm teaching them how to perform blower door tests. One of them put

Envelope Leakage Test

Testing Company:
Name: Authenticated Building Performance Diagnostics
Address: 211 Cambridge Glen Road
Cambridge , VT 05444
Phone: 802.578.5007

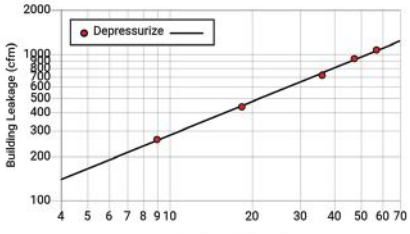
Technician:
Name: Jim Bradley
Credentials: BPI Building Analyst Certification 10/11/22
Email: jim@authenticateddiagnostics.com

Building Information:
Project ID: Custom Homes - Brown Res
Address: 16 Town Road
Jericho, Vermont 05465
Year Built: 2023
Geo-Tag Data: Latitude: 44.491271
Longitude: -72.957220
Timestamp: 2023-04-29 13:55:49

Customer Information:
Name: Tom Brown
Address: 16 Town Road
Jericho, Vermont 05465

Measured Leakage: 950.7 CFM50

Test ID:	RBES TEST OUT		
Purpose of Test:	RESNET Multi-Pt Env. Leakage		
Measured ACH50:	1.05 (+/- 5.2%)	Effective Leakage Area: 39.3 in²	
Building Volume:	54,450.0 ft³	Enclosure Surface Area: 0.0 ft²	
Coefficient (C):	48.0 (+/- 19.5%)	Exponent (n): 0.763 (+/- 0.058)	
Correlation Coefficient:	0.99916		
Test Standard:	RESNET 380 Multi-Point	Test Mode: Depressurize	
Test Characteristics:	Indoor Temp: 65 °F	Outdoor Temp: 55 °F	
	Altitude: 678.0 ft	Time Average Period: 10 seconds	
Test Date and Time:	2023-04-29 14:01:41		



Envelope Leakage Test

Test Readings:

Target (Pa)	Bldg (Pa)	Adj Bldg (Pa)	Fan (Pa)	Flow (cfm)	Config
Baseline	-1.1				
-60.0	-58.1	-57.1	-35.8	1,088.1	Ring A
-48.0	-48.4	-47.3	-27.1	948.8	Ring A
-35.0	-37.2	-36.1	-151.8	730.8	Ring B
-23.0	-19.4	-18.4	-55.8	444.8	Ring B
-10.0	-10.0	-9.0	-136.1	265.9	Ring C

Test Equipment:
Flow Device: Model 3 110V Fan
Pressure Gauge: DG1000
Serial #: 5840
Calibration Date: 2020-06-09

Deviations from Standard:
- None

Comments:
None

Report by TEC Auto Test 1.9.2 (3), © 2023 The Energy Conservatory, Inc. Page 2 of 2

With the test completed, a professional-looking report appears instantly with all your data (inset), which you can email as a PDF to yourself and your client in real time **(7)**.

the outdoor pressure line in line with the fan flow, and I was getting readings saying, "we can't get the building pressure, something is wrong." So, I checked, and sure enough, the outdoor pressure line was too close to the fan exhaust (the line needs to be at least 5 feet away). So, I moved the pressure tap and continued on with the test.

Collecting airflow data (autozeroing). The program begins the multi-point test and collects airflow data at five different pressure points, starting with 60 pascals **(5)** and going down to 48, 35, 23, and 10 pascals **(6)**. The app will sense if you need to change ring size mid-test, and it'll prompt you to do so. Then once you change the ring, the app will just say "continue," and it'll carry on with the test. For example, on the project shown in the photos, a pop-up window, "Update Flow Device Configuration," appeared while the program was autozeroing at 35 pascals. It noted, "Flow too small to measure for current configuration. Install ring B and press Continue or press End Test to end test at previous pressure." My son swapped out ring A with ring B, and we continued the test.

After autozeroing the 10-pascal target pressure, a pop-up window asks, "Test Complete. Would you like to review the report?" The two-page report appears instantly with all the data (temperature measurements, building volume, measured CFM50 and ACH50, etc.) **(7)**. It looks highly professional, and you can email it to yourself and your client in real time. As a blower door tester, I've found this has certainly upped my game.

Assessment. The TEC Auto Test app will enhance the power of your DG-1000 manometer. Its multi-point testing gives you a more accurate, across-the-board differential baseline and average of what the actual leakage is by taking into account factors such as the delta between indoor and outdoor temperatures, the altitude, and whether it's windy. Again, the software is more accurate for predicting building leakage at lower pressures, which are more common during normal operating conditions. Also, the professional-looking report is great. You can send the report as is or take that data and modify it for your own report.

The only negative is that poor cellphone service will limit some of Auto Test's functionality. I frequently work in rural sections of Vermont with no cell service, so I have to manually add some information later on, such as the location, altitude, etc. The software will adjust the numbers accordingly. Other than that, using TEC's Auto Test app has been phenomenal.

Jim Bradley is a BPI-certified home-performance contractor, builder, and remodeler based in Vermont. He is currently a project developer and manager for Hayward Design Build in Colchester, Vt..

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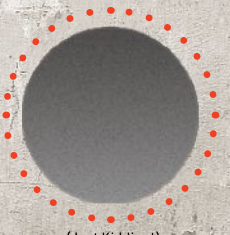

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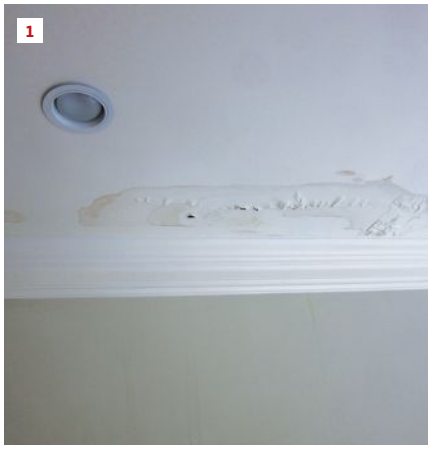
BY DOUG HORGAN

Rebuilding a Leaky Chimney From the Roofline Up



Water damage is evident on a ceiling above a second-floor fireplace **(1)**. Infrared imaging confirms that the area is wet after rainstorms **(2)**.

In the attic above the damage, IR imaging (inset) shows wet chimney block **(3)**. An M & J trade partner inspects the chimney's base; roofing cement covers its shingle-to-flashing juncture **(4, 5)**.

Photos by Doug Horgan

Early in the design process of a renovation project on a client's recently purchased home, we noticed some ceiling damage above a fireplace on the upper level **(1)**. Infrared and moisture-meter measurements confirmed the area was wet after rainstorms **(2)**, and a look in the attic showed that the masonry chimney for the fireplace was the source of the leak, with wet block and water dripping down onto the ceiling **(3)**.

We brought in M & J Contractors from Sterling, Va., roofers who are experienced with complicated repairs. On the roof, we immediately noticed a large smear of roofing cement at the base of the chimney, obviously a previous attempt at repair **(4, 5)**, as well as four different colors of caulking on the flashings, on mortar joints, and on the cracked crown of the chimney. When it's obvious that multiple repairs have been made, that can indicate the real problem is difficult or expensive to fix **(6–10)**.

We also saw a lot of efflorescence—white, powdery residue—on the outside of the masonry. Efflorescence results from minerals, mainly calcium from the mortar, being dissolved and washed out of the masonry by water traveling through the structure. Once the water comes out, it evaporates and leaves the minerals behind. This was another clue about the problem—there was a lot of water moving within the chimney **(6)**.

Inspecting the base flashing, we discovered it was nailed to the face of the stone **(7, 8)**. With all the layers of caulking, it didn't appear to be leaking, but unlike a through-flashing run into the masonry, a face-applied flashing can't stop water within the masonry from traveling down below the roof level. Though many chimneys allow some water to soak down through the roof level in heavy rains, as long as there isn't much of it, this water can slowly dry out without causing any issues.

On this chimney, however, enough water was running through that it was wetting things that need to stay dry. The original masons had used a steel angle a course below the roofline to corbel the chimney out to hold the stone veneer above. This angle caught any water in the outer 4 inches of the chimney and pushed it out onto the primary bedroom ceiling, where we originally saw the water damage.

Through-flashing. We've tried several approaches to repairing leaky chimneys. Putting a good cap on the

Efflorescence-stained stone veneer indicates that a lot of water had moved within the masonry chimney **(6)**. The base flashings along the back, sides **(7)**, and front are nailed to the face of the stone (the peeled-back caulk reveals a nail head) **(8)**.

The chimney's concrete cap **(9)** and corbeled 1-inch-thick bluestone top are heavily caulked in an attempt to keep out moisture **(10)**. After assembling an impressive scaffold anchored to the building at multiple levels to provide lateral strength, the masons begin to remove the stone veneer and the cracked crown on the chimney **(11)**.

top can help keep a lot of water out (we've installed a number of metal chimney caps because they shed water well and last longer than the crowns the local masons typically install). Elsewhere, any cracked or open joints should be pointed up. "Breathable" masonry sealers are fairly effective, at least on brick, and last a few years. These approaches can reduce the water entering a masonry chimney and slow leaks to the point they don't add up to much.

However, this chimney was in bad condition from the roofline up. The large amount of efflorescence and failed attempts at stopping leaks over the years led us to recommend a more certain solution: installation of a through-flashing at the roofline, waterproofing up and over the chimney core, and a rebuild of the masonry veneer.

Chimney repair. Working from scaffolding, the masons, Stonework by Santo, removed the stone veneer and the cracked crown from the chimney **(11)**. Minor repairs were done to the first course of block at the roofline to make even steps for the through-flashings. A liquid-applied masonry waterproofing (MasterSeal 581, formerly Thoroseal)—designed to fill holes and small voids, work on dirty, existing masonry, and make a uniform coating without seams, unlike sheet materials—was brushed onto the block to seal the chimney core **(12)**.

