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On the cover: Project managers for BOWA, a design/build remodeling firm serving the Washington, D.C.-metro area and Northern Virginia, use a variety of business tools to keep projects running on schedule. Photo by Clayton DeKorne. See the story on page 29.

FEATURES

- 29. Schedule Management for Project Managers**
Scheduling the work, and working the schedule
- 34. Exterior Wall Headers**
Sorting out the options for efficiency and performance
- 42. 2018 JLC Index**
Our annual listing of features and departments

DEPARTMENTS

- | | |
|--|---|
| <ul style="list-style-type: none"> 7. Training the Trades
Air-barrier basics 11. Q&A
Raising ceiling joists; cellophane strip on asphalt shingles 15. On the Job
Rebuilding a wind-damaged deck 19. Business
A big but often overlooked cost of building 23. Troubleshooting
A "never worry again" insulated ceiling | <ul style="list-style-type: none"> 47. Products
Fireclay sinks; glass rinser; energy-efficient boiler; composite siding; wood-moisture meter; kitchen hardware; more 51. Tools of the Trade
Beam saw; cordless impact driver; bit system; cordless jigsaw 54. Advertising Index 55. Trade Tips
Framing for the long haul 56. Backfill
Restoring the Mayflower |
|--|---|

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Air Barrier Basics

Many folks argue that **airtightness** is the most important aspect of energy efficiency. But I try to look at energy efficiency as a two-part equation: Convert the energy as inexpensively as you can, and then hold onto that energy for as long as you can. It's the latter part of that equation where airtightness plays a major role. Even if you maintain adequate thermal control through good insulation levels, a lack of a good, airtight control layer will either let in unconditioned outside air (infiltration) or let out conditioned inside air (exfiltration). Both of these conditions are detrimental to a home's performance and result in wasted energy dollars.

THE MOISTURE CONNECTION

The airtightness issue goes beyond how well a building's HVAC system performs. Uncontrolled air leakage can also provide a vehicle for unwanted moisture to enter a building assembly, which can become the reason for a building to fail, leading to costly building repairs.

In older homes with little or no insulation and no control over air movement, the energy lost through air exfiltration simply "baked" the home dry. The energy inefficiency of those older homes extended their lives, because most failures in air and moisture management simply used the energy being lost through the assembly to dry it out and to minimize damage.

Current energy conservation requirements in the energy code severely limit the amount of energy moving through the building assemblies that we are building today. This lack of energy movement coupled with airborne moisture can lead to a shortened lifespan of the assembly. In other words, our efforts to build better houses have removed the forgiveness factor that once existed in older assemblies.

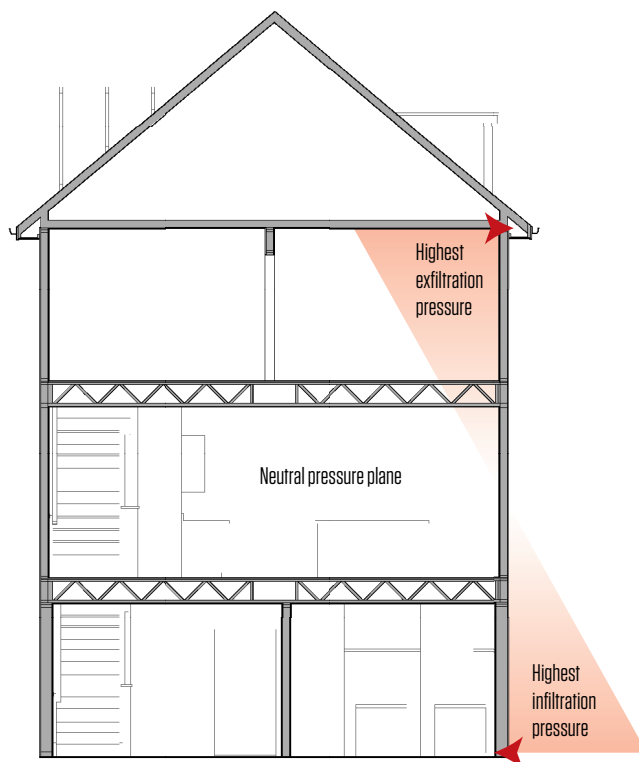
Recently, the building code has recognized airtightness as an integral part of energy conservation. Buildings now must pass airtightness tests using a blower door that pressurizes or depressurizes a building. The code requirement for airtightness is 3.0 ach (3.0 air

changes per hour) at 50Pa (50 pascals of constant pressure). This requirement is very modest compared with more stringent criteria such as the Passive House standard at .60 ach 50Pa. Understand, buildings cannot be "too tight," but rather they can be underventilated. I have designed numerous homes that meet or significantly exceed the Passive House standard. All of them are performing exceptionally well, and all of them are mechanically ventilated. A proper mechanical ventilation strategy is an absolute requirement for an effective air-barrier system.

THE STACK EFFECT

Before we discuss strategies for air-sealing a building, we need to talk about what that building typically experiences in terms of air

The Stack Effect



Layers of pressure. As warm air rises inside a typical home, the pressure changes from inward pressure (infiltration) at the bottom of the building to outward pressure (exfiltration) at the top, with a neutral pressure plane in the middle. Because the pressure increases with the distance from the neutral plane, the top and bottom of the building are the most critical for establishing an air barrier.

pressure. Most buildings undergo both infiltration and exfiltration (if not, they would implode or explode). Buildings constantly try to equalize their internal pressure: 1 cfm comes in to equal 1 cfm going out, or vice versa.

Pressure in a building is not arbitrary. On the contrary, it is pretty predictable (see The Stack Effect, page 7). Because warm air rises, the highest exfiltration area is at the top of the house or the upper limits of the air barrier. Consequently, the area of highest infiltration pressure is at the lower limits of the air barrier or the basement. The median of the two is known as the “neutral pressure plane.” The neutral pressure plane sees neither infiltration nor exfiltration, but rather it is the line where the pressure changes direction. Looking at this illustration, the farther you move from the neutral pressure plane, the greater the pressure, and the more critical it is to maintain an airtight barrier. Your air-barrier strategy should start at the points of highest pressure and move towards the neutral pressure plane. This strategy is applicable to both new construction and remodeling.

THE RED LINE TEST

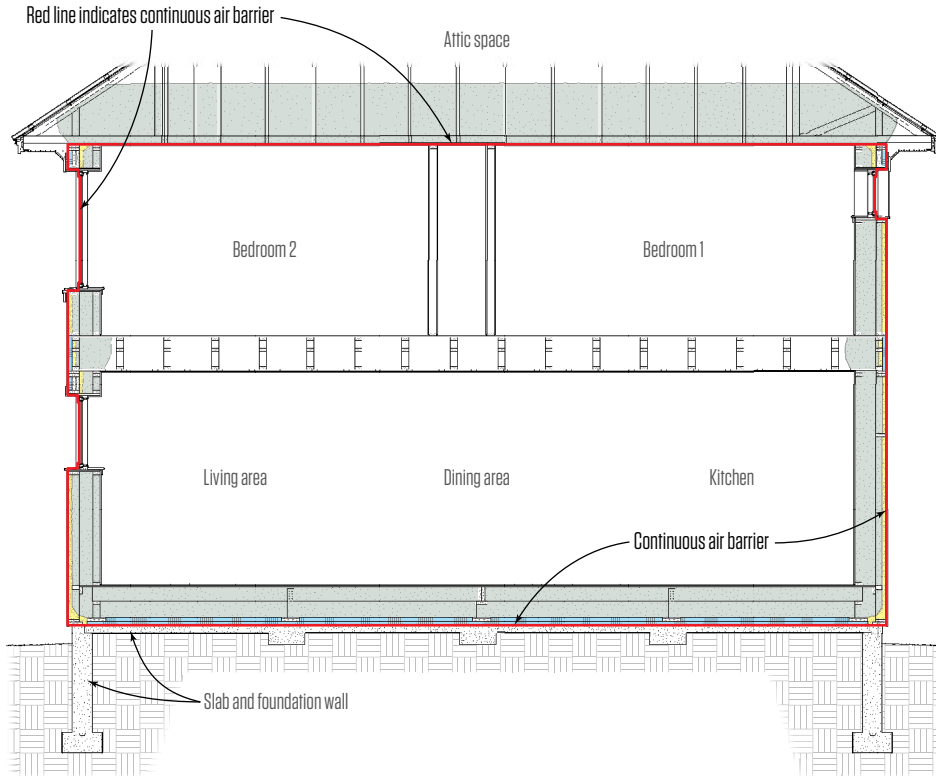
With a clear understanding of the challenges, it is time to develop an effective air-barrier strategy. I like to begin all discussions

of air-barrier strategies with the “Red Line Test,” which I first learned about from Joe Lstiburek of the Building Science Corporation (see Red Line Test, below). He explained it like this: “You should be able to take any section of a building on paper, put a red pen on the paper, and trace the building’s air barrier without lifting the pen. Eventually, the red line of the pen should connect to the starting point.”

The most important point that Lstiburek is making with his test is *continuity*. In other words, a successful air barrier must be continuous and unbroken around the entire perimeter of the building envelope. This crucial point bears repeating: The success of an effective air-barrier strategy is in its continuity. When I am asked what the best material is for an air barrier, my answer is always the same: “The one that is installed properly.” And with that answer, I reference Lstiburek’s Red Line Test.

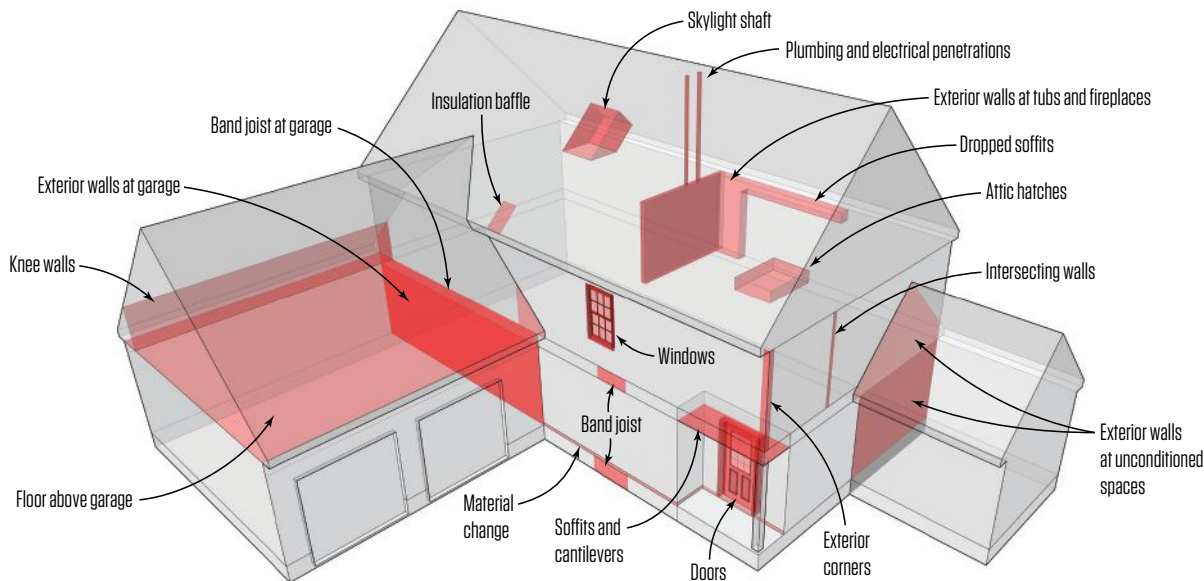
Specific air-barrier strategies seem to be the topic of endless debate. Should the air barrier be on the outside of the building? Should it be inside? Should it be in the middle of the wall assembly? The truth is that an air barrier can be effective in any of those areas. The two most important criteria for achieving a successful air barrier are that all the materials used in the air barrier must be installed properly, and that the air barrier must be continuous.

Red Line Test



Red Line Test. The key to a successful air barrier is continuity. On any section drawn through a building, it should be possible to follow the air barrier around the entire perimeter of the building envelope with a red pen without lifting the pen from the page. In this fairly complex building envelope, the air-barrier line passes from an insulated slab, through the walls and attic, and back down to the slab.

3D Thermal Bypass Checklist



Three-dimensional thermal bypass checklist. Many organizations have published lists of areas in a building that are likely to challenge the air barrier. Making a 3D rendering takes the checklist one step further, giving users a visual graphic to better understand and deal with these areas of concern.

