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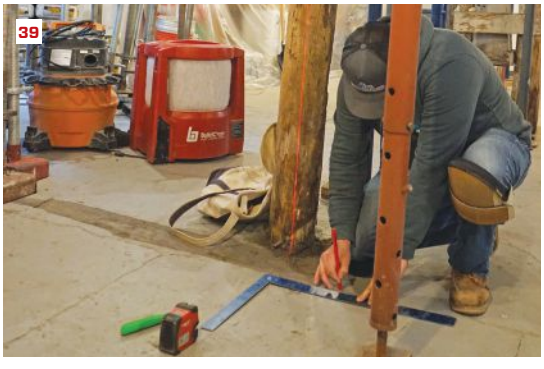

On the cover: A painter applies Poly Wall sealant to a window for the airtight shell of a high-performance home in Marietta, Ga. See the story on page 25. Photo by Chris Laumer-Giddens.

FEATURES

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THE JOURNAL OF LIGHT CONSTRUCTION (ISSN 1056-828X), Volume 38, Number 10, is published 10 times per year (January, February, March, April, May, June, July/August, September, October, November/December) by Hanley Wood, 1152 15th St. NW, Suite 750, Washington, DC 20005. Annual subscription rate for qualified readers in the construction trades: $39.95; nonqualified annual subscription rate: $59.95. Frequency of all magazines subject to change without notice. Double issues may be published, which count as 2 issues. Publisher reserves the right to determine recipient qualification. Canada Post Registration #40612608/G.S.T. number: R-120931738. Canadian return address: IMEX, PO Box 25542, London, ON N6C 6B2. Periodicals postage paid at Washington, DC, and at additional mailing offices. POSTMASTER: Send address changes to JLC, Box 3530 Northbrook IL 60065-3530.

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Chief Editor, JLC Group Clayton DeKorne, cdekorne@hanleywood.com
Executive Editor, JLC Group Andrew Wormer, awormer@hanleywood.com
Senior Design Director Tina Tabibi, ttabibi@hanleywood.com
Managing Editor Laurie Elden, lelden@hanleywood.com
Senior Editors Ted Cushman, tcushman@hanleywood.com;
Tim Healey, thealey@hanleywood.com;
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The Journal of Light Construction,
Hanley Wood LLC
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Washington, DC 20005
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INFORMATION DIRECTORY

CONTACT INFORMATION

jlconline.com; 202.452.0800
JLC
Hanley Wood LLC
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Washington, DC 20005

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847.778.9863
ptourbaf@hanleywood.com

Christie Bardo
Senior V.P., Digital and Residential Construction
703.307.3014
cbardo@hanleywood.com

EAST / SOUTH

Paul Pettersen
Strategic Account Director
516.252.8020
ppettersen@hanleywood.com

MIDWEST / SOUTH CENTRAL

Kay Ross-Baker
Strategic Account Manager
630.707.0811
krossbaker@hanleywood.com

WEST COAST

Carol Weinman
Senior Strategic Account Director
831.373.6125
cweinman@hanleywood.com

CANADA

John Magner
York Media Services
416.598.0101
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Could This Be Your Busiest Summer Ever?

Two decking contractors share how you can make the most of a crazy time.

Yes, the summer of 2020 is going to be strange.

But not that strange. At least not for decking contractors and remodelers with decking projects. The project pipelines may not be as full as everyone likes, but there is opportunity out there. Maybe more than you imagine.

That's the word from a pair of respected deck builders, Mike Walter and Phil McLain. Both self-employed contractors set down their cordless drills long enough to share a secret or two that may help you make the best of a challenging time.

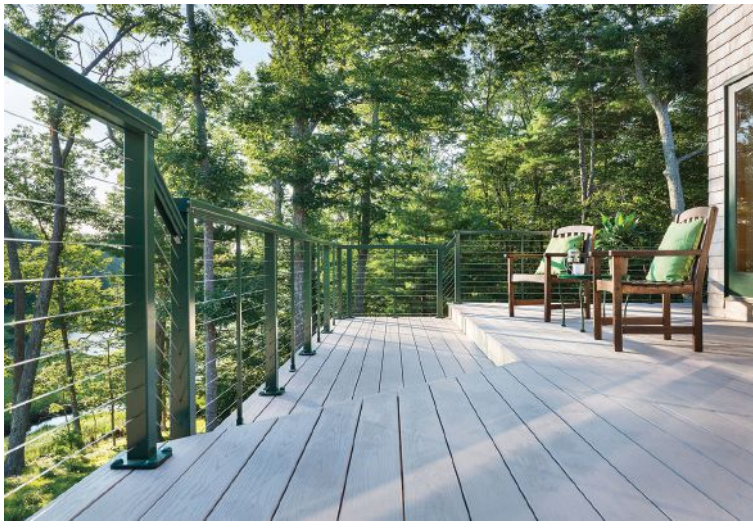
"I'M A DECKY"

Veteran deck-builder Mike Walter takes the times in stride. And why not? After nearly four decades in business, he has seen his share of ups and downs. Even so, this past spring takes the cake. "I've never seen anything like it," he sighs. How is Walter tracking down new projects and winning bids? A few thoughts:

- **Fly your Decky flag.** Creating a winning impression with a potential customer is always a top goal. Walter knows attitude counts for a lot so he's not shy letting folks know "I'm a Decky. I'm a decking geek. They can quickly sense that I enjoy what I do," he says. That positive energy is often a winning differentiator.
- **Frontload the presentation.** "I have these high quality, professional folders I show. One shows all the lighting, another one all the decking. The decking one shows decks I've waterproofed, a big upsell," he says. The waterproofing photos naturally leads to ideas about how to outfit the dry underneath area with a ceiling, lights, and speakers.

JUST THE FACTS

Business is good in Estes Park, Colo., Phil McLain's home and service area. A general contractor, McLain's company is focused on "...super high-end homes in the region for the last 15 years," he says. Deck construction remains a priority, with at least five projects in the works. Here's how McLain keeps his crew busy:



- **Agenda-free consultations.** "If you get a sense the budget is tight and set, I definitely won't push nicer products. But I definitely have a standard I won't go below," McLain says. "You wonder how some of these decks are still standing because another contractor cut so many corners. I tell people how it is in a truthful, straightforward manner. No change orders. No surprises. The referrals and business will come your way."
- **Silver lining.** Have you checked today's super-low interest rates? McLain's customer certainly have. "I have some folks ready to do deck projects with interior remodeling, too. They're exciting projects. It's because the Fed is keeping interest rates really low."
- **Form follows function.** It's all about the backyard view in mountain country. "Views are very important to people here," McLain observes. "I like to pitch cable rail because it doesn't obstruct the view. If that's something that interests them, great. From there I recommend the best product available. I don't want callbacks."

Learn more about deck design including a free online visualization tool for building the perfect deck at **Feeneyinc.com**.

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Produced by Hanley Wood Strategic Marketing Services Group

Weaving Shingle Corners, With Flare

BY EMANUEL SILVA

In the area where I work, many of the existing homes have cedar shingle siding. Currently costing more than $225 per box, the prestained No. 1 grade R&R (rebutted and rejointed) red-cedar shingles that I used on this project are a premium siding material, so they're not as commonly used in new construction as they once were. But I renovate and remodel a lot of existing housing stock and often have to match the home's siding when modifying a wall for a new door or window, or when building a new porch, deck, or addition. It makes sense to use installation details that ensure that this premium building material lasts as long as possible.

In this article, I'll focus on the corners. Some shingle-sided homes have corner boards, but another traditional option—especially here in New England—is to wrap the shingles around both the outside and inside corners. In addition, the old homes in our area often have siding that is flared out over the foundation at the base of the wall, instead of terminating at a water table or remaining in the same plane as the wall. This complicates shingle installation a little bit, especially at the woven corners, but it looks great and is actually a practical detail for homes with irregular fieldstone foundation walls. With a careful approach and a few special tools, it's not difficult to install flared, woven cedar-shingle corners.

Underlayment. I've dug into plenty of walls that lacked any 15-lb. felt paper (the old-school WRB) or building paper between the shingles and the sheathing, without finding any significant water damage. That's because shingles with 5 inches or so of exposure provide triple coverage, an effective way to shed water. But I always install building paper over the sheathing as required by code, first covering any inside or outside corners with peel-and-stick flashing membrane.

On the corner shown here, I installed 12-inch-wide Vycor Plus vertically, overlapping the inside and outside corners by 9 inches on one side and 3 inches on the other. Then I ran a full width of Vycor up the wall at the corners to cover the 3-inch legs. On a larger wall section, I would detail the corners and then cover the rest of wall with Blueskin SAF housewrap.

Next, I installed Cedar Breather, a nylon matrix that creates a gap between the back of the shingles and the WRB. This rainscreen detail allows the shingles to quickly dry out from both the inside and outside, which helps to prevent them from curling and cracking.

Adding the flare. As far as I know, there is no uniform angle for the flared shingle detail at the base of the wall on old homes, so there was a bit of trial-and-error in my method. I started by ripping a couple of pieces of 1-by PVC trim to make a pair of upper and lower furring strips—one measuring 1 inch wide and one measuring 2 inches wide—to kick out the shingles. Then I mocked up the flare detail on my workbench to find the proper bevel angle for the furring strips.

When a shingle is pressed against the furring strips to make the flare, the back of the shingle contacts only the top edge of the furring

Photos by Carter Silva

The author starts by mocking up the flare detail to determine the 15-degree bevel angle on the PVC furring strips **(1)**. After gluing and screwing the furring strips together into an assembly **(2)**, he installs them as units **(3)**. Next, he staples up Cedar Breather over the self-adhered flashing membrane to provide a space for airflow between the shingles and the WRB **(4)**.

The author trims enough of the first inside corner shingle so that the edge is flush with the wall **(5, 6)**, tacks the shingle in place, and uses a compass to scribe the flare on the opposing shingle **(7)**. Then he cuts **(8)** and planes **(9)** the shingle to the scribe line before tacking it to the furring strips with 2-inch ring-shank siding nails **(10)**.

strip. So after a couple of trial cuts, I figured out that a 15-degree bevel on the edge of each furring strip provided the proper angle for full contact.

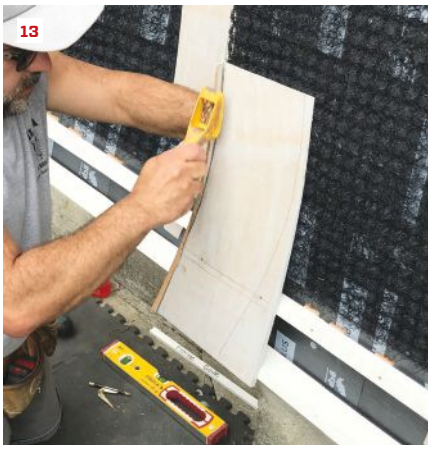
After ripping the upper and lower furring strips and cutting them to length, I assembled them as single units on my workbench, rather than installing them one piece at a time on the wall. This made it easier to square up the assemblies, level them, and shim them as needed as I screwed them to the wall.

There are a couple of reasons why I made the furring strips from PVC rather than wood trim. For one thing, PVC won't rot; but even more importantly, it holds the ring-shank siding nails that I use to install the shingles tenaciously, much more so than eastern white pine does. This is especially important with flared shingles, which are under some tension that tends to make the nails want to withdraw from the substrate.

Starter course. I always begin with an inside corner and work from the inside out, as it is much easier to run an outside shingle long and trim it to fit than it is to cut an inside shingle to the exact size needed. Before installing any shingles, though, I scribed a pair of lines across the butt end of each one to mark the 5-inch exposure line, and to mark the 5 3/8-inch fastener location above the butt. Then I tacked the first (right-hand) shingle in place so I could use it to scribe the flare on the adjacent (left-hand) shingle with a compass.

Until recently, I would have used a jigsaw to cut the shingle just off the scribe mark. But lately, I've been using a Makita 12-volt Max CXT 3 3/8-inch cordless circular saw for trim cuts in 1-by stock, including curves like this, because it's faster and makes a smoother cut. Then I pared the cut back to the scribe line with a Stanley Surform 21-115 shaver, a versatile and virtually indestructible tool that belongs in every toolbelt. Unlike a block plane, this tool can also be used to carve out concave curves, an ability that's needed for the shingles on the outside corner.

To roughly scribe the back of the first outside-corner shingle, I used a flexible 3/8-inch-by-3/4-inch batten ripped from PVC stock. After cutting and shaving that shingle to the scribe line and tacking it in place, I pressed the adjacent shingle into position against



On the outside corner, the author uses a flexible batten to scribe the first starter shingle **(11)**, then tacks the shingle in place and scribes the back of the opposing shingle **(12)**. A Surform tool is used to smooth the joint after the second shingle is installed **(13)**. Once the starter course is in place, the first course and subsequent courses are installed in similar fashion, working from the inside to outside corners **(14, 15)**.

the furring strips and scribed the back of that one. After cutting and trimming this second outside-corner shingle to the line, I nailed it to the furring strips. Then I cleaned up the corner where the two shingles overlapped, using the Surform.

Nailing. There's nothing fast about weaving shingle corners, including the nailing. For one thing, I carefully hand-nailed these shingles to the wall. To prevent cracks and splits, I drilled holes for all of the 2-inch stainless steel ring-shank fasteners, using the 5 3/8-inch scribe line to accurately place the holes in the right location, 3/8 inch above the exposure line and at least 3/8 inch away from the edge of the shingle.

On the flared portion, I drove the nails in as close to simultaneously as possible rather than nailing off one side at a time, tapping in one nail and then the other until they both were driven home. Otherwise, the shingles would have split. As I move up the wall and the shingles flatten out, predrilling isn't as critical, but I still usually hand-nail the shingles rather than fire up a siding nailer. As I said, there's no quick way to install shingle siding.

First course. After the starter course was nailed off, I duplicated the scribing procedure with the first course of shingles, starting from the inside corner again but instead scribing the shingle on the opposing (right-hand) corner. This created a water-shedding overlap at the inside corner.

As I installed the field shingles, I overlapped each joint on the starter course by at least 1 1/2 inches. At the outside corner, I again reversed the scribing sequence so that the woven shingles would properly overlap the starter-course shingles.

Remaining courses. I continued the same sequence as I installed each course of shingles, working from the inside corner out and using a spirit level to keep the courses on track. Occasionally, I nailed together a corner shingle joint that had opened up, carefully drilling a small pilot hole through the face of the outer shingle into the edge of the opposing shingle to keep the nail on track and keep it from splitting either shingle. But in general, shingles with only a 5-inch exposure lay flat on the wall, and this step isn't as necessary as it is with shingles that have a wider exposure.

After I finished weaving the corner, I came back and lightly cleaned up the shaved joints with 120-grit sandpaper as needed, then touched everything up with matching stain.

Emanuel Silva, a frequent contributor to JLC, *owns Silva Lightning Builders in North Andover, Mass. Follow him on Instagram: @emanuel.a.silva1996.*

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BY MELANIE HODGDON

Mapping Your Company's Restart

In these days of uncertainty, nobody can predict whether, when, or to what extent "business as usual" will return. As a client of mine remarked, "Even when science suggests that it's 'safe' to open businesses, how do we know whether our customers will come back?"

Realistic questions like this spark additional ones, including:

- Will I be able to rehire my workforce if there's insufficient work to support them?
- What criteria should be used to determine how the workforce changes in terms of roles?
- If roles are to be consolidated, shared, or split up, what's the best way to approach this?
- Might our current processes and procedures be overhauled to reduce or eliminate duplication, redundancies, or missing parts?

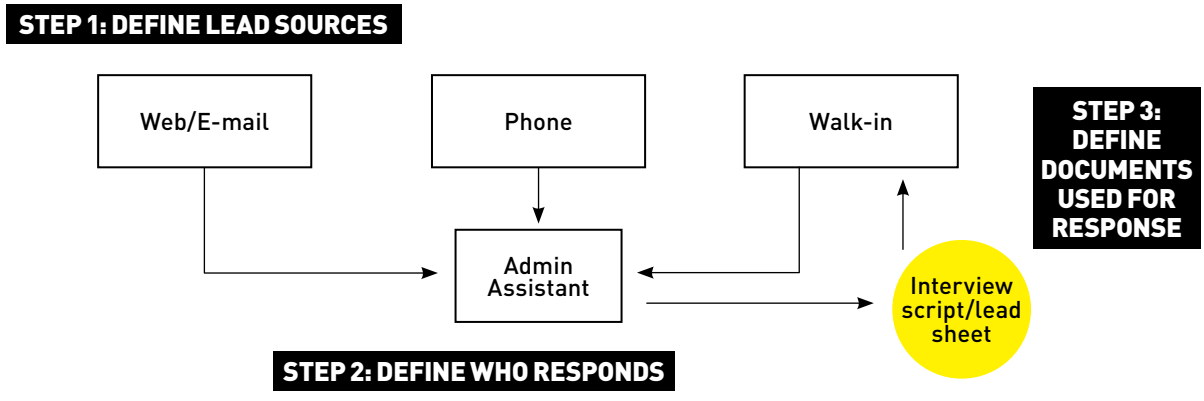
One of the impediments to improvement is that a company's current practices tend to be so ingrained and feel so comfortable that it may be difficult to identify possible replacements for them. I often hear business owners talk about having their employees write up their respective job descriptions. But this strategy is usually unsuccessful, because these documents become only a record of what is, not what could or should be. And the tasks are described in isolation, so the precedent and dependent activities are left out. In effect, this is like asking a cog to describe its job, when what is more important is how that cog serves the purpose of the entire machine through its interaction with other cogs. Focusing on employee procedures is also misguided because these procedures are typically handed down from individual to individual as personnel change. This can lead to misunderstandings, changes in procedure that produce unintended consequences, perpetuation of inefficient or irrelevant processes, and a lack of context.

I currently use software to assist companies in streamlining processes, defining roles, and improving what I'll call "paperwork" (contracts, manuals, procedural documents, and so on), but in the past I usually did it with a big sheet of paper, with input from key field and office personnel. The results can be extremely revealing, and I recommend the exercise as a way to understand what's happening in your company even when you're using software to streamline operations.

MAPPING A PROCESS

Start with a particular process, such as how incoming leads are handled. Then "just" trace everything that happens, who is involved, how information is shared, and which "pieces of paper" are used. You don't have to make a pretty flow chart, but it does help to use colors or different shapes to represent roles or individuals.

The diagram below is one example that examines leads coming



To examine a business process, start by sketching a simple flow chart. This one begins to map how incoming leads are handled.

via three pathways—website/e-mail, phone, and walk-ins (if you have an office or showroom). Start by drawing boxes for those three lead sources, and then define who responds to each one. Put that down, too, and link the bubbles. Here's where you start to see whether, and how, the responses might differ, and whether that's a good thing, something to attempt to automate, or something you want to change.

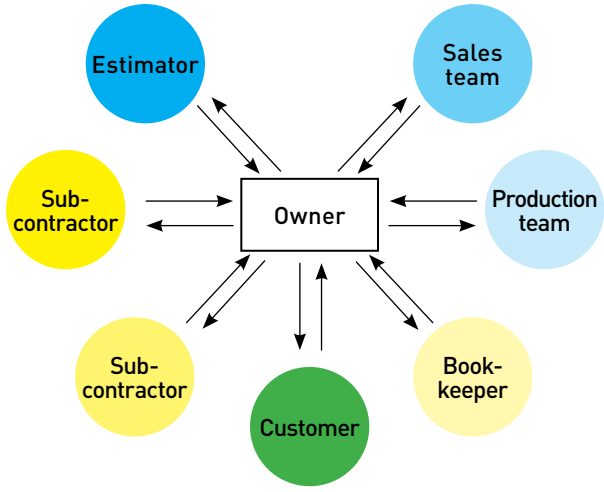
In the case shown in the flow chart on the previous page, all initial inquiries go through a designated gatekeeper—the administrative assistant (AA). In small companies in which everybody's wearing multiple hats, this person could be a receptionist, salesperson, or even the owner.

Now what? Well if it's a walk-in and a salesperson is available, the AA would link the walk-in prospect with the salesperson, who would then run with the ball.

So let's follow that thread for a minute. What existing documentation (such as a lead sheet or "script") does the company use to streamline the prospect interview process? If there are forms used, stick those in, too. Listing them will let you see what's in use (which might benefit from updating) or where you may want to insert a new form. Stick that in there, perhaps in color.