We then used peel-and-stick window flashing to temporarily seal the roofline while we worked (normally, we use a layer of flexible adhesive masonry flashing, which we leave in place as a backup layer below the metal flashing). On smaller chimneys where the

A waterproof cement-based coating (MasterSeal 581) is applied up and over the block chimney core **(12)**. The stepped, 16-ounce copper through-flashings are fabricated and soldered on site **(13)**. The large pieces are tacked in place with masonry anchors, and the edges sealed with polyurethane caulk **(14)**.

Textroflash peel-and-stick through-flashing is applied to the cured cement-based waterproofing on the chimney core and lapped onto the copper step flashing **(15)**. The stone veneer is reapplied, building the chimney out to its original 44-by-66-inch dimension **(16)**. A new chimney cap was later installed by the mason.

flues are closer to the outer layers, we sometimes avoid sticky flashings due to the potential for heat damage, but this chimney was large enough that we weren't concerned.

Next, M & J workers fabricated stepped through-flashings to cover the stepped masonry on site. They elected to make large pieces that covered many steps, but we often use one flashing pan per step, with upper pans overlapping lower ones. I feel more confident in overlapping pans, as there's no concern about thermal metal movement with such small pieces, and I also believe they're easier to do. But we've also done many large flashings with no problems so we let the people with the tools in their hands choose the method **(13, 14)**.

We also typically use a separate counterflashing between the pans and the roof, which makes reroofing easier later. On this existing roof, the flashings were run as one piece.

With the metal installed, the masons put a layer of adhesive Textroflash through-flashing (h-b.com) on top of the steps, applying it to the cured waterproofing on the chimney's block core and lapping it onto the copper step flashing. Santo's crew prefer to add this layer to protect the metal from their work and from the caustic masonry over time **(15)**. The veneer was reapplied to the top of the chimney **(16)**, and a new cap placed at the top.

Once the masonry work was complete and the scaffolding removed, the roofers came back to lift the shingles and step flashings at the chimney and tie in with ice membrane and make other minor repairs to any shingles damaged from the scaffolding.

We often recommend this kind of complicated retrofit, as we've had numerous failures with half-measures. When clients elect to go ahead with the full repair, we know they won't have any problems in the future.

Doug Horgan is vice president of best practices at BOWA, a design/build remodeling company in McLean and Middleburg, Va.

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Helical Pier and Grade Beam Foundation

On a wet site, this design allows the footings to 'hover' above the water table

BY CHAD SMITH

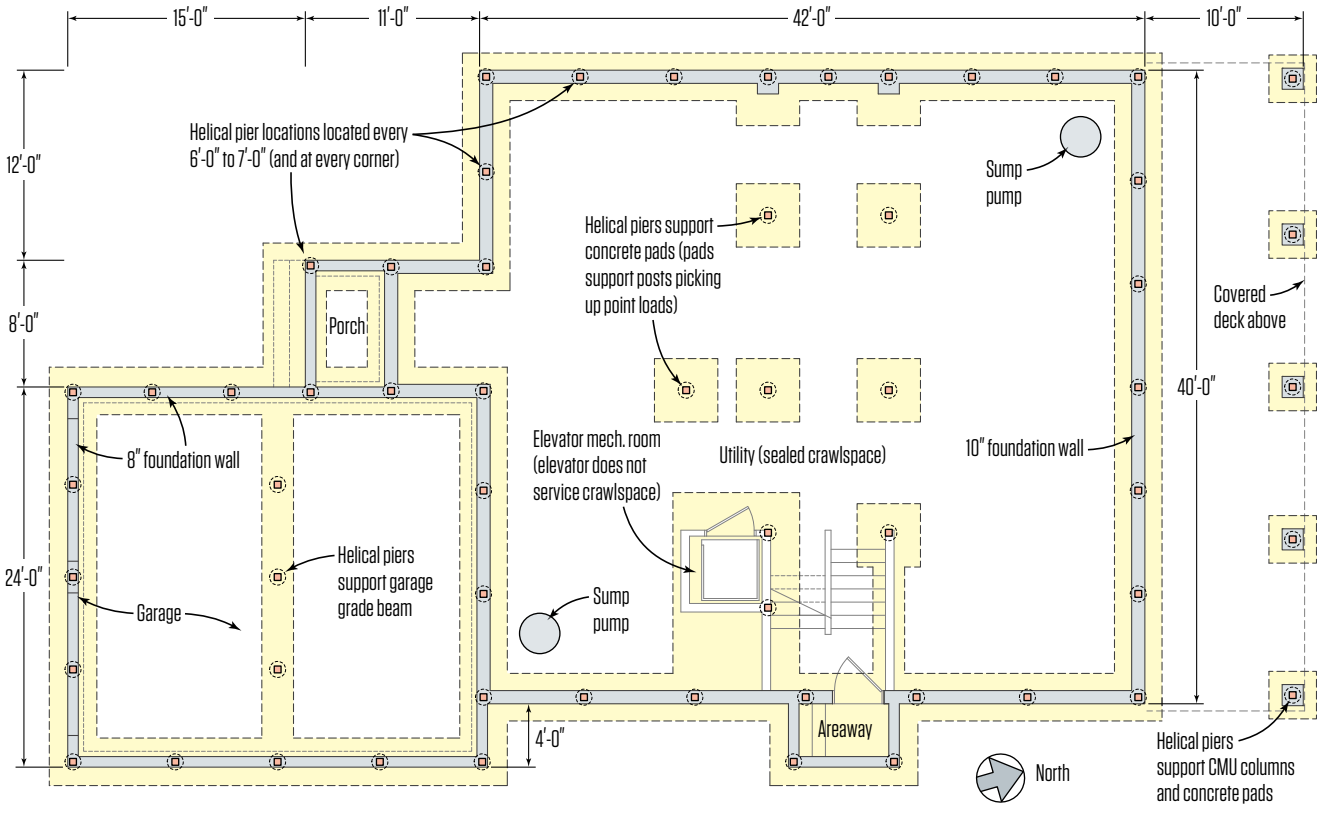
My brother is currently building a house on the waterfront of the Magothy River, near Annapolis, Md., in an area where soil conditions are too inconsistent for a conventional foundation. The building site is about 60 feet from the water's edge, with significant groundwater at 3 to 4 feet below grade. To avoid any possibility that the foundation would settle in those saturated soil conditions, plans called for the new home to be supported by a concrete grade beam and a series of concrete pads bearing on 59 helical piers, each penetrating 17 to 18 feet below ground level. My company, which has about 20 years of experience using helical piers (we call them piles in my area) in a variety of applications, did the layout and pier installation and worked directly with the subcontractors and tradespeople who excavated the site and formed and poured the grade beam and walls.

Photos by Chad Smith; illustrations by Tim Healey

HELICAL PIERS

On most of our projects, the helical pier supplier—typically either Pier Tech or Ideal—does the general engineering for loads based on the plans that we provide, and a local engineer then checks the loads and certifies the plans. The most common helical pier we install measures 2 7/8 inches in diameter and, when installed to 1,000-foot-pounds of torque, will support 9x loads (i.e., 9,000 pounds of weight). On this project, our target was 1,670-foot-pounds of torque for 15,000 pounds of load per pier. The load bearing range for

Foundation Plan



To deal with the building site's high water table, plans for the waterfront home called for a grade-beam footing bearing on helical piers driven 14 feet into the ground. In addition to being evenly spaced along the walls and at the corners as shown above, piers were located below load-bearing concrete pads for interior and exterior columns.

a helical pier is often referred to in terms of kips, or kilo-pounds. So, for example, 15,000 pounds of bearing equals 15 kips.

We installed the piers using our 10,000-pound mini-excavator, which is equipped with a torque head that's fitted with hydraulic pressure sensors coupled to a digital drive monitor. This allows us to do a calculated readout of the torque achieved based on the difference between the input hydraulic pressure and the return pressure. With our digital equipment, we then download the data and provide it to an engineer as proof of successful installation, which often saves on witness testing or having to hire an engineer to perform on-site witness verification, which can be costly.