It is incredibly rare that a building's air barrier is ever made from just one or two materials. While some materials may dominate the composition of the air-barrier system, there are always points where multiple materials are responsible for maintaining continuity. For example, exterior sheathing might be the primary air barrier in a home, but most homes also have doors and windows—areas where the exterior sheathing doesn't exist. The window or door then becomes part of the air barrier. With this change in material comes the critical connection of the exterior sheathing to each of the windows and doors. These areas where materials change are where the air-barrier continuity can be easily challenged. An effective air-barrier strategy is not just choosing material for each specific location, but also being able to trace the Red Line through those critical areas where the air barrier may comprise four or five different materials in just a few short inches. Again, the key to an effective air-barrier strategy is *continuity*.

THE THERMAL BYPASS CHECKLIST

There are many critical areas where the continuity of an air barrier is likely to be challenged, and many organizations such as

Energy Star have compiled extensive lists of those areas; Energy Star calls its list the "Thermal Bypass Checklist." But for most people, a graphic representation of a checklist like that is the best way to get the point across.

With that in mind, I developed my own three-dimensional version of the checklist to visually illustrate the points where an effective air barrier is most likely to be challenged (see 3D Thermal Bypass Checklist, above). Instead of depending on a written list, the areas of concern are highlighted in a 3D representation of the building. These areas are common to the work that all of us do every day.

But as common as these challenges seem to be, I often see that many of them are not being solved for in our industry. The failures I see most often are where the continuity of the air barrier is broken. The solution for creating a successful air barrier is being able to visualize and think through every inch of the barrier—especially in critical areas—to maintain continuity.

Steve Baczek (stevenbaczekarchitect.com), of Reading, Mass., is an architect specializing in energy-efficient design and certified passive homes. Follow him on Instagram @StevenBaczekArchitect.



For a more detailed discussion of air barriers, go to www.jlconline.com/training-the-trades/air-barrier-basics.



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Q A client wants to create a vaulted ceiling in an addition with a shallow, 4:12-pitch roof. The rafters are 16 inches o.c., with no structural ridge. Can I raise the ceiling joists to create the vaulted ceiling?

A Darren Tracy, PE, owner of West Branch Engineering, in Saratoga Springs, N.Y., responds: Yes, you can raise the ceiling joists, but with restrictions. Because you do not have a structural ridge, you must utilize rafter ties. Ceiling joists can serve as rafter ties to resist outward thrust on the walls from the rafter loads if they are installed parallel to the rafters and in accordance with code.

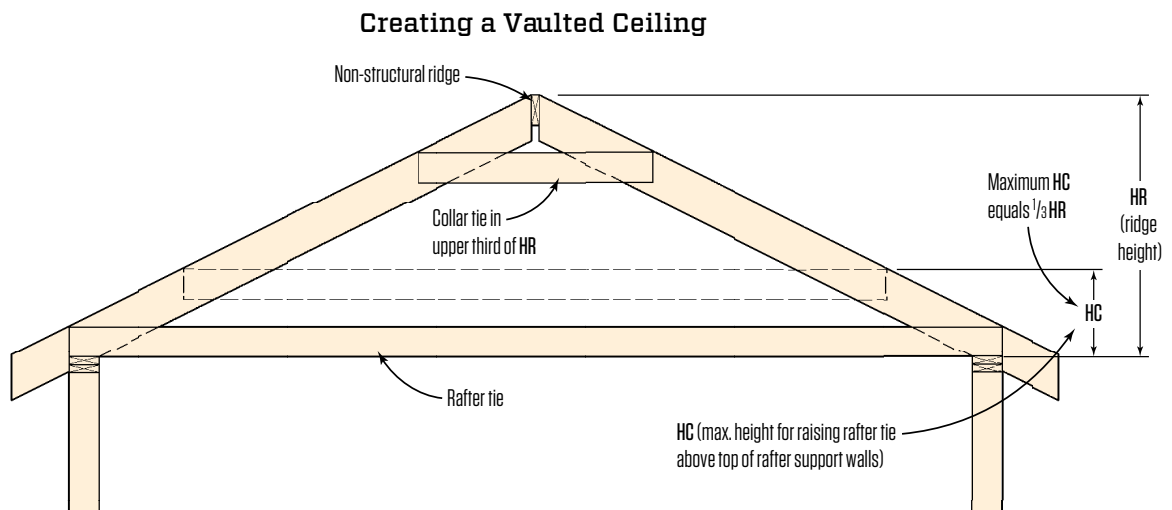
Figure R802.4.5 of the 2018 IRC states that a rafter tie can be raised a maximum distance of “HC” above the top of rafter support walls. HC is determined by a simple formula in which that height is a function of the ridge height (HR): The ratio of HC/HR cannot exceed $\frac{1}{3}$ (see illustration, below). For example, in a roof structure where the ridge height is 9 feet above the top

of the support walls, the maximum height that a rafter tie can be raised is 3 feet ($\frac{3}{9} = \frac{1}{3}$).

Additionally, be sure to adhere to the specific fastening requirements in the 2018 IRC Table R802.5.2 for the rafter-to-rafter-tie (ceiling joist) connections. That table provides the number of 16d nails at each connection based on rafter slope, rafter spacing, and snow load.

Section R802.5.2 also states, “Where the ceiling joists are installed above the bottom third of the rafter height, the ridge shall be installed as a beam.” In other words, to raise the ceiling joists more than one-third of the ridge height, a structural ridge would be required. With a properly engineered structural ridge, rafter ties can be eliminated completely. Also section R802.4.4 states that a roof with a pitch less than 3:12 requires a structural ridge.

As a final note, do not confuse rafter ties with collar ties. Collar ties, which are designed primarily to resist wind uplift, are required in the upper third of the attic space. Unlike ceiling joists, collar ties can be made of less-substantial material (1x4 minimum) and can be spaced up to 4 feet apart. Ridge straps can be used in lieu of collar ties to resist uplift.



In a roof with a non-structural ridge, rafter ties (which resist the outward thrust of the rafters) can be raised a maximum distance (HC) that is no more than one-third the distance between the top of the supporting wall plates and the top of the ridge (HR). Collar ties (designed primarily to resist wind uplift) must be located in the upper third of HR.

One of my fellow workers insists that the cellophane strips on the backs of asphalt shingles have to be removed before the shingles are installed. Another co-worker says that it's OK to leave them in place. Which one is right?

Reed Hitchcock, executive vice president of the Asphalt Roofing Manufacturers Association (ARMA), asphaltroofing.org, responds: Your question is a valid one, but something that ultimately should not be of any concern to roofing contractors or installers. Here is the story behind those cellophane strips.

As you know, asphalt shingles are shipped and stored in bundles. Each shingle is manufactured with an adhesive strip that allows it to adhere to its neighbor above when they are installed. The adhesive on the shingle is activated by heat—usually from sunlight beating down on the shingled roof.

But shingles can also be subject to heat during shipping and storage, especially in the hot summer months. And many supply houses store pallets of shingles where they are exposed to direct

sunlight. To prevent shingles from sticking to each other while still in the bundle, manufacturers add a small strip of cellophane on the back of each shingle. In the industry, this strip is often referred to as “release tape.” The cellophane release tape lines up with the adhesive strip on the shingle below it in the bundle to keep the shingles from sticking together.

Because the cellophane strips have no effect on the performance of asphalt shingles, it's fine to leave them in place as you install the shingles. In fact, the effort to remove them is unnecessary and just adds an extra step for the contractor. The only time that a cellophane strip should be removed is on the extremely rare occasion that it sticks to the adhesive layer of an adjacent shingle instead of remaining stuck to the back of the shingle being taken from the bundle.

For those contractors who still insist on removing the cellophane strips as the shingles are installed, rest assured that doing so has no adverse effect on the installation or performance of the shingles. But something to consider is that once removed, those lightweight plastic strips tend to fly around. Chasing down and disposing of all those wayward strips can create even more work for the contractor.

So our recommendation is to just ignore the strips. Once a shingle is taken from the bundle to be installed, the cellophane strip has served its purpose.



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The original red-cedar deck sustained damage when a tree fell on it during a windstorm (1, 2), but it was due for replacement anyway, thanks to sketchy ledger connection details and extensive rot. The columns and W10 steel girder supporting the deck were the only components that were reused. To stabilize the steel girder, the crew braced it with a 2-by and a cable tensioned by a come-along (3).

Rebuilding a Wind-Damaged Deck

BY ROB CORBO

In March 2018, four nor'easters blew through my home state of New Jersey. A client we occasionally hear from called and asked us to look at her deck, which had been hit by a large oak tree uprooted during one of those storms (1). It turned out that the damage resulting from the uprooted tree—which took out two sections of rail and damaged five joists (2)—was the least of the deck's problems; the rest of the deck was rotten to the core. Our client was lucky the tree hit the deck and revealed its other problems before someone was seriously hurt.

When I assessed the damage for my client's insurance company, I focused on the structural integrity of the deck as well as on the damaged area, since I didn't want to be involved in a repair that might make us liable for the entire deck going forward. I thought it likely that the fallen tree had pushed the deck out of square, and that the deck returned to its original position only after the tree had been removed. Because I suspected that this may have compromised the joist-nail connections at the house ledger, in my proposal I provided an estimate for removing the existing deck and building a new one.

DEMOLITION

Fortunately, our clients received their insurer's OK for the full scope of work and gave us the go-ahead to get started. In New Jersey, permit application requirements vary from town to town, and even though we were not changing the deck's footprint, the town required a copy of the survey showing the original deck's location and an architect's plan detailing deck construction. Two items we inherited from the existing deck were incorporated into the new plan: a 24-foot-long W10 cantilevered steel girder that supported the old deck framing, and an electrical service head attached to the southwest corner of the deck (3).

Because we weren't sure how significant the load was where the cable came in contact with the deck, we supported the service head with a makeshift tripod, then attached it to the steel girder with a C-clamp and heavy-duty rope. Then we attached a cable and turnbuckle between the house and the girder (before attaching the service head), using an eyebolt through the foundation and another C-clamp on the beam. After that, demolition was a piece of cake.



Cutting away the stucco (4) revealed considerable damage to the sheathing and cripple studs underneath the sliding door leading out onto the deck (5, 6). A solid PT header was installed underneath the slider to replace the cripples (7). After resheathing, the crew flashed the assembly with Vycor (8) and installed a new ledger (9).

INSTALLING THE LEDGER

When project manager Danny DoCouto examined where the old ledger had been attached to the house, he determined that there was no rim joist to which we could bolt a new ledger. It also appeared that behind the house's traditional three-coat stucco siding, a number of areas had rotted where the old deck ledger had been fastened. We had no choice but to remove the stucco siding down to the framing where the new ledger would be attached (4).

To remove the stucco and the wire mesh, we cut through them with a grinder and chipping hammer, uncovering a balloon-framed system clad with rotted sheathing (5). Most of the cripples underneath the sliding door that provided access to the deck were rotted as well (6).

We pulled off the rotted sheathing and removed the cripples, but rather than replacing them, Danny used treated 2x10s to build up a solid header under the sliders (7). Where the framing was exposed, we pulled out the old fiberglass insulation and filled the bays with Rockwool Roxul stone-wool insulation to provide a fire

stop and some protection from air infiltration. Then we installed new 1/2-inch sheathing to complete the rebuild, giving us a sound substrate for the new ledger (8).

After marking the stud locations on the stucco siding, we covered the sheathing with two strips of 12-inch-wide Vycor SAF flashing. We installed the lower strip first, taking care to lap it over the stucco at the bottom. When we installed the upper strip, we tucked the flashing in as best we could underneath the membrane behind the stucco at the top and made sure it lapped over the bottom strip. Then we bolted the ledger into place directly into the studs and the header underneath the sliders (9, 10).

OUT-OF-LEVEL GIRDER

Next, we tackled the 24-foot-long W10 girder, which was cantilevered 8 feet on the driveway side so no obstruction interfered with the access to the three-car garage. We were concerned that it had been compromised, since its cantilevered side had been hit when the oak tree came down on the deck. An engineer who



The new ledger was lag-bolted to the house framing (10), while the old girder was primed, painted, and capped with a flashing membrane and a treated 2x6 plate (11). A string line established a reference elevation for the out-of-level girder, and notches (12) or shims (13) were used as needed to bring the joists flush with the string (14). Here, the deck is almost completed (15).

the homeowner had consulted on the project approved it for construction and provided documentation to include in our permit application stating that the existing girder could safely support the proposed loads.

Still, when we checked elevations on the girder and house with a laser level, we discovered that the girder was $2\frac{3}{4}$ inches out of level. Whether the impact of the tree had bent the beam or fatigue was a factor (or both), others who were higher up the food chain had approved the girder for construction. So rather than continuing to speculate, we concentrated on a solution for installing joists on the out-of-level girder.