Then what happens? If the next step is a sales call, how is that scheduled? Does the salesperson set the date and time or does the AA? Let's assume the salesperson sets the sales-call schedule; what is involved with the initial sales call? Is there a checklist? Photos taken? More interview questions? Notes on level of finish in current space? Impediments? Access challenges? Budget conversation? If you're a design/build company, this call would be your opportunity to discuss how your company operates in terms of the design vs. the build. This should also be laid out in a document you leave behind after the sales call; don't rely on a verbal explanation. When was the last time you reviewed such explanatory documents? Stick them on the flow chart and add them to the list of items to be reviewed.

Now back to the flow chart: What happens when the inquiry comes in via web/e-mail or phone? If everything goes through the AA, who is responsible for running the script or following up—the AA or the salesperson? Does your website have an automated process for responding to inquiries?



This is the sort of "process" to avoid. When everything flows through one individual, there is too much potential for interruption and delay of the communication, completion, and follow-ups required to keep processes running smoothly.

KINKS IN THE HOSE

As you work through your flow charts (and plan on this taking a day or two), you may find yourself documenting processes that look ripe for improvement. For example, the diagram in the upper right is what a kink in the hose looks like. When one person is responsible for suggesting or approving actions or making decisions, a whole process can get hung up if that person is unavailable. Some classic examples include field personnel calling the owner to get an answer, and the entire crew hanging around waiting for a response. Bookkeepers may be unable to send an invoice out the door until it has been reviewed (and usually massaged) by the owner. Bills may go unpaid because the owner hasn't gotten around to approving them.

When you see this kind of visual representation of too many decisions made by one key person, brainstorm how to cut down on the degree of kink. Maybe the invoicing process has to be standardized so that once a fixed-price job is sold, the payment schedule is set and implemented by the bookkeeper. A standardized change-order process should keep things moving without input from the owner. If the job is sold T&M, there should be a similar process that's followed every time. Markups should be consistent, should reflect the profit requirements of the company, and should not be applied "depending" on the job or customer.

The fewer mini-decisions that have to be made, the more upper-level employees and owners are freed to manage the company at a higher level. If field crew continually ask for advice and solutions, it's time to empower the lead (or supervisor or foreman) to make decisions, assuming that person is competent. People don't grow into enlarged positions of responsibility until, or unless, they are trained to solve problems on their own, with diminishing amounts of support from "above." Maybe the bookkeeper should be authorized to pay bills up to a set amount, with authorization required on larger amounts. Be sure that you diagram all the internal checks, confirmations, authorizations, and Q&A interchanges.

LACK OF COLLABORATION

On the other hand, there may be situations in which 100% responsibility for a critical task should not be placed on a single individual. A case in point is estimating. There may be several links in the chain between identifying the requirements of a project, writing up the scope of work, estimating, and handing off to production. All too often, the estimator ends up coming up with the cost and

even the sale price of the job without conferring with production. Whenever possible, have estimating and production work collaboratively. For one thing, another set of eyes is always helpful. For another, there's no opportunity to play a blame game if both parties are involved.

WHAT CAN MAPPING ACHIEVE?

Here is a detailed rundown of what you want to achieve to effect real change in the company:

Review current practices to look for opportunities for improvement by reducing over-dependence on a single person (kinks in the hose); by identifying redundancies or overly complex practices (eliminate "middleman" scenarios); and by introducing collaboration to reduce error and expand team approaches.

Assess staffing requirements. If the economy will not support "business as usual" and you have to make the hard decision to let people go or not bring them back, how can you reduce staff and still maintain coherent processes (reduce overcomplexities)? Review the flow chart to look for places to eliminate or re-route pathways.

If realistic staffing "post-COVID-19" doesn't support all the services you're currently providing, what is absolutely necessary for the continued survival of the company? Are you using as part of your sales pitch a recitation of services that perhaps you can no longer afford? A case in point might be companies selling T&M work who provide customers with copies of all purchase receipts plus time cards. This might involve scanning, copying, and otherwise collecting and transmitting stuff that may overwhelm your skeleton staff. Instead, consider making it known that job-related costs can be reviewed by appointment only during certain hours of the day.

If subcontractors have gotten used to being able to just drop by and pick up a check, or wheedle a check from the jobsite project manager, consider imposing limits on interruptions placed on your office staff. One way is to modify your subcontractor agreement (presumably you have one; if you don't, put that near the top of your list!) to stipulate that bills received between the 1st and 15th of the month will be paid on the last day of the month, and bills received between the 16th and last day of the month will be paid on the 15th of the following month. That confines sub payments to two days a month, and time can be budgeted by the bookkeeper.

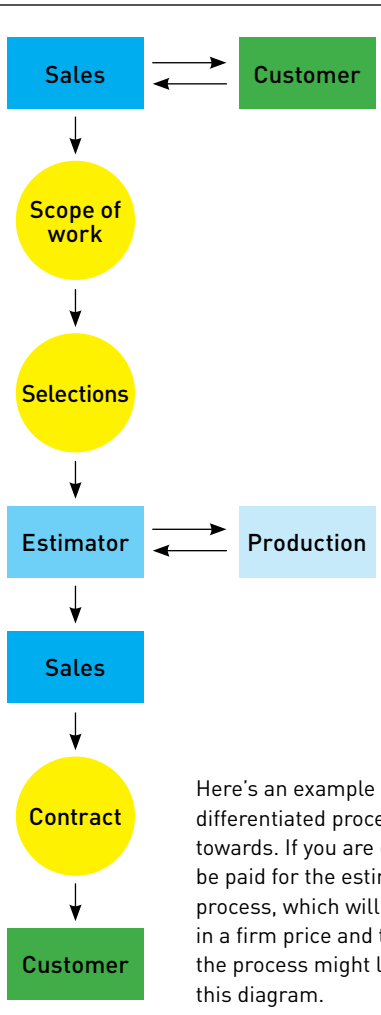
Generate realistic job descriptions. Avoid listing tasks in isolation, and use a flow chart to define a more global and integrated description that includes the "Why" and "For Whom" for the task. For example, instead of listing "enter job-related costs" as one of the bookkeeper's tasks, substitute "enter job-related costs within 48 hours in order to populate job-cost reports in a timely manner. Designated job-cost reports will be generated and e-mailed to the project manager every Friday afternoon before 3 p.m." That puts the task in context and also identifies who is responsible for retrieving, viewing, analyzing, and possibly reporting on job status based on the reports.

Use the flow chart to identify who interacts with whom among the staff, and for what purposes. Be specific.

Review and improve existing forms and documents. Every document, spreadsheet, report, and the like that is part of the company's operations should be listed somewhere on the flow chart. It will be easy to see "holes" in the process that you need to fill in.

All documents and forms should be reviewed to determine if they are meeting the purpose for which they were designed. Also, everything stemming from your office should convey the same brand. Make sure addresses, logos, font, and color schemes are consistent.

Using flow charts to map business processes is time-consuming but it can teach you a lot about what's going on in your company *now*, plus point the way to making changes that will allow you to do what needs to be done but at a higher level of efficiency and, if need be, with fewer employees.



Here's an example of a differentiated process to work towards. If you are going to be paid for the estimating process, which will culminate in a firm price and timetable, the process might look like this diagram.

Melanie Hodgdon, president of Business Systems Management, provides management consulting and coaching for contractors.

BY BILL HULSTRUNK

Dense-Packing Unvented Roofs

Over a 28-year career in the home-performance industry, I've been involved in the insulation of thousands of unvented cathedral roofs using dense-pack cellulose. Since I started working in the industry, codes have changed to the point that the prescriptive code for new construction no longer includes the methods I use. It's too bad, because those methods are simple, reliable, effective, and safe when done properly. In any case, dense-packing unvented roofs is still allowable as an alternative method with permission of local authorities having jurisdiction, and it's still widely practiced on existing homes by home-performance contractors and weatherization professionals. *[Editor's note: for a thorough discussion of roof insulation and venting codes, see "Avoiding Wet Roofs Part II," Jul/18.]*

I began my career in 1992 working with a local weatherization company in Albany, N.Y. We started dense-packing roofs at that time, and we continued to use the technique on multifamily buildings across New York state until the mid-1990s. We dense-packed a couple of hundred roofs during that period.

In existing construction, weatherizers typically dense-pack cellulose behind strapped housewrap **(1)**.

Then, during my nine years of running the Weatherization Assistance Program in central Vermont, we dense-packed more than 1,500 roofs just in our territory alone. Four other agencies in the state were doing the same thing, so you could multiply that number by five to come up with a reasonable statewide estimate.

After that, I worked for National Fiber, a cellulose manufacturer, for 11 years. I was the technical manager for the company, supplying training and technical support to installers, architects, builders, homeowners, and code officials. During that time, the firm provided material for dense-packing thousands of roofs in the Northeast. One of my roles was to train installers in the correct techniques for that application.

I know from personal experience that there are tens of thousands of dense-packed, unvented cathedral roofs in existence in the northeastern United States. And in my time working in the industry, I have become acquainted with only a handful of failures in that type of roof assembly. Each problem I have investigated was associated with either a roof leak or a failure to pack in the material to the recommended "self-supporting" density that won't settle.

TECHNIQUES

There is a variety of situations where dense-packing an unvented roof is an attractive solution. One classic example is when a contractor is weatherizing an existing story-and-a-half house. Typically, the knee wall under the roof is poorly insulated and even more poorly air-sealed. Often, there are built-in cabinets or other elements that make insulating and air-sealing the knee wall difficult. In my experience—no matter how perfect a job we thought we were doing—after a snowfall, the roof over that area behind the knee wall was always the first to melt off. If we insulated the slope above the space, however, there would be no thermal issues with that area—it would perform as well as the rest of the roof. To accomplish this, you have to gain access to the area behind the knee wall. Then, the method is to apply Typar housewrap and strapping to the underside of the exposed roof rafters, and dense-pack the roof through holes in the Typar **(1)**. (For more on this, see "Home Performance Contracting," Sep/09.)

Often, weatherizers encounter an existing drywall ceiling on a sloped roof. In that case, there may be existing fiberglass batts in the cavities. You can often hook those batts out—take a painter's pole, take off the roller, bend a hook, feed it down the roof slope, and then turn it to hook the fiberglass batt and pull it out. This is harder to do if the batts are paper-faced and stapled to the rafters.

If the batts are thin and don't fill the cavity, you can inject

Photos by Bill Hustrunk

Where access from below is impractical, cellulose can be dense-packed into existing rafter bays from the roof ridge **(2)**. In new construction, the author recommends packing the material behind strapped Insulweb fabric **(3)**.

cellulose between the batts and the roof deck and compress the batts down against the drywall ceiling. But you don't want to inject cellulose that way if the batt fills the entire cavity: In that case, the batt may prevent the cellulose from coming into full contact with the underside of the roof sheathing, which is critical for the durability of the roof sheathing, as discussed below.

In this type of job, the rafters are typically smaller—2x10s, or even 2x8s. It's relatively easy to get a good dense-pack in the small volume of those cavities; it's not much different from insulating a wall. In new construction, however, the situation is different. In particular, it's more challenging to install cellulose to the proper density in a very deep cavity, such as you might see in the roof system of a high-performance house.

In contemporary super-insulated designs, builders have achieved deep cavity depths by building down rafters. In the classic example, the rafter is sized to the roof loads, then an assembly similar to a Larsen truss is constructed: A 2x4 is hung off the bottom of the rafter using scabs ripped from plywood. The deeper the rafter cavity, the more densely the cellulose must be installed for the material to remain self-supporting. Typical density for a 2x6-rafter cavity would be 3.5 pounds per cubic foot. For a 2x12 rafter, we want 3.8 lb./cu.ft., and for an 18-inch-deep cavity, 4.1 lb./cu.ft.

In the case of a very deep cavity, you have to build the density from the inside drywall all the way up to the roof deck, not only horizontally but vertically as well. One way to go about this is to use a 3-inch hose to fill the space, then go back in with a smaller, 1 1/2-inch hose to pack the material in tightly. This requires training and experience, and I would recommend that only skilled contractors attempt it.

The way to verify the correct density is with a bag count. Each bag of cellulose weighs 25 pounds; you can measure the area that you need to insulate and multiply it by the rafter depth to find out how many cubic feet you have to fill. Simple math lets you calculate the number of bags you need for the job, or for one rafter bay. Then you can keep track of how much material you're using and be sure that you're installing it densely enough.

In new construction, I recommend using Insulweb, a tough air-permeable polypropylene fabric, to hold the cellulose in place. Insulweb has several advantages. For one thing, it gives you unlimited air relief. We have difficulties sometimes when we're blowing behind an air-barrier membrane such as Intello, because it doesn't let the air out. So we end up cutting air-relief slits in the membrane, and then taping back over the slits afterwards. Insulweb eliminates this extra step.

In addition, Insulweb allows you to feel the density of the cellulose as you install it. At 3.5 lb./cu.ft., the cellulose has the feel of a firm mattress, while at 4 lb./cu.ft., the cellulose starts to feel hard to the touch. The translucent properties of Insulweb allow you to visually keep track of your progress as you work. In the density range that we're talking about, if the material is too loose in the cavity, you'll see layering lines in the cellulose—an indication that the density is not sufficient. Again, this is a situation where training and experience are necessary to ensure a good installation.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Here, cellulose that was installed at an insufficient density to be self-supporting has settled away from the roof sheathing. According to the author, this allows moisture migrating through the material to condense on the underside of roof sheathing. The sheathing on the left **(4)** was not damaged, but the sheathing on the right **(5)** had to be replaced.

TROUBLESHOOTING

As I mentioned, I've had the opportunity to investigate problems with this kind of installation. The first example comes from when I was working in weatherization. A homeowner whose roof we had dense-packed called us, saying that his ceiling was falling down. In that case, a fallen tree branch had punched a hole in his roof, and rainwater was leaking in.

Later, when I was working for National Fiber, I was called in on about four complaints. In every case, the cellulose in the rafter cavities was insufficiently dense and had settled away from contact with the roof sheathing. Moisture infiltrated the cavity during winter, passing through the cellulose to the air space and condensing on the underside of the roof sheathing. In a couple of cases, we caught the problem early enough that there was no damage to the roof sheathing, and we could simply re-tube the cavities and pack the material to its proper self-supporting density. In the other cases, there was damage, and the sheathing needed to be replaced.

Here's what's happening: In a correctly installed dense-pack, the cellulose stays in contact with the roof sheathing. This allows the material's hygroscopic properties to come into play. Moisture migrating through the material that approaches the sheathing is reabsorbed into the drier cellulose and diffused away from the surface. In addition, the borate fire retardant in the cellulose inhibits fungal growth, protecting the sheathing.

In recent years, I've been inspecting existing unvented roofs and thick double stud walls using long moisture probes in early March, when the moisture-modeling tool Wufi predicts problems. The moisture readings I've taken are consistently low (that is, safe) from the inside all the way to the outside with a slight uptick as we hit the exterior sheathing, showing that the cellulose is redistributing moisture inward faster than the moisture is flowing outward.

KEYS TO SUCCESS

When you dense-pack an unvented roof, here are factors to control for quality and performance:

- Do not install cellulose below active roof leaks.
- Address wet basements or crawlspaces before insulating your roof.
- Pull out any existing fiberglass, or make sure that you can dense-pack the cellulose to the outside.
- Dense-pack behind containment fabric when possible, since this allows good quality control.
- Strap the ceiling perpendicular to the rafters, either before or after the fabric is installed; this increases support and reduces bulging.
- Dense-pack the ceiling to the correct self-supporting density for the cavity depth (at least 3.5 lb./cu.ft. for 2x6, more for deeper cavities, per guidelines stated earlier).
- Calculate the number of bags required for the ceiling. For cavities 18 inches deep or deeper, calculate the number of bags per rafter bay.
- To reach required density, re-fill rafter cavities with a large hose (2 inches or 3 inches), then re-tube across the rafter cavity with a smaller (1 1/4-inch or 1 1/2-inch) hose.

Bill Hulstrunk is vice president of insulation technology at NatureTech.

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BY NIGEL COSTOLLOE

While the painters' work affects how good the paint job looks **(1)**, what happens before they arrive affects how well the job performs over time. Bowed and buckled clapboards are often caused by interior moisture driving through siding that has not been back-primed **(2, 3)**.

Avoiding Paint Callbacks

As a custom painting contractor in the Boston market, I've spent a good part of my lifetime studying the way paint works. That includes taking courses and seminars provided by the Painting and Decorating Contractors Association, which I think every professional painter ought to join (I'm the president of our local chapter's residential forum; painters interested in best-practice solutions are encouraged to visit pdcaresidentialforum.org).

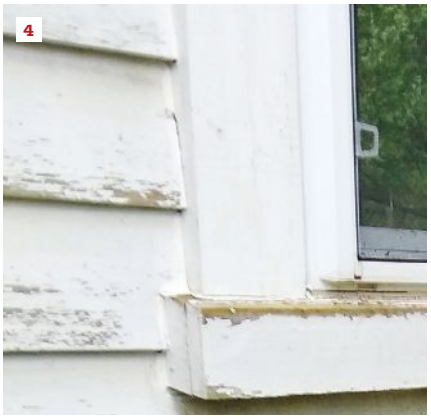
While formal training for painters is certainly helpful, experience is still the best teacher. And when you think about it, painters are in a unique position to learn from experience, because we revisit projects years after construction is complete. Few builders have that opportunity; they might build a new project for a client and have a punch list at the end of a job for minor mistakes or things that didn't get finished. But builders don't usually get a chance to go back after five years, seven years, 40 years, even 100 years to see what's working and what isn't working on a home. We painters do—in fact, that's most of what we do: We come along and fix things that are failing, and we get to learn from that failure.

THE SOURCE OF MOST PROBLEMS

No coating lasts forever, especially on wood. Depending on the environment, you can expect a well-executed paint job to last somewhere between eight and 12 years. But often, paint begins to experience trouble long before that. And from what I've seen, that trouble is virtually never related to a flaw in the paint itself. Manufacturers have had years to perfect their formulas, and they do continual research and development. If you invest the dollars for good-quality paint, rather than buying the cheapest can on the shelf, you can expect excellent performance from the product.

When I see problems, they're usually not caused by the paint or stain. Most commonly, problems can be traced back to the way the house was built or maintained. Less frequently, the issues relate to how the substrates—the wood trim, siding, or window and door frames—were prepped for paint. And least commonly, the problem is with how the paint was applied. Prep and painting are the painting contractor's job. But what the carpenters do before the painters even show up at the site can make all the difference to the endurance of the coating.

Photos by Ted Cushman and Clay DeKorne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Unprimed siding won't hold paint for long. This paint job on a new addition **(4)** is less than five years old. Factory-installed primer is better than no primer, but it won't block the bleed-through of extractive oils in cedar **(5)**. An additional coat of acrylic primer is needed before the finish coat. All field cuts need to be primed before installation of all siding and trim **(6)**.

These days, most of my company's painting projects are likely to involve some carpentry as well. I now have a few well-rounded carpenters on my own payroll, and they sometimes spend days replacing siding and trim, or even remodeling a porch, before my prep crew starts work. So the tips here aren't just kibitzing—they're what our own carpentry crew needs to do in the field. If your carpenters do the same things on the next house you build or remodel, they'll be helping to give the paint or stain a fighting chance.

TIPS FOR TROUBLE-FREE PAINT

Use preprimed material. The minute you put wood up on a wall, the sun starts to attack its fibers, and the wood begins to experience swelling and shrinking as it gains and loses moisture to adjust to the surrounding air. To protect the wood, every piece of siding or trim that is nailed to a building should be primed first on six sides—that is, on all four faces and on both ends.

If you use unprimed material, you should prime it yourself before you nail it up. That includes priming the back face. Although it doesn't face the weather, the back of a board is often attacked by moisture coming from within the house. Back-primed wood can resist that moisture, but wood that hasn't been primed on the back will curl or cup. That unbalanced movement stresses the nailed connections, and moisture migrating toward the outdoors also attacks the bond between the coating and the wood, causing early peeling or wear.

Don't over-rely on the factory primer. A factory-installed primer stabilizes the wood during shipping and storage, and it provides temporary protection when siding, trim, or windows are first installed. But it's not usually intended to be the primer for the material in service. That's why the label on a new window or door will often warn you that the unit should be primed again before it's painted. With those components, and also with preprimed clapboards and trim, we always reprep the surface and apply a field primer before we apply the finish coating of stain or paint.