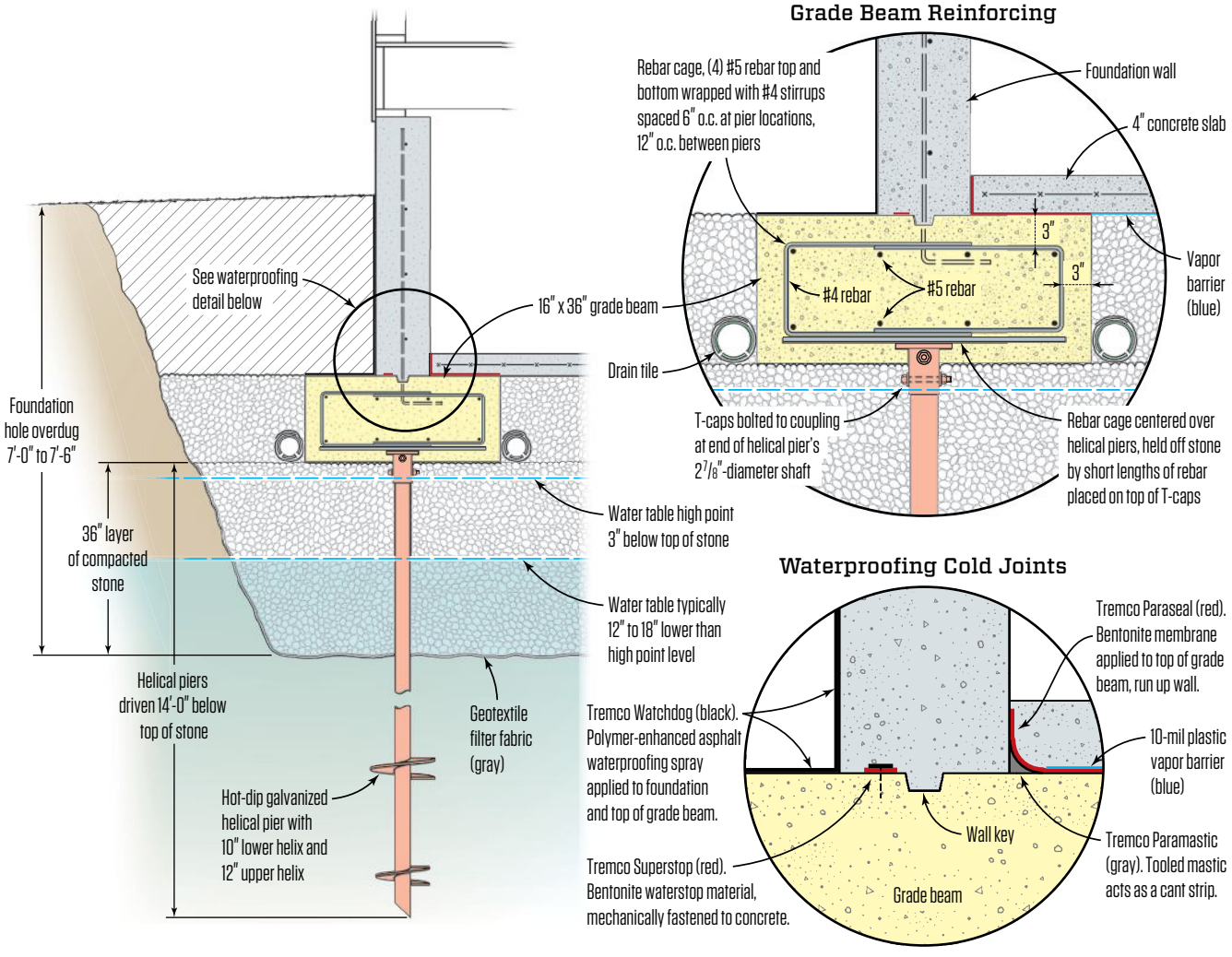
EXCAVATION AND LAYOUT

On this job, the soil was so wet that we had to overdig the building footprint to a depth of about 7 to 7 1/2 feet below grade and fill the overdig with a 3-foot layer of #6 stone on top of geofabric. The stone was placed and the elevation of the grade beam was planned based upon the known elevation of the water table (I live 13 houses up the street, and my brother lived at this location for 16 years prior). After we placed the stone, we compacted it with a 5,000-pound vibratory roller.

All the helical-pier depth measurements were taken from the top of the stone, which acts as an underdrain, allowing water to flow freely beneath the grade beam and the flatwork, and as a firm base for driving the machine that we used to install the piers. The water table here can vary by as much as 30 inches, and we had record rains just prior to starting this job, so the water table was only 3 inches (not feet) from the top of the stone during the entire process. More typically, the water table would be 12 to 18 inches lower.

Once the grade beams were poured and the forms were stripped, we added another, 16-inch-thick layer of stone along with the drain tile before pouring a 4-inch-thick concrete slab. As a result, the top-

Helical Pier and Grade-Beam Foundation



Roof and floor loads are transferred down through the walls to the concrete foundation and steel-reinforced grade-beam footing, which in turn bears on helical piers, each capable of supporting at least 15,000 pounds. Groundwater can move freely through the compacted stone base, while the waterproofing details shown above keep it from entering the crawlspace.

of-slab elevation was 23 inches (3 inches of water draft, 16 inches of additional stone, and 4 inches of concrete) above the water table high point elevation.

This system minimizes the need for interior and exterior drain tile because the sump basins can receive water directly from the stone. Still, to limit the amount of hydrostatic pressure on the foundation walls were the water table to rise high enough during a storm, we supplemented the existing sump basin (from a preexisting home) in the center of the foundation with two additional sump basins placed at opposite corners of the foundation to help rapidly drain off water and appease the local inspector. Drain tiles wrapped with a sock and covered in stone are located adjacent to the footing grade beams and empty into the sump basins, which have pumps and 1½-inch piping for discharge.

Batter boards. During site layout, we used our survey points and offsets to place old-school batter boards to set up and establish the inside and outside lines of the foundation. This saved money on engineering and surveyor revisits, since we only paid for the offset points needed to set the batter boards. From the batter boards, we established the elevation for the top of foundation, which we used to calculate the downward measurements for the elevations of the helical piers, top of grade beam, and top of slab.

To account for the site's high water table, more than 7 feet of soil was excavated for the crawlspace foundation and replaced with a 3-foot layer of stone on top of filter fabric **(1)**. To install the helical piers **(2)**, the author uses a mini-excavator equipped with a torque head fitted with hydraulic pressure sensors that allow him to monitor the pier's installed torque **(3)**. Batter-board lines were used to lay out the grade beam and pier locations **(4)**.

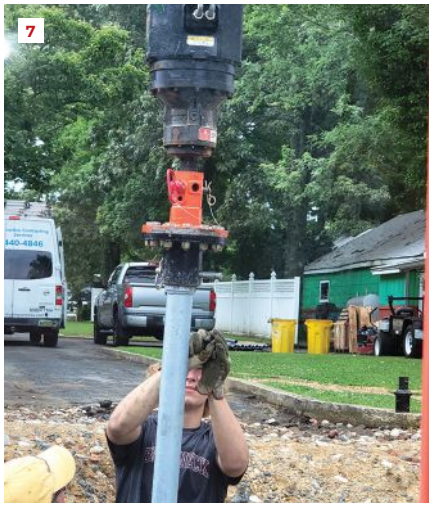
To locate the helical piers, we moved the actual footprint of the home inward from our outside-of-wall marks by 18 inches (grade-beam width is 36 inches, so 18 inches—or half the width—gives us the centerline of the grade beam). We then coordinated the pier locations by measuring off the running distance and placing marks on our lines. Doing this allowed us to use a plumb bob to locate the pier centers on the stone, which we marked in paint. Since the base was stone, we used 60d nails to pin the actual centers. This saved us another engineer visit.

Once the grade beams were poured, we would again use the batter boards to mark the wall corners as well as determine the top-of-wall height. The batter boards took a bit of time to set up perfectly in the beginning, but they were a critical element for accuracy and efficiency and saved us four extra engineer visits at $500 to $700 per visit (a savings of $2,000 to $2,800).

We laid out the helical pier locations based on the engineer's projected load for a center-to-center spacing of no greater than 7 feet. The hot-dip-galvanized piers are a twin-helix design by Pier Tech Systems using a cross-bolt link between each section, which minimizes deflection at the coupling joint. These twin-helix piers have a 10-inch-diameter lower helix and a 12-inch-diameter upper helix, with a 2 7/8-inch shaft diameter.

PIER INSTALLATION

Most of the time, we don't know what the soil conditions are or what we might hit unless we perform a soil boring or analysis near every pier location, which tends to be cost prohibitive. Due to our local experience—especially with waterfront construction and specifically with this community—we knew the soils would require at least 7 to 10 feet of depth before a helical pier would achieve the desired load capacity. While piers are available in a variety of lengths as a custom order, it's more economical to purchase standard,



During helical pier installation, a magnetic spirit level fixed to the shaft helps to ensure that it is plumb **(5)**. When the lead reaches full depth **(6)**, a 7-foot-long extension is fitted to the torque head **(7)** and cross-bolted to the top of the lead **(8)**. After the assembly has reached the target torque and then been driven to a full 14-foot depth below the surface of the stone, a worker bolts a T-cap to the top of the extension **(9)**. To make sure that the elevations of the T-caps were all within 1/8 inch of each other, the author first used the string line for reference when installing the piers, then used a rotary laser to fine-tune them.

7-foot-long piers and add extensions if more length is required.

For this project, we purchased enough leads and extensions for at least 59 locations throughout the foundation. Along with grade-beam support, pier locations include the mounting positions for structural posts and an elevator shaft, a grade beam in the garage, and porch support. Because we try to use the same size pier for most applications, we commonly have additional leads and extensions in stock, so a project isn't delayed should we require field alterations.

All the helical piers on this project were driven to at least 14 feet below the top of the stone, with a few needing to be driven to nearly 21 feet in the far north corner, which is on the waterfront. We began the installation by driving the first two piers to a measured torque of 1,667 foot-pounds to achieve the load rating of 15,000 pounds per pier—or 15 kips—as determined by the 9x yield specified by the supplier (1,670 x 9 = 15,030). With the piers spaced 7 feet on-center, this would provide the load-bearing capacity required by the engineer.

After driving the first few piers, we determined that we were achieving the target torque at a depth close to 12 feet. Since that was so near the 14-foot total length of a 7-foot lead plus a 7-foot extension, we decided to drive all the piers to 14 feet. This saved us from having to cut off 59 piers, which would then need holes drilled for bolts to attach the T-caps for support of the grade beam. Due to the strength of the steel, cutting a pier to length and drilling holes through it is not a quick and easy task, so we try to avoid it if possible.

We measured down from the batter-board string lines to the top of the helical piers to get the elevation roughly in range, then used a Hilti rotary laser for fine-tuning the installation so that the tops of all 59 piers are within 1/8 inch.

GRADE-BEAM FOOTINGS

Once all the piers were driven, we tied up a grid of #5 rebar to pairs of prefabricated #4 stirrups spaced approximately 6 inches apart

The torque, depth, and installation time and date of each helical pier were recorded on its T-cap and documented photographically **(10)**. A total of 59 helical piers—each with a minimum bearing capacity of 15,000 pounds—were installed to support the grade beam footing **(11)**.

During the project, an existing sump pit (from a previous structure) was used to help manage the water level on the wet site **(12)**. After assembling the rebar cage for the grade beam on top of the piers, the crew built 36-inch-wide-by-16-inch-deep forms in preparation for concrete **(13)**.

at the T-caps to reinforce the grade beam at the pier locations and about 12 inches apart between the piers. This cage was built on top of and centered over the pier T-caps and held off the stone by short lengths of rebar placed on top of the T-caps. This way, when we poured the concrete grade beam, the concrete would fill the gap between the stone and the rebar so that the steel would not be exposed.

We assembled the grade-beam cage from 534 stirrups prefabricated from 3,300 lineal feat of #4 rebar, 442 lineal feet of #4 hook dowels located 16 inches on-center, 2,136 lineal feet of #5 longitudinal rebar, 176 lineal feet of #6 transverse rebar installed 48 inches on-center, and 380 lineal feet of #5 rebar in the interior column footings to support point loads from structural posts and an elevator shaft.