After scraping and priming the girder, we applied Vycor flashing tape to the top of the beam and bolted a PT 2x6 plate in place (11). We placed the first joist on the high side of the girder, where the joist was dead level. Because we wanted to pitch the framing slightly from the ledger to the outside edge of the deck, we notched the 2x6 plate with a circular saw and chisel so that the joist was recessed into the plate by $\frac{1}{2}$ inch (12).

Next, we installed a second joist 16 feet away from the first, where the girder started its cantilever. This joist required a 1-inch-thick shim instead of a notch to maintain the same pitch. We then pulled a line between the two joists, so that we could set the remaining joists with the line dictating how much shimming or notching would be required to bring each joist up to level (13).

To match the string height, we ended up recessing the first four joists, while the next two were installed flush with the plate. We had to shim the next six joists. Finally, before installing the last joists on the cantilevered portion of the girder, we screwed a $\frac{5}{4}$ -by-6-inch treated board to the 2x6 girder plate to reduce the size of the shim needed under each joist. Then we shimmed the final joists to their proper height, using a 6-foot level for reference (14).

Once we'd taken care of the problems with the ledger and the beam, the rest of the deck installation went smoothly (15).

Rob Corbo is a building contractor based in Elizabeth, N.J., specializing in high-quality gut rehabs and renovations of inner-city residences.

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A Big But Often Overlooked Cost of Building

David Gerstel has been a licensed builder for four decades and is the author of the construction industry classic, *Running a Successful Construction Company*. The following article is adapted from his new book, *Nail Your Numbers: A Path to Skilled Construction Estimating and Bidding*.

Right at the beginning of my new book, I offer this encouragement: “You *can* nail your numbers.” I want to emphasize to readers that bidding and estimating can be mastered, though it is not easy to do so. (Of course, it’s not. Is there any construction industry skill that’s easy to master?)

In fact, you can master estimating to the point that your projected numbers for the direct (on-site) costs for building your projects will vary, on average, from the actual costs by a mere one or two percent. That is, on any given project, you may run off somewhat one way or the other. But over a series of projects, the slippages will balance out.

The “trick”—or the skill, actually—to nailing your numbers comes down to abiding by four fundamental rules of estimating:

1. Don’t miss any work called for or implied in the plans and specs.
2. Don’t miss any component of labor costs, from wages all the way through minor insurance burdens.
3. Don’t miss any of the costs for materials to be used by your crew all the way through consumables, like dry line and pencils, and delivery charges.
4. Make sure that none of the work you are subbing out falls between trade partners and is, thereby, left out of your estimate.

A category of items that are especially easy to miss, but that must not be neglected, is best described as “General Requirements.” GRs are a big cost on virtually every project, yet they are often underestimated or outright overlooked because they are merely implied in the plans and not explicitly called out. Even detailed specifications may barely mention them. For example, daily cleanup is a significant GR. Likewise, a portable toilet, temporary power, and erosion control devices are often required but are called out only in comprehensive specs.

It is critical to spot such items during estimating. If they are missed, an estimate can wander way off target—towards the low side. For that reason, *Nail Your Numbers* includes an entire chapter on the subject.

When I first sketched out my book, I had no intention of giving

GRs such detailed attention. I thought that they would be obvious to every builder who took the business side of his work seriously enough to spend money on my book, and that I’d be wasting readers’ time if I made more than passing mention of them. I was wrong.

When I first sketched out my book, I had no intention of giving General Requirements an entire chapter of their own. I thought that they’d be obvious to every builder who took the business side of his work seriously enough to spend money on *Nail Your Numbers*. I was wrong.

The need for a detailed discussion of GRs started to dawn on me as I was doing the research for *Nail Your Numbers*. I was interviewing a builder I will call “Ed,” sitting beneath the 200-year-old ridge beam of the cabin that he repurposed as the kitchen space for his beautifully crafted home. I had asked him how he handled General Requirements in his estimates.

Ed considered the question and said, “I don’t think I know what you mean by General Requirements.”

I was startled. Ed had worked in the world of construction for over 30 years and not become acquainted with GRs! I scratched up a quick answer. “Well, items like jobsite cleanup at the end of every day.”

“I think of that sort of thing as marketing,” Ed replied. And he did not mean that he recaptured his costs for cleanup as marketing within his markup for overhead. What he meant was that he did the work for free. He did it in order to build client satisfaction; and he considered that satisfaction pay enough.

I did understand his reasoning up to a point. A well-kept jobsite does create client satisfaction. But, I also thought to myself, clients likewise appreciate tight framing, a superb level-five drywall finish, and crisply mitered trim. Extending Ed’s logic, we could give away some of that, too, and call the giveaways part of our marketing



Are you having trouble capturing all the General Requirements in your estimates? Here's a way to sharpen your awareness of them. When you notice someone else's job, pull over and scan the site. See how many GRs you can spot. Meanwhile, try scanning the site shown above for General Requirement items. I see five, listed below.

They are: Portable Toilet, Scaffolding, Recycling, Temporary Power, Gate. And there are arguably two or three more that are at least implied.

program. Why stop at providing free General Requirements?

Overlooking General Requirements is a serious matter. As we will discuss below, they can run to a very substantial percentage of the cost of a project, amounting to even more than profit mark-ups. Yet it turns out Ed is far from being the only builder who is unaware of them. Wayne Del Pico, a construction consultant and author with experience in commercial, retail, and public as well as residential construction reports that builders regularly ignore GRs. "General Requirements such as scaffolding," he reports, "are assumed to have no cost" because they are seen as not directly related to production. Scaffolding? No cost? Not related to production? Good grief, really!

DEFINITION OF GENERAL REQUIREMENTS

So, just what are these General Requirements that regularly escape attention during estimating? Some builders think of them as "project overhead," or "indirect overhead" as opposed to direct

overhead costs, namely expenses such as those for office computers that are incurred off the jobsite. I prefer to stay away from those terms. There's enough confusion and controversy around "overhead." Why further muddy the waters by using the word to describe very different costs? GRs are jobsite costs, not costs incurred away from the jobsite, as "overhead" implies.

Here's my definition of General Requirements: All those items of work at a construction site necessary to build a project, but that do not become a permanent and visible part of the project. Thus, subflooring is not a General Requirement item. But hauling the cutoffs to the dump, along with other waste, is. The labor and material for setting new plants as part of landscaping a project is not a GR. The labor and material for protecting existing plants are General Requirement items. As for Ed's daily cleanup? That is definitely a GR item, and it is a costly one for builders who do a good job of it.

Of course, like any idea, my definition has a limited range of convenience; you can apply it only so far before you run into counterproductive distinctions. For example, material for subflooring is definitely not a General Requirement cost. But the delivery charge for bringing the material to your jobsite could be considered a General Requirement cost. After all, it does not show up in the completed building. But for purposes of estimating (or for job costing), it's not worthwhile to separate out the delivery cost and stick it in GRs. Because you will likely pay for it with same check you issue to pay for the material, it's more convenient to account for it together with the material cost.

You could say something similar for special inspections, such as those for on-site welding. If we wanted to categorize everything strictly according to the definition, we'd put the inspections in our GR division. After all, the inspections are not a visible, per-

Here's my definition of General Requirements: *All those items of work at a construction site necessary to build a project, but that do not become a permanent and visible part of the project. Thus, subflooring is not a General Requirement cost, but hauling the cutoffs to the dump is.*

manent part of the project when it is completed. But suppose that your estimating spreadsheet is organized in the natural order of construction, from site prep through finish coatings. In that case, you may find it more convenient, more natural, to provide a line for special inspections right along with the structural work for which they will be necessary. You can go either way so long as you provide for special inspections somewhere when you are building an estimate.

That said, there are a great many items of work that are unambiguously GRs. They belong in the General Requirements division of your estimate and, at least as I see things, nowhere else. They can be divided up in various ways. Some estimators prefer to categorize them as either “field” or “management” requirements. My own preference is indicated in the “Selected General Requirements” list, below, where I have listed the categories I favor and provided a few examples of each.

The examples shown here are only a small sampling of all the possible GRs that can occur in a project. The extensive list in my book includes more than a hundred items. And even that list is not exhaustive. Some of the items might strike you as obscure, and you may not have encountered them in your work. Others, however, like steel scaffolding, are frequently experienced GRs that can readily impose major cost. Whether they’re obscure or prominent,

SELECTED GENERAL REQUIREMENTS

PRECONSTRUCTION

- Plan check by building department
- Street use permit
- Local business license
- School district fee

DURING CONSTRUCTION

- Material protection and security
- Hole covers
- Scaffolding
- Waste removal
- Temporary power
- Lighting
- Dewatering

PROJECT LEAD TASKS

- Ordering material
- Submitting RFIs
- Adjusting trade-partner schedules
- Scheduling inspections
- Keeping of time cards

POST CONSTRUCTION

- Final roll-up
- Building performance audits
- Occupancy permit

you should have a comprehensive selection of GRs listed in your master spreadsheet/checklist. That’s the only way that I know of to make sure that when it comes to GRs, you abide by that overarching rule of estimating: Don’t miss anything. Providing lines for all your possible GRs will prompt you to check for and spot those costs that are not visible in the plans and specs.

CONSEQUENCES OF NEGLECT

The financial consequences of neglecting General Requirements can be severe. Even small, niggling items like scheduling (and rescheduling) trade partners and maintaining a photo record of work progress can add up to significant dollars. Costs for big items like scaffolding, daily setup and breakdown, and portable toilets can range from large to huge.

You miss this stuff at your peril. Providing for GRs with just a single line, as did one estimating program I reviewed, or even a few lines, is seriously negligent. That’s a path to going bust because the cost of your GRs can easily exceed the average profits you will be able to capture across good economic times mixed with bad. And going without profit, as I have stressed in *Nail Your Numbers*, is hazardous in the extreme. Profit is not gravy. It is a buffer against a range of unpredictable costs from building failures to litigation that all construction companies experience to some degree.

So what portion of total direct costs do General Requirements typically amount to? That depends on the type of work. Builders I have interviewed who do custom work ranging from kitchen remodels to new homes report that GRs comprise 8% to 10% of their direct costs on average. That is in line with my own experience. However, some cost catalogs that report data collected from a wider variety of builders across the country suggest a broader range of numbers. They show GRs running as low as 4.5% for production builders and as high as 20% for repair jobs and even some remodel projects.

So how much for your projects? As always with estimating, it’s best to find out for yourself. Make sure you are seeing all the items of work for your projects that are invisible in the plans and specs. Make sure you provide lines for them in your estimating spreadsheet or checklist. From there, move to charging for them appropriately, either by gathering complete trade-partner quotes or by accurately figuring labor and material costs by using tools such as the labor productivity records discussed in a previous *JLC* article (see “Nail Your Labor Productivity Numbers,” Sep/18).

Finally, if you have been thorough, then believe in your estimates. Avoid second guessing your numbers for fear of not landing a project. All that counts is not missing anything and standing by your accurately figured numbers. It matters not at all what someone else says your numbers should be.

David Gerstel's new book, Nail Your Numbers: A Path to Skilled Construction Estimating and Bidding, is available from local and online book-sellers. To learn more about Nail Your Numbers, go to DavidGerstel.com or Amazon.

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A “Never Worry Again” Insulated Ceiling

BY JEREMY KASSEL

Last winter, I was contacted by a repeat customer who was concerned about water staining on the drywall of the cathedral ceiling in his master bedroom. Over the phone, the customer mentioned having already repaired the water-stained drywall, only after he had a roofing contractor inspect the roof to confirm that it had a clean bill of health. I had an intuition that the “roof leak” and the second-round of drywall damage was caused by something else.

PROBLEM

When I arrived at the home, I took one look at the ceiling and knew that we weren’t dealing with a roof leak—we were dealing with an air leak. The location of the water staining was just “downhill” of recessed lights, which can be a common source of heat and air loss when installed in a cathedral ceiling.

This section of the house, which is located in Climate Zone 5, was renovated two years before my customer purchased the home in 2010. The master-bedroom roof was raised, and from an adjacent vantage point in the attic, I could see that the roof was framed with 2x10 dimensional lumber rather than scissor trusses. The recessed light housings took up about 7½ inches of real estate in a 9¼-inch rafter cavity, leaving little space for both insulation and ventilation above the housings.