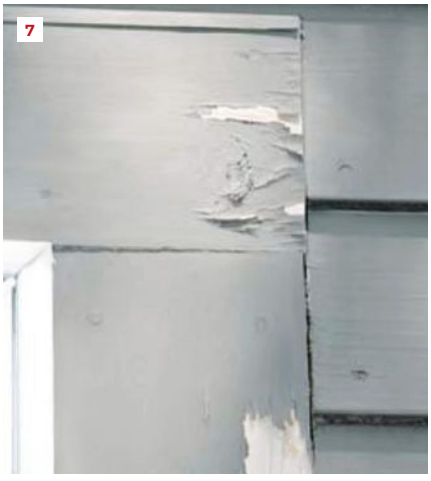
In fact, even if wood is installed and primed, but then sits for an extended period before the finish coating is applied, it may need to be washed or even sanded again and primed again. Primer is not supposed to serve as a finish coat; it is supposed to help the finish coat bond. And if it weathers before the finish coat goes on, you can't count on it to do even that.

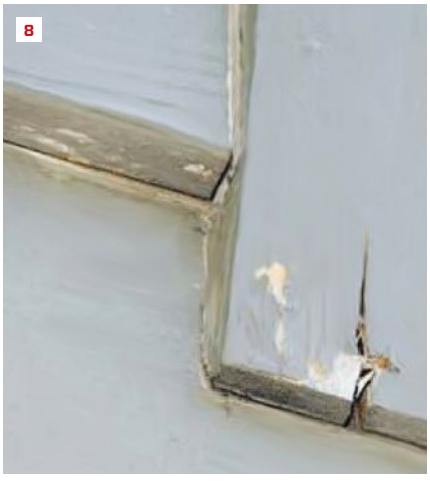
The one exception is factory-primed wood shingles. Many companies now apply both a permanent primer and a durable top coat to shingles, under ideal factory conditions and with controlled drying and curing. That's the best coating a wood shingle or shake can get—better than any field-applied coating. If you're going to use wood shingles, I'd advise you to go that route.

Field-prime all cut ends. Whether you use factory-primed material or prime it yourself, make sure to prime every cut end or edge. That's easy to do—just keep a can of primer and a brush at the chop-saw station and have the carpenter who's doing the cutting prime each end before he passes it to the carpenter who's nailing.

If you don't prime the cut ends, you're leaving open the part of the wood that is most open to moisture entering: the end grain. Nature intended wood to draw water into the end grain. In service, unprimed ends will absorb water and swell, and paint will start to come off the wood at that location first. If painters arrive to paint or stain a house that is sided with clapboards whose cut ends are unprimed, or trimmed out with boards whose ends are unprimed, there is very little they can do to address the issue. So it's up to the people installing that wood to make sure that the ends are primed.

Understand limits of finger-jointed material. Many wood windows and doors are now assembled with finger-jointed wood. We also see a lot of finger-jointed siding and trim. If the wood has a factory primer applied, it may hide those joints, but it doesn't protect them from the weather. So it's important to prime finger-jointed material again as soon as possible after installing it. If





Here, carpenters have installed factory-primed window casing without sealing the ends. Failure has begun at unprimed ends **(7)**, and in one case, water absorbed into an unprimed end has caused the wood to check **(8)**. Not all of the failure is due to the carpenters, however. Stain was applied without any sanding or a second coat of primer, causing the finish to fail **(9)**.

Water will collect and seep into the wood around an overdriven nail **(10)**. Over time, smooth-shank nails will work their way proud of the surface **(11)** as siding changes in moisture content and temperature. Nails like this should be replaced with stainless steel, ring-shank nails.

those joints start to open up and let moisture in, they may not hold up the way they're supposed to, and they'll start to look bad as well.

Some finger-jointed material uses very small pieces of wood that don't match between one section and the next. Pieces with different grain density and grain orientation move in different ways, and they also accept paint or stain in different ways. If you use this kind of material, you should make sure your customer can accept the way it looks; coatings on sections with flat grain will wear or come loose sooner, and the joints and variations may quickly become apparent to the eye. While the material may be economical, the results may not be to everyone's liking.

Use the right nails. When siding and trim are nailed with smooth-shank nails—even galvanized nails—daily and seasonal wood movement can work the nails loose from the material over time, leaving them standing proud. On repaint jobs, our prep crew usually has to pull a lot of nails that are high, and we always replace them with ring-shank nails (either hot-dipped galvanized or stainless steel). There's no good reason for a carpenter in new construction not to use ring-shank nails in the first place. I've never found a ring-shank nail that has worked its way high of the siding or trim.

Be careful to drive nails just flush with the top surface of the wood, or perhaps a hair lower. Good carpenters develop a feel for how to set the nails just right with the final tap of the hammer. But gun nails are harder to control, and carpenters may get in the habit of driving the nail heads into the wood. That's bad practice—it provides a place for water to pool and attack end grain, and it creates a surface condition that is hard for primer to seal.

Keep joints tight. Open miters and wide gaps between siding or trim boards typically are caulked by the painter. But a caulk joint will not last more than a few years, and as it breaks down, the finish will, too. Paint lasts much longer when backed by primed wood.

PAINTER'S PURVIEW

There's a lot more to say about a durable paint job. Good surface prep and skilled application of the right coatings are critical. If you choose a well-qualified painting contractor, they'll likely be done properly. Just as important are the priming and nailing techniques I've described here; they could add years to the lifetime of the coating the painter applies.

Nigel Costolloe owns Catchlight Painting (catchlightpainting.com) based in Boston, Mass.

AZEK Exteriors | Builder BRAND LEADER 2020

THE MICHELANGELO EFFECT: HOW PVC SHEET AND TRIM SAVED THIS CURVED CEILING

A thorny design requirement inspired this Louisiana homebuilder to think outside the moulding.

Your first thought when you look up in the home's 27-foot-by-36-foot grand salon is, "How?" Quickly followed by, "*Why?*"

Welcome to the central entertainment area of a new 14,000-square-foot, two-bedroom (yes, two) multimillion -dollar home in Baton Rouge, La. One of the home's signature architectural feats is the salon's nearly 1,000-square-foot ceiling. The curved ceiling displays an ornate custom profile you might expect in a stately French chateau, which this home certainly rivals.

TOUGH CHALLENGE

For general contractor Chad Roper (pronounced row-pay) of family-owned and -operated Alfred Roper Construction, the central question about the ceiling was, "How am I going to build this?"

The lavish ceiling effect was a carryover design from the client's previous 35,000-square-foot home, though that ceiling was flat. Hmmm … curved ceiling, 19-foot height, Louisiana heat and humidity, intricate moulding and installation, cracking and separation issues, embedded lighting, sprinklers, ductwork.

What could go wrong?

BIG IDEA

"I didn't receive any instructions other than they wanted that profile on a curved ceiling," recalls Roper. "The architect had a lot of faith in me."

The initial stage was installation of plywood ribbed joists. "I made the curves on the joists" Roper says. A gypsum ceiling was placed over it. "It was tricky to get the curve correct," he adds.

The curve was formed using two layers of 3/4-inch plywood securely fastened to each joist above. The plasterers took care to follow that curve during the process of installing the 1-inch-thick gypsum ceiling. "Popping grid lines on the floor and using lasers helped pinpoint each can location,." says Roper.

The main event was the intricate profile of the ribs. Should he risk plaster? Every time Roper poured a cast, it broke. Scratch that. How about wood? Backfilling the space created by the sloped ceiling could separate. Then it hit him. To build up the profile, why not cut out and laminate PVC sheeting? Not only would it have a bit of needed flex but it would also be comparatively light and crack-proof. "I ran it by the architect and owner and they loved the idea," Roper says.

PVC TO THE RESCUE

Roper arranged to have AZEK 4-foot-by 8-foot PVC sheets cut on a local millwork's computer numerical control (CNC) machine. "The 1-inch thickness was close to what I needed. It really worked out great. I just wish I had come up with the solution right away," the homebuilder says.

The PVC solution worked like a charm. First, Roper and his installation team covered the curved ceiling frame with metal lath using 3-inch trim screws and Loctite PL construction adhesive, followed by 1-inch gypsum plaster. Then the AZEK PVC decorative elements were affixed, also with Loctite PL construction adhesive and trim screws.

REMARKABLE FINISH

"CNC milling with AZEK sheets and trim was the best approach. With that ceiling height I didn't want a callback," Roper explains. Everything has performed without a hitch, with no callbacks.

Photo Courtesy of AZEK Exteriors

His installation team is also thankful. The lightweight AZEK PVC profiles were installed in just two days.

The owner and architect are delighted. The ingenuity displayed with this ceiling only adds to Roper's growing reputation as the region's go-to luxury homebuilder. The story even made the rounds at AZEK. "Just when you think you've seen every application possible, something like this comes along," says the company's division sales manager, Jason Sparger.

To learn more about using PVC sheet and trim products, visit **AZEKexteriors.com**.

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Produced by Hanley Wood Strategic Marketing Services Group

A High-Performance Shell

Exterior layers protect the structure of this modern house

BY CHRIS LAUMER-GIDDENS

My company, LG Squared, is an architecture and construction management firm based in Atlanta. Our current project is a high-performance custom home in Marietta, Ga. We designed the home, and we are also supervising the construction. In this story, I'll look at the methods we are using to make the home durable and energy-efficient.

This project is an implementation of the so-called "Perfect Wall" concept, which entails keeping the structure of a building within the conditioned envelope. In theory, the idea is to construct the four control layers—the water control layer, the air control layer, the vapor control layer, and the thermal control layer—so that they wrap the building outside of the structural components. That way, the structure of the building is protected just like the inhabitants are.

In this case, the structure of the house is wood framing and sheathing. We accomplished air and vapor control by applying the Poly Wall Blue Barrier fluid-applied membrane system to the wall sheathing. We achieved thermal control by applying Rockwool Comfortboard 110 insulation to the wall exterior. We secured the insulation to the wall with 1x4 wood strapping and attached the cladding system to the furring strips to serve as the water control layer.

We built the roof in a similar fashion. First, we applied Polyguard Deckguard HT peel-and-stick underlayment to the sheathing. We installed Rockwool Toprock insulation on the

Photos by Chris Laumer-Giddens

The roofing crew applies peel-and-stick underlayment to the plywood roof deck **(1)**, rolling the material under pressure to create a good bond **(2)**. The painters apply Joint Filler 2200 to sheathing cracks and nail holes **(3)**, as well as to window rough-opening corners **(4)**.

roof deck, secured the insulation with 1x4 wood strapping, and installed standing-seam metal roofing on the top. The result is a shell with water, air, vapor, and thermal control layers that are continuous over the whole enclosure, including both walls and roof. Let's walk through the process.

DRYING IN

We started by installing the Deckguard HT peel-and-stick underlayment to the roof sheathing **(1, 2)**, so we could have a dry interior for the building. For a belt-and-suspenders approach, we applied Henry Rubberized Wet Patch roofing mastic to the seams of the underlayment. Peel-and-stick underlayment on low-slope roofs, when acting as a temporary roof before a permanent one is installed, tends to leak through capillary action. The roofing mastic helps prevent that, and it adds robustness to the underlayment in service for permanent water and air control.

Next, we applied the Blue Barrier system to the walls. There are three components to Poly Wall's system: Joint Filler 2200, a thick gun-applied structural adhesive and detail sealant; Flash 'N Wrap 2400, a thick trowel-applied flashing for windows and doors; and Liquid Wrap 2300, a roller-applied or spray-applied covering that serves as a vapor-permeable membrane that protects against air leakage and bulk water. All three formulations are based on the same chemistry: STPE (silyl terminated polyether).

Our painting crew installed the Blue Barrier system. They started with the joint filler, installing it in every plywood seam **(3)**. The framers had left a gap the size of a 16d nail between all the sheets of plywood, to allow for a strong, thick bead of sealant. They had also

The painters apply Blue Barrier Flash 'N Wrap 2400 to a window rough opening **(5)**, roll Liquid Wrap 2300 onto the field of the wall **(6)**, and detail a window flange with Joint Filler 2200 **(7)**. At the wall top, the overhanging peel-and-stick underlayment is sealed to the wall with Joint Filler 2200 and Liquid Wrap 2300 **(8)**.

set the nail-gun compressor to slightly overdrive some of the nails, so every overdriven nail head received a dab of sealant.

At the juncture where the wall meets the foundation, we had left a half-inch gap between the wall sheathing and the foundation slab. The painters inserted backer rod into that gap, then applied and tooled a bead of joint filler.

The painters applied Joint Filler 2200 to the corners of window openings as well **(4)**, then trowel-applied Flash 'N Wrap 2400 flashing to the rest of the opening **(5)**. The crew installed 2400 at every door and window opening, covering the jambs, head, and sill of the opening, and then 4 inches onto the face of the plywood sheathing, at a minimum of 25-mil thickness. Thickness was verified with a mil gauge while the product was still wet.

Finally, the painters roller-applied 2300 Liquid Wrap over the entire shell of the building **(6)**, covering all wall sheathing, and all previously installed 2200 and 2400. The minimum thickness installed was 40 mil, verified with a mil gauge.

At the top of the wall, the roofing crew had left the peel-and-stick hanging a few inches past the edge of the wall. When the painters reached the top, they applied a bead of Joint Filler 2200 to the plywood joint between the roof sheathing and the wall sheathing. Then they folded the peel-and-stick down, adhering it to the wall with a bead of 2200 and staples **(8)**. Finally, they sealed that joint with a 50-mil-thick layer of 2400, covering at least 3 inches of both peel-and-stick and sheathing and taking care to seal over every staple.

Windows were next **(7)**. We used Marvin windows with a nailing fin, putting a screw in every hole in the flange. Then the painters came back to trowel apply another coat of 2400 over the flanges and extend the 2400 at least 3 inches past the flanges. Minimum thickness of this application was 25 mil. Overall, the average thickness of the Poly Wall at the windows is 50 to 60 mil, with some areas as thick as 80 mil.

After windows, our crew installed a continuous layer of Polyguard Term Flashing Barrier at the wall-to-foundation-slab joint, connecting to the metal termite flashing installed during the foundation installation. This peel-and-stick barrier (which has

Outriggers are secured to the roof deck with structural clips **(9)**, and the roof deck is insulated with Rockwool Toprock DD **(10)**. The walls are insulated with Rockwool Comfortboard 110, with joints staggered **(11, 12)**. The insulation is secured to the wall with battens and long screws.

been tested for compatibility with Poly Wall) is termite-proof, and it adds a layer of robustness to the air and vapor control at the joint.

AIRTIGHTNESS TESTING

Immediately after applying Poly Wall, we performed the first blower-door test—first infiltration, then exfiltration. During the exfiltration test, with the house under positive pressure, we filled the house with theatrical fog to help identify leaks. The result was 0.09 ACH50, and 75% or more of that leakage was coming out through the gaps around the blower-door frame and through a patio door that was installed incorrectly (which we corrected before the next test). Considering the leakiness of the blower door itself, we estimated the actual leakage of the house to be closer to 0.05 or 0.07 ACH50.

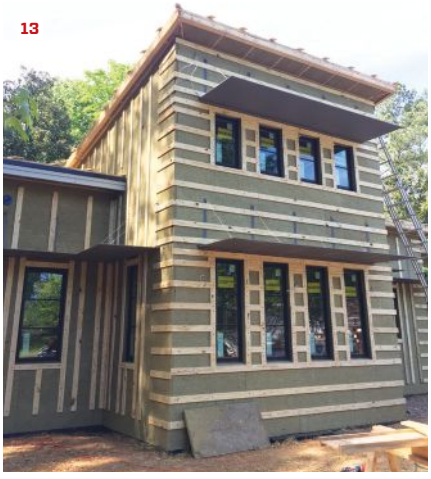
After the blower-door test, we installed rough-in for HVAC, electrical, plumbing, and low-voltage. Then we performed our second blower-door test the same way, checking infiltration and exfiltration, and running the fog machine. The result was 0.05 ACH50—more than 10 times tighter than the maximum allowed by the very strict Passive House standard, and a tiny fraction of the leakage allowed by code.

INSULATION

Once the Poly Wall step was complete, the insulation was delivered. We installed outriggers to the exterior of the air and vapor control layers at the roof edges to support the roof overhang **(9)**, and then began to insulate the roof **(10)**. (The framing crew installed all the insulation and strapping for the roof as well as the walls.)

The outriggers are framed with 2x4s on edge, fastened through the sheathing to the roof trusses using StiffClip CL structural clips made by The Steel Network, and specified by our project engineer. We insulated between the outriggers using 3 1/2-inch-thick Rockwool Toprock DD, then covered the whole field of the roof with that same thickness. Then we went back over everything with a second layer of 3 1/2-inch Toprock, for a total Rockwool thickness of 7 inches, or about R-30. We strapped over the insulation diagonally, fastening the strapping to the framing below with 9-inch screws. Every 8 feet, we cut a gap in the strapping to allow ventilation air to move in the cross-strapping direction. At the roof edge, we installed Cor-A-Vent vent strips around all four sides of the roof.

On the walls, the crew installed two 2-inch-thick layers of Rockwool Comfortboard 110, staggering the joints both horizontally and vertically **(11, 12)**, for a total of 4 inches thick (about R-16). The material came in 2-foot-by-4-foot panels; the crew ripped the first course down to one foot in width and tacked the pieces to the


13


14

The shell has a continuous blanket of Rockwool **(13)**. Strapping holds the insulation in place and provides nailing for the siding. The roofers install standing-seam metal roofing **(14, 15)**. The siding crew installs Fry Reglet metal trim pieces **(16)**.


15


16

wall using screws with 3-inch metal washers. Then they stacked successive courses up. The material is stiff and rigid enough that it can be stacked as high as 10 feet without our fastening the pieces to the wall. Then the crew applied the outside courses, temporarily tacking the outer pieces to the inner pieces with the 7-inch screws they were using to fasten the strapping. Finally, they applied the strapping, screwing it to the framing inside **(13)**.

At the time the insulation was being installed, the interior studs were still exposed so that the crew could tell where the studs were. They took care to screw into the framing; in case they should miss a stud, they were instructed to leave the screw in place, not back it out, and use a second screw to hit the stud. That way, the membrane would seal around the screws, and we wouldn't leave any small air-leakage holes.

Part of the house has horizontal lap siding and part has vertical plank siding. We ran the strapping either vertically or horizontally, accordingly, to provide nailing. But at the corners of the house, we ran the strapping horizontally so that we could cantilever the ends all the way out to the corners, where there was no framing behind the insulation. We made sure to span two studs with these horizontal pieces. We installed vertical blocking between the horizontal pieces at the outboard end, securing the blocking in place with wide staples.

The house received standing-seam roofing with a $1^1/_2$-inch standing seam **(14, 15)**. For siding, we chose Trespa composite siding for the vertical treatment, and Nichiha fiber cement for the lap siding and panels. All the wall trim, supplied by Fry Reglet, is metal, which enabled us to terminate the siding without caulking **(16)**. The result is a tough, durable water control layer covering a continuous, uninterrupted thermal control layer (the Rockwool insulation), which in turn protects a resilient, continuous air and vapor control layer (the Poly Wall Blue Barrier and the Polyguard peel-and-stick roofing underlayment). This house should provide the owners with many decades of maintenance-free serviceability.