We then built the forms for the 36-inch-wide-by-16-inch-high grade beam around the cage and on top of the stone, allowing approximately 3 inches of space between the rebar and the form. When we poured the concrete, we needed a truck-mounted boom pump with a 100-foot reach, but with an overhead power line near the site, we needed to build supports to keep the boom flat rather than up at an angle. We used 38 yards of concrete to pour the grade-beam footings and another 13 yards for the pads, columns, and post footings.

FOUNDATION WALLS

Once the grade beam was poured, the rest of the project took shape like a traditional poured foundation except for the amount of steel used. Because rebar is not too expensive, the homeowner decided to increase the amount of steel to create stiffer wall sections. While the engineer said this extra measure wasn't necessary, the additional rebar is cheap insurance to limit any cracking potential in the future. The total amount of rebar used in the walls included 876 lineal feet of #4 horizontal rebar, 402 lineal feet of #4 vertical rebar 16 inches on-center, and 156 lineal feet of #4 rebar

A truck-mounted boom pump with a 100-foot reach delivered the 38 yards of concrete needed to pour the grade beam **(14)**. Ten-inch-wide foundation walls for the main house **(15)** and 8-inch-wide foundation walls for the garage **(16)** were formed and poured on top of the grade beam. After the forms were stripped, a waterproofing membrane was applied to the exterior of the walls and additional #6 stone brought in to bring the bottom of the slab level with the top of the grade beam **(17)**. A 10-mil vapor barrier was installed over the stone before the 4-inch-thick slab was poured.

at the corners. This steel reinforcement was tied to the vertical sections that extended up from the grade beams.

Prior to pouring the walls, we pinned an expandable granular bentonite waterstop called Tremco Superstop to the grade beam next to the key to seal the cold joint between the footing and the wall. Then the wall forms were filled with 44 yards of concrete.

After the forms were stripped and the concrete cured for a few days, we sprayed the exterior walls with several coats of Tremco Watchdog, a polymer-enhanced-asphalt-emulsion waterproofing membrane. On the interior, we formed a cant strip at the joint between the footing and foundation wall using Tremco Paraseal Paramastic, a putty-like bentonite compound that we applied with a duckbill trowel to form a 2-inch radius. Then we covered the joint with a Paraseal bentonite membrane that extended up the wall about 3 inches and covered the top of the grade beam.

With the waterproofing in place, we placed drain tile both inside and outside the grade beam and added more stone so that it was flush with the top of the grade beam. This allowed for normal placement of the 10-mil plastic vapor barrier, which overlapped the grade beam, followed by 6-by-6-inch welded wire mesh. The flatwork was then completed, with the 4-inch-thick concrete slab overlapping the grade-beam footing.

An area in the garage that had been part of the original home that was razed required compacted fill, so we had to wait a few weeks for the concrete to cure before doing that operation. Even though the garage backfill was compacted, we installed additional helical piers to support another grade beam in the center of the garage to help support the garage flatwork and ensure there would not be any future settling. At this point, we were able to backfill the foundation and begin the normal framing operation.

Chad Smith owns Distinctive Contracting Services in Arnold, Md.

Photos by Bill Robinson

Sleuthing Out Moisture

One professional's approach to identifying the causes of elevated moisture in buildings

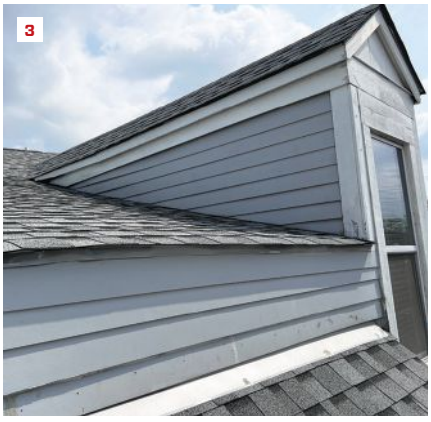
BY BILL ROBINSON

Over a 35-plus-year career of building, renovating, and inspecting houses, I have developed a process to identify moisture sources, assess damage, and develop solutions. It's largely informed by my location in climate zone 2. While I started out in California, I came to New Orleans (NOLA) in 2008 to observe the destruction of Hurricane Katrina and stayed on to help the rebuilding effort, which continues some 15 years later. In this hot, humid climate zone, any building project must address overwhelming moisture loads—ones much greater than in most parts of the country. Average annual rainfall here is about 60 inches. The relative humidity is often over 80%, the alluvial soil is full of moisture, and let's not forget hurricanes, which are an ongoing threat.

Almost all my work, whether I am consulting or doing renovation work, starts with a site visit. I concentrate on the building envelope, the part of the building—floors, walls, ceilings, and roofs—that separates the interior conditioned space from the exterior unconditioned space. The visit results in both data and observations that form the basis of my report. Most of the time, I am working for building owners to ferret out a problem and devise a way to fix it. Every building and every problem is different, and there is no easy recipe to follow. Instead, I lean on an assortment of lifelong work practices, which underpin the process I follow on a building inspection:

- Solidly understanding how buildings are put together. I am

No kickout. This roof-wall intersection **(1)** should have a kickout flashing to direct runoff into the gutter. This **(2)** is what the wall looked like when the gutter and the siding near the roof were removed.



No cut back or step flashing. Siding running down to the roof shingles **(3)** is wicking water and is at risk of failing. Worse, this roof also lacks step flashing. The combined errors are causing water leaks inside the dormer.

constantly reinforcing this knowledge by observing mistakes; failures are great learning opportunities.

- Studying building science. I have been a student of the physics of moisture and energy transfer through building envelopes my entire career. At this point, the best lessons come from observing buildings and working out what combination of principles (convection, conduction, radiation, condensation, diffusion, drainage, and so forth) are at play.
- Knowing building codes and industry standards.
- Asking questions about the problems. I call this the Columbo approach (after the TV detective).
- Collecting and analyzing data relevant to elevated moisture. This involves an organized process of using detection tools, recording the results and combining them with what I've learned by asking questions, and making sense of all these outputs to determine not just the cause of the problem but also the best course of action to solve it.

KNOW HOW BUILDINGS ARE PUT TOGETHER

A solid understanding of how buildings are put together is fundamental and provides a good starting place for sleuthing out where moisture leaks originate.

Moisture typically enters a building envelope through transitions and penetrations. Transitions are places like roof-wall intersections, inside and outside corners, and changes in materials, such as a transition from manufactured stone to any type of horizontal siding or stucco. Penetrations include doors, windows, and mechanical service entry points. Think Larry the Cable Guy or anyone drilling a hole through the envelope. But also think about the tiny penetrations, such as cracks and gaps between materials and the minute openings in porous materials, such as stucco or brick. There are obviously other ways moisture can get into a building; however, I like to start out simple.

GROUNDED IN BUILDING SCIENCE

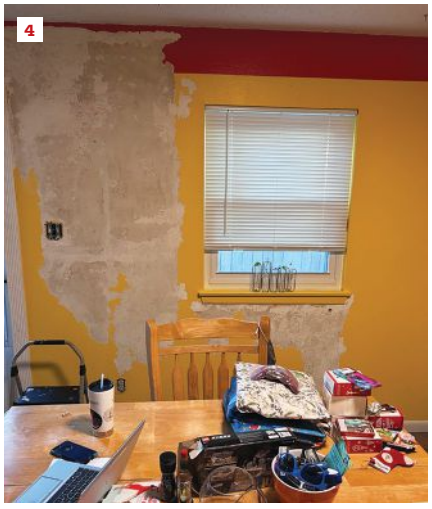
A strong foundation in building science goes a long way toward helping practitioners solve for moisture. This can get pretty involved, but here I'll zero-in on a few simple concepts to start with: the importance of drying, the forms moisture takes, what constitutes a leak, and the movement of water.

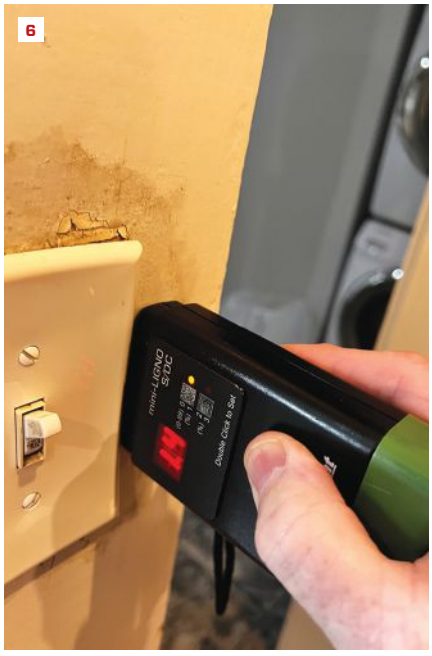
The first—importance of drying—overturns what used to be an accepted building performance rule: "Buildings need to breathe." We (hopefully) no longer think this way. Now we need to think "buildings need to dry." That is, building materials can get wet, even soaked, as long as they can dry. Wood, for example, won't rot as long as it is dry more than it is wet. In my climate zone, wood that remains wet will rot fairly quickly because the temperatures are frequently around 70°F to 90°F—the temperature range that decay fungus thrives in. In other parts of the country, wood rot remains inactive for long periods of cold weather. Frequent wetting and drying might delay rot and mold growth, but it can still be destructive, as the swelling and shrinking with changes in moisture content can open up joints over time and invite more water in where it can seep down into cavities that take longer to dry.

We now use a lot of materials that are impervious to water, which might on the face of it seem like a good thing. But this also means many building materials can trap moisture that gets behind them.

Water comes in three recognizable forms: liquid, vapor, and ice.

Liquid. We tend to over-focus on rain as the primary source of bulk water, ignoring groundwater and runoff, which can add significant volumes of water to a building.





Outdoor humidity levels are high in the author's region, and it's not uncommon for moisture diffusing through the exterior to condense on the back of an interior wall, causing paint to blister in larger areas **(4)**. Air leaks carrying humid air that condensed near a switch **(5)** and an outlet **(6)** also damaged wall surfaces.