After we began demolition, my worst fears were confirmed. The previous contractor had used no insulation over the tops of the cans, and sloppy fiberglass installation on the sides of the housings, or even none at all. Inadequate insulation around and above the light housings resulted in an appreciable amount of air movement and heat loss. In winter months, this combination of air movement and heat loss resulted in air-transported moisture condensing on the underside of the roof sheathing. At times, there was enough condensation to drip from the

Water stains on the drywall of this cathedral ceiling look like they might have been caused by a roof leak (1). But given the location of the water stains, the author knew this was not a leak, but rather condensation due to poor insulation and air leaks around the recessed light fixtures (2).

Photos by Jeremy Kassel



After demolishing the existing ceiling to expose the framing (3), the author reinforced the rafter-to-ridge connection with new joist hangers (4). The owner wanted to replace the high cathedral ceiling with a conventional flat ceiling (5).

underside of the roof, collect on the top of the drywall, and make its way into the living space through the path of least resistance.

To add insult to injury, two years after purchasing the home, my customer added a whole-house humidifier to the existing HVAC system. I can only imagine that the added moisture in the air exacerbated the problem.

SOLUTION

The homeowner expressed a desire to completely eliminate the cathedral ceiling. While removing the cathedral ceiling would mean losing a dramatic feel to the master bedroom, the customer was vocal in his willingness to gain a more intimate space that would be more economical to heat and cool. It would also be easier to paint a lower ceiling and change the lightbulbs. My approach to solving the problem was made much easier by the fact that the homeowner was looking for a “never worry again” solution to the condensation problem.

Here are the key elements to the new ceiling as well as the reasons I chose them:

- A new, flat, level ceiling 8 feet off the finished floor. This was more economical to heat and cool and easier for future homeowner maintenance than the previous cathedral ceiling.
- R-38 unfaced fiberglass batt insulation. This formed an economical and practical thermal barrier
- 1-inch foil-faced rigid foam insulation. After being taped at the joints, this layer of insulation became an air and vapor barrier and mitigated any thermal bridging.
- Recessed light-housing boxes. Rigid foam boxes around the recessed lights ensured a continuous layer of thermal protection and made it easier to air-seal around recessed lights.

- Spray foam sealant. I find this to be the best way to air-seal around penetrations and irregularities and in tough-to-insulate areas.

IMPLEMENTATION

Here is my “never worry again” approach to solving the condensation problem, as well as to fulfilling the desire for the homeowner to have a more practical living space.

Step 1. All of the existing drywall, fiberglass insulation, and foam insulation baffles were removed from the sloped and flat portions of the ceiling. Upon taking down the drywall ceiling, I confirmed my hypothesis: Sloppy installation of fiberglass (or none at all) was found adjacent to and on top of all the recessed lights.

Step 2. We removed the existing recessed lights and reconfigured the wiring for the new ceiling.

Step 3. Before enclosing the attic, we inspected the soffits and roof ridge to make sure there were clear pathways for venting the attic area over the new ceiling.

Step 4. The ridge cuts on the existing rafters had been improperly cut, and were shimmed out with 5/8-inch OSB blocking. While I had the ceiling open, I installed joist hangers on the ridge to ensure a more secure rafter connection. A quick notching on the underside of each rafter cut allowed me to properly seat the joist hangers.

Step 5. We set up a laser level to attach a new ceiling ledger board. Then we simply infilled with 2x8 ceiling joists to frame a flat, level ceiling 8 feet off the finished floor.

Step 6. After framing, we installed our electrical wiring drops for our four recessed lights, as well as for the ceiling fan.

Step 7. Recessed lights are notorious for heat loss and air loss. To overcome these problems, we built “boxes” out of 1-inch-thick rigid insulation. These boxes were taped and air-sealed on the



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To make it easier to air-seal and insulate the new ceiling, the author assembled light-housing boxes made from foil-faced rigid foam (6). They were tightly taped at all corners and to the continuous layer of rigid foam fastened to the ceiling joists (7). After strapping the ceiling in preparation for drywall, the author sealed all penetrations—including the electrical box for a ceiling fan—with canned foam sealant (8). The new worry-free ceiling is shown at right after the first coat of mud (9).

bench before we installed them in the ceiling.

Step 8. We installed the light-housing boxes in the locations of our lighting, drilling $\frac{3}{4}$ -inch holes in the center of the top of the boxes to send in our wire drops.

Step 9. We installed unfaced R-38 fiberglass insulation batts in every joist bay, as well as over the light-housing boxes.

Step 10. The entire ceiling assembly was covered with 1-inch rigid insulation. We taped all of the joints including the joint around the light-housing boxes. The insulation value of the assembly is approximately R-44.

Step 11. Using foam sealant, we sealed the perimeter of the rigid insulation layer where there were gaps against the existing drywall. We also sealed wire penetrations in the light-housing boxes, as well as around the box for the ceiling fan.

Step 12. We installed $\frac{5}{8}$ x4 (nominal) furring strips as a nail base for our drywall ceiling and support for our recessed lights, using

3-inch deck screws to fasten them through the rigid insulation to the joists. All of the new ceiling joists were marked on the walls, so we could snap chalk lines on the rigid insulation and ensure our screws were absolutely hitting our new framing.

Step 13. We took drywall delivery into the master bedroom from a boom truck. This allowed us to accept 14-foot sheets, so we wouldn't have any butt-joints in the ceiling. We then hung $\frac{1}{2}$ -inch drywall on the furring strips. The thicker furring strip gave a nice, positive screw base for our ceiling, which we taped, finished and primed as usual.

Step 14. After painting the ceiling, we installed the trim kits for the recessed lights as well as the new ceiling fan.

Jeremy Kassel is the owner/operator of Kassel Construction, in Glenmont, N.Y., as well as the co-host of the House Calls Podcast. He can be found on Instagram @kasselconstruction.

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FIELD GUIDE

BUSINESS



Schedule Management for Project Managers Scheduling the work, and working the schedule

BY DOUG HORGAN

Keeping projects on schedule is one of the core responsibilities of a project manager, or “project lead,” in a building and remodeling company. At the company where I work, we have 15 to 20 jobs running at any given time, each with its own project manager tasked with arranging the work. Knowing how to create and work a schedule is an essential skill for those individuals.

Finishing a job on time is one of our core promises to our clients. If we fail, they have a right to be mad. But when the schedule slips, it's not just about feelings: The company loses money. The way we build our project budgets is based on how long we think it's going to take to complete a project. Losing a day here and a day there because of schedule slippage can add up. If you add seven days of lost time to a 65-day schedule, for example, you've gone 10% over budget on supervisor and site labor.

We try to prevent all that by skillfully managing the schedule.

In this story, I'll look at some of the scheduling tools we use to create and visualize the job schedule. I'll discuss some of the factors that can interfere with the schedule and hinder the timely accomplishment of projects. And I'll look at some of the practices we've instituted to help overcome those obstacles and complete our jobs in a timely fashion, as promised.

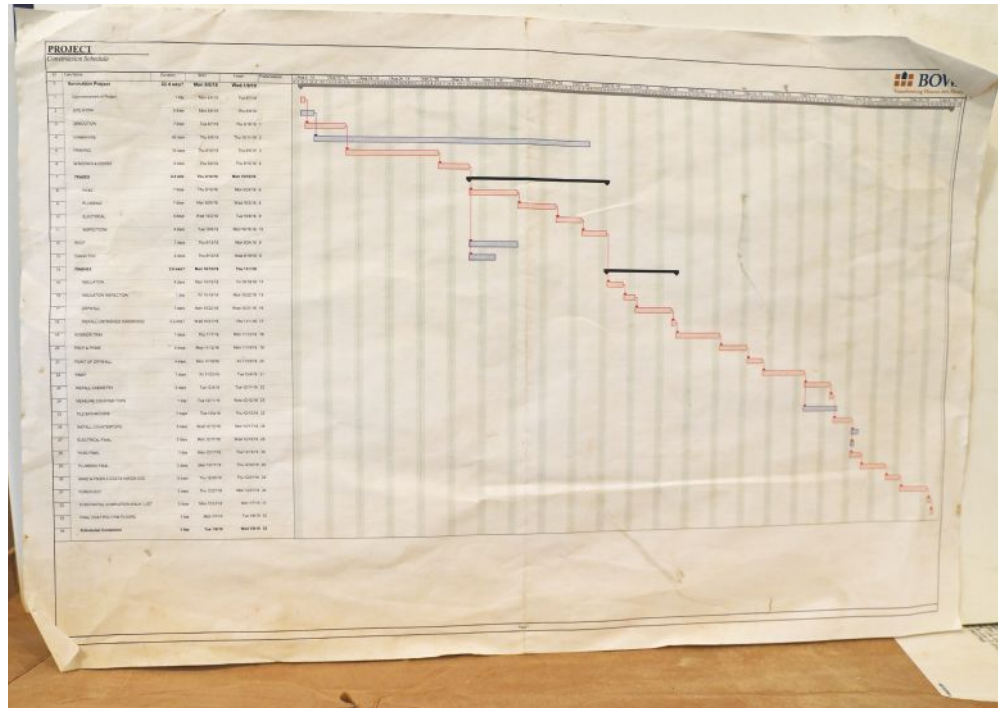
In our company, our project managers work with “production managers” who manage a team of PMs, carpenters, and laborers. Production managers also help with the design and budgeting process.

It's the production manager's role to create a master schedule for each job. We use Gantt charts, which we usually create using Microsoft Project (though for simpler projects, other methods are fine).

GANTT CHARTS AND THE CRITICAL PATH

Gantt charts show the phases of a project as they progress through time, and they illustrate which ones need to finish before another

This Gantt chart from a long-running gut-rehab and structural remodel shows the wear and tear of daily use on the job. Down the left-hand column are listed job phases and tasks. In the field to the right are bars indicating the time each step will require. Start and stop times for job steps are staggered to indicate the order in which tasks have to be performed.



starts, so they make a great visual guide to the whole project. For typical construction projects, calendar days are set out left to right. Construction activities are written in order down the left edge. The days we plan to do each activity are shown as a line or block on the calendar days, so a long activity will have a long bar, and a short one a smaller bar. When one activity has to finish before the other starts, they don't overlap, so the "Foundation" bar ends before the "Framing" bar starts. The result is a set of lines generally running from top left (first activities at the beginning of the project) to the bottom right (punch-out at the end).

Normally, our activities are defined by the work that a crew or trade will do at one point, such as "plumbing rough-in," "tile kitchen floor," "main roof shingles," and so on. The plumbers will be on a schedule more than once: "Ground works" is its own line because it happens separately from rough-in and final trim, which each get their own lines as well.

The "critical path" is the chain of all the activities that have to finish before each other to get the whole project done, and these tasks are the ones that need the most attention as we work the project. Of course, everything needs to be done by the end, but there are often a few activities that can happen in a wide window of time, because other tasks don't depend on them; these are not on the critical path for the project.

We use Microsoft Project for our Gantt charts, but it's overpowered for what we do with it. We sometimes use hand-drawn paper versions or use X'd out cells in a spreadsheet to make a simpler version, which is perfectly adequate for many jobs.

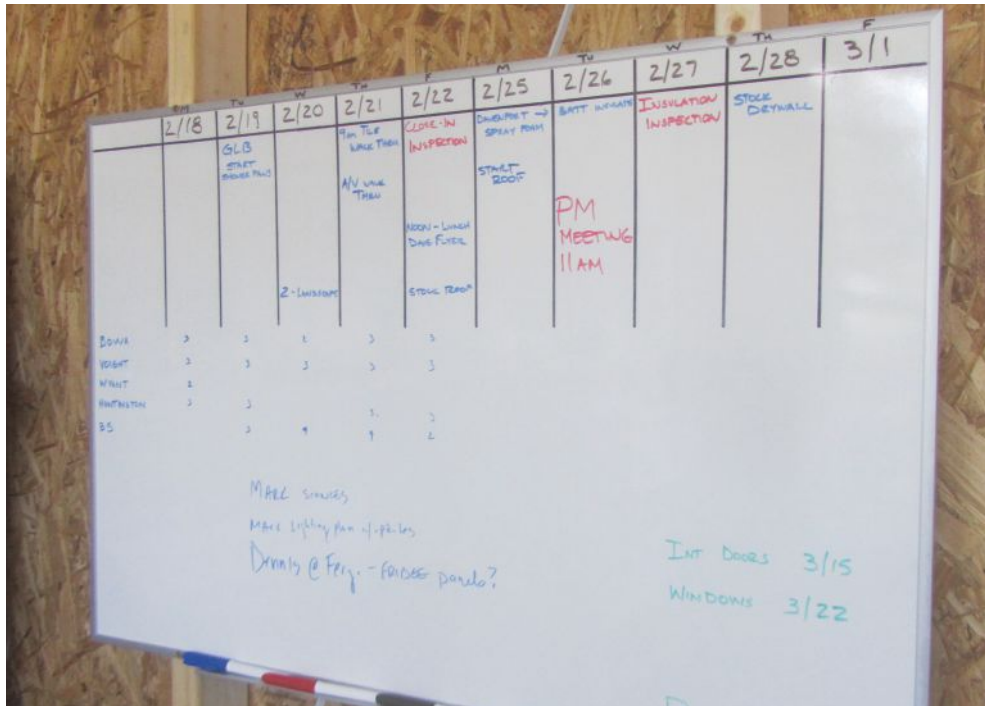
CREATING THE SCHEDULE

Many remodeling jobs are basically similar, and most custom home projects have a lot in common too. So when we are partway through designing a project and creating a budget for it, the production manager will pull out a similar project, take the Gantt chart from that project, and tweak it here and there to make it line up with what they expect will happen on this one.