Architect and builder Chris Laumer-Giddens is a principal of LG Squared, in Atlanta.

remodeling

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Reading Blueprints

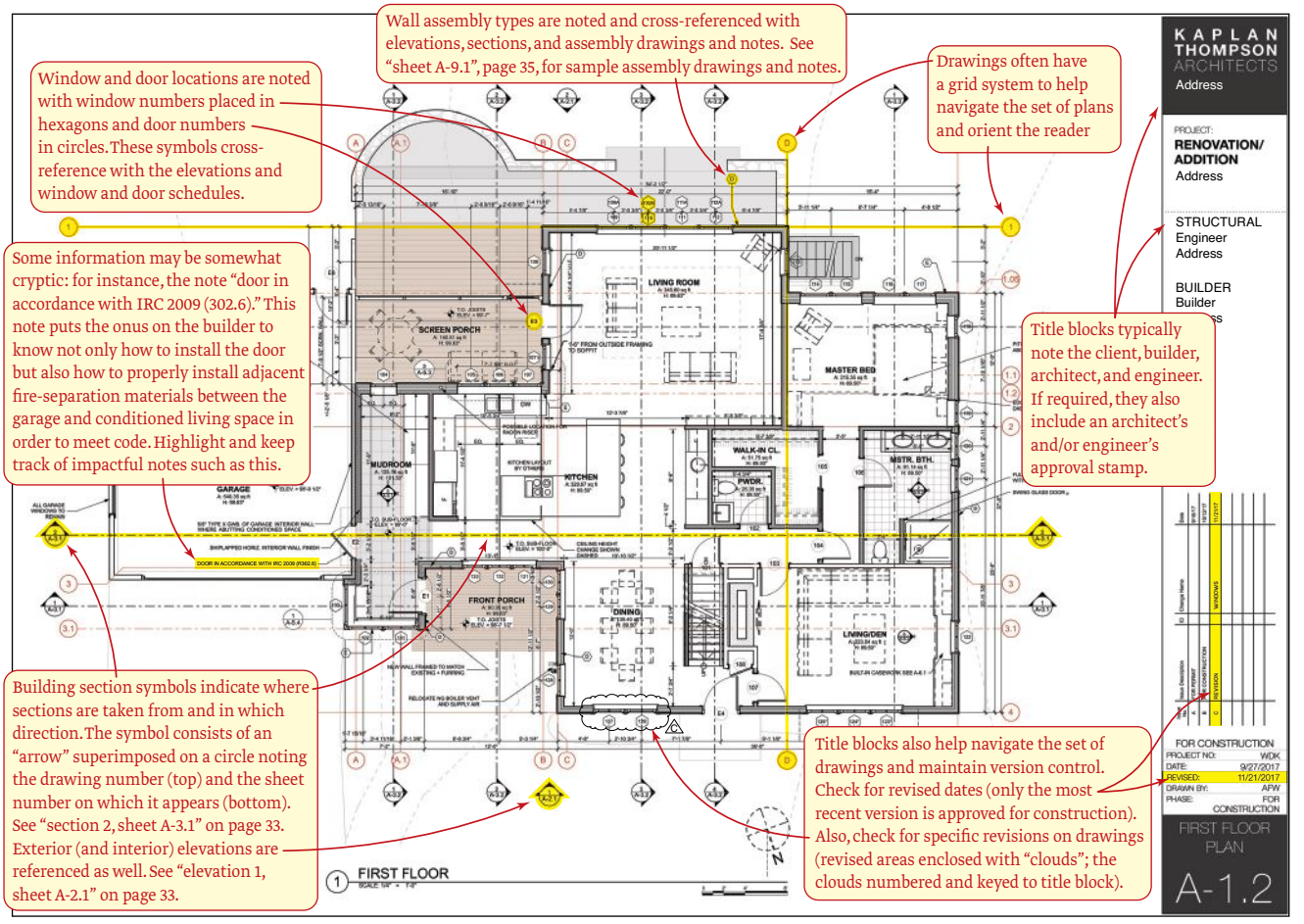
A primer on how to understand construction drawings

BY JLC STAFF

Blueprints are the complete set of drawings that show what a designer wants a building to look like. These drawings are made to an exact "scale" (a ratio of size; the length of a line on the drawing equals a proportional length on the building) and include dimensions, as well as plenty of detail on material choices and installation directions. Construction drawings were first called blueprints because a 19th century process for reproducing multiple copies of a set of drawings showed the building outline and dimensions in white over a blue background—a process that continued to be used well into the 20th century. These days, blueprints rarely even have blue ink, but the name is still used for the set of drawings that provides a detailed map for the builder to follow while turning a designer's vision into reality.

Depending on the complexity of the project and the requirements of the local building department, blueprints can range from a couple of simple sheets that convey code-minimum requirements to a thick sheaf of documents that lays out every construction decision right down to the cabinet pulls.

In this article, we show only a few pages of a complete set of construction drawings. The intent here is to provide a short introduction for carpenters and other tradespeople on how to begin to navigate a set of construction drawings. Our hope is that this will help young workers know how to study and better understand



The floor plans are typically at the beginning of a set of drawings. In addition to showing the location of walls and dimensioning, floor plans contain information that often references other sheets in the drawing set. A variety of symbols are used to indicate section cuts, interior and exterior elevations, and window and door locations.

their scopes of work, and in a larger sense, foster better communication between the construction trades and designers.

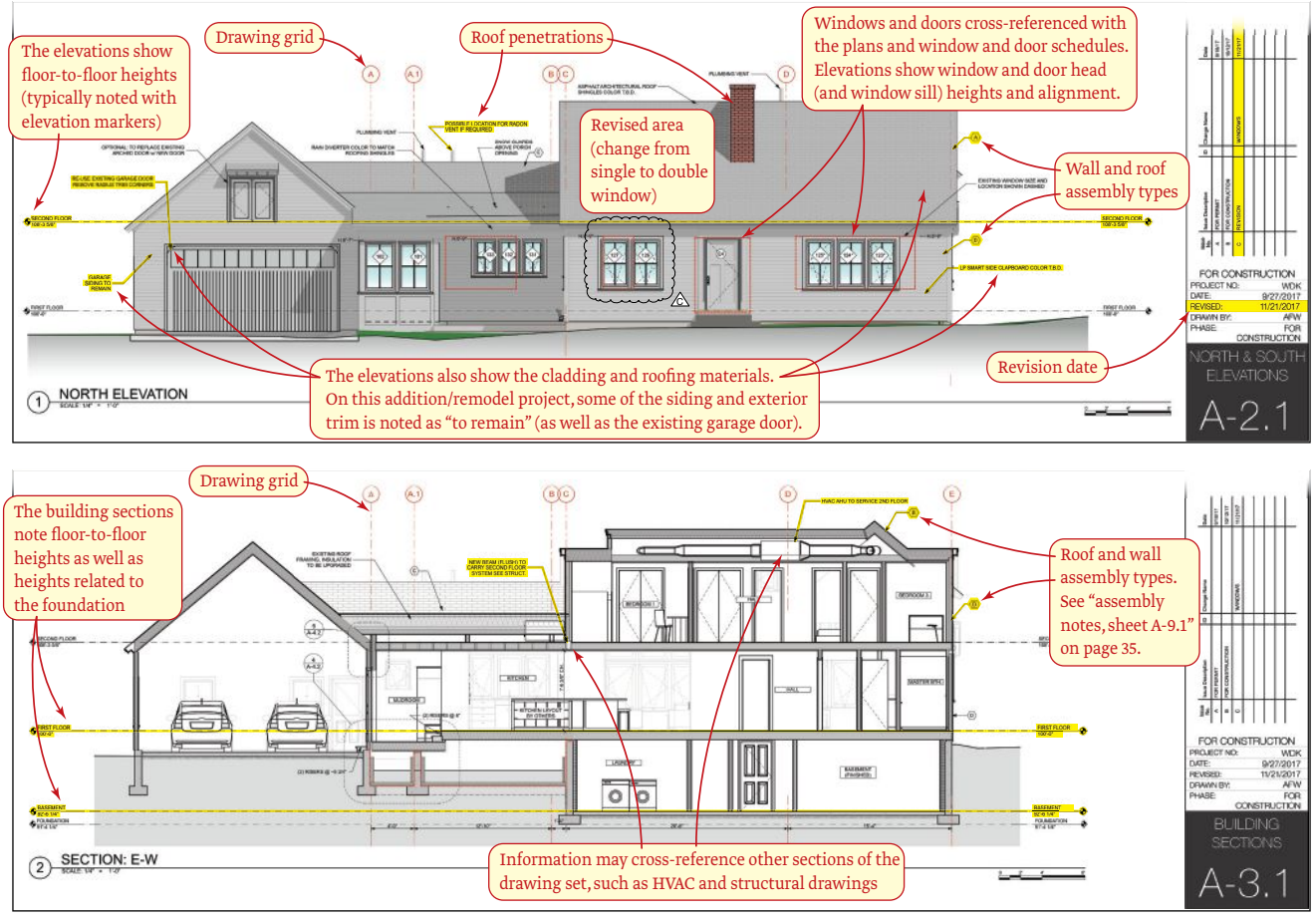
ARCHITECTURAL VS. STRUCTURAL PAGES

Most plans are broken out in several different ways. One of the most important to carpenters is the distinction between "architectural" and "structural" details. Architectural details show things like room dimensions, fixture locations, window and door locations, and finish materials. Carpenters use the dimensions on the architectural sheets to lay out wall framing and to verify, for example, that a floor joist is not located where a toilet drain has to go. The architectural pages of a plan are usually designated by the letter "A" followed by a page number.

Structural pages show locations and sizes of important details such as footings, foundation walls, posts, and beams, and these pages are marked with an "S" and a page number. Large projects may have pages for electrical, plumbing, and mechanical contractors as well.

ELEVATIONS AND PLAN MAP THE PROJECT

Usually, the first few pages of a set of drawing show "elevations"—views of the building's vertical planes, as seen from one direction. These show you what a vertical plane looks like when you are looking square on the finished building front, side, or rear. Elevations provide a quick overview of what you're about to build. Most of the time, these are only provided for the exterior, to show siding materials, exterior trim, final grade, the relative heights of floors and eaves, and window and door locations. If the designer intends for window and door heads to align, this is where it would



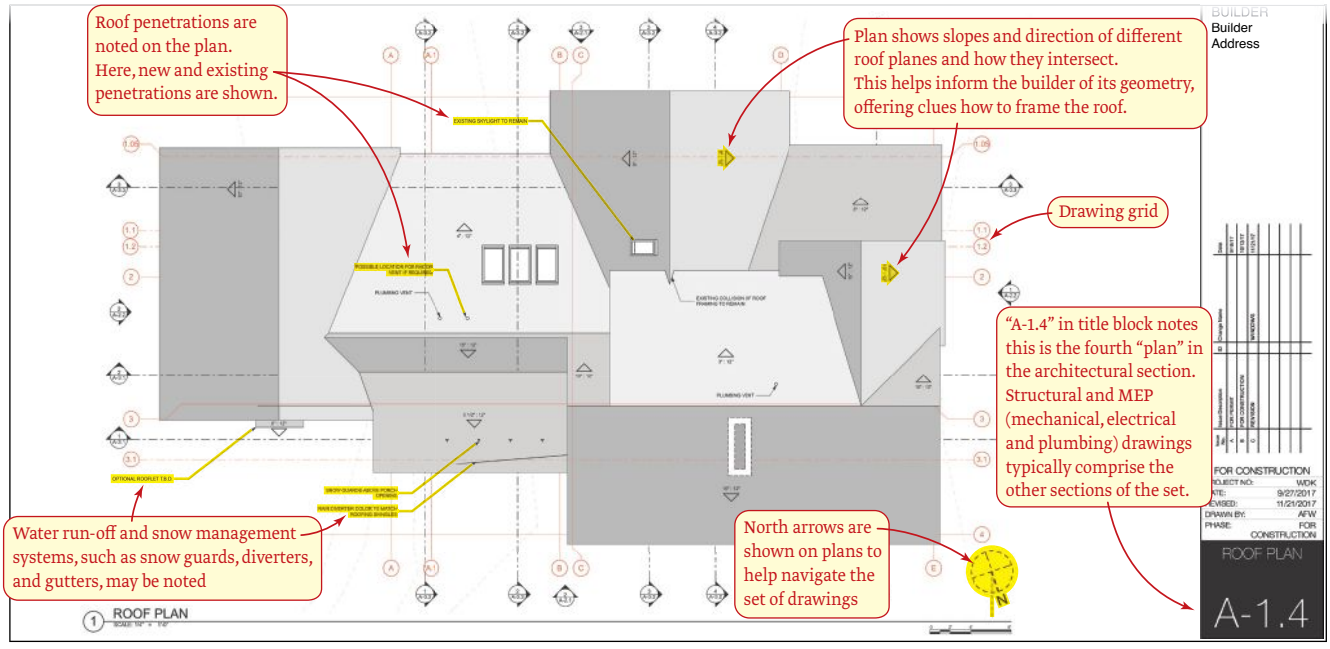
Partial sheet "A-2.1" shows the north elevation (or "Elevation 1"). The exterior elevations indicate siding, exterior trim, roofing, and roof penetrations as well as the finish grade, relative heights of floors and eaves, and window and door locations (top). **Partial sheet "A-3.1"** shows the building section (or "Section 2"). A section allows you to see through the building and display critical information to the builder. Note where in the building a section is taken, which way it is "looking," whether it is straight or offset, and what information it is designed to show (bottom).

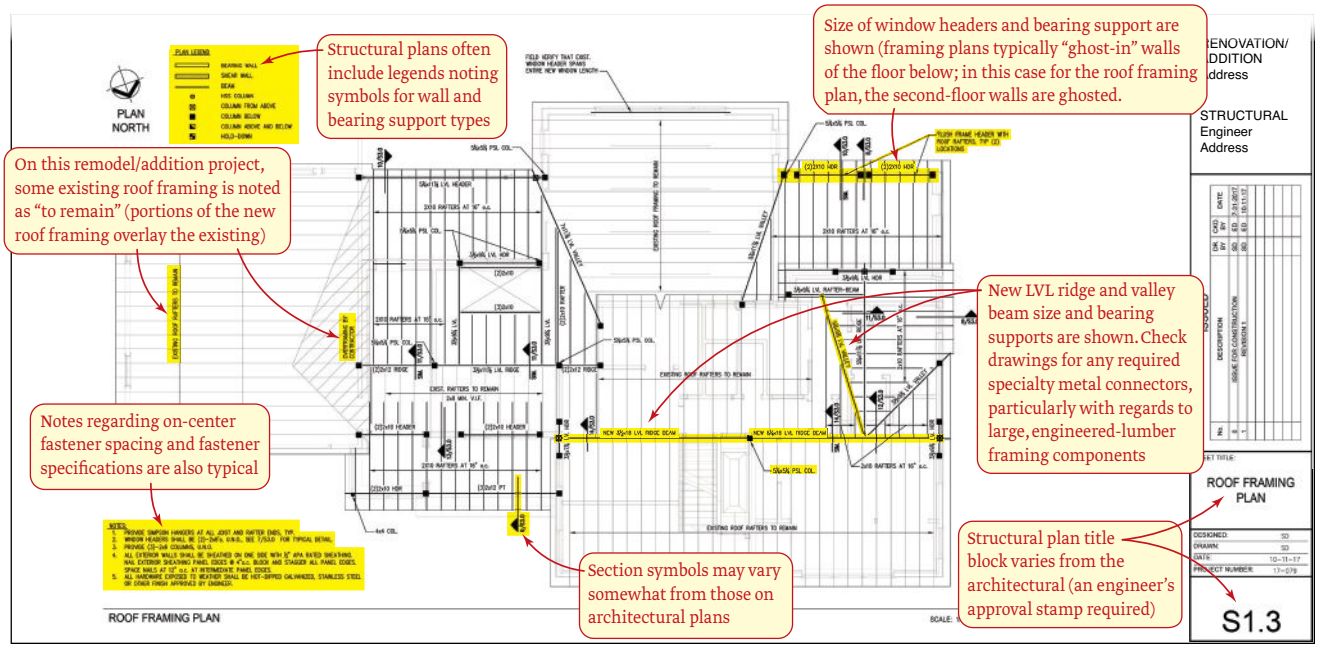
be shown. However, plans for higher-end homes with lots of interior trim may also include interior elevations. Interior elevations are especially useful in areas like kitchens and baths where there is a lot of cabinetry and other built-in casework.

Plan view. Since drawings are two dimensional, elevations don't show how different faces of a building may relate to each other. For example, you can't tell how far a breezeway to the garage is set back from the front of the house. To see these differences requires the "plan" view.

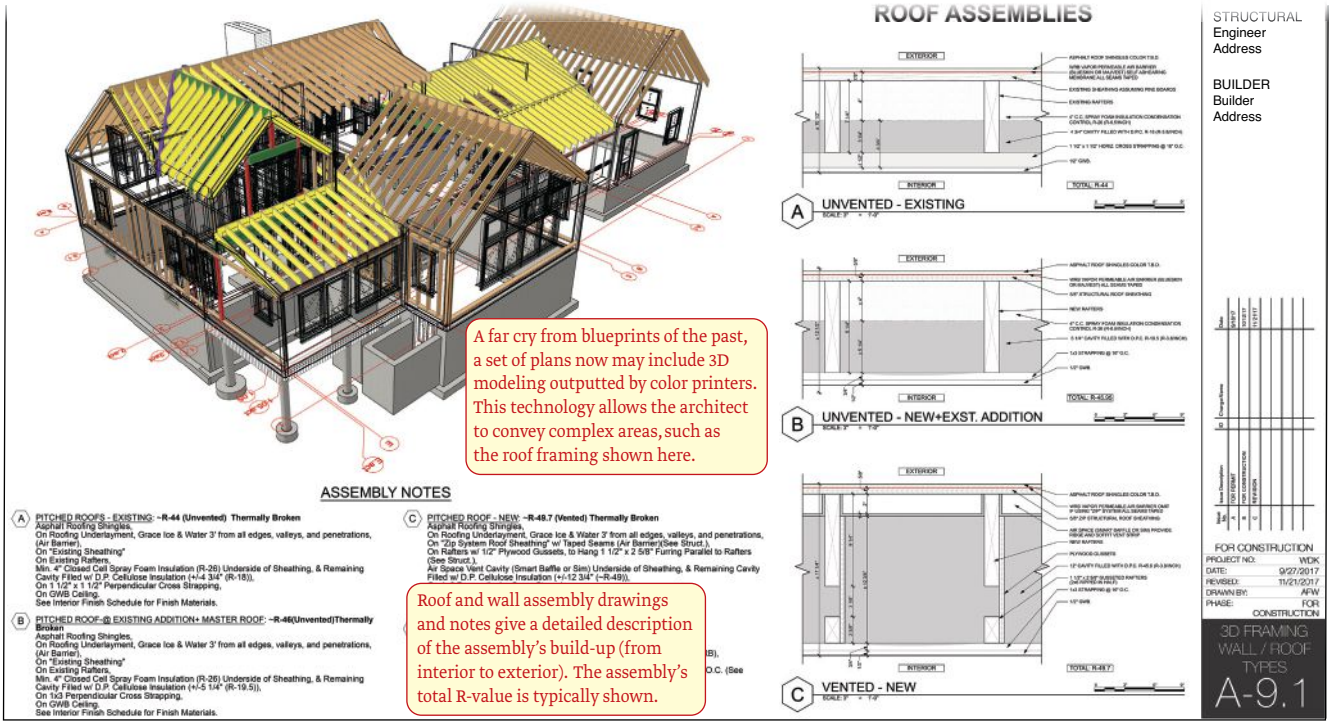
A plan view is like a road map where you look down on the geography of that house. Each level of the house will have at least its own page in plan view showing dimensions for all the walls and permanent fixtures, such as doors, windows, tubs, and toilets, and a basic kitchen layout. Most plans will provide dimensions for every wall and opening, and the center locations for all those fixtures. Besides illustrating the locations of walls and partitions, plan views reference other sheets in the drawing set, using a variety of symbols to indicate section cuts, interior and exterior elevations, and window and door schedules.

Remodeling plans. For remodeling projects, the plans will specify which parts of the house are part of an addition, which existing areas are to be remodeled, which areas need to be demolished (sometimes called out on a separate demolition plan), and which areas are to be left alone.





Partial sheet "A-1.4" shows the roof plan (top). The roof plan notes all penetrations, such as chimneys, vent pipes, and skylights, as well as the various roof slopes and how they intersect. **Partial sheet "S-1.3"** shows the structural roof framing plan (bottom). Notes regarding on-center fastener spacing and fastener specifications are typical. For this remodel and addition, the roof framing, ridges, valleys, beams, and headers are superimposed over the "ghosted" second-floor plan.



Partial sheet "A-9.1" shows a 3D model made with BIM (building information modeling) CAD software that helps framers identify the roof framing components needed for this remodel and addition. The roof and wall assemblies, shown in section on the right, give a detailed description of the layers from interior to exterior and include performance details, including total R-value.

Framing plans. Of particular use to carpenters are the framing plans, which, when included, are typically pulled off on separate sheets that are drawn by a structural engineer or licensed architect and show location and size (and on-center spacing) of joists, rafters, beams (ridges and valleys), window and door headers, and columns. Unless otherwise specified, framing dimensions on plans are usually plate to plate, before any sheathing or drywall is applied.

When laying out rough openings, it's always a good idea to check the dimensions on the plan view against the door or window manufacturer's published opening sizes. If there's a discrepancy, the manufacturer is usually right, but you should still make the designer aware of the situation.

A good set of plans goes so far as to include the layout for all joists and rafters, and may include 3D outputs to model complex framing. However, in many cases, the plans only specify the spacing and leave out the rest for the carpenter to figure out. When you're the one doing that, study all sections and related sheets carefully. You might not think a carpenter needs to know the location of, say, a toilet, until you're called back to move a joist that's in the exact place the plumber needs to run the drain line for that toilet. Identifying discrepancies early can go a long way to ensuring the job runs smoothly.