We tend to over-focus on rain coming from above, but runoff from rain falling on other areas of a site can often be even more devastating. Water running down this slope **(7)**, for example, will be absorbed by the brick veneer, which will hold water in the wall and eventually cause microbial growth and decay of the structure behind the brick. In addition to the siding being too close to grade **(8)**, the gutter downspout is dumping water on and under the building.

Vapor. Water in vapor form is damaging when it condenses on a cool surface. Condensation "leaks" are a lot less obvious to many in the trades, and many an air leak goes unnoticed because a contractor is looking for a water leak.

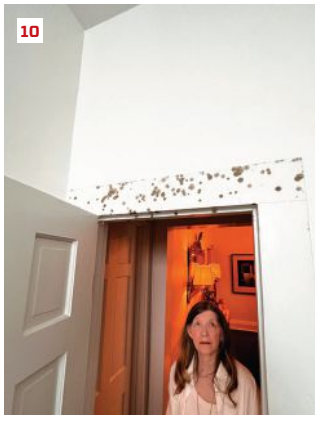
Ice. There is no need to be overly concerned about ice where I am, but ice dams are a source for moisture intrusion in many parts of the country.

For there to be a leak, there must be:

- A source of water or moisture-laden air.
- An opportunity: any breach in the building envelope.
- A driving force.

Moisture and energy go from more to less: hot to cold, wet to dry, high pressure to low pressure. Keeping this in mind allows us to determine where the moisture load is highest. In my climate zone, for example, the outdoor humidity is typically much higher than the air-conditioned interior's, and so moisture tends to move from outdoors to indoors and condense on surfaces toward the interior (such as the back of a drywall or plaster finish). In heating climates, the opposite is true: The indoor relative humidity in winter is typically much higher than it is in the cold outdoors, so moisture will move from indoors and tend to condense on surfaces near the outside of the wall (such as the back of the exterior sheathing).


9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11

Dark stains on the inside of these cabinet doors **(9)** indicate microbial growth most likely caused by a poor air seal between the conditioned space and the attic above. The inside surfaces of the cabinet door are cooler than the other surfaces inside the cabinet and most often below the dew point. Dark stains above a door **(10)** signal poor ventilation in a bathroom. The growth is concentrated over the door because the HVAC return in the hallway pulls air though the closed door when occupants are showering. Cold air from a floor register **(11)** is causing moisture to condense on a wood door, causing it to deteriorate. The moisture is likely coming from air leaks around the door. This moisture might not have been a problem if the surface of the door wasn't frequently so cold.


12

There are two problems with this bath fan **(12)**: The ceiling stains are from air leaks that are depositing high humidity and condensation on the outside of the fan housing. In addition, condensation from inside the ducts is dripping though the grille.

BUILDING CODES AND INDUSTRY STANDARDS

I am trying to stop saying that buildings that meet building codes are barely legal buildings, but old habits are hard to break. I have transitioned into some expert witness work and have learned that in many cases, if the code is followed, there is nothing much to litigate. (In many cases, following code includes following manufacturers' written instructions.) I am finding that divergences from codes and standards are a tell-tale sign that there are other things done incorrectly that may lead to moisture intrusion. A simple example is whether the kraft vapor-control layer of fiberglass batt insulation should face to the interior or exterior. In my region, it is better to face to the exterior, where the humidity level is typically highest. In mixed and heating-dominated climates, the opposite applies.

ASK QUESTIONS

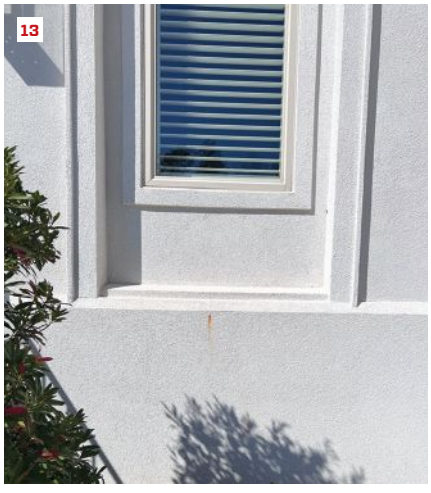
To form a coherent understanding of moisture problems, you need more than snapshots of the present conditions and visible surfaces. Moisture problems evolve over time. Building owners, service personnel, inspectors, and pretty much anyone who interacts with a building are witnesses to problems, and their observations can be helpful in sleuthing out true causes.

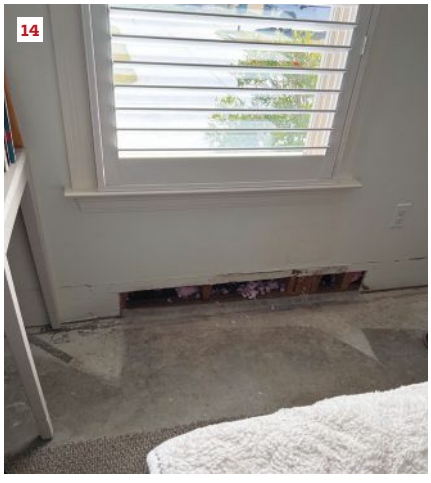
In new homes, the construction documents will answer many questions concerning possible problems. And of course, asking the project lead questions about such things as flashing, caulk, and water-resistive barriers can be helpful. Previous experience, or problems with a particular item, can lead to more questions and solutions.

It is helpful to know how long a problem has existed in an occupied home and if there was a triggering event—an equipment change, a renovation or installation of new furniture that altered air pathways, a storm or flood—leading to the problem. To sniff these answers out, it's often helpful to interview the occupants.

When I begin a site visit, I ask homeowners or (when possible) tenants:

- Why have you contacted me? When and how did you identify there was a need for a building evaluation?
- How many occupants, and do they have any health problems?
- How old is the house? How long have you lived in it?
- Has any work been done on the building in the last few years?
- Do you have available copies of any recent reports from home inspectors, insurance companies, or IAQ consultants?





A rusting fastener **(13)** was one sign that seemed to suggest water leaks around a window. But when the author was called in to perform a window leakage test, no window leaks were detected. Instead, the author discovered water leaking under the bottom wall plate **(14–16)**.

- Do you have any contractors lined up to do the mediation work?
- May I look at recent energy bills, especially from the cooling season? This is climate specific.

These are the basic questions and from there I can get the picture of what we are looking for. It is all about asking the right questions. I find the more talking we do, the more likely I might get what I need. Homeowners are not thinking about the problems from an analytic framework; it's usually emotional, and you have to talk around the problems and get them to tell their stories about their home. Not all of the detail will be relevant, but if you push the conversation in the right way, you can get them to divulge those details that do matter.

COLLECTING AND ANALYZING DATA

Once I do an initial walk-around, I use a thermal camera to identify leaks and a moisture meter to confirm the moisture levels.

In my walk-through, I concentrate on "the four D's":

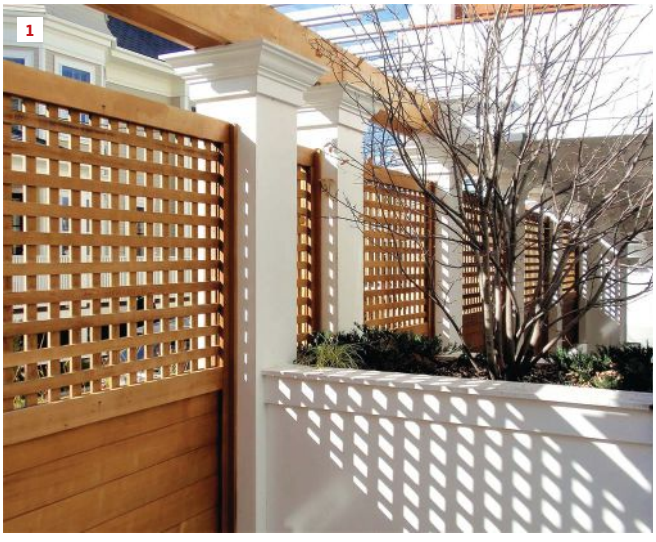
- Deflection: overhangs, drip edges, kickout flashing, crickets.
- Drainage: gutters, grade, rainscreens, drainable WRBs.
- Drying: In older balloon-framed homes, the walls were not insulated, and this allowed for adequate drying. In this market, rainscreens have not taken hold, so new construction pretty much does not dry. The industry is inching toward enhanced drainage in the form of textured WRBs, mats, and other materials to create a drainage space behind the exterior cladding and trim.
- Durability: The use of durable materials might seem to be a no-brainer but not so much. The old homes here are often more than 75 years old and, evidenced by the fact they are still standing, were built to dry.

I am not a licensed home inspector, as I'm not doing real-estate inspections for banks. Rather, I am typically looking at existing issues identified by a homeowner. Of course, if I find any life safety issues, I will bring them to the occupant's attention. A common example I see in older homes is a water heater, which here is typically in the attic, with a vent that is not safely connected.

When I first entered the moisture-evaluation world, I was overly confident that my knowledge of construction made me qualified to solve all problems. As I burrowed deeper into the consulting world, I came to realize that recordable data was necessary not only to convince clients of my abilities but also to communicate my conclusions to program and finance partners, town officials, and other contractors working on the property. And often by getting a broader picture of the conditions, I am able to work out solutions for problems that aren't immediately obvious and have compound causes.

Bill Robinson is a NOLA-based building-envelope consultant. Follow him on Instagram: @bandannabil.