It's the project manager's job to implement the schedule and make the promises into reality. Ideally, when the schedule's being created, the PM also has a chance to chime in about whether it's practical. They may say, "The waterproofing sub and the electrical heavy up can't overlap here," or "This isn't enough time for the framer." This doesn't always work out, because we can't always identify the lead for each project far enough ahead of time. In the end, we hope to have at least three people looking at the schedule, even if a different manager ends up running the job.

We also consult with the key subcontractors to make sure that they can accomplish their phases of the work in the time that we're allotting. On smaller jobs, this is less significant; we don't need a long conversation to know how long it takes a plumber to rough in a 6x10 bathroom, or a drywaller to hang and tape two rooms. But we've had custom house foundations that took eight weeks to build. We sub out a lot of our carpentry too, and some of our larger jobs are 10,000- or 20,000-square-foot houses. On projects like that, it's essential to have a detailed discussion with the sub who is going to be taking up a huge block of your schedule.

Staffing can also be a factor. For example, if you know that it's



This “look-ahead” chart is updated weekly by the project lead as a short-term planning and execution road map. The project manager and the production manager will meet routinely to update this chart and discuss the appropriate phone calls, materials ordering, or other steps needed to enable work to proceed as planned.

unusual for a plumbing sub to bring two crews to the site, but you plan on having them run floor heat at the same time they rough in the domestic water, you should clarify that in advance. In those cases, we may even include an understanding about staffing levels in the subcontract for that phase of the job.

As we build the schedule, we seek clarity about what the experts call “dependencies.” I think of a dependency as something that can’t start until something else is completed. We can’t fabricate countertops until cabinets are installed, shower glass can’t be measured until the tile is complete, and so on. We can’t schedule these out of order; we need to identify those constraints and stretch the schedule according to the dependencies.

But this brings up the concept of “float”—which, in practice, is when people say that the work will take longer than they actually think it will, because they don’t want to make promises they can’t keep. If the plumber thinks it’s a two-and-a-half-day job, they might say it will take three or four days to be on the safe side. Well, if you’re checking in with all the trades and they all take that same approach, you could add a dozen or more days of float over the course of the project.

A conversation that you can have with people ahead of time is, “OK, I understand that you won’t promise to be done before three days, but how long do you really think it’s likely to take? How about if I pencil in the next trade for when you think you’ll really be done, and if you need more time I can push them back half a day?”

On some of the bigger jobs, you can build in an explicit promise to everyone that you’ve included a few days of slack time in the to-

tal job—but you’re not going to give everyone a few extra days each. We’ll all do the best we can, and then at the key milestones of the job, we’ll have a couple of days to make up for any of us having issues.

The key milestones where we find we really do need to allow these extra days include foundations—because those are built in the mud, and if it rains, you can’t do them. And then the other places we always build in a little slack are at close-in inspection (when the mechanicals have to be completely roughed in before they’re inspected and the drywall crew covers everything up) and, of course, at the end of the job.

SCHEDULE TOOLS

The Gantt chart lets everybody look at the whole sweep of the job from beginning to end. But it’s not the only tool needed to make that schedule a reality and not just a wish.

At least once a week, the production manager visits each job and meets with the project manager for an update. To prepare for this meeting, the project manager creates a look-ahead schedule each week for the next two weeks. This two-week daily schedule organizes the conversation between the project manager and the production manager. Taking a half hour to write all that stuff out and see what is going on in the next couple of weeks prompts us to communicate: It reminds us that we need to be calling all our subcontractors two weeks before we want them, to remind them that this is when we need them. This practice also helps remind us about materials that need to be ordered or selections that aren’t complete.

In fact, a lot of us, including myself, have found that two weeks is



Here's a view of another "look-ahead" calendar. Project managers may use a variety of methods to construct their forward-looking calendars, sometimes looking ahead as far as six weeks to stay on top of time-sensitive job requirements.

not far enough out in advance for a look-ahead schedule. For example, some material orders require a much longer lead time than two weeks. I like to look ahead at least three weeks, and the PM on a complicated project may build a look-ahead that is as long as six weeks forward.

There are many ways to do that; I've made a look-ahead calendar out of a piece of plywood and used sticky notes to fill it out, so that I can move the stickies around as time passes. Some of our PMs use a whiteboard and erase each week as it goes by, wrapping back around to the top when they run out of space at the bottom. Large desk-blotter calendars are popular, too, because each day has plenty of room to write in. Some use computer calendars as well.

WHAT COULD GO WRONG?

In my general reading about construction scheduling, I've run into some formal studies of the topic. One study surveyed commercial mechanical contractors to ask about the causes of schedule delays. The list they came up with rings true to me:

- Other subs behind schedule
- Out-of-sequence work
- Interference with other subs
- Drawings unclear or incorrect
- Work changes

A similar survey highlighted these factors as top causes of delay:

- Materials not available
- Prerequisite work not done
- Change in priorities
- Not enough labor
- Work underestimated

These studies weren't from residential remodeling jobs, but my gut tells me that these top factors are common sources of delay in residential work too.

STAYING ON TRACK

The point of focusing on these common factors that interfere with the schedule is this: The master schedule created at the beginning of a job is not a set of rails that you can just set the job on and expect it will roll on, right down to the end. The job schedule is little more than a wish, and it's a wish that will come true only if you take the steps to make it come true.

The way we make the schedule a reality is by following a set of routine practices. First, we schedule standing weekly meetings with the client, the production manager, the project lead, and any other key players needed (designer, key trades, and the like). This is our way of ensuring that the client is fully involved and reasonably available. In high-end residential remodeling, not getting timely information from the client might be our most frequent cause of delay, so we have found these weekly client meetings to be very helpful in keeping the lines of communication open.

Then there are the meetings with trade contractors as needed to keep the work moving. We start with a kickoff meeting at the beginning of each phase of work. If it's a relatively small job, that may not amount to much, though we always want to be sure the crew has the latest set of plans and is familiar with our trade standards. If there's something new or unusual or a chance of significant problems, that meeting could involve many people—maybe the architect or designer and maybe the owner of the trade contracting



Frequent ad-hoc meetings between project managers, production managers, and trade contractors to iron out critical details help to keep jobs moving and on schedule. Here, metal roof details are being discussed with the roofing contractor.

company as well as the trade crew. Nothing slows a job down more than redoing work that was done wrong! On a recent project, for example, we called a meeting with the roofing contractor, the roofing crew leader, the architect, and our PM to review all the metal roof details, because the contractor was ordering the roofing material pre-bent from the manufacturer, and we wanted to make sure all the terminations and intersections were properly addressed (see photo, above).

Then we meet again with the trades whenever there are decisions to be made about the work, or something to coordinate. For example, architects don't always draw a specific detail for locations where two different materials are going to butt together or connect, so we'll often meet with the sub to discuss options before we start asking the owners or the designer what they would prefer. Scheduling frequent on-site meetings helps us to figure out these tricky details.

Simply calling the trades a few times before they're scheduled to work is actually a key practice. Calling two to three weeks out (or more on a large project), then a week, and again a couple of days ahead keeps our project top of mind for the trade's scheduler.

It's also important to keep things moving ahead of each trade's work. After calling two or three times to say you'll be ready for them on Wednesday morning, it's important that the subs who are ahead of them are done on Tuesday afternoon. Most of the trades understand the importance of promised dates, and they'll work to keep on track. A fallback is to complete at least some of the space (like the whole first floor) so the next trade can get started while the tardy team finishes up. In fact, on larger jobs, we often work floor-by-floor so crews can overlap. We don't need to have a 15,000-square-foot house empty ex-

cept for one crew when we can schedule each level separately. The painters can be priming the basement when the drywall finishers are working the main level and the hangers are on the attic level.

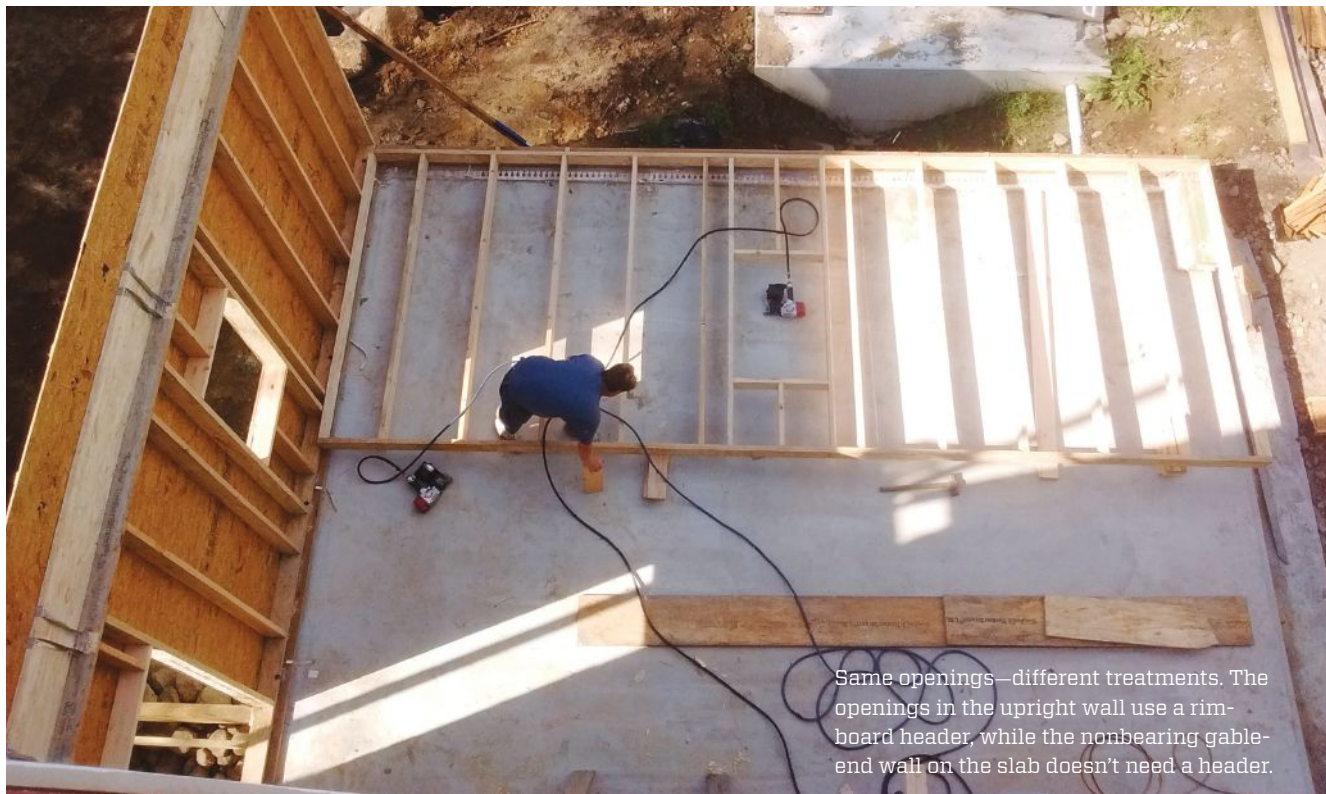
All these practices help us "make ready" the work, a term I learned from the Lean Construction movement. People can't get their job done unless the antecedent work is complete and they have correct plans and selections ready, all the materials on hand, room to work, and so on. Our role as managers is to get all these things ready so the crews can actually accomplish their work.

Making it easy for trades to do a good job is the best way to approach a project. Help a crew at the start of a job, and odds are they'll return the favor later on (the opposite happens too). I learned this lesson while working as a project manager, when I saw on the plans that a large supply duct needed to fit in an I-joint floor system. We decided to pre-cut the holes in the I-joists to make room for the duct to be slid in from one end, and the grateful HVAC crew did little extras for us throughout the rest of the job because we had saved them so many hours at the beginning. Since that project, I've done what I could to help everyone be productive from the start, including steering people away from quality issues we are going to be watching for—rework is a schedule and morale killer, and we aim to prevent it up front.