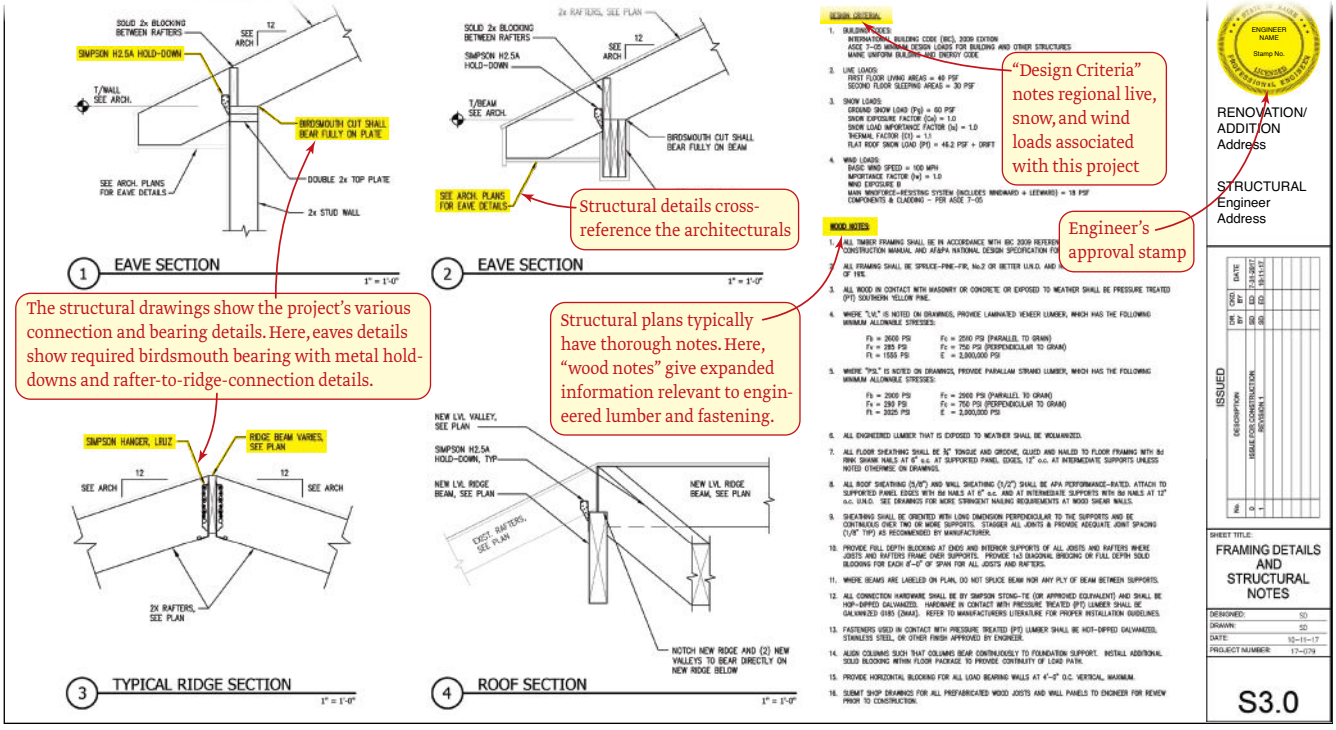
SECTIONS HELP YOU SEE INSIDE

For a simple project, elevations and plan views may be all an experienced carpenter needs. Few projects are that simple though, and a third way of seeing is usually included. Called a "section," this view cuts through a wall, floor, or roof to provide details of material size or installation that can't be gleaned otherwise.

Section views are called out with lines through the plans at the relevant area and are labeled on the elevation view with an alphanumeric reference, such as A1 or S3. More than any other type of drawing, sections are deliberately included in the drawing set to display critical information to the builder. Study them carefully. Note where in the building a section is taken, which way it is "looking," whether it is straight or offset, and what information it is designed to show.

NOTES AND SCHEDULES PROVIDE DETAILS

Elevations, plan views, and sections are all visual, but they don't tell the entire story. Sometimes, the entire story doesn't need



Partial sheet "S-3.0" shows the structural engineer's framing details and notes. The structural drawings show the project's various connection and bearing details as well as design criteria notes such live, snow, and wind loads. Here, "wood notes" provide expanded information relevant to sheathing, engineered lumber, and fastening requirements.

telling. For example, if you're a spec builder, the designer doesn't need to tell you which line of windows to use. You or the owner can make that call. The designer needs to include only rough parameters that inform the plan reviewer at the building department that the windows will comply with the relevant codes.

But for any build that's contracted, the plans are usually incorporated into the contract by reference. That means the plans will spec details such as window and door brands, sizes, and models in written sections labeled as notes or schedules. Notes often seem like boilerplate, with phrases like "All work to comply with the version of the International Residential Code in force in that jurisdiction at the time of construction." Other notes provide useful information regarding tolerances and expectations. For example, regarding exterior trim and siding, you might see "Carpenter to prime all fresh cuts prior to installation." That's the sort of thing you want to know prior to bidding the job.

Verify information. There is usually language to the effect of "General contractor shall verify all dimensions and report discrepancies to the architect before proceeding." While that does sound like boilerplate, it also protects both parties. If the architect gets a span wrong and the contractor doesn't inform him or her, then the liability is on the contractor. Inform the designer (and document that by using email or keeping detailed notes of conversations), and you, the contractor, avoid that blame.

The notes and schedules will also include details such as roofing and siding types, nailing schedules, insulation type and depth, and in some cases, bath and kitchen fixtures and lighting. In many instances, though, fixture details are left out to be chosen as construction progresses. The locations of details are often indicated on the plan with letters enclosed in a small hexagon, which refer to specific notes.

When the project uses proprietary products such as framing hardware or engineered joists, the notes will often include only the basics of installation. It's up to the builder to verify the details by reviewing the manufacturer's instructions. That points to what is probably the most important thing to keep in mind when reading plans, which is not to guess. If you aren't sure, verify the detail with the designer or product manufacturer. It's much better for them to own a situation than for you to guess at it. As soon as you do, you own it.

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Beam-Line Replacement

A streamlined approach to a common structural renovation

BY JAKE LEWANDOWSKI

One of the most common structural repairs our company, Great Lakes Builders, is asked to complete is the replacement of a basement's center girder. We're based in Chicago, and in this part of the country, people commonly refer to this girder as the "beam line." Here, as in other parts of the country where basements are common, the first-floor floor joists break over the girder running down the center of the basement, and it's common to have bearing walls over this beam, as well, so it is supporting both the first and second floors. In older homes, this critical structural support is often in a poor and failing condition.

The causes for failure are many. Often, the posts supporting the beam were built on inadequate footings—sometimes just large, flat stones, or brick and mortar that eventually deteriorated in the soil. Older homes often had dirt floors and elevated moisture levels that wicked into the posts, leading to rot of the post bottoms and settling of the beam. Termite infestation of these center girders and their support posts is also common in many parts of the country.

Almost always, the beams are undersized for the current loads. In our work in high-end vintage homes, we usually see alterations at some stage of the building's life: A new $100,000 kitchen, a living-room floor that was leveled 20 years ago, and a master bath put in with exotic tile are a few examples. Often, the alterations add significant loads, but the challenge is not always purely structural; you also need to understand the expectations of the client. Some

Photos by Jake Lewandowski

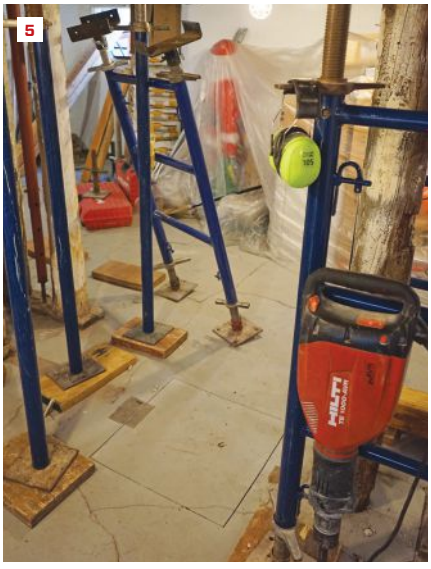
clients think a wavy floor adds character, but others are terrified of the plaster cracking or of tile breaking. We need to know we can meet, or even exceed, client expectations before signing a contract.

In the beam-line replacement covered in this article, the 100-year-old center beam not only supported first- and second-floor loads but also supported a chimney, which added an intense point load. A cluster of posts had been added at the midspan for support, but these proved insufficient over time for the underbuilt structure. To remediate these conditions, we followed an engineer's design to replace the wood beam with three wide-flange steel beams, each 8 to 9 feet long, for a total beam length of about 25 1/2 feet. We added two more beams, each about 4 feet long, on each side of the center beam to help carry the chimney load. All these beam sections were supported on 3-inch, schedule-40 columns with 8x8x1/2-inch base plates bolted into new 2x2x1-foot concrete footings. The photos that follow hit the high points of how we did it.

Jake Lewandowski is construction manager of Great Lakes Builders.

Here's the condition of the existing beam line we found when arriving at the job. This photo **(1)** shows the original wood posts clustered around the chimney location. Over time, steel "jack posts" (red), which should be considered temporary and do not meet code, had been added. The original posts, showing signs of deterioration from wicking ground moisture **(2)**, were supported on brick footings, over which a thin "rat slab" had been poured at some point to cover the original dirt floor.

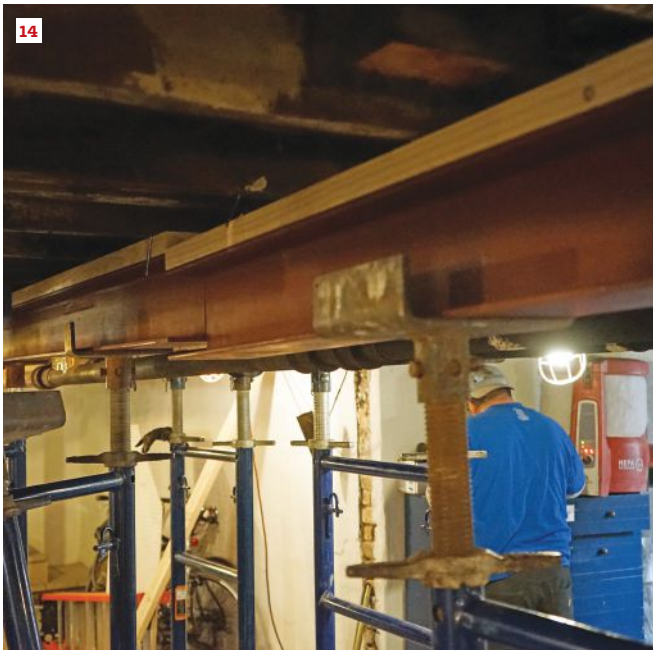
To temporarily support the load, we added two lines of heavy-duty shoring running parallel to the beam line **(3)**. In this case, we were not jacking the floor, only supporting the floor at the existing elevation. Before installing the shoring, we measured where our new footings would be placed, keeping the shoring lines out of the way. Once the shoring was in place, I began to lay out the footing locations, using a laser to reference the centerline of the main beam **(4)**.



With the beam line marked and the footing locations defined, the crew cut through the slab to place new footings **(5)**. We cut through the existing slab, which varied in thickness from 3/4 inch to 1 1/2 inches, with a small grinder outfitted with a vacuum shroud **(6)**. Once the perimeter of each footing was cut, we broke the slab out and dug the footing holes to a depth of about 15 inches **(7)**.

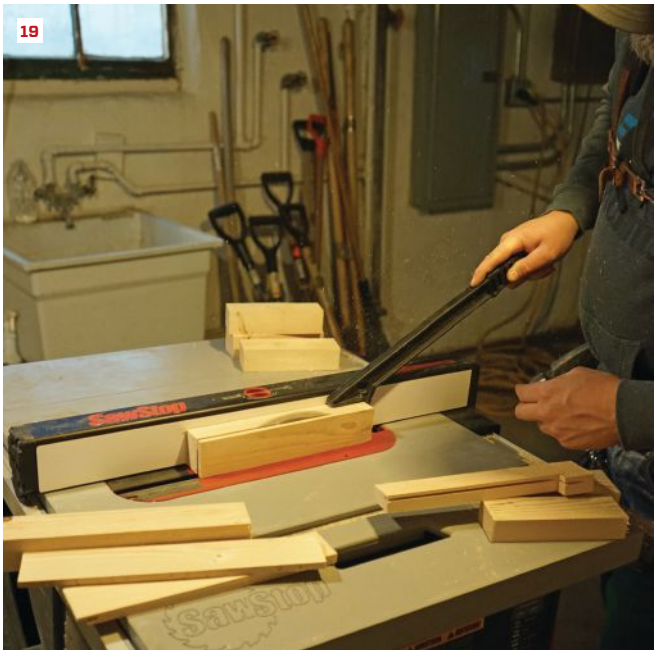
For each squared-off footing hole **(8)**, we wired together a grid of #5 rebar (specified by the engineer), including rebar chairs **(9)** that held the grid 3 inches above the bottom of the hole. We poured each footing to a depth of 12 inches, well below the slab elevation **(10)**, allowing us to finish out as shown on page 44. We used a "high early" Quikrete 5000 mix, which rapidly cured to 3,000 psi in a few days **(11)**.

While the footings were curing, we prepared the steel I-beams, pinning a wood plate **(12)** to the top of each beam section **(13)**. This 2-by nailer allowed us to mechanically fasten the beam to the joists, which would keep the joists from rotating. It also allowed us to adjust the elevation of the beam by mortising the plate rather than by removing material from the existing joists.



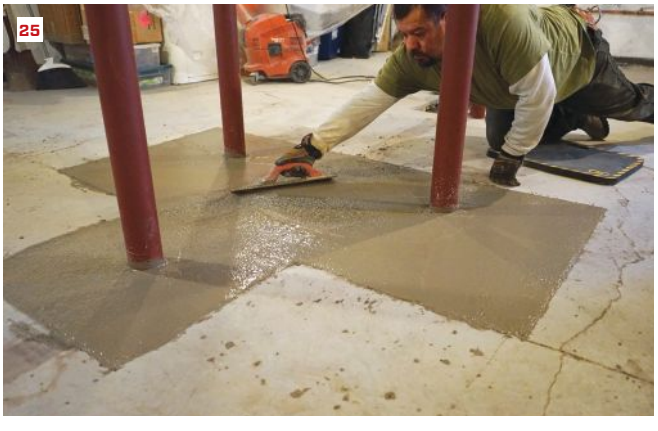
We rough-fit the beams **(14)** to mark the joist locations on the plate and measured the depth of the mortises we needed to cut. Each mortise was a different depth to accommodate the variation in the elevations of the joist bottoms **(15, 16)**. On this job, the client did not want our work to cause any cosmetic damage to the finishes in the house above, so we were careful to support the floor at the existing elevation.

With the mortises cut, the variation in the bottom elevation of the joists was apparent **(17)**. Such variation in joist size is common in older homes. When the house was framed, lumber dimensions varied more than we typically see today, and the carpenters were only concerned with having the tops of the joists at the same height. Once the mortises were cut, the beam sections aligned to within 1/16 inch or so; they would be pulled into perfect alignment when the post was bolted in place **(18)**.

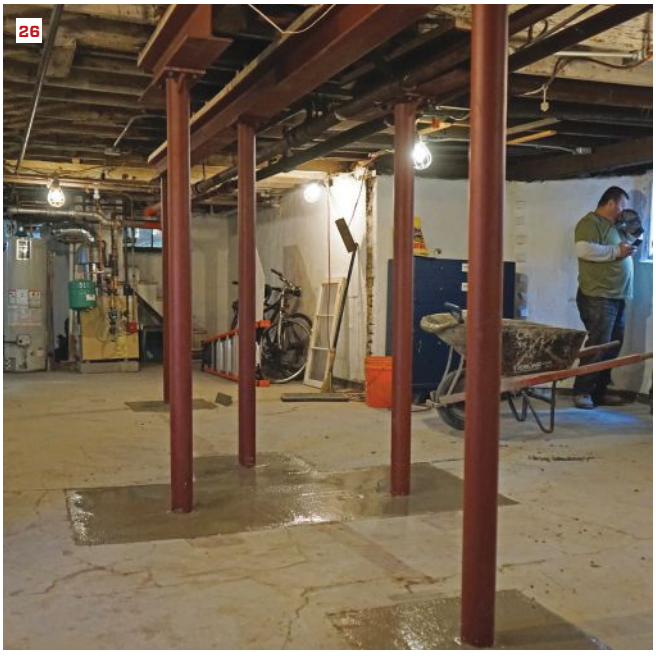


The bottom of some joists would be higher than the 2-by plate. For those, we cut shims **(19)** that we pounded into place where needed for firm bearing **(20)**. One end of the new beam had to be grouted into a pocket in the foundation **(21)**. This required enlarging the original beam pocket for the new steel beam, including a 7x7x1/2-inch setting plate specified by the engineer to spread the load at the foundation.

With the post base plates bolted to the new footing, the crew focused on cutting away the slab **(22, 23)** in order to join the footing area of the three posts supporting the chimney and midspan. Once the old slab was removed, the footings were broomed clean in preparation for a new pour **(24)**. The goal here was a clean fit and finish of the new work, with the post bases recessed below the surface of the existing slab.



The slab area around the two end posts was also widened, then all three areas were covered with a new, thicker (3-inch) slab. After the surface was finished **(25)**, the result was clean—better than the existing slab **(26)**. While the structural elements of our new work are of critical importance to us, in the end, what the customer will see is how clean it looks. And there is no doubt on this point here.



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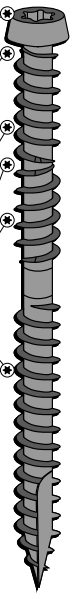

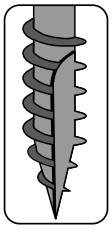

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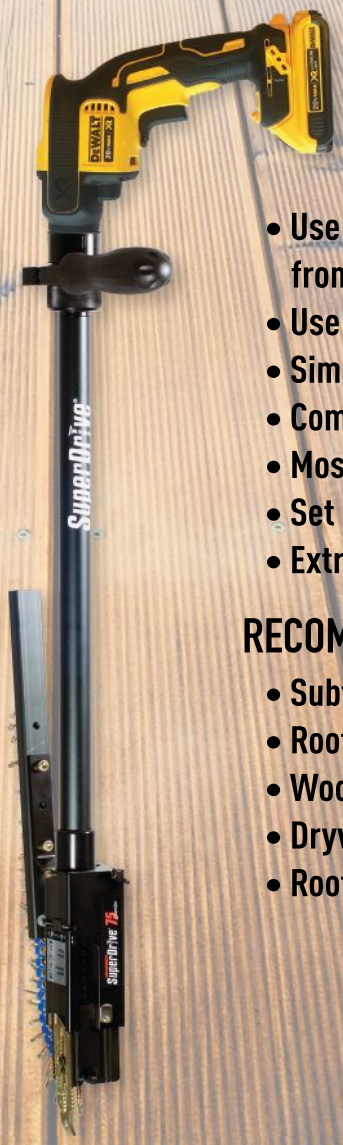

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ELECTRICAL CORDS CAN BE SUCH A DRAG.

Adding Curves to a Redwood Trellis

by Mark Ellis

PHOTOS BY MARK ELLIS

Over my 40 years as a carpentry contractor, I've been lucky enough to do some creative deck projects, some of which included curves. I think that incorporating curves into their projects scares off more than a few contractors. Me? I get excited.

There are many ways to introduce curves into an outdoor project. Probably the most straightforward is to simply create and install curved braces, instead of using angled pieces of solid straight lumber. The easiest way to do that is to cut the curved braces out of large, solid timbers, but finding quality material with the dimensions required is often both difficult and costly. In addition, you need to have the equipment and skill to make accurate cuts on sometimes thick material, and there is usually a lot of waste.

More times than not, the task requires laminating thin pieces of material together around some sort of form to create the curved shape. This is not as difficult as you might think.

Design

On a more complex design, it helps if you have a CAD software program—or the ability to use SketchUp—that will enable you to draw parts to scale. I started with DataCad and then moved up to Chief Architect. Most CAD programs can tell you the radius and the length of the pieces required to make your parts. What the programs cannot tell you, however, is how thin the material will need to be for you to bend it to the required radius.