BY VINCENT SALANDRO



1. Heavy-Duty Wood Lattice
Woodway Lattice is opposed-angle-stapled with the angle reversed at alternate lath intersections to hold the assembly tightly together, and the 4-by-8-foot panels are glued along at least four joint lines for additional strength. Suited for privacy or garden spacing, the Square Lattice, pictured, is available in western red cedar, redwood, mahogany, and treated western white woods in either standard ($^{3}/_{8}$ inch) or heavy-duty ($^{13}/_{16}$ inch) thicknesses. Woodway recommends applying a water- or oil-based finish to protect the wood. woodwayproducts.com

2. High-Performance Solar Shingle
CertainTeed says its solar Solstice Shingles integrate with any asphalt shingles and can produce about as much energy as conventional, rack-mounted solar panels without a bulky appearance. The shingles are rated for hail impact and can produce energy even under diffused light and shade, according to the company. The shingles can be installed by a contractor with the assistance of an electrician. certainteed.com

3. Energy-Efficient Water Heater
The LG Inverter Heat Pump Water Heater offers a Uniform Energy Factor of 3.75, which will deliver greater energy savings (when the unit isn't operating off the electric-resistance backup) than conventional electric water heaters. This water heater reportedly provides up to 66 gallons of hot water every hour. The inverter system allows the heat pump to operate down to 23°F ambient air temperature, minimizing the need for the backup heat source. The water heater functions at a quiet sound level of 32 dBA and can be managed remotely using the LG ThinQ phone. app. lg.com/us

4. High-Tech Door Hardware
Copper Creek Hardware has launched Electronic LED keypad deadbolts and levers, in black coated, stainless steel, and polished stainless finishes. Each features a latch bolt that extends and retracts by an electric motor and digital LED touch screens. The deadbolts and levers have a limited lifetime warranty on the mechanical components. coppercreekhardware.com

5. Self-Cleaning Range Hood
Hauslane's 30-inch Chef Series UC-C400 Under Cabinet Range Hood features a self-cleaning system that flushes steam and water (from a tray on the unit that users periodically fill with water) to clear grease from the internal fan. The ducted, under-cabinet range hood has dual motors and six speed settings, and it articulates with either a 6-inch-round or 10-by-3 1/4-inch-rectangular duct. Suggested retail price is $340. hauslane.com

6. Smart Thermostat Kit
Offering control over three types of indoor air quality equipment simultaneously, the Honeywell Home T10+ Smart Thermostat Kit from Resideo Technologies includes the Honeywell Home T10+ Smart Thermostat, a floor/slab sensor, an Equipment Interface Module, a wireless, smart room sensor, a wireless outdoor sensor, and a return and supply air sensor. The EIM allows for the installation of humidification, dehumidification, and ventilation systems without running new wires. resideo.com

7. Moisture-Resistant Exterior Paint
Element Guard is an exterior paint that Benjamin Moore claims is formulated to withstand wind-driven rain, excessive humidity, and high-moisture painting environments. The paint can resist rain as soon as 60 minutes after application and can be applied in temperatures as low as 35°F, according to the manufacturer. Available in flat, low lustre, and soft gloss finishes, Element Guard reportedly offers strong adhesion, cracking and peeling resistance, and mildew resistance. Pricing is $66 per gallon. benjaminmoore.com

8. Multiuse Wood Screws
The MVP Multipurpose Wood Screw features FastenMaster's double-lead SureStart point and Torx tap drive for wobble-free installation. The manufacturer claims that its ProjectLife Coating delivers corrosion protection and its SureSink Head countersinks into the wood without compromising clamping force. The screws are available in six sizes from 1 1/2 to 4 inches. A box of 100 1 1/2-inch screws retails for around $20. fastenmaster.com

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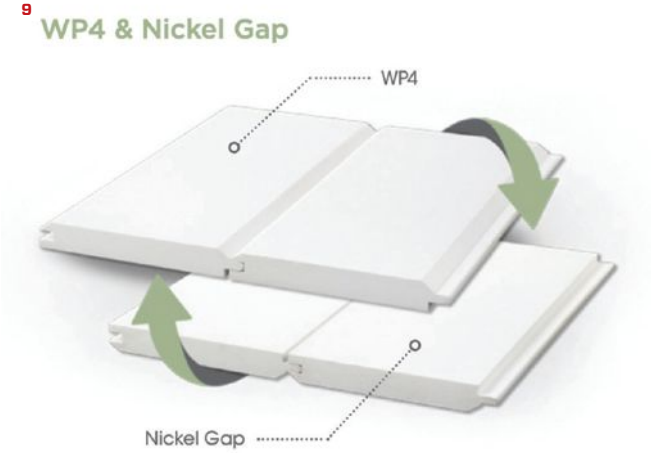

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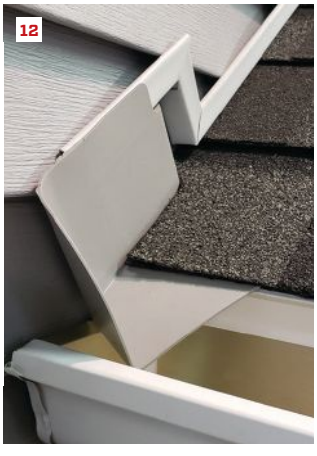

9. Reversible PVC Trim
Wolf Home Products has added tongue-and-groove WP4 & Nickel Gap and Shiplap & Nickel Gap profiles to its trim lineup. The reversible profiles, made from lightweight, high-cell-density PVC, will not absorb moisture and can be cut, drilled, mitered, nailed, or glued without the use of special tools, according to Wolf Home Products. Both profiles come in 18-foot lengths and in 1-inch-by-6-inch and 1-inch-by-8-inch sizes. wolfhomeproducts.com

10. Fiber-Mesh Drainable Building Wrap
Engineered to protect multistory structures from the elements and manage excess moisture in wet, coastal climates, Typar DrainableWrap uses an integrated layer of fibers to create drainage and channel wind-driven rain and bulk water away from the structure. Typar says when it's used as part of the company's Weather Protection System, resistance to water and air intrusion is balanced with appropriate moisture vapor transmission. Available in 5-foot-by-150-foot rolls, it can be left exposed for up to six months. typar.com

11. Pourable Floor Adhesive
Bona Quantum Flow from Bona US is a one-component, silane-based wood-floor adhesive. Reportedly easy to pour, the adhesive can cover a large surface area quickly and efficiently. It can provide acoustical sound deadening and prevent warping and buckling caused by humidity changes over time, according to the manufacturer. Typically ready for foot traffic in two hours, the product emits no VOCs and reportedly will not harm the finish on prefinished floors. bona.com

12. Roof-to-Wall Flashing
As readers of *JLC* are aware, serious moisture damage can result from a lack of kick-out flashing. J'd Out Kickout Flashing from American Flashings has a two-step water deflector. The first is set at 2 inches high with an integral J-channel on top, and the second is an out-turned leg with a recessed channel. The first deflector bumps out an inch from the wall, allowing siding of any type to slide into the recess behind the out-turned leg so the end is hidden. The top channel hides the angle cut in the siding and is sized for a standard J-channel to slip into from the roof-slope side. The kickouts cost $19 each or $32 for a left and right pair. americanflashings.com

13. Weather-Resistant Decking Solution

ThruFlow Legacy XP panels assemble with connecting tabs and elongated screw holes. Because of their open architecture, the UV-resistant, non-slip panels are lighter in weight than other decking products and allow sunlight to pass through, which the manufacturer says keeps the decking surface cooler. Medium-strand-glass-fiber reinforcement and a thick rib structure below help the polypropylene panels withstand greater loads. The panels are available in 1-by-3-foot, 1-by-4-foot, 1-by-5-foot, and square 4-foot-by-4-foot sizes and in light gray, maple, and sea foam hues. thruflow.com

14. Flooring Installation Portfolio

Laticrete has added profiles and trim to its roster of tile, stone, and flooring installation products. The German-engineered and -manufactured profiles and trim for floors, walls, countertops, stairs, and balconies are available in five materials: two stainless steel options, aluminum, brass, and PVC. The products can be used with a variety of finishes, including tile and stone, terrazzo, wood, and luxury vinyl tile in indoor and outdoor applications. laticrete.com

15. HVAC Piping Wall Penetration Seal

The Airex Titan Outlet features an enclosure with weatherproofing capabilities that fits over and seals around piping penetrations using elastomeric gaskets and seals. The manufacturer claims its product prevents the wall gaps and exterior surface cracks associated with rigid wall penetration sleeves or rigid penetration flashing materials. An integral, over-molded, and flexible elastomeric sleeve seals refrigerant piping and insulation and includes a designated region for a stainless steel clamp that mechanically secures against vibration, rodents, and insects for outdoor use. airexmfg.com

16. Plug-in Power Vent

Rather than needing to be hardwired, the GAF Master Flow EZ Cool Plug-in Power Attic Vent plugs into a 110-volt electrical outlet. When installed as part of a properly balanced ventilation system, the vent delivers up to 1,050 cubic feet per minute of airflow and ventilates up to 2,000 square feet of attic space. Users can regulate attic temperature with an adjustable thermostat or via smart devices. The product retails for around $160. gaf.com


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Dash-Board Portable Workshop

BY NATHAN RINNE

As a carpenter who primarily focuses on custom furniture and built-ins, I've found the track saw has become something of a necessity for the way I work. Could I get by without it? Sure, but with the amount of time I save using one vs. other methods to make crosscuts as well as more complicated compound cuts, I can honestly say I wouldn't want to work without mine … or without a good workbench. Over the years, I have found that having a worktable dedicated to my track saw is a must-have for any of my jobs, whether on site or in the shop. I've tried everything from a pair of sawhorses and a sheet of plywood to various commercially available worktables, all of which have left a lot to be desired. As such, I have always been on the lookout for that one setup that would check all the boxes for me: rigid, lightweight, portable, well-designed, and well-built. One evening, while scrolling through Instagram, I came across an ad for the Dash-Board Portable Workshop. After watching several videos about it, I believed the build quality of this workbench was far and above anything I had used in the past, and I decided to see about testing one out.

I contacted Dash-Board and ended up speaking with inventor and company owner Rob Schumacher about the system and the company's review process. It's a small company, and Rob has a hand in pretty much everything it does, from product development to marketing and even follow-ups with customer service. The fact that he spent years in the finish carpentry and cabinetry field shows in the way he designed the bench and accessories. Rob has spent a lot of time perfecting and tweaking the design, and if you check out the company's Instagram account, you will see several iterations of the basic bench that's produced today.

First impressions. My Dash-Board shipment arrived over the course of several days and in quite a few packages, every piece wrapped and padded in a way to avoid any possibility of damage from careless handling. Since I got both the basic bench and the platinum accessory pack, I had a ton of pieces to assemble, but I was able to put them together in one afternoon.