Using all these practices, the picture on the Gantt chart can be made to happen, budgeted costs kept under control, and most importantly, the promise to the clients fulfilled.

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

FRAMING



Same openings—different treatments. The openings in the upright wall use a rim-board header, while the nonbearing gable-end wall on the slab doesn't need a header.

Exterior Wall Headers Sorting out the options for efficiency and performance

BY MIKE GUERTIN

When our company began building high-performance homes regularly in the late 1980s, we looked for ways to use as little wood in exterior walls as possible while still maintaining a strong frame. Until then, we framed headers for window and door openings like most framers in our area—a double 2x12 with a 1/2-inch plywood spacer for a 2x4 wall. With the header installed directly below the double 2x4 top plate on an 8-foot-high wall, the bottom of the header put the finished window head jamb at about 6 feet 10 inches off the finished floor.

Like a number of progressive builders, we experimented with reducing the size of the lumber and the number of plies used to build headers based on the loads they needed to support. In some cases, we moved the headers into the floor framing above the opening, while in other cases, we eliminated structural headers on some openings all together. By doing so, we decreased the thermal bridging, increased the space for insulation, and improved the energy efficiency. Plus we saved labor and lumber.

DO HEADERS MAKE A WALL STRONGER?

In most cases, there is no structural advantage to installing headers where they aren't required or to using larger headers than what is needed to support the load. And there can be downsides. Oversized or unnecessary headers cost more than properly sized headers or alternative headers. And large-depth lumber headers are more likely to result in drywall cracks as green wood dries out or as dried lumber expands and contracts with seasonal humidity changes.

When I look at the prescriptive options available right in the code, I'm surprised so many framers still frame the way I did 40 years ago. But homebuilders and framers are notoriously slow to change practices. Some argue that beefier headers appear stronger and impress clients. Another argument is that it's easier to use the same sized headers throughout a house, regardless of whether a header will be for a large patio door or a narrow window. Thoughtful header design does take planning. But that little bit of extra work pays off in reduced lumber costs, fewer call-backs, and improved energy efficiency.

Photos by Mike Guertin

TABLE R602.7(1)
GIRDER SPANS* AND HEADER SPANS* FOR EXTERIOR BEARING WALLS
 (Maximum spans for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir* and required number of jack studs)

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf) ^b																							
		30								50								70							
		Building width ^c (feet)																							
		12		24		36		12		24		36		12		24		36							
Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e	Span ^d	NJ ^e								
Roof and ceiling 	1-2 x 6	4-0	1	3-1	2	2-7	2	3-5																	
	1-2 x 8	5-1	2	3-11	2	3-3	2	4-4																	
	1-2 x 10	6-0	2	4-8	2	3-11	2	5-2																	
Roof, ceiling and one center-bearing floor 	1-2 x 6	3-3	1	2-7	2	2-2	2	3-0								1-10	2								
	1-2 x 8	4-1	2	3-3	2	2-9	2	3-9								2-4	3								
	1-2 x 10	4-11	2	3-10	2	3-3	3	4-6								2-9	3								
	1-2 x 12	5-9	2	4-6	3	3-10	3	5-3	2	4-2	3	3-6	3	4-10	3	3-10	3	3-3	4						
	2-2 x 4	3-3	1	2-6	1	2-2	1	3-0								1-10	1								
	2-2 x 6	4-10	1	3-9	1	3-3	2	4-3								2									
	2-2 x 8	6-1	1	4-10	2	4-1	2	5-7								2									
	2-2 x 10	7-3	2	5-8	2	4-10	2	6-8								2									
	2-2 x 12	8-6	2	6-8	2	5-8	2	7-10								3									
	3-2 x 8	7-8	1	6-0	1	5-1	2	7-0	1	5-6	2	4-8	2	6-5	1	5-1	2	4-4	2						
	3-2 x 10	9-1	1	7-2	2	6-1	2	8-4	1	6-7	2	5-7	2	7-8	2	6-1	2	5-2	2						
	3-2 x 12	10-8	2	8-5	2	7-2	2	9-10																	
4-2 x 8	8-10	1	6-11	1	5-11	1	8-1																		
4-2 x 10	10-6	1	8-3	2	7-0	2	9-8																		
4-2 x 12	12-4	1	9-8	2	8-3	2	11-4																		
Roof, ceiling and one floor (clear span)	4-2 x 12	11-2	2	8-6	2	7-2	2	10-5																	

1 Start by finding the example's structural scenario in "Girders and Headers Supporting" column.

2 Next, find the snow load (in this case, 30 psf)...

3 ...then the building width (32 feet, rounded up to wider 36 feet listing).

4 Following down the "Span" column, find an equal or longer header span (for the 3'-2" example, choose longer 3'-3" span).

5 Last, in the "Size" column, find listings of "1-2x10" or "2-2x6s" for the 3'-3" span. Note: These are the minimum size headers for that opening in that configuration. Also, be aware of the number of required jacks (NJ) for each side of the span.

Note: Rows omitted from table to highlight example

See lateral bracing for headers illustration on page 36

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.
 a. Spans are given in feet and inches.
 b. Spans are based on minimum design properties for No. 2 grade lumber of Douglas fir-larch, hem-fir, Southern pine, and spruce-pine-fir.
 c. Building width is measured perpendicular to the ridge. For widths between those shown, spans are permitted to be interpolated.
 d. NJ = Number of jack studs required to support each end. Where the number of required jack studs equals one, the header is permitted to be supported by an approved framing anchor attached to the full-height wall stud and to the header.
 e. Use 30 psf ground snow load for cases in which ground snow load is less than 30 psf and the roof live load is equal to or less than 20 psf.
 f. Spans are calculated assuming the top of the header or girder is laterally braced by perpendicular framing. Where the top of the header or girder is not laterally braced (for example, cripple studs bearing on the header), tabulated spans for headers consisting of 2 x 8, 2 x 10, or 2 x 12 sizes shall be multiplied by 0.70 or the header or girder shall be designed.

Table excerpted from the 2018 International Residential Code. Copyright 2017 Washington, D.C.: International Code Council. Reproduced with permission. All rights reserved. www.ICCSAFE.org

Navigating the header span table. IRC table R602.7(1) is easy to use. Above, we size a 3'-2" exterior header in a 32-foot-wide, two-story building with less than a 30-psf snow load, and with the second floor supported by a center bearing wall. Find "Roof, ceiling and one center-bearing floor" in the far-left column (1). Find the column for a 30-psf snow load (2), then the column for a 36-foot-wide building (next listing up from 32 feet) (3). Find the span for a 3-3 header (up from 3-2) (4). In the "Size" column to the left, find listings for 1-2x10 or 2-2x6s (5). These are the minimum size headers for that opening in that configuration.

DO YOU EVEN NEED A HEADER?

For several code cycles, there has been a subsection for nonbearing walls (2018 IRC R602.7.4). It says: "Load-bearing headers are not required in interior or exterior nonbearing walls. A single flat 2-inch by 4-inch member shall be permitted ... for openings up to 8 feet in width." There is a limitation that the space between the flat head board and the bottom of the top plate can't exceed 24 inches.

So we don't need a structural header unless the walls bear the ends of floor joists, roof rafters, trusses, or a concentrated load. And in most cases, you don't even need to install cripples or blocking between the top plate and the flat rough-opening head board. Besides eliminating the header, you can also skip structural jack studs because there is no load for them to bear, saving even more lumber.

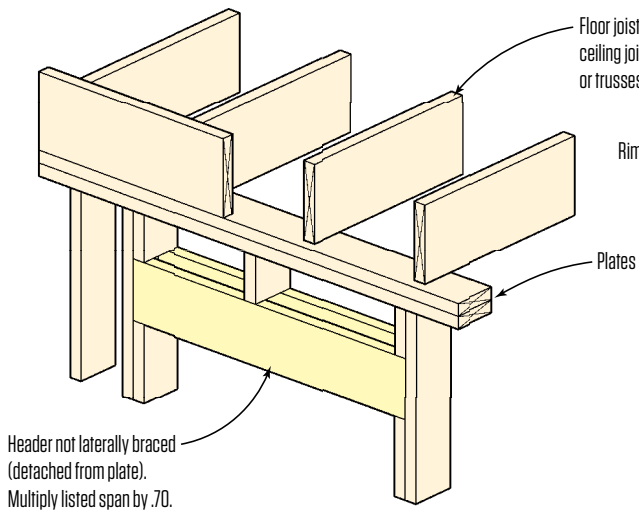
Stack framing 24 inches on-center—where joists, rafters, and trusses align with studs—has become more common as energy codes call for greater wall insulation and builders opt for 2x6 walls.

When a window unit is less than 22 inches wide, the code does not require a header in 24-inch-on-center framing. I've framed houses where the design called for accent windows over kitchen cabinets or narrow windows in a corner to cast light into otherwise dark spaces. In those cases, we purposely sized the window units to fit between studs, thereby eliminating headers and jack studs. We simply installed the horizontal head and sill boards with the normal stud spacing to box out the rough openings.

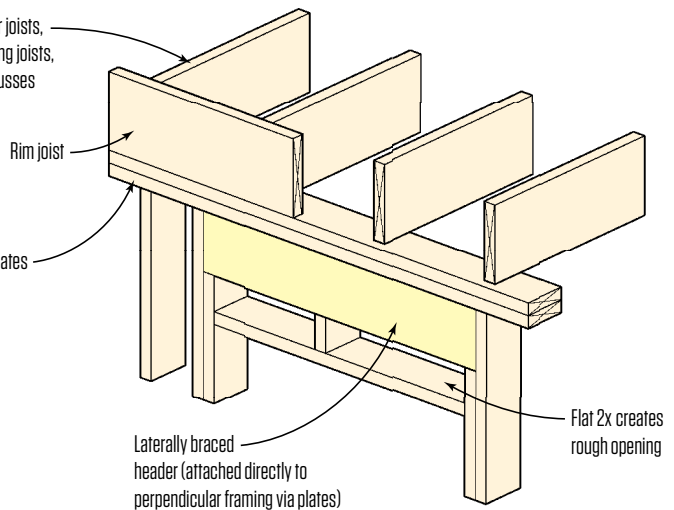
SIZING UP HEADERS

The code tables help you determine the right-sized header for the opening width and the load it supports in a conventionally framed house. In the 2012 IRC and earlier versions, the header span table for exterior bearing walls was published in the middle of Chapter 5, "Floors"—not a logical place when you're thinking about part of the wall framing. Earlier tables included only 2-ply, 3-ply, and 4-ply

Header Not Laterally Braced



Laterally Braced Header



Lateral header bracing. Footnote (f) to the table on page 35 notes that spans in the table assume that the headers are attached to lateral bracing, typically in the form of floor joists, ceiling joists, or trusses attached directly to the top plate. When the header is not attached directly to the top plate (and the bracing), the header span is reduced by multiplying the listed span by 0.70.

headers. A new table was added in the 2012 IRC for single-ply headers. In the 2015 IRC, a single exterior-wall header table, R602.7(1), was published in Chapter 6, “Walls,” which united all of the disparate parts. The same table appears in the 2018 IRC, although the allowable spans differ slightly from those in the 2015 IRC.

The header table R602.7(1) (see page 35) is pretty easy to follow once you understand how the information is broken up into the series of columns and rows. The table rows in the left column list combinations of the number of floors, the ceiling and roof, and whether there is a clear span from one side to the other or there is a center bearing wall or beam supporting floor joists in the middle of the building.

The column information is divided into sections by snow load (30, 50, and 70 psf) and is further divided by the building width (20, 28, and 36 feet in the 2015 IRC, and 12, 24, and 36 feet in the 2018 IRC). While the width options are limited to three in each table, it is important to point out that footnote (c) permits us to interpolate if the building width is between the listed widths. Or if you don’t want to interpolate a header size for, say, a 26-foot-wide house, you can just use the header spans for the next-larger building width—28 feet in the 2015 IRC or 36 feet in the 2018 IRC.

I approach the table by first locating the row group that matches the floor and roof framing of the house I’m building. The example on page 35 has a header supporting an opening in an exterior wall that supports a roof, a ceiling, and a floor with a center bearing wall. Then I match the header span from the house plans or window schedule

with the span lengths listed on the table under the proper snow load for my area. From there, I look back to the header size column to see what header will work. The headers are listed by the number of plies (1 through 4) and the lumber size (2x4 through 2x12).