I'm sure there are mathematical equations and material-property charts for different wood species that can be used to determine the proper lamination thickness for a particular radius curve, but most of us probably do not possess that skill set—I know I don't. My approach was trial and error at first, and eventually, from experience, I gained a good idea of how thin pieces would need to be to form certain curved shapes. Basically, the lamination thickness is determined by the curve radius, the type of wood, and your own strength. Logically, you would like these pieces to be as thick as possible and still do the job, because using fewer laminations saves time.

Forms

Once you have determined the shape you want to make, you'll need to create

These arched subrails (above left) and sweeping pergola rafters (above right) are just two examples of how the author has incorporated curved laminations into his projects. Learning to glue together multiple thin layers of wood while bending the glued layers around a curved form is the key to making these elegant architectural details.

To laminate curved braces (similar to the arched subrails in the photo at top left), the author assembles plywood forms with 2-by stringers connecting the sides (above left). The stringers provide plenty of room for the multiple clamps needed to bend the laminations (above center). After the epoxy adhesive has cured, the clamps are removed (above right).

a form to bend the laminations around. The form can be simple or it can be more involved, depending upon the shape and size of the pieces.

One thing to note is that usually a glued-up lamination will spring back a little towards its natural shape once the form that is being used to hold it to its new shape has been removed. In practice, this is mainly a problem when using fewer laminations; the more laminations there are in an assembly, the less that springback occurs. Once again, experience will be your guide, and—depending on the shape of the curve—often you can discount springback entirely. In other cases, you may need to "overbend" the lamination to account for springback.

For braces, I usually cut two pieces of ½-inch plywood with the desired inside radius of my curve. Then I connect the two pieces of plywood with intermediate pieces of 2-by material, flush with the top of the radius. The number of connecting pieces that will be needed is determined by how tight the radius is and how long the curve is. The more connectors there are, the more precise the curve will be.

Glue-up

Laminating material, especially for tighter radii, should be reasonably free of knots and preferably have a vertical grain. Most adhesives will work better with drier material, which unfortunately doesn't bend as easily.

At this point, if you haven't determined the thickness of the laminating strips, you can figure it out using trial and error. Start by ripping the material to the thickest piece that you think might be able to bend to the radius you are working with. I have a 14-inch band saw with a maximum cutting height of 6 inches that I can

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To make the long curved beams and stringer for the redwood pergola featured in this article, the author started with thin stock sourced from a local lumberyard (A). He screwed the first layer to the pergola's support posts, then applied construction adhesive to each additional layer as he built up each component, one lamination at a time (B, C, D).

use to resaw stock, but I've found that it's faster to just make two passes on a table saw. If you're fortunate, you'll have access to a lumberyard that can resaw material for you. Before I moved a few years ago, I worked with a great lumberyard that ripped 2x12 material into ¼-inch-thick slices at a reasonable cost.

Next, clamp one end of a sample laminating board to the form, then see how easily the material bends to the form. You do want some resistance, but not to the point that the piece cracks or breaks. As you bend, examine the outer surface of the material and look for any surface splintering; flat-grain material tends to splinter more than vertical-grain material. If there is splintering, you will need to try again with thinner material. I've used material as thick as ¾ inch for the laminating strips for some glue-ups; in other cases, the material needed to be as thin as ⅛ inch.

Once you have determined your requirements and milled the rest of the material to the proper dimensions, the real fun begins. There's no need to be too fussy about how cleanly milled the laminations are—the outside pieces need to have a smooth face, but interior laminations only need to be a consistent thickness. Also, make sure the pieces are as dust free as possible, by brushing them off well.

Depending upon the radius, you may need more clamps than you think, or have readily available. Over the years, I've acquired many different types of clamps, and I choose a specific type depending on what I'm doing. For example, one-handed quick clamps are great for starting and getting the material into rough position, but they don't usually create enough pressure. If I can, I use spring clamps, but often I need to use bar clamps. If the material is wide, I may use K-style or cabinet clamps for their wider surface area. Or I will use spring or bar clamps on each side of the material.

For adhesives, I've tried many types, some with more success than others.

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A


B


C


D


E

Once the author had cleaned up the edges of the beams with a power planer and random orbit sander and rounded over the corners with a router (A), he lifted the beams into position and bolted them to the support posts (B). After installing the rafters, he capped the pergola with the curved laminated stringer, which he glued up simultaneously along with the support beams (C). Then he installed the remaining straight redwood stringers to complete the project (D, E).

Carpenter's glue is fine for smaller pieces, though it has a limited working time, which makes it unsuitable for larger surface areas. You have to be able to mate the surfaces before the glue starts to skim over, since failure to do so will result in a weak bond.

I've tried polyurethane glues (such as Gorilla Glue) with mixed success. Some pieces seemed fine but others failed, so I don't recommend them. Instead, my go-to adhesive for most laminations is two-part epoxy. It is expensive, but it has the qualities I'm looking for: long work life, strength, and a waterproof bond. It reaches almost full strength fairly quickly, allowing more laminations in a given period. If you are comfortable with what you are doing and reasonably quick, you can apply it to multiple layers and clamp them all at once. Just make sure you have it clamped up before the epoxy starts to set up. The amount of hardener you use and the specifics of the epoxy should allow you to determine how much working time you will have.

By the way, not all epoxies are the same. Make sure you use an adhesive epoxy, like West System. I've found that this company is a good source for various types of epoxy resins and hardeners, as well as for technical information and support.

Once the adhesive has set, you can release the clamps, and you should have a permanent shape that matches your form. All that is left to do is plane and sand the edges of the lamination smooth, and install. I start by using a small power planer if the laminations are offset more than 1/16 inch or so. Then I follow up with a oscillating sander, beginning with courser grits and moving to 100 to 120 grit for outside parts. I also radius the corner edges with a palm router. ❖

Mark Ellis owns Creative Redwood Designs in Pioneer, Calif. Follow him on Facebook at CreativeRedwoodDesigns.

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PHOTOS BY MIKE GUERTIN

Rock-Solid Stair Posts

Blocking and a long threaded rod reinforce the structural connection between the posts and stringers

by Mike Guertin

Guard posts at the bottom of deck stairs are notoriously wobbly. Often, the posts are just screwed or nailed to the outside stringers, with the bottom stair tread providing the only reinforcement to the assembly. The posts may feel stiffly supported right after installation, but a few seasons of wet-to-dry and hot-to-cold conditions—as well as everyday use and abuse—will take their toll, and eventually, these connections loosen up. That's why I pay particular attention to how I reinforce the bottom of the stairway and secure the guard posts—I want them to remain solid and stiff for many years.

One approach that many deck builders use to install stable stair guard posts is to bury the post bases deep in the soil or in a concrete footing. I've worked on 30-plus-year-old decks where the buried post ends were still solid, but that's not always the case. It's not unusual to see the beginnings of rot in buried pressure-treated posts, even ones that have been installed relatively recently, so if you take this approach, be sure to use wood treated to at least the AWPA UC4B (ground contact/structural use) standard, or even UC4C (ground contact/extreme use) if available. That way, you can be more confident that the buried portion of the posts will remain rot-free for a long time.

You might find it difficult, though, to find PT 4x4 posts suitable for this approach. Some lumberyards only stock wood treated to the UC4A ground-contact standard, which is intended for general use, such as for joists that are close to the ground and posts that rest on footings but that aren't necessarily buried.

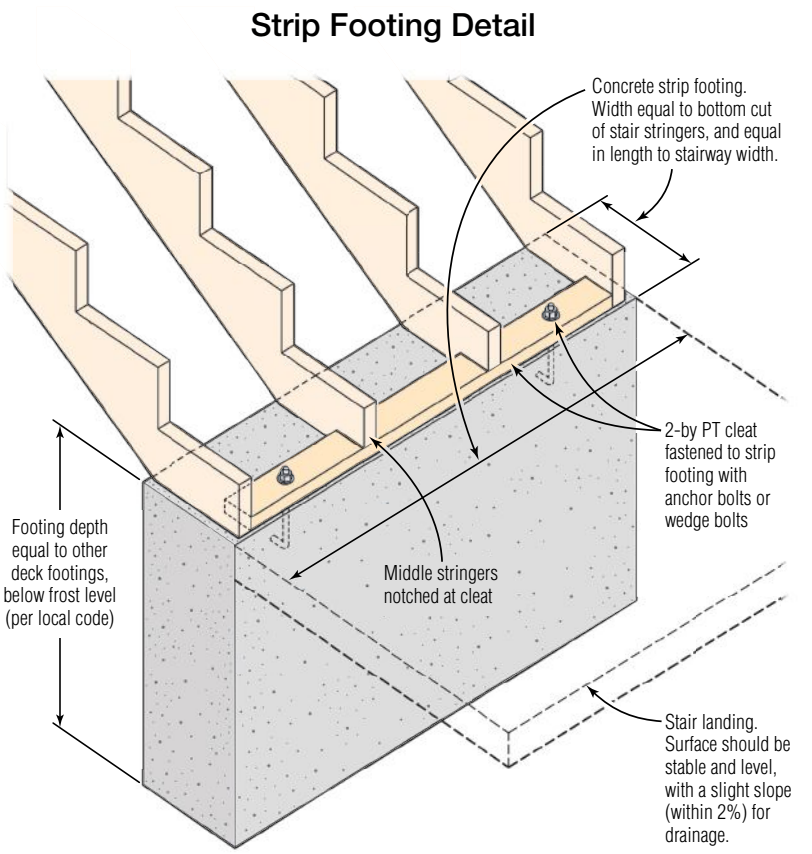
Rather than risk buried posts that can decay unnoticed, I use an above-the-ground post-reinforcing system, where the condition of the posts can be monitored and parts replaced if necessary.

The Footing Stabilizes the Posts

No matter where you build decks, the bottom of the deck stairs must be supported by footings. The 2018 IRC (R403.1.4 "Minimum Depth" and R403.1.4.1 "Frost Protection") requires that when a deck is attached to a dwelling for support at a ledger, the footings on the deck—including the stairway footings—must reach

below frostline. When a deck is free-standing, the minimum footing depth required by code is 12 inches (R403.1.4.1, exception #3 "Frost Protection").

There are several ways to meet this requirement, and if you live in an area that has a frost-free climate or that has the type of well-drained soil that doesn't expand when frost occurs, a 4- to 6-inch-thick concrete slab landing might be the simplest option (if approved by your local inspector). Otherwise, my favorite approach is to pour a concrete strip footing that is at least the width of the bottom cut of the stair stringers (about 10 inches), the same length as the width of the stairway, and the same depth as the other deck footings (below frost level) (see Strip Footing Detail, right). While this might sound like a lot of concrete, it's not a lot more than if you were going to dig three or four 10-inch-square or 12-inch-diameter footing holes (per DCA6) next to one another, and it eliminates the problem of dirt from the closely spaced holes caving in on the others. (For more on floating vs. fixed footings, read "Deck Stairs on Frost Footings" at deckmagazine.com.)



Instead of using individual concrete piers to support each stair stringer, the author prefers to dig and pour a monolithic strip footing, which is sized to extend below frost depth and fully support the stringers' seat cuts. The stair stringers are locked to the footing by a PT cleat anchored to the concrete.

Connecting the Stringers to the Footing

To provide an anchor point for connecting the stringers to a footing or an integrated footing and landing, I secure a 2x4 (or larger) PT cleat to the concrete, either with cast-in-place HDG J bolts installed during the pour or with expansion anchors that can be installed after the concrete is cured. The 2-by has to align with the front end of the stringers, so it helps to cut the stringers before casting the footings and landing so that you know exactly where to dig. In that case, I install ½-inch-diameter generic HDG J-type anchor bolts when I pour the footing. If for some reason I'm not certain of the stringer layout, the cleat can be fastened to the concrete with expansion anchors (either ITW Red Heads or Simpson Strong-Tie anchors are typically stocked at the yards near me) after the concrete has cured.

After laying out and cutting the stringers but before installing them, I stack them up and bore a 9/16-inch-diameter hole 2 inches down from the top of the tread cut and 2 inches in from the riser cut. Later, I'll run a ½-inch-diameter threaded rod through the holes; drilling the holes before installing the stringers ensures accurate hole alignment.

I cut 1½-inch-by-3½-inch notches at the bottom of the center stringers so that they will fit around the 2-by cleat, and toe-screw them down with framing screws. The two end stringers don't need to be notched—they are simply screwed to the ends of the cleat with structural screws (**Figure 1**).

Installing the Guard Posts

Once the stringers have been fastened to the footing cleat, the 4x4 PT guard posts can be mounted to the outer stringers. On the job shown here, I mounted the posts inside the stringers, but with this system, it is possible to mount them on the outside of the stringers. To hold the posts in place while I install blocking and the threaded rod, I fasten them to the stringers with a couple of 4½-inch-long structural screws. I plumb them in line with the stringers; in the final step, I adjust the camber of the posts (**Figure 2**).

Next, I install a row of blocks ripped to

Figure 1. After pouring the concrete for the strip footing and stair landing, the author uses anchor bolts to connect a 2-by PT cleat to the footing (above left). When installing the end stringers, he fastens them to the cleat with structural screws (above right). The middle stringers will be notched to fit over the cleat.

Figure 2. The author screws the guard posts to the stringers (above left), then installs a row of blocking that fits tightly between the stringers (above center). A 1/2-inch-diameter galvanized threaded rod that fits through prebored holes in the posts and stringers ties the assembly together (above right).

the height of the stringer from footing to tread cut. The blocks are positioned behind the guard posts in a straight line and fastened through each stringer with 5-inch structural screws about 1½ inches up from the bottom of the stringer and down from the tread cut. I also drive additional 4-inch screws through the back of the blocks into the 2-by cleat.

Using straight 4x4 PT stock for the stair posts and cutting the posts and PT blocking to length on a sliding compound miter saw ensures that all of the components are square. So even before my final adjustments, the posts are close to plumb.

Using the prebored holes in the outside stringers as a guide, I drill a 9/16-inch-diameter hole through the 4x4 posts, then run a ½-inch-diameter HDG threaded rod through the stringers and blocks. When long rods aren't stocked locally, shorter lengths can be joined together as needed with ½-inch HDG threaded couplers. With nuts and washers installed at each end, I snug the rod up, but I don't tighten it down yet (**Figure 3**).

Next, I install a second row of blocking aligned with the front of the risers and on top of the cleat, fastening the blocks with structural screws or framing screws. (When the posts are positioned outside the end stringers, the first blocks run from stringer to stringer, rather than from post to stringer, as on this job.) Another variation I've tried is to cut 1½ inches off the riser face of the intermediate

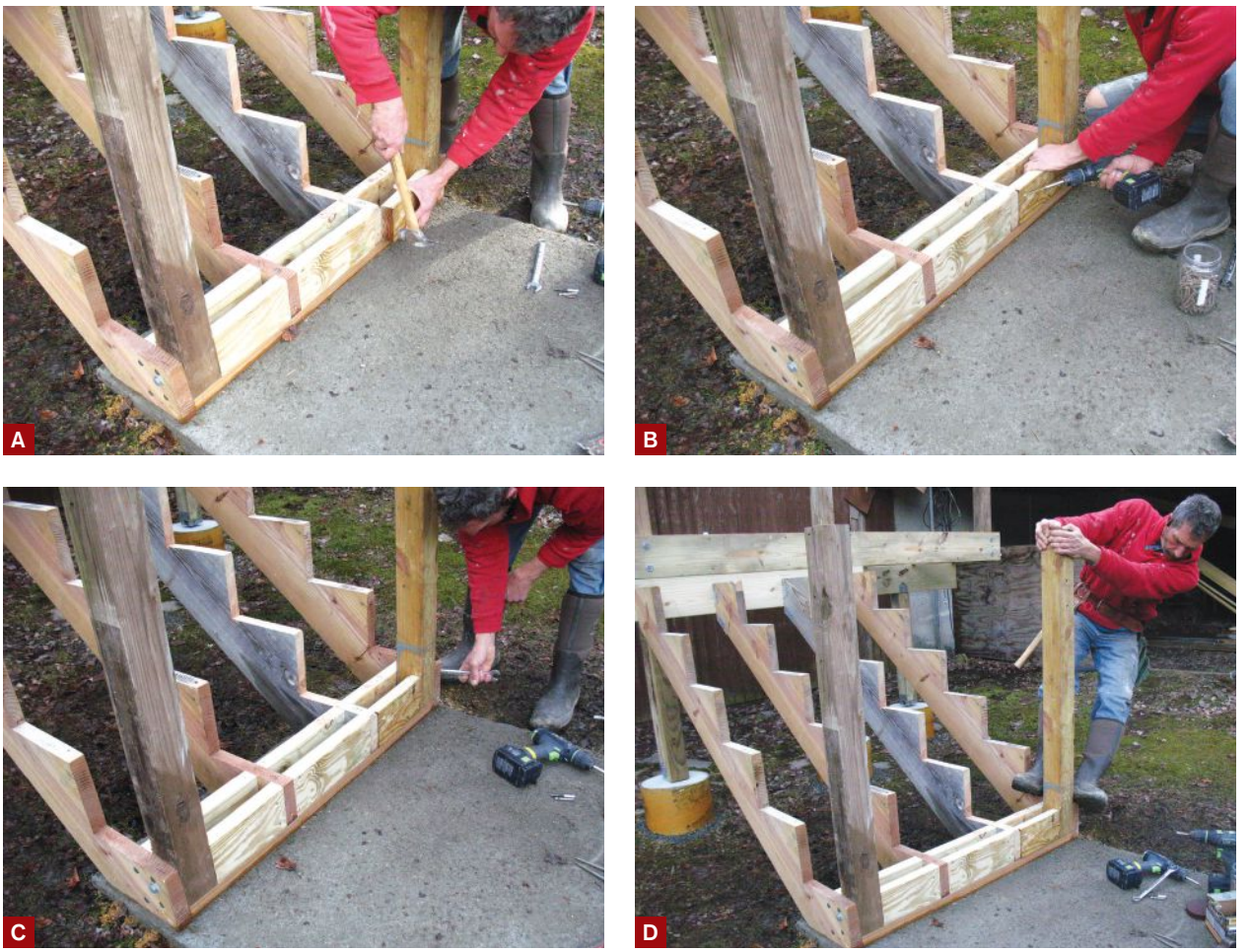


Figure 3. Next, the author installs a second row of blocking, aligned with the front of the stringers, to reinforce the assembly (A). After screwing the blocking to the stringers (B), the author tightens the rod nuts (C), and tests the assembly (D), making adjustments as needed with shims so that the posts are plumb.

stringers so that a single block can be installed from one end to the other.

Finally, I tighten down the end nuts and trim off the excess rod, coating the cuts with a rust-prohibiting coating. Tightening the nuts can cause the posts to camber inward. Final adjustments can be made by loosening the nuts, inserting shims between the outer stringers and the blocks (or between the blocks and posts), and retightening.

Although it's not shown in the photos, I also bore ½-inch-diameter holes through each block along the front, just above the cleat, so that any water that collects between blocks can weep out.

Testing the Assembly

To get a rough idea of the strength of this assembly, I set up a cable winch to pull on the top of a post, and I measured the load with a spring scale. In my makeshift testing, I achieved a load of about 400 lb. before the washers began to pull through the outer stringer. I think this is plenty strong, but using heavy-duty 3-inch-by-3-inch bearing plates instead of standard-cut washers would help the connection resist a greater force. On most jobs, not as a scientific test but for peace of mind, I give the posts a yank to make sure nothing moves.

Of course, this assembly will secure the posts from moving in an outward direction only; they can still move in line with the stringers under force. So I'm also counting on the guardrail assembly between the lower post and the post on the deck (which is designed to resist force in the direction of the stairway) that will be installed later to reinforce the lower post. ❖

Mike Guertin is a builder and remodeler in East Greenwich, R.I., and leads the Deck Workshop at JLC Live and the Deck Expo. See his website at mikeguertin.com; follow him on Instagram: @mike_guertin.

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Lighting Up Outdoor Living Spaces

Easy-to-install low-voltage LED systems offer a lot of design flexibility

By Jason Russell

Twenty-five years ago, there weren't many lighting options for adding some evening pizzazz to decks or outdoor living spaces. While I never personally included one on any of my projects, electrician-installed 120-volt AC systems were fairly common; I've torn out more than a few old decks with a line-voltage system, most with light fixtures that stopped working years ago. In some cases, the fixtures were full of water, basically health hazards and accidents waiting to happen.