The bench itself comes preassembled and is very sturdy, something severely lacking in the commercially available setups I've used. For example, the top is made from Baltic birch plywood instead of MDF, and the amount of extruded aluminum in the frame puts any competitors to shame. At almost 8 feet long and 24 inches wide, it is sized for breaking down sheet goods efficiently while providing full-length material support. Any of the parts that aren't milled aluminum (parts vary from 1/4 inch to 7/16 inch thick) or extruded aluminum are made from carbon fiber, which is extremely durable and lightweight.


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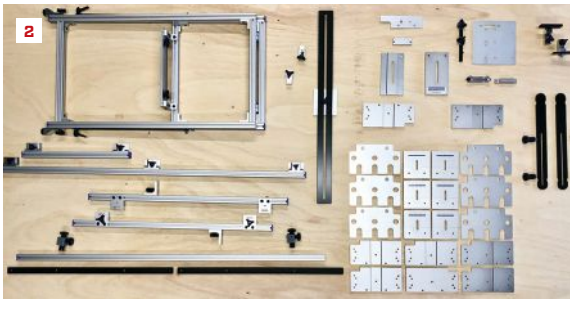
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The Dash-Board Portable Workshop is shipped direct from the manufacturer ready to assemble and set up on site. The workbench has a Baltic birch plywood work surface that measures 92 inches long by 23 3/4 inches wide and weighs about 60 pounds as shown **(1)**. The author upgraded the standard bench with the company's Platinum Pack, which includes a set of guide-rail brackets needed to make crosscuts with a track saw, bench dogs, an assortment of different fences, and other useful accessories **(2)**.

Photos: 1, 3–5, courtesy Dash-Board Portable Workshop; 2, Nathan Rinne

Performance. The Dash-Board is designed to make quick work of breaking down sheet goods. For crosscutting, it has guide-rail brackets made from 1/4-inch plate aluminum that allow you to quickly hinge the track out of the way when you need to move the workpiece, and then simply drop the track back down into a pin on the opposing guide bracket, guaranteeing a square, repetitive cut every time. You accomplish this by squaring the side-mount fences to the track upon initial setup. The two-piece design of the fence ensures material support on both the left and right sides of the cut, which combined with the design of the guide-rail bracket, provides continuous support even at the point of cut. Using the carbon fiber flip stops on the fence makes repeat square cuts an easy task. I find this especially useful in cabinet construction as I can cut all my shelves to exact tolerances without needing to measure anything but the initial shelf.

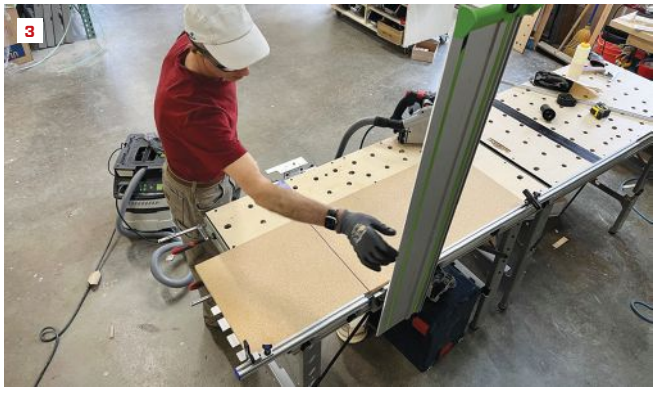
Rip cutting is also an easy task, using the Universal Track Stars and Outriggers. Simply mount the SpiRail Dogs to your track and each of them will slide and drop into the slots on the Track Stars. The various parallel guides and rip gauges allow you to make repetitive rips and quickly break down sheet goods. The Outriggers are a must for material support, but they also help complement the ingenious design that has you cut just to the side of the bench, thereby missing all brackets and accessories with your blade as you do so.

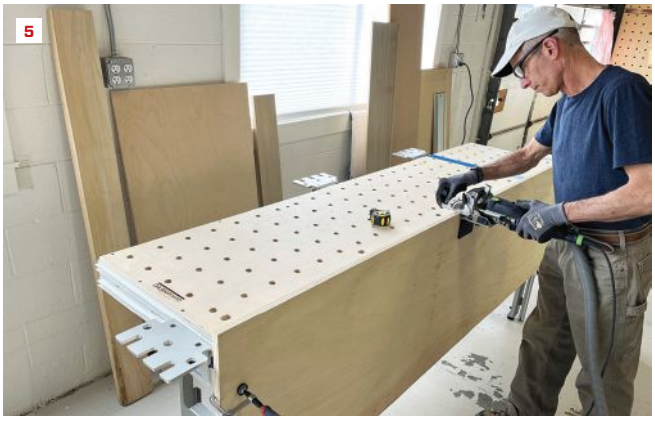
The Dash-Board also functions as an incredible door and panel bench, thanks to a pair of optional door and panel supports that mount to the bench. These allow you to stabilize and clamp a door or panel along the side of the bench and perform any number of drilling, planing, and routing tasks while on the job.

Cost. The standard Dash-Board bench costs $1,760 (which includes shipping), and the Platinum Pack (which includes most of the accessories described in this review) is priced at $2,700. While the price of a complete package may seem cost-prohibitive to some, the company offers a number of options for building a custom bench or adding any of the features and accessories they make standard in their offerings to an existing bench. From my perspective, however, I like to spend my time making money and would be more than happy to take the write-off that comes with purchasing the complete Dash-Board system.

In my opinion, both the Dash-Board's design and the quality of its materials are better than those of any other commercially available unit on the market, and I would not hesitate to recommend this bench to anyone looking to up their on-site carpentry game. dashboardpws.com

Nathan Rinne owns Rinne Trimcraft, in Lake of the Ozarks in Missouri. He specializes in on-site carpentry with an emphasis on ornamental built-ins. Follow him on Instagram at @rinne-trimcraft and on Facebook at facebook.com/rinnetrimcraft.





Crosscuts as wide as 24 3/4 inches are possible when the guide-rail brackets are fitted to a track saw's guide rail **(3)**. Adding the system's Outriggers to the workbench provides additional support for ripping sheet goods **(4)**. Doors or panels can be clamped vertically to the side of the bench with the addition of optional supports **(5)**.

StealthMounts Tool Mounts

BY TOMMIE MULLANEY

Misplacing a tape measure or not having a place to hang a drill can be a daily frustration on the jobsite, so when I discovered StealthMounts, a British company that creates injection-molded ABS accessories such as tape hooks, battery holders, level holders, and more, I had to try its products out. After more than six months using them daily, I've found the holders and clips that I've bought to be rugged and extremely useful.

I started off with the StealthMounts bench belt universal tool holder ($14 for a six-pack set on Amazon), which I use primarily on ladders to hold a tape measure, drills, and nailers. Designed to work with a tool's belt hook, these holders can be mounted just about anywhere with a couple of screws (not supplied). I've added a second mount to my miter saw stand to give my measuring tape a dedicated, easily accessible home instead of just resting it on the stand, where it would eventually be in the way or knocked off.

Next, I bought a two-pack magnetic bit holder ($18 on Amazon) for my Milwaukee M12 impact driver. The bit holder uses the existing belt-clip threaded hole with the supplied screw, making this a "plug and play" product that was quick and easy to install without affecting the drill's ergonomics. Now I have access to several bits at all times, as well as a small magnet on the side for loose fasteners.

Track-saw guide rails can be tricky to keep out of harm's way, so I bought several sets of StealthMount's guide-rail holders ($33 on Amazon) to store them safely in my van. The holders have cam locks that secure the rails in place and keep them from rattling around. batterymounts.com

Tommie Mullaney owns Black Label Carpentry in central Florida. Visit his web page at blacklabelcarpentry.com or follow him on Instagram at @BlackLabelCarpentryCo.

Made of tough ABS plastic, StealthMounts universal tool holders can be placed virtually anywhere to provide a spot to hang a tool with a belt clip (top). Among the other accessories that the company offers are bit holders fabricated specifically for the drill/drivers of a number of different manufacturers (above).

Metabo HPT Work Light

BY TIM UHLER

Offering 10,000 lumens in a compact unit that weighs little more than the battery, this battery-powered light from Metabo HPT is nothing short of perfect. It's on the company's MultiVolt platform, so it can be plugged in and run off A/C power, and it has 15 brightness levels, is IP65 rated, and is a good value at $200 (tool only).