The header span table doesn’t differentiate between wood species like the floor-joist and rafter span tables do in Chapters 5 and 7. D-fir, hem-fir, SYP, and SPF are all grouped together in the header table. Also note that the header spans can change from one IRC version to the next. As lumber-rating authorities change the capacity of one or more species, the IRC tables reflect those changes with changes to header spans. So if your code jurisdiction adopts a more recent version of the IRC, you may have to change your header sizes according to the revised table.

HOW MANY JACKS?

When choosing the type of header to use, pay close attention to the number of jack studs that are required for each header assembly in the header span table. Next to each header span column is a column labeled “NJ,” for number of jacks. Always use the number of jacks listed in the NJ column next to each span.

Most framers are familiar with double jacks being used on wide openings for patio doors, doors with sidelights, and mulled windows, but you’ll find cases in the 2018 IRC table where double jacks are required on openings as narrow as 2 feet under certain snow-load and floor-span combinations. Note that in the example on page 35, a single 2x10 header actually requires three jacks,

Illustration: Tim Healey

Figure R602.7.1(1)
Single-Member Header in Exterior Bearing Wall

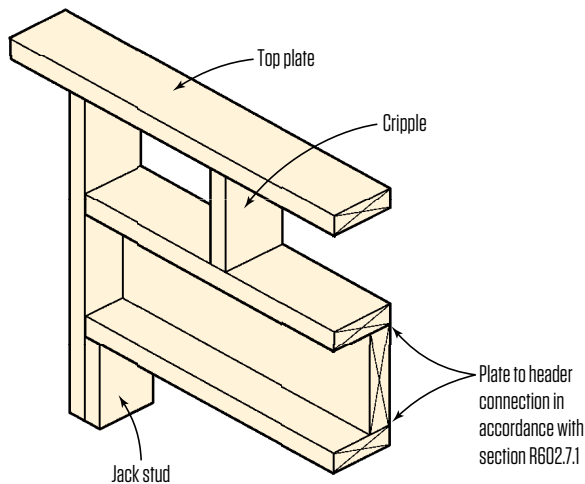
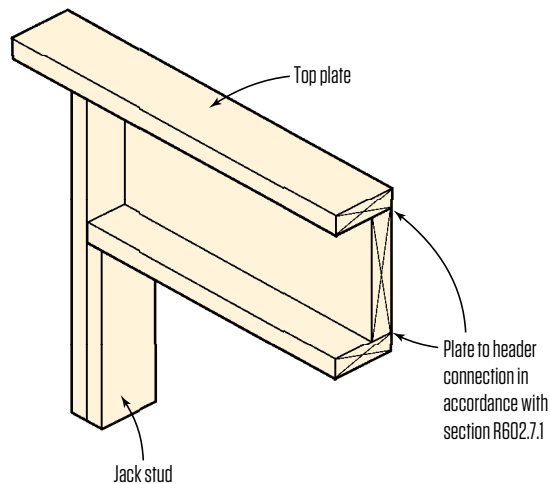


Figure R602.7.1(2)
Alternative Single-Member Header Without Cripple



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Single-ply headers. The IRC has a specific subsection for headers made from a single lumber ply. The header must be attached to flat 2-by boards on the top and bottom with cripples between the flat 2-by and the top plate. The code also lists an alternative where the plate takes the place of the top flat 2-by.

while the double-2x6 option requires two jacks. These multiple jack requirements are going to be a big change for many framers and inspectors to get used to.

CHECK THE FOOTNOTES

The code always seems to tuck away important information in the footnotes to its tables. A new footnote (f) to the header span table in the 2018 IRC notes that spans listed assume that the top of the header is laterally braced by perpendicular framing, which would typically be floor joists, ceiling joists, or trusses. Headers are laterally braced through their direct connection to the underside of the plate, which is connected to the perpendicular framing members (see illustrations, facing page).

The footnote goes on to say that when the top of the header is not laterally braced, then the spans of headers made of 2x8s, 2x10s, and 2x12s must be reduced by multiplying the listed header span by 0.70. Framers will typically run into this span reduction when a header is installed lower than the top plate with cripple studs inserted between the header and the top plate. As an example, for a header without lateral bracing with a span listed in the table at 4 feet 2 inches, you would multiply that span by 0.70 for a reduced span of 2 feet 11 inches. The lesson here (if you are working under the 2018 IRC) is to frame the headers tight to the underside of the top plate, and then cripple the rough opening down to a flat 2-by at the head of the rough opening to avoid the span reduction and to keep header size to a minimum.

SINGLE-PLY HEADERS

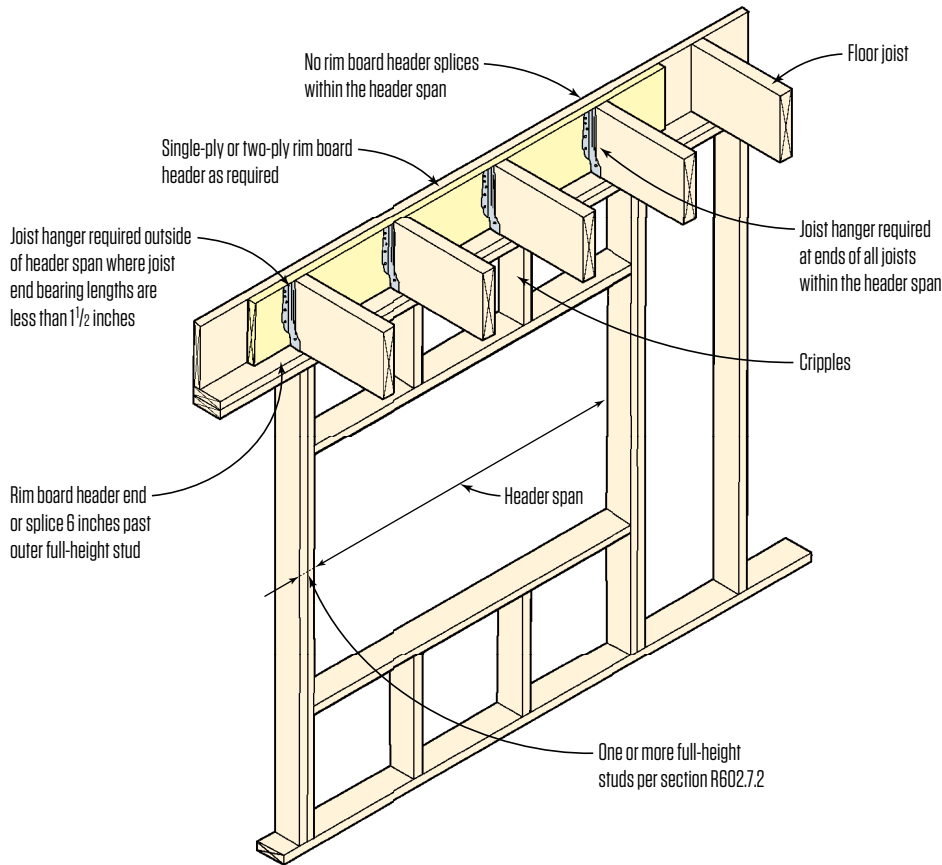
While the 2018 IRC includes single-ply header options in the span tables, subsection R602.7.1 and figures R602.7(1) and (2) (see illustrations, above) address special considerations for single-ply headers. These sections require that you install flat 2-by boards at the top and bottom of single-ply headers. The exception is when the header is sandwiched tight to the top plate. In that instance, the plate acts as the flat 2-by. These stipulations may influence your decision to use single-ply headers—in some cases, the amount (and cost) of lumber can be more than using a properly sized double-ply header. Another interesting note is that single-ply headers are not listed as choices on the header table for interior walls, R602.7(2).

RIM-BOARD HEADERS

When our company was looking into ways of increasing the efficiency of our framing, we wondered why we needed to frame a header into the wall when we potentially had a header above the top plate in the form of a rim board (see photos, page 39). Often, the rim board can bridge a window or door span, provided you follow a couple of code requirements. Subsection R602.7.2 and companion figure R602.7.2 in the 2015 and 2018 IRC illustrate requirements for creating a rim-board header (see illustration, page 38).

Rim-board headers are sized according to the same span table used to size regular headers, so they can be single ply, double ply, or more. There can be no joints in a rim-board header anywhere over the opening or within 6 inches beyond the outer bearing stud.

Figure R602.7.2
Rim Board Header Construction



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Rim-joist headers. Often, the rim joist above an opening can fulfill the header requirement. Spans follow the same header span table as regular headers, and the material can't have a joint over the opening. Also, the header must extend 6 inches beyond the opening, and the number of full-height studs on each side must equal half the number of studs displaced by the opening.

The number of outer studs framing the rough opening at each end (and supporting the rim header) must equal half the number of studs displaced within the opening based on the maximum stud spacing permitted by the code in table R602.3(5), "Size, Height and Spacing of Wood Studs." This part is easier than it sounds. As an example, if the opening in a 2x6 framed wall is 6 feet wide, two studs would fall within the opening with a 24-inch-on-center stud layout. You would then need to add one additional full-height stud on each side of the opening, doubling the number of supporting studs. Even though these studs are full-height, they are functioning as jack studs, and for the most part, the number of supporting studs should match the number of jacks listed in the "NJ" column of the header span table R602.7(1).

According to figure R602.7.2, joist hangers are required for all joists

within the main header span. But when joists align with the supporting studs at the ends of the header, hangers are not needed provided there is at least 1 1/2 inches of top plate for the joists to bear on.

BOX HEADERS

A box header is made by installing a structural panel on the outside face of the framing (for a one-sided box header) or on the inside and outside faces of the framing (for a two-sided box header). The panels span between the top plate of a wall and a flat 2-by at the head of a rough opening. When nailed according to the code schedule, the sheathing and framing work together as a header, eliminating the need for a lumber header. Box headers use a minimal amount of lumber, so there is more space for insulation. You just need to follow the conditions outlined in figure R602.7.3 (see illustration, page 40).



Minimizing the size of headers means increased insulation in the wall. A rim-joint header allows full-depth wall insulation in the spaces above a door opening, where there would have been solid lumber years ago (above left). An LVL installed inside the regular rim joist acts as a header for the window opening below (above right).

To create a box header, first frame in the cripple studs between the top plate and a flat 2-by at the head of the rough opening with jack studs supporting the ends of the flat 2-by head. Make sure that the structural sheathing and the top plate continue through the opening with no joints. Follow the fastening schedule of 8d common nails spaced 3 inches apart and driven into the plates and cripples. The sheathing must be a nominal $\frac{1}{2}$ inch thick, and the strength axis must run parallel to the wall length. If you are already framing with structural sheathing, then single-sided box headers are easy to incorporate. And even if you typically sheathe walls with $\frac{7}{16}$ -inch panels, you can substitute $\frac{15}{32}$ -inch sheathing where needed. The tiny difference in thickness shouldn't cause any problems.

The code lists opening spans for 9- and 15-inch-tall box headers. But box headers can't be used in all situations. They're allowed only for walls that support just a roof and ceiling, or for walls supporting a roof, ceiling, and a floor with an interior center bearing wall. In many cases, the exterior wall sheathing alone can span an opening for a single-sided box header. Take the example of a first-floor 3-foot 2-inch header in a two-story 26-foot-wide house with a center bearing wall. A single-ply 9-inch-tall box header is good for up to a 4-foot span, and a 15-inch-tall box header works for spans up to 5 feet.

Two-sided box headers offer greater spans, but they throw a wrinkle into the fabrication. If you apply an interior structural panel to the face of the studs, you will need to pad out all the studs to match the plane of the panel before installing drywall. If you're framing walls with 2x6s, another option is ripping $\frac{1}{2}$ inch off the plate, tops of the

king studs, and the head board. All that finicky detail is probably more work than the benefit gained from getting a wider span.

MIX AND MATCH HEADERS

There is no rule that says that all the headers in a building have to be the same. You can select the header option that best suits each given situation. Each opening in a wall may be addressed in a different way. On the first floor of a two-story house, you may have no structural headers for openings in the gable wall, and then use box headers or rim-joint headers in the load-bearing walls. And for wide openings, you may prefer a conventional header. On the second floor, nonbearing openings again may not need headers. But openings in second-floor bearing walls may get properly sized single or double headers, or you may opt for box headers because there's likely no rim board above.