When the first 12-volt DC systems were introduced, I jumped at the opportunity to include them in my designs, like most deck builders, because they didn't require conduit or an electrician to install it. But they were clunky-looking and difficult and time-consuming to hook up, or came with flimsy connectors that inevitably failed in a couple of years.

The weakest link in the first-generation low-voltage deck lighting systems was the bulb technology. Standard halogen, incandescent, or fluorescent bulbs don't last very long, especially in an exterior environment. And if you happen to touch a halogen bulb with bare hands during installation, that bulb's life expectancy is even more limited because you didn't give it the white-glove treatment (literally; oils from your skin left behind on the bulb's special heat-resistant quartz glass can start to etch it under high temperatures, creating hot spots that weaken the bulb). To accommodate these hot bulbs, fixtures had to be large, requiring large holes cut into the framing to make room for the light housing.

Enter LEDs (or light emitting diodes), which have revolutionized the way we see everything at night. This technology has made outdoor lighting systems more stable and the fixtures more compact. With a lifespan approaching 50,000 hours, an

PHOTOS BY CALVIN RUSSELL AND JASON RUSSELL

LED fixture virtually guarantees that you will never have to worry about those lights for the life of the deck.

System Basics

Today's low-voltage lighting systems consist of three basic components. The first is the power supply, a low-voltage transformer that converts 120-volt AC power to 12-volt (or, for certain systems or situations, 24-volt) DC power. The second is the low-voltage wiring that connects the transformer to the lighting fixtures. And finally, there is the most visible part of the system: the LED light fixtures, which must be approved for use in wet locations.

When designing a lighting system, first decide how many light fixtures are wanted or needed and where they will be located. Drawing a simple diagram will go a long way when determining how much wire you will need and where you will need to run the wiring. But more importantly, you need to know the number of light fixtures in order to size the transformer.

Transformer. A simple rule of thumb when speccing the power supply for a system is to choose a transformer that has enough watts to power all the lights on the system. To figure this out, take the total watts of all the light fixtures and add them together. For example, if there are 25 lights total, with each light rated at 1 watt, you need a transformer that will power at least 25 watts. To be safe and provide a little reserve capacity, I'd use a minimum of a 50-watt transformer for this application. That's a small transformer, but this is a far lower power requirement than what is needed to drive older systems, in which even small incandescent or halogen fixtures with typical T5 wedge bulbs draw at least four watts and sometimes more than 10 watts for the same amount of lumens, or light output.

For safety, a transformer with a UL 1838 listing is limited to 15 volts output and 300 watts, which is plenty for most LED systems.

Figure 1. Most LED lighting systems can be powered by a 12-volt DC transformer, but some systems are designed to operate at 24 volts DC (A). This 24-volt DC unit has an external programmable photoelectric sensor (B).

I like to use transformers that have a photoelectric sensor, which gives you the option of activating the lights automatically when it gets dark enough. It also allows you to program how long the lights stay energized: from dusk to dawn, for four hours, for six hours, for eight hours, or off altogether. Transformer technology is improving all the time, and I expect to soon see ones that allow the loads to be split into multiple zones, which can then be controlled with a smartphone app and activated separately (**Figure 1**).

Make sure you consider your transformer location before installing it. Low-voltage lighting systems need a 120-volt power outlet for the transformer to plug into. If there isn't a GFCI line-voltage circuit nearby, you'll need to have an electrician install one. Also, if you put the transformer where it gets too much light at night from auxiliary lighting like outdoor flood lights or internal house lights, the photo-eye on the transformer may not activate the LED system. If this is the case, you may need to make a shield from some metal flashing to protect the photo-eye from receiving too much light.

Wiring. What makes low-voltage lighting so simple to install is the wiring, which consists of two wires that are usually bonded together as one in a waterproof, flexible direct-burial sheath (no conduit required). This cable comes in multiple gauges and can be split in half when necessary.

The size of wiring available in your region may vary depending on your weather conditions. Here in the mild Pacific Northwest, where 16-gauge and 12-gauge wire is widely available, I generally use 12-gauge wire. When I'm running more than 500 feet of cable (which is not common on a deck, though maybe more common when the system includes landscape lighting), I'll switch to even larger diameter 10-gauge cable for the supply lines to minimize voltage drop.

Most LED systems will operate fine on 12-gauge wire, with a single hook-up to the transformer. Some larger transformers have higher voltage poles to hook up wire to. For example, there might be 13.5-volt and 15-volt terminals on your

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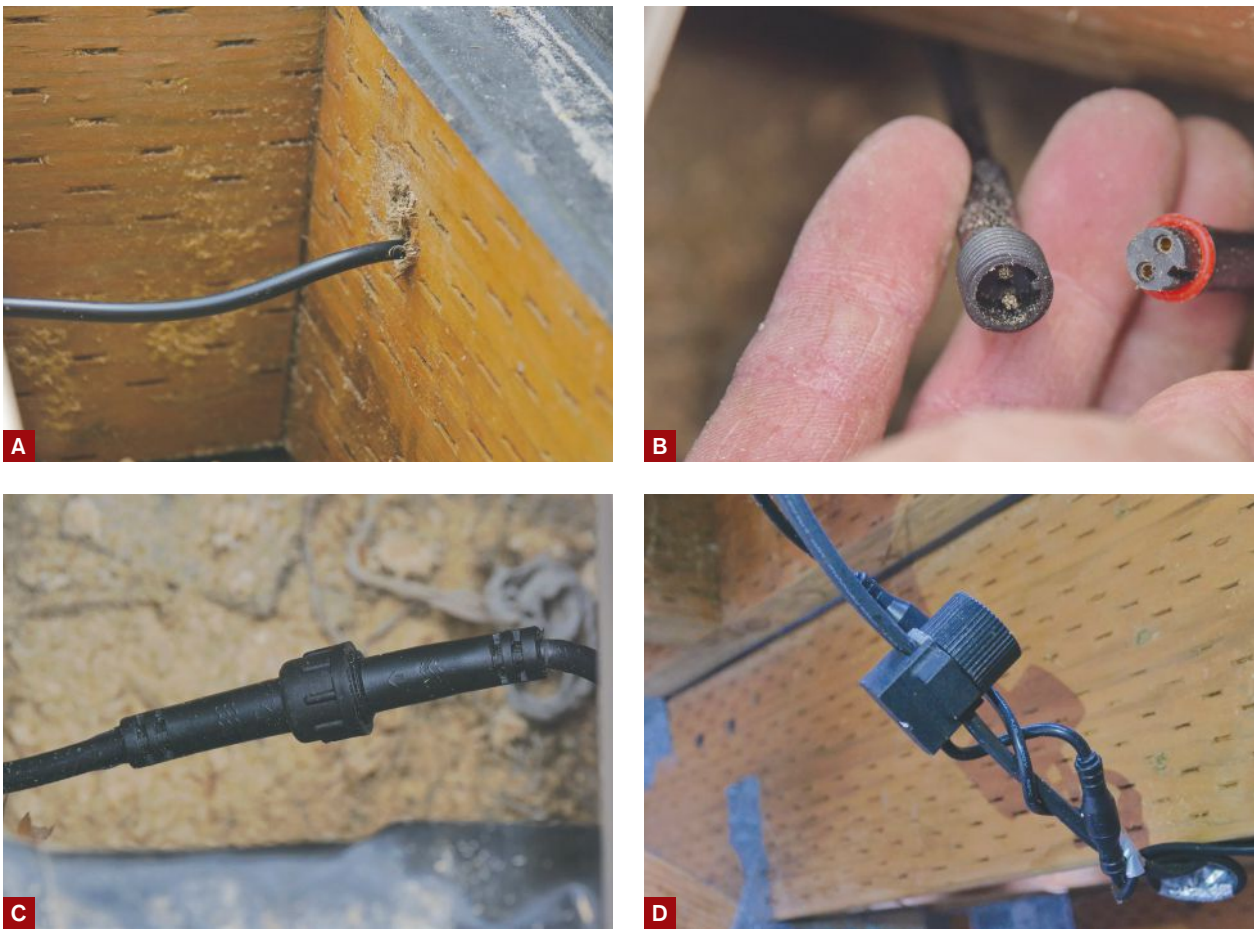

Figure 2. Low-voltage two-wire cable is UV-protected and weatherproof, so it doesn't have to be run in conduit (A). While there is no industry standard for fittings, companies like In-Lite offer high-quality waterproof cable connectors for extending lines (B, C), connecting fixtures to supply lines, and adding branch lines (D).

nominal 12-volt transformer. If you're not sure of the proper wiring configuration, consult the manufacturer in regards to wire thickness, length, and transformer size (**Figure 2**).

Fixtures

In general, I plan lighting so that it meets code, provides for task illumination, and—my favorite part—adds an element of pizzazz to the space, through a combination of decorative and accent lighting.

Code requirements. When there's a door leading out onto a deck that has access to grade, an exterior light controlled by an interior switch is required by code near the door. This is typically a line-voltage light fixture installed by an

Choosing Lighting Products

I've seen the low-voltage lighting market explode over the past 10 years, with product quality generally rising as competition has increased. Most of the major decking-products manufacturers have jumped into the lighting business, along with independent companies that specialize in outdoor lighting fixtures and accessories. Among my favorite products are the fixtures from In-Lite (in-lite.com) and Regal Ideas (regalideas.com) featured in this article. But there are inferior products on the market as well. How do I know? Because I've already done warranty replacements from installing a bargain light kit purchased off the internet to save a buck, and got burned. So be careful with those too-good-to-be-true online deals.

Some clients express an interest in solar, but I don't feel it is a long-term solution, and I don't care for the look of solar panels on top of every light. Besides their limited light output, the variety of fixtures is limited. For example, as far as I know, there are no small solar lights that can be installed in the face of a step or the edge of a deck, as shown in this article.

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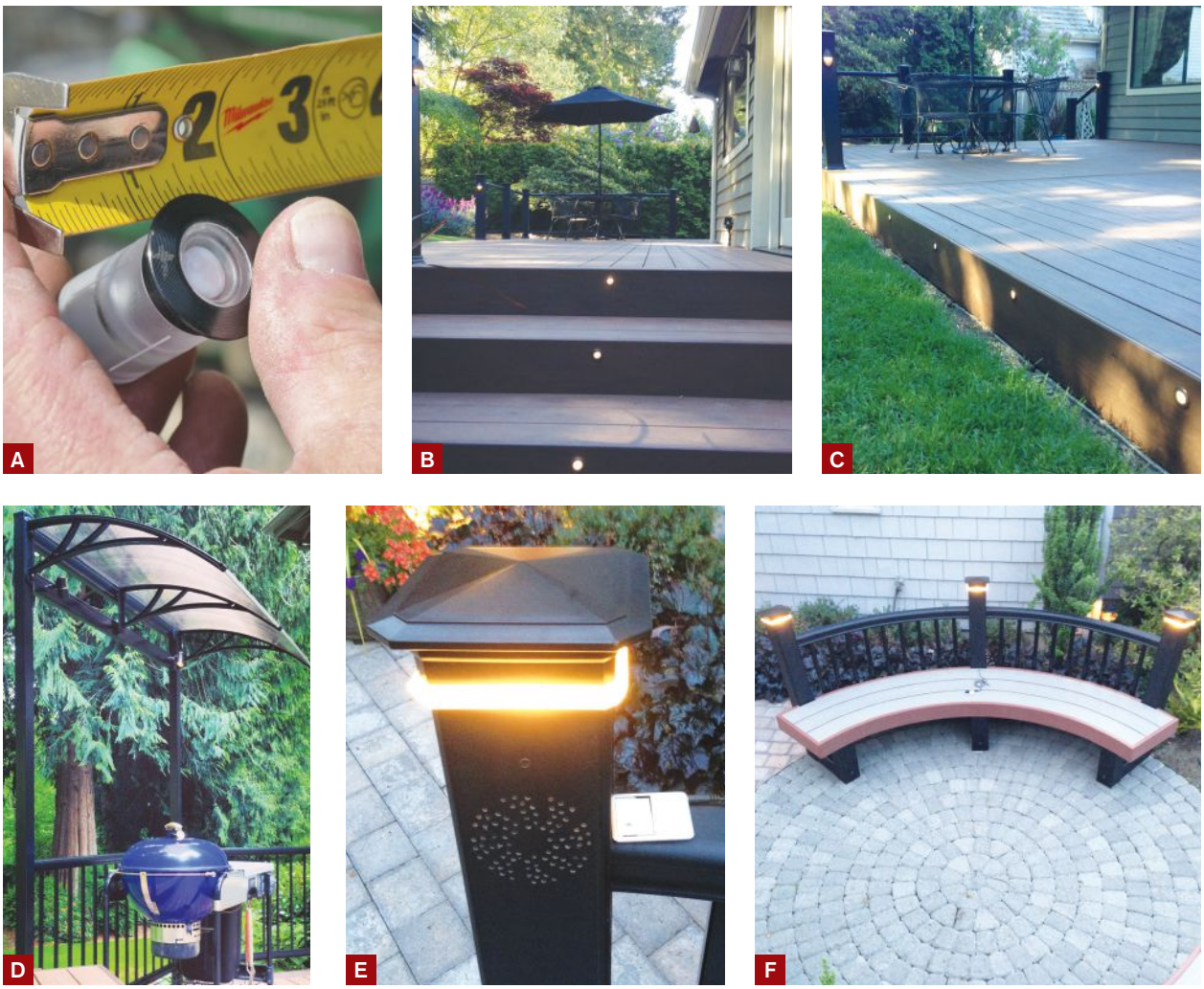

Figure 3. Measuring less than 1½ inches in diameter, small puck lights (A) are ideal for providing practical lighting in stair risers (B) and accent fascia lighting (C). When designing a system, be sure to provide task lighting to illuminate specific areas, such as dining tables and grills (D). Post-cap lighting adds both safety and style to outdoor areas (E, F).

electrician, but many clients like to coordinate the fixture style with the outdoor lighting package. At the same time, there needs to be at least one 120-volt GFCI-protected receptacle serving the deck.

General and task lighting. Grills, outdoor kitchens, and dining areas are among the spaces on a deck that require illumination. I put safety lighting—around stairs and other transitions, and near spas and hot tubs—in the same category. People need to be able to see what they're doing, but it's also a good idea not to overdo it with fixtures that are too bright. Separately-controlled circuits that can be dimmed are a good way to manage light levels in the various areas on a deck.

Decorative lighting. When considering the placement of decorative or accent lighting fixtures, you don't need to be traditional. I've seen many creative examples of lighting on floors of decks, up privacy walls, and under benches to create indirect lighting as well.

Decorative lighting can also serve a practical purpose. For example, I like to include multiple 1-inch round LED lights in my projects, using them on stairs and at transitions to highlight safe paths from upper to lower areas (**Figure 3**).

Once the transformer location and light-fixture locations have been determined and you know approximately how much wire will be needed, it's time to create a path from the transformer to each light location. Before installation, though, it's a good idea to test your light kit in place in the dark to make sure lights are spaced correctly and lighting levels are what you expect.

Installation

I pay a lot of attention to wire management, during and after installation. The

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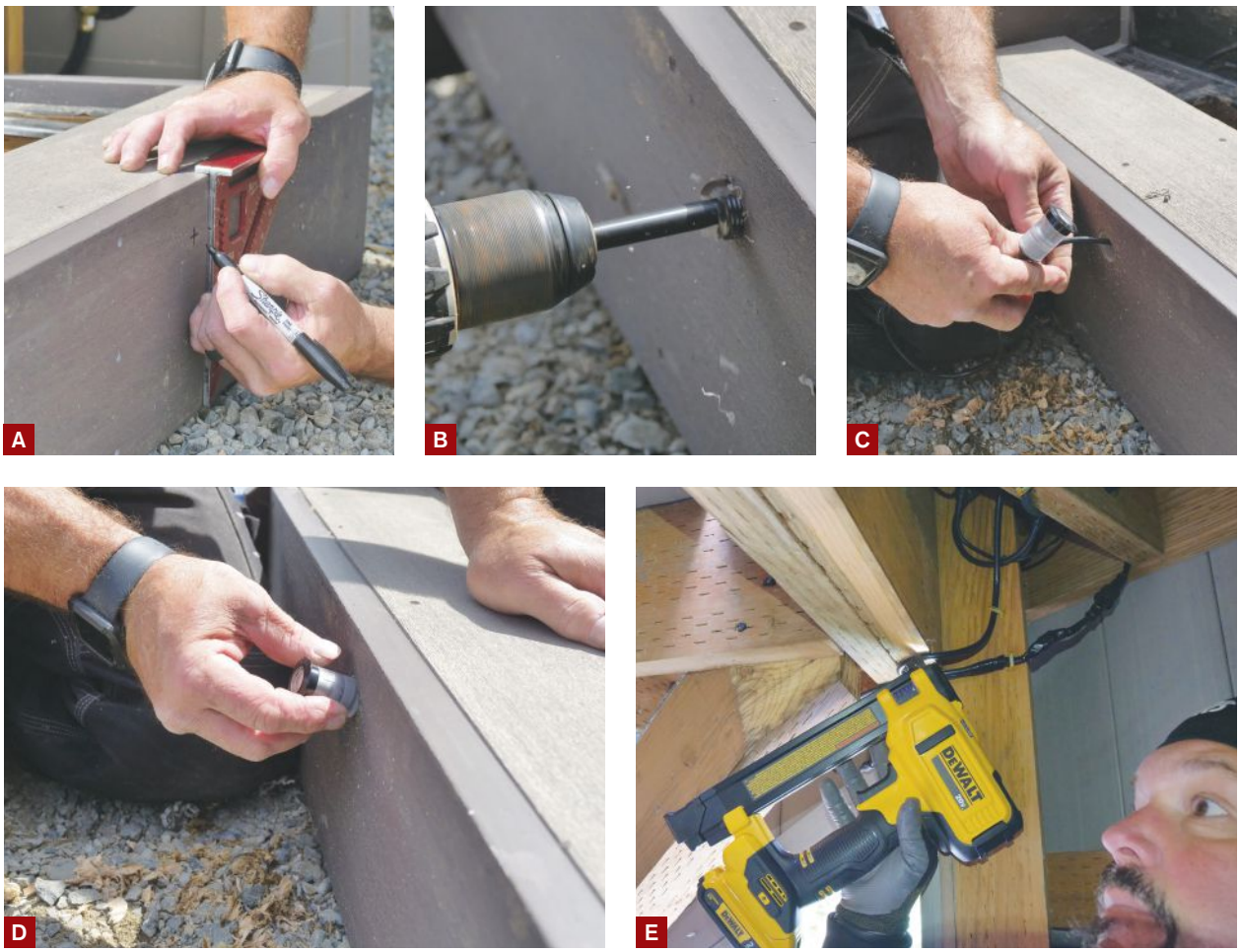

Figure 4. To install a puck light, the author lays out (A) and drills the proper diameter hole with a Forstner bit (B), which creates a clean hole in composite material. After connecting the fixture to supply wiring (C), he installs the fixture; friction holds it in place (D). A cordless stapler makes quick, neat work of running the wiring for the low-voltage system (E).

liberal use of cable zip ties and staples goes a long way toward keeping things looking tidy under the deck.

Cable staples can be tapped in manually, of course, but it's faster to use a staple gun. Arrow makes an inexpensive cable staple gun, the T-59, that looks similar to its standard T-50 stapler. Another option is DeWalt's new cordless cable staple gun, which I've just acquired. It runs on DeWalt's 20-volt platform and makes effortless and quick work of securing cable to the frame of a deck (**Figure 4**).

I start by connecting the cable to the transformer and testing each connection before I install the fixtures. This way, I can be certain each light works before installing it.

Low-voltage wire doesn't really have positive and negative sides, so if you cross over the polarity on every light, the lights will still work as long as you have a positive connection to each wire. The other cool thing about LED technology is that you only need to run one wire to make all the connections—you don't need to run multiple wires to make the lights emit the same amount of light. Everything is the same. The last light in the run will be the same brightness as the first as long as the transformer is rated for the proper amount of wattage to power the lights.

There are a number of ways to connect the lights to the power supply, depending on what is supplied to you from the manufacturer. My old way of hooking up lights was to either cut, splice, solder, and heat-shrink each connection, or to use heat-shrink crimp connectors and then heat-shrink over each set of connections. Both techniques are time consuming, but are better than twisting wires and using electrical tape.