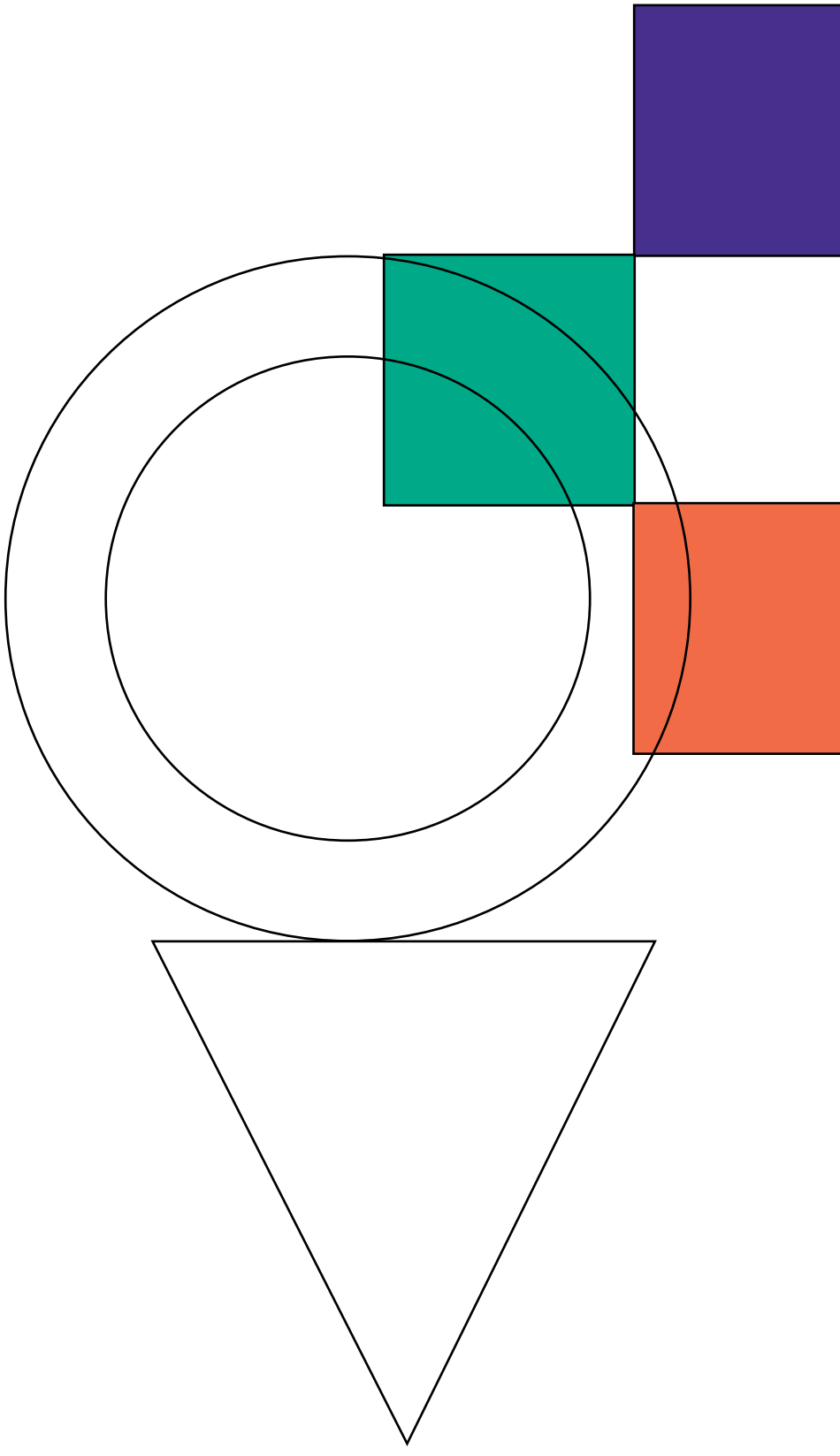
The unit has a handle on top for carrying (or hanging), a leg that folds out as a stand, a 5/8-inch-diameter threaded fitting for mounting on a tripod, an adjustment dial for brightness, and a USB port to charge a phone. A larger, 8.0-Ah battery lasts a little over 90 minutes with the light at full brightness, which is fine with me because it takes half that time to recharge. If you're already in the Metabo HPT ecosystem, then I highly recommend this light. metabo-hpt.com

Tim Uhler is a lead carpenter for Pioneer Builders in Port Orchard, Wash. He is a contributing editor to JLC *and* Tools of the Trade. *Follow him on Instagram at @awesomeframers, subscribe to his YouTube channel, or visit his website: awesomeframers.com.*

Metabo HPT's MultiVolt battery-powered work light has a compact footprint, a tripod mount, and 15 light settings.

Photos: top, Tommie Mullaney; bottom, Tim Uhler

JLC



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BY CLAYTON DEKORNE

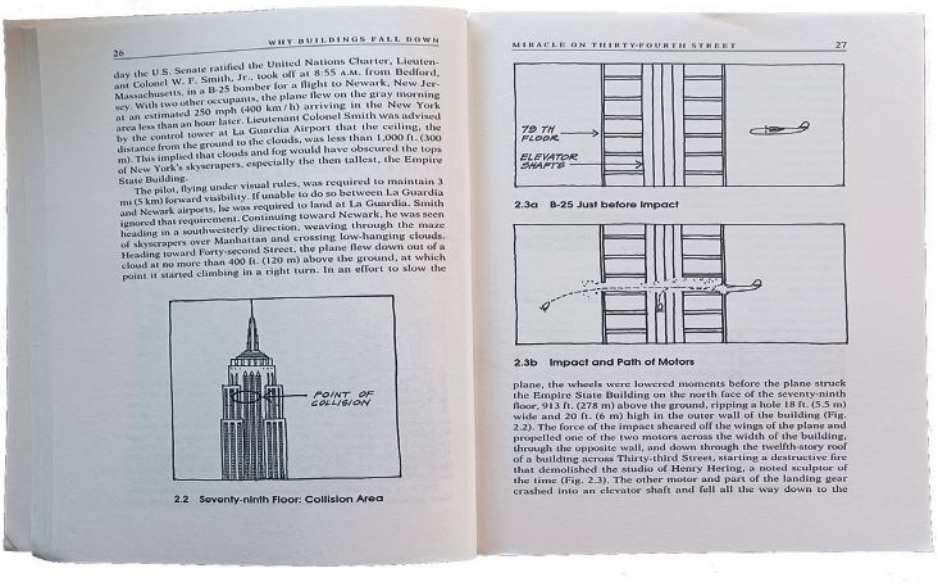
An Armchair Engineer's Reading List

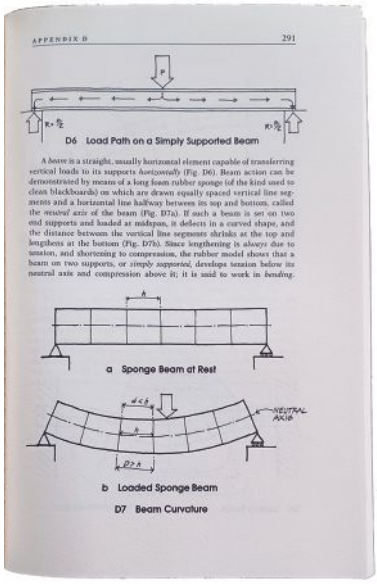
Carpenters may not need to solve static equilibrium equations, but they can benefit from understanding the principles of engineering. Toward that end, a pair of books written by Mario Salvadori—*Why Buildings Stand Up* (W.W. Norton, 1990) and, with co-author Matthys Levi, *Why Buildings Fall Down* (W.W. Norton, 1992)—render engineering statics into plain English. Both books lean heavily on J.E. Gordon's classic *Structures: Or Why Things Don't Fall Down* (Penguin, 1978), which follows on an earlier title, *The New Science of Strong Materials: Or Why You Don't Fall through the Floor* (Penguin, 1975)—two books that launched a genre of sorts designed to immerse lay readers in the principles of building statics without math, just words.

Gordon used engineering fundamentals (elasticity, tension, compression and bending, shear, and tension) as the organizing principle of his work, while Salvadori shaped his first, *Stand Up* edition around types of structures (pyramids, houses, bridges, and such), and his second, *Fall Down* edition around famous building disasters. It is this second title that is perhaps the most readable, as the ruin of building ambitions is especially riveting to witness from the safety of an armchair.

In his pair of books, Salvadori combined Gordon's essayist style, which weaves together observation and humor, with a historian's flair for drama and intrigue, so along the way, we get a fair overview of the structural underpinnings to many of the world's greatest architectural achievements, some still standing and some destroyed. Sifting in this historical view harks back to yet another volume in the armchair engineer's genre: David McCullough's *The Great Bridge* (Simon & Schuster, 1972), a highly readable historical account of the design and construction of the Brooklyn Bridge.

For carpenters, mechanics, and practitioners at every level of the AEC (Architecture-Engineering-Construction) food chain, these books provide both education and entertainment to hone our understanding of how construction works. Presumably, they pertain as much to the "E" as to the "A" and "C." "It is only when the subject is stripped of its mathematics," Gordon explains, "that one begins to realize how difficult it is to pin down and describe those structural concepts, which are often called 'elementary.'" The engineer, famous among the trades for speaking an obscure jargon, will likely gain some insight into how to communicate the importance of their knowledge to all parties involved.

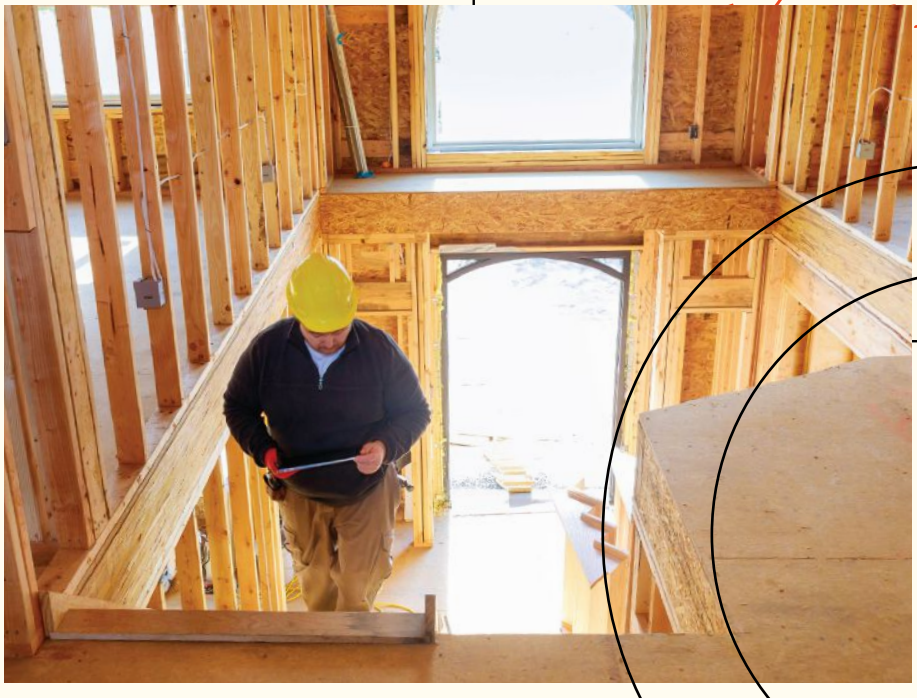




Never forget. Among the books covered here, *Why Buildings Fall Down* offers a compelling read for those who revel in disaster … and occasional success, as evidenced in the instructive saga of how the Empire State Building survived the impact of a plane crash—an episode eclipsed by a pair of famous New York buildings destroyed by much more powerful plane crashes.

Statics for all. *Why Buildings Fall Down* also stands out for its appendices, which provide a concise and highly readable overview of building statics—a must-read for non-engineers.

JLC



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