For the past several years, however, I've been using In-Lite's cable and lighting system. Each light comes with a special connector that works with 12-gauge wire and larger. The connector has three stainless steel barbs in its base for each

Figure 5. One of the most striking lighting fixtures that the author has used on his projects is the CrystalRail system, from Regal Ideas, which consists of aluminum mounting brackets (A) with built-in LED lighting that connects to the deck's low-voltage system (B). The LED fixtures in the mounting bases illuminate tempered-glass panels that are part of the system, providing a dramatic nighttime look to the deck from all directions (C, D).

wire; the barbs pierce the wires to make a positive connection to both wires at the same time. Then dielectric grease encompasses each barb to ensure a long-term connection.

I like the In-Lite connectors because they provide a solid, positive connection that installs with minimal effort and doesn't compromise the integrity of the main wire—no splicing is required. The downside is they are slightly bulky, so plan to spend a couple of extra minutes organizing the connection points.

Beyond the Basics

If you want to create an amazing lighting experience on your client's deck, consider Regal Ideas CrystalRail. CrystalRail is a unique system in which special pods hold low-iron glass and emit light through it. At night, the glass glows blue, to incredible effect. Regal Ideas also sells traditional aluminum-framed glass systems that are lighted (**Figure 5**).

There are as many approaches to lighting up outdoor spaces as there are folks who build them. A good way to look for inspiration is by checking out what other builders are doing. On Instagram, see @infinitedecks for some alternative lighting for decks or @imaginedesignandbuild for complete landscape lighting solutions. Pinterest is another source for finding outdoor lighting inspiration. ❖

Jason Russell specializes in custom heat modification of PVC decking and railing products, automation, and custom audio installation, and owns Dr. Decks, in Tacoma, Wash. therebelcarpenter.com

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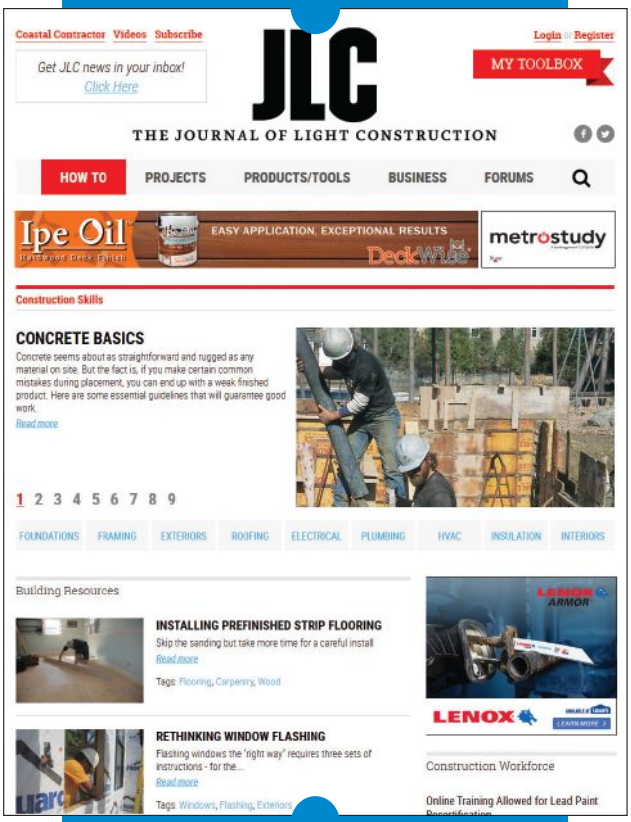

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Summer Camp

by Andrew Wormer

When I was wee, my family of nine used to load up our big old Ford Country Squire station wagon with kids and gear and head up to Canada to go camping for a week or two. This always involved some drama, such as Massasauga rattlesnake sightings, errant fishhooks, and biblical downpours in leaky canvas tents, but what I remember most is the beauty of the area: Forests, clear lakes, and the granite of the Canadian shield poking up everywhere through the landscape. Taking a look at photos of one of WWG Design & Build's recent NADRA-award-winning projects brought back memories of those happy days.

While the serene setting is familiar, this lakeside deck is considerably more civilized than the provincial campgrounds that my family enjoyed (or was it "endured"?). Jon Witt, who owns the Fenelon Falls, Ontario-based company, explains that the water level on this lake fluctuates seasonally, and that his clients wanted a platform that could be used during the spring high-water season—for a few weeks each year, the water level is only 8 inches below the deck surface.

Witt says that one of the lakeside project's main challenges was dealing with the lot's steep hill and large outcrops of granite bedrock. With no way to mechanically move the lumber to the building site, every piece had to be handbalmed from the rear of the house and down the embankment to the water's edge.

Fitting the deck to the rock outcropping involved a lot of heavy masonry anchors and some careful scribing. To ensure that the PT decking could withstand the harsh northern climate with grace, the decking was pre-finished on all four sides with Cutek Extreme stain, by a local company named DEck Protect. For a barefoot-friendly surface, the decking was fastened to the framing with the Camo Edge hidden fastening system.

After completing the lower deck, Witt and his crew had to figure out the meandering path and stair system to traverse the steep embankment and granite outcroppings. But the result was worth the effort, and during the short but glorious Canadian summer, I suspect that there's no place the family that owns this camp would rather be. ❖

Andrew Wormer is editor of PDB.

PHOTOS BY JON WITT

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BY SYMONE GARVETT

1. Outdoor Kitchen Components
Trex has teamed up with Danver Stainless Outdoor Kitchens to offer new cabinetry and coordinating components in the Trex Outdoor Kitchens collection. The lineup includes seven door styles—Danver's top-five sellers and two designs exclusive to Trex—and 14 powder-coat colors and wood-grain-inspired finishes. The semi-custom components are available in 3-inch increments from 9 inches to 48 inches and are made from 304- or 316-grade stainless steel. Contact a local distributor for pricing. trex-outdoorkitchens.com

2. Clear Glass Railing
Viewrail glass railing is designed to hide hardware and fasteners, while preserving views and providing safety and protection from wind. Frameless side-mount, base-rail, and standoff-pin systems hold 1/2-inch tempered and 9/16-inch laminated glass, while framed systems (with posts) accept 3/8-inch and 1/2-inch tempered or 9/16-inch laminated glass. All Viewrail glass panels are fabricated from Starphire low-iron glass. Contact a local distributor for pricing. viewrail.com

3. Body-Heat Sensor System
Recognizing early signs of heat stress is key to worker safety in the warmer months. With Kenzen's cloud-based heat-monitoring system, workers wear devices on their arms that have sensors that monitor metrics including heart rate, activity, and skin and ambient temperatures. When core body temperature is too high, alerts are sent to workers via device vibration or iOS or Android app notification, and to supervisors via a web dashboard, signaling that the worker should take a break. The system is sold as a subscription on a per-worker, per-month basis. kenzen.com

4. Miniature Water Heaters
EcoSmart's newly designed Eco Mini collection provides immediate hot water in small quantities, making it a suitable point-of-use heater for remote sinks in a garage, outdoor kitchen, studio, or guest house. Models come in 1.5-, 2.5-, 4-, and 6-gallon sizes, all equipped with an external temperature control knob and a cord and 15-amp plug for use in a 120-volt outlet. Pricing ranges from $135 to $205, depending on unit size. ecosmartus.com

5. Advanced Bidet Seat

Icera's iWash S-11 bidet seat was created to enhance the functionality of a traditional toilet. The seat can be installed on most standard elongated toilets and offers a minimalist profile. The system includes a stainless-steel, self-cleaning sprayer with customizable spray options (rear, front, oscillating, and power wash) and a ceramic water-heating system that provides instant and unlimited warm-water spray. Other features include a built-in deodorizer, in-bowl night-light, silent-close lid, and wall-mounted remote control. It retails for $675. icerausa.com

6. Exterior Refrigerator

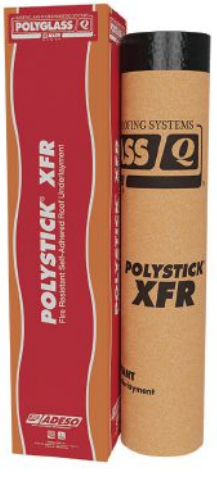
Vinotemp is moving out onto the patio with its Brama Outdoor Refrigerator, which may be installed as a built-in or a freestanding unit. It measures 23 1/2 inches wide by 32 1/3 inches high and has a black cabinet body, a locking stainless steel door, three pull-out adjustable glass shelves, and an internal LED control panel for temperature adjustment. Additional features include leveling legs, an LED light bar, and an automatic defrost function. Pricing starts at $1,200. vinotemp.com

7. Energy-Efficient HVAC

Carrier has unveiled two new residential HVAC systems: the Infinity 26 Air Conditioner and Infinity 24 Heat Pump, both featuring the manufacturer's Greenspeed intelligence function. For most applications, the energy-efficient Infinity 26 offers a SEER rating of up to 26.0, and an EER of up to 16.5. The Infinity 24 offers a SEER rating of up to 24.0, an EER of up to 15.0, and an HSPF rating of up to 13.0. Both products produce sound levels as low as 51 decibels, according to the manufacturer. Contact a local distributor for pricing. carrier.com

8. Dual-Purpose Roof Underlayment

Polystick XFR, a new dual-purpose roof underlayment from roofing and waterproofing systems manufacturer Polyglass USA, combines the manufacturer's existing ADESO and Burn-Shield technologies to provide both waterproofing and fire resistance in high-temperature applications, including combustible decks with metal roofing. It features an SBS (elastomeric) modified bitumen upper compound and a self-adhesive lower compound, with fiberglass reinforcement for additional stability. Contact a local distributor for pricing. polyglass.us



9. Acoustical Sealant

Dap's newest wall and floor sealant, Sound Block E90, is designed specifically to reduce sound transmission through penetrations in wall and floor systems, as well as improve STC ratings in sound-rated applications. The sealant is recommended for use with openings around electrical boxes, pipes, duct systems, cut-outs, and other types of penetrating utility equipment, and for abutting surfaces, corner joints, and other perimeter edges. Sound Block E90 is sold in 28-fluid-ounce plastic cartridges designed for easy gun application. Pricing starts at $6. dap.com

10. Modern Smart Fan

Classic design meets modern aesthetics in the Modern Forms Tip-Top Smart Fan. The fan features a wet-rated, weather-resistant aluminum housing, allowing use on an outdoor porch as well as in an indoor room, and includes a 23-watt LED luminaire powered by WAC Lighting. An app integrates with smart home devices and will turn the fan and luminaire on and off, change speeds, reverse the rotation of the blades, and dim the lights. The fan is available in two finish combinations and in two sizes, 44 inches and 52 inches. Pricing ranges between $300 and $395. modernforms.com

11. Unhinged Skylight

The Marvin Awaken skylight is named for the array of LED lights surrounding the interior of the skylight that mimic the soft glow of the sun. Instead of having a conventional hinged connection, the skylight pops open, so the glass remains parallel to the plane of the roof when it opens. This allows for a bug screen around the perimeter of the roof window that accordions out as the skylight opens. The skylight comes with a single flashing kit that can be used for either deck-mounted or curb-mounted installation. Contact a local distributor for pricing. marvin.com

12. Decorative Wood Connectors

The Avant Collection in Simpson Strong-Tie's Outdoor Accents line of code-listed decorative wood connectors and fasteners includes new angles, joist ties, gable plates, post bases, and decorative side plates, all featuring straight edges and chamfered corners for a clean, contemporary look. Connectors and fasteners in the line are made from exterior-rated galvanized steel with a black powder-coat finish for corrosion protection. Contact a local distributor for pricing. strongtie.com

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Smart Utility Locator

BY JEFF KIRBY

Whenever you need to excavate any portion of the existing terrain, it's always a good idea to call your local "before-you-dig" number. But sometimes, you need to know the location of a utility underground in a pinch and cannot wait for a tech to come and spray out the location for you. In those instances, it would be extremely convenient to be able to grab a Leica DD230 Smart Utility Locator out of your truck and quickly set up and mark out exactly where the utility is.

I had the opportunity to use a DD 230 locator on several projects this past fall, and it allowed me to mark out utilities easily, quickly, accurately, and conveniently. Among its many extremely helpful qualities is its IP66 rating (meaning it is dustproof and waterproof), so it can be used whenever and wherever, regardless of weather conditions. And its built-in "Good-to-Go" health self-check system can pinpoint and troubleshoot any system issues it may be having, so you can have confidence in its accuracy.

The unit provides depth estimation up to 10 meters (33 feet) below ground level. That's nice, because you can see not only where pipes and cables are located, but also how deep they are. This allows you to know that if you are not planning to dig as far down as the utility is, you are in the clear. It also allows you to know just how far down you need to go if you plan on unearthing the utility for any reason.

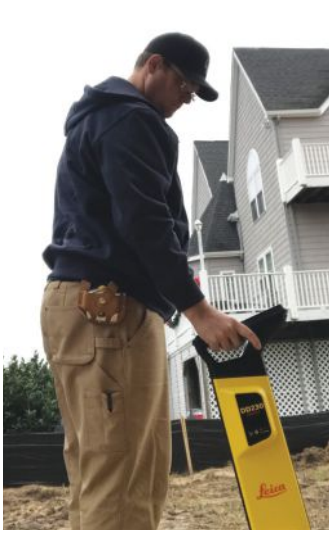
One of the things that surprised me was that the unit didn't come with any long-winded instruction manuals. This is because all of the instructions are on its large screen, giving it a real "plug-n-play" feel when you insert the battery and start using the equipment—which I loved.

Last, but definitely not least, I have to mention the unit's smart technology. This equipment has the ability to connect via Bluetooth to your phone or tablet, and with the GPS technology, you're able to essentially map out the location of the utilities on plans. I personally didn't have a need for this level of functionality but am impressed by this equipment's capabilities.

At around $2,300 (for the locator only; the kit shown at left with the DA230 signal transmitter and carrying case runs about $3,500), the DD230 is not inexpensive. But when you compare that cost to the peace of mind it offers when you are in a jam and need to locate a utility on a moment's notice, it is well worth every penny.

If you are doing site work on a regular basis for which you need to know what is underground and where, I highly recommend acquiring a Leica DD230 Smart Utility Locator. leica-geosystems.com

Jeff Kirby is a project manager with Graulich Builders in Lewes, Del.



The Leica DD230 Smart Utility Locator features a bright display that is easy to read, even in sunny conditions. The locator is sold alone or in a kit that includes a carrying bag and a DA230 1-watt signal transmitter, which improves underground utility detection.

Photos by Jeff Kirby

Easy-Leveling Extension Ladder

BY TIM UHLER

Because we don't typically deal with electrical hazards, we've always used aluminum extension ladders to access roofs or—when coupled with another ladder, a pair of ladder jacks, and a plank—to install siding. Aluminum ladders don't feel as sturdy to me as ladders made of fiberglass, but they're a lot lighter and easier to move around, especially on uneven ground. Sure, we can dig holes into the ground to level our ladders, but they still don't feel all that stable to me.

For the last year or so, we've been using Little Giant's Hyperlite SumoStance fiberglass extension ladder, which is lighter than similar fiberglass ladders and a little heavier than our aluminum ladders. It's a worthwhile trade-off: The Sumo flexes less and feels more stable. But I think the best feature is the legs. Not only can you adjust them individually for uneven ground, but you can also widen them to stabilize the ladder. Both features have worked well (though the legs stopped sliding on our first test ladder, and no one could figure out why. The second test model that the company sent to us has worked flawlessly).

In addition to the leveling and outrigger system, the Sumo has a side-to-side bubble level and a front-to-back angle indicator to help set the ladder up safely. The ladder feet can also be set to flat or spiked positions, depending on where it is being used. This non-conductive OSHA-compliant ladder is a big improvement over our old aluminum ladders, and we are very protective of it because we like it so much (other trades on our sites keep asking to borrow it).

We've been using the 28-foot Type 1AA (up to 375 pounds) version, but the SumoStance is also available as a Type 1A (up to 300 pounds) in lengths from 16 to 40 feet. The model we're using lists for about $700 directly from Little Giant. littlegiantladder.com

Tim Uhler is a lead carpenter for Pioneer Builders in Port Orchard, Wash., and a contributing editor to JLC.

The SumoStance fiberglass extension ladder features a high-visibility, bright-green color, a side-mounted dual-pulley lift system, outrigger-style legs that double the width of the base and are adjustable for uneven ground, and built-in side-to-side and front-to-back bubble levels to help set the ladder up safely.

Photos by Tim Uhler

BY TIM HEALEY

From Bra Cups to PPE

Sixty years ago, the first lightweight, disposable dust masks were developed by 3M. These early versions would lay the groundwork for the modern, single-use N95 respirators used today (prior to the N95, respirators resembled WWI gas masks; they were uncomfortable to wear and needed to be rinsed before being reused). While the benefits of lightweight, maintenance-free PPE are clear, the origin story of how they came about is less so.

Starting in the late 1930s, 3M began work on a new line of products known as "nonwovens" while searching for an inexpensive, noncorrosive backing for electrical tape. Nonwovens are composed of synthetic fibers bound together via heat and pressure without weaving. Following unsuccessful attempts to produce a quality tape backing, 3M pivoted to marketing nonwovens as decorative ribbons for gift wrapping in the mid-1940s. By the late 1950s, it had developed molded nonwoven technology to stiffen ribbons and bows, which opened the door to making other three-dimensional shapes.

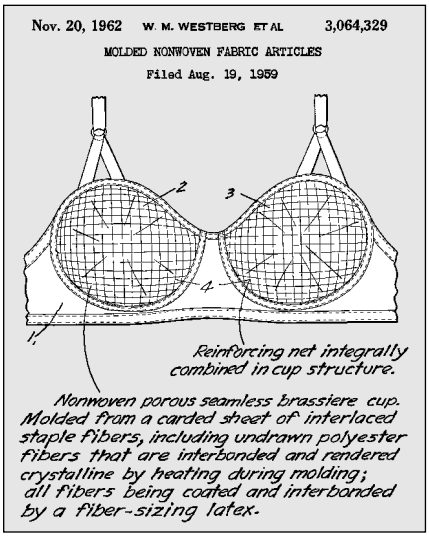
Competing epiphanies. The transition from molded nonwoven ribbon to respiratory PPE is a little fuzzier. One version of events involves Sara Little Turnbull, a well-known product designer and former décor editor for *House Beautiful* magazine. In 1958, Turnbull reportedly began consulting with 3M's gift-wrap division. Excited by the molded nonwoven technology, she recommended 3M pursue new applications for nonwovens, presenting more than 100 new product ideas, one of which was a molded brassiere.

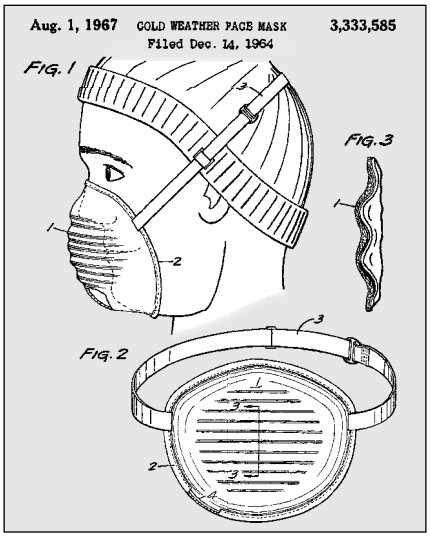
Turnbull's PPE epiphany apparently occurred while visiting sick family in a hospital. A keen observer, she noticed hospital staff fidgeting with their cloth face masks and got the idea for a new product based on the molded bra—a "bubble" surgical mask. The bubble mask was introduced in 1961, but it had to be re-branded as a "dust" mask because it couldn't block pathogens.

An alternative "aha" moment involved a 3M scientist, Pat Carey. According to *A Century of Innovation: The 3M Story* (3M, 2002), Carey noticed a display of Halloween masks as he walked through a local store and got a bright idea. Excited, he apparently rushed back to the lab and made a prototype out of nonwoven material and asked his co-workers to "try breathing through it." This quick demonstration led to applying nonwoven technology to the development of maintenance-free respirators and surgical masks.

Regardless of whose brainchild it was, the N95 respirator has become essential to the construction and health-care industries.

Tim Healey is a senior editor at JLC.





This 1962 3M patent (left) notes the brassiere as the principal product for "molded nonwoven fabric articles," as well as applications such as "porous breath-filtering face masks used by surgeons … and industrial workers." An early bra-like, PPE relative is the "cold weather face mask" shown here in a 1967 3M patent drawing (center). A modern N95 respirator (right).

Left and center: Images courtesy the US Patent Office. Right: Adobe Stock/Felipe Sanchez

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