ENGINEERED-LUMBER HEADERS

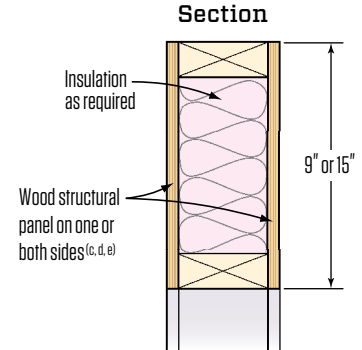
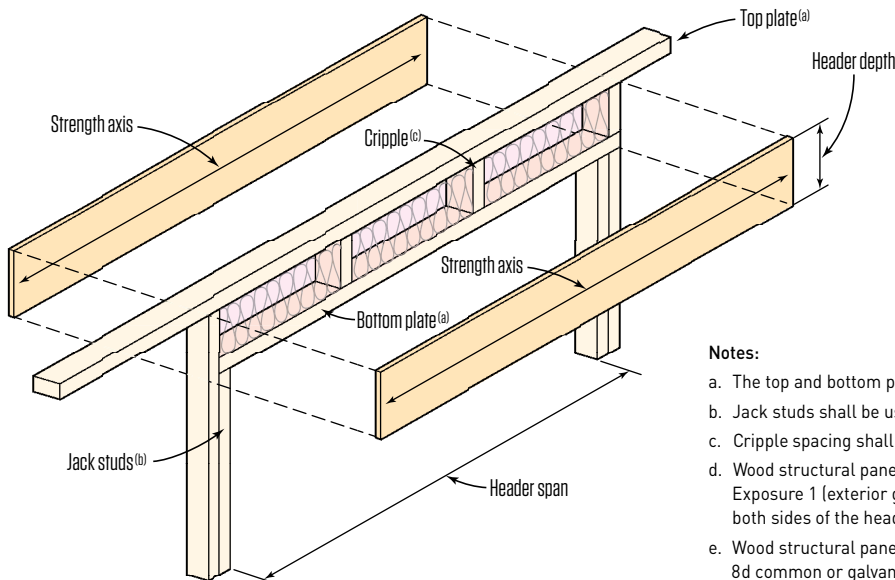
LVL, LSL, PSL, and glue-laminated headers are usually more consistent in manufactured height and less prone to shrinking and swelling than headers made from dimensional lumber, so many builders have migrated towards using them. Engineered-lumber manufacturers provide header span tables that are similar to the ones listed in the IRC, making it easy to size a header for an opening.

I've used engineered lumber for single-ply headers and for rim-board headers following the same measures outlined in the code for these header options. In many cases, the engineered-lumber headers

Table R602.7.3
Maximum Spans For Wood Structural Panel Box Headers^(a)

Header Construction ^(b)	Header Depth (inches)	House Depth (feet)				
		24	26	28	30	32
Wood structural panel — one side	9	4	4	3	3	—
	15	5	5	4	3	3
Wood structural panel — both sides	9	7	5	5	4	3
	15	8	8	7	7	6

- a. Spans are based on single story with clear-span trussed roof or two story with floors and roof supported by interior walls.
- b. See Figure R602.7.3 for construction details.



For SI: 1 inch = 25.4 millimeters, 1 foot = 304.8 millimeters

Notes:

- a. The top and bottom plates shall be continuous at header location.
- b. Jack studs shall be used for spans over 4 feet.
- c. Cripple spacing shall be the same as for studs.
- d. Wood structural panel faces shall be single pieces of 15/32-inch-thick Exposure 1 (exterior glue) or thicker, installed on the exterior or both sides of the header.
- e. Wood structural panel faces shall be nailed to framing and cripples with 8d common or galvanized box nails spaced 3 inches on center, staggering alternate 1/2 inch. Galvanized nails shall be hot-dipped or tumbled.

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Box headers. In certain situations, sheathing attached with a strict nailing schedule can be combined with a framed opening to create a box header. Box headers can be 9 or 15 inches tall, and the structural sheathing can be on one side or both sides. A separate span table is included for single-sided and double-sided box headers.

can span greater distances compared with similar-sized dimensional-lumber headers. Some companies also make engineered-lumber headers in a laminated sandwich with rigid insulating foam as a core or face for the header. Before choosing to use an engineered-lumber header, check the manufacturer instructions for any special use conditions that might not be covered in the code.

HEADER CONSTRUCTION

When building headers from multiple plies, you should always follow the fastening schedule in IRC table R602.3(1). But the information there is limited. The only nailing schedule for a header is for a two-ply header with a 1/2-inch spacer, presumably for 2x4 wall construction. That table calls for 16d common nails at 16 inches on-center or 16d box nails at 12 inches on-center. I run

two rows of nails for headers made from 2x6s to 2x10s. For 2x12 headers, I add a third row of nails in the middle.

But more often than not, I'm framing headers for 2x6 walls. In that case, I make double headers by sandwiching 1 1/2-inch rigid foam insulation between layers of 2-by or LVL stock. Because nails won't reach the outer plies, I use 5- or 5 1/2-inch FastenMaster FlatLok or HeadLok screws or 5-inch Simpson Strong-Tie SDWS screws. The low-profile screw heads flush out with the lumber surfaces, so they don't interfere with sheathing or drywall. I space the screws roughly 16 inches apart and about 2 inches down from the edges of the header.

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- *— In-depth coverage
- L — Letter to the editor
- Q — Question and answer
- P — Product information

Note: This year's Index also contains entries for the articles from the Professional Deck Builder sections in the March, May, July, September, and December issues of JLC. Those articles are indexed separately at the end of this JLC Index, and those page numbers refer to the page numbers within the PDB sections. The codes used are the same as those listed above.

JLC Index

Adhesives and caulks:

drywall, high-yield (P), JAN:49
sealant, indoor/outdoor, acrylic latex (P), JAN:49
sealant, one-hour (P), APR:57

Air conditioning:

See HVAC.

Air-sealing:

See also Energy efficiency; Insulation.
aerosol-delivered air-sealing system to meet energy code, low-cost, MAR:31
details for tight shell and affordability, starting at design phase*, APR:49
fast-curing, slow-curing, and gap-filling (P), FEB:50
often-missed locations to get to 3 ACH50*, AUG:31
vapor-open approach for old wood-framed box sill, FEB:17
windows, why and how-to, step by step, APR:9

Appliances:

island cooktop hood, stainless steel (P), DEC:38
range, electric, with true white finish (P), JAN:49
range hood and cooktop with wireless communication (P), FEB:50
range, induction (P), JUN:62
refrigerator drawer, indoor/outdoor (P), OCT:57
refrigerator, undercounter (P), JAN:49

Architecture:

See Design.

Asphalt shingles:

See Roofing.

Basements:

See Foundations.

Bathrooms:

See also Showers and tubs; Toilets.
faucets, mid-century-modern (P), NOV:48
faucets, transitional and classic styled (P), JUN:62
floating vanity bracket, heavy-duty (P), AUG:56
sink with sloping basin (P), JAN:49
vanities, modern (P), NOV:48
voice control for bathroom fixtures (P), JUN:62

Boilers:

See HVAC.

Bookkeeping:

See Business.

Business:

See also Employees; Technology.
customer charges and transparency, opposing views on, NOV:21
estimates, adjusting for risk with weighted averages, APR:31
estimating and bidding exam as tune-up guide to prompt thinking, DEC:17
estimating and bidding, the importance of distinguishing between, JUL:21
estimating, effective, using narrative historical labor productivity records, SEP:23
estimating, sloppy, debunking rationalizations for, and identifying charges to include, AUG:49
labor costs, tracking with Google smartphone form and processing in Excel, JUN:31
managing and training employees to work

independently, the importance of, MAR:29
markup, variability and discussing with customers, JAN:23
scope of work agreement based on job progression*, JAN:35; (L), MAR:9
subcontractor bids, and avoiding omissions with included/not included form, OCT:23

Cabinets:

custom, site-built, planning, cutting, and assembly details for*, OCT:41
drywall screws vs. star-drive-head screws for installing (Q), JUL:11
knobs and pulls, vintage/modern design (P), NOV:48
outdoor, waterproof (P), OCT:57

Cedar shingles and shakes.

See Roofing; Siding.

Chimneys, air-sealing chase for double-wall metal chimney (L), MAR:9

Climate and construction:

See also Storms; Wind and wind loads.
perimeter beam in truss system to prevent uplift of wide overhangs and hide gutters in N.C. wind zone, SEP:15
pier-and-beam foundations on coastal sites, installation details for*, SEP:29
rebuilding a flooded house over an 8-foot-tall vented crawlspace, or "Texas basement"*, NOV:41
slab-on-grade homes, lifting in flood zones, resetting on columns, and finishing*, SEP:37

Code, building:

aerosol-delivered air-sealing system to meet energy code, low-cost, MAR:31
air-sealing often-missed locations to get to 3 ACH50*, AUG:31
drip edge requirements, wind resistance and choosing profile type for asphalt shingles, MAY:49
electrical, and requirements for pigtailed (Q), APR:13
fire sprinklers, NFPA rules and materials and methods for installing*, NOV:27
ice barrier membrane and correct way to install drip edge per code (Q), MAR:17
ice barrier membrane, installation height and code (Q), FEB:13
LED lighting and IECC, and importance of professional design and products*, MAY:39
PT lumber for sills, and code (Q), DEC:9
silica dust, OSHA rules for working with and how to comply, MAR:65
vintage code books, collection of, NOV:56
window seat and tempered glass, IRC vs. responsible assessment of safety need, SEP:11

Concrete:

See also Foundations.
block, removing efflorescence from before installing rigid foam (Q), AUG:11
Hobbit House, earth-sheltered, with concrete walls and tapered arch roof, JUL:59

Countertops:

sintered stone, FEB:50
quartz, composite concrete and glass (P), APR:57
quartz, in stone and marble colors (P), MAY:52

Crawlspaces:

See Foundations.

Customers:

See Business.

Decks:

See also Porches; Structural.
composite plugs, color-matched (P), MAY:52
decking, composite, strong (P), DEC:38
decking gaskets, wide-flange, with hidden fasteners (P), MAY:52
decking, thermally modified (P), SEP:58
deck joist flashing tape, strong, waterproof (P), MAY:53
framing, steel (P), DEC:38
flashing, cold-weather (P), JUL:49
railing, rod, aluminum (P), MAY:52
railing, rod, durable (P), DEC:38

railing system, PVC, reinforced (P), MAR:59
screw and plug system, auto-feed compatible (P), JUL:49

under-deck water management system (P), DEC:38
waterproofing coating for hardwood (P), SEP:58

Defects:

failed girder, correcting with fabricated steel bracket, OCT:27
garage wall rot and rebuilding curved head flashing for arch-top doors, AUG:58

Demolition,

tear down of farm silo, top to bottom, FEB:56

Design:

air-sealing details for tight shell and affordability, starting at design phase*, APR:49
framing a Passive house with complex design using steel, glulams, and LVLs*, APR:39
Hobbit House, earth-sheltered, with concrete walls and tapered arch roof, JUL:59
Michelangelo as draftsman and GC, APR:64
slab-on-grade homes, lifting in flood zones, resetting on columns, and finishing*, SEP:37

Doors:

See also Garages.
bypass doors for pantry, installation details for, NOV:13
door frame, exterior, one-piece, screwless (P), FEB:50
door glass, new modern design (P), SEP:58
entry, installation kit (P), NOV:48
garage, arch-top, rebuilding curved head flashing for, AUG:15
garage, steel, weather-resistant (P), DEC:38
glass, hurricane-resistant (P), MAR:59
glass, lift-and-slide, installing in thick double stud wall, APR:17
hardware, ceramic-coated, durable (P), JUN:62
steel, installing in brick and block foundation wall, JUN:21

Drainage:

See Exteriors; Foundations; Moisture and moisture control; Siding; Sitework.

Drywall:

hanging, tips for quick and efficient, SEP:7
sound resistance with double drywall, FEB:17
wallboard, mold- and moisture-resistant (P), JAN:49

Education and training:

air-sealing windows, why and how-to, step by step, APR:9
asphalt shingles, guidelines for installing, MAY:11
cedar shingles, drainage plane and installation details for, JUN:11
drywall hanging, tips and tricks for quick and efficient, SEP:7
fiberglass batts, guidelines and how to install, AUG:7
floors, squeak-free, how to achieve with proper subfloor installation, OCT:9
knowledge, experience, and insights from longtime roof cutter, *From the Top Plates Up* book review, JUN:72
layout square, using white mark to facilitate wall plate layout, DEC:46
nail racks, trick for holding together when tossed, OCT:69
painting training program for high-school students, FEB:9
reciprocating saws, cordless, uses and how to use, overview for new carpenters, MAR:11
sheet stock, how to measure and cut with circ saw, JAN:7
window casing, how to install, DEC:6
window stool, how to install, NOV:7
wood, strip, how to install, step by step, JUL:7
wood, strip, scribing the final board for (Q), OCT:15

Electrical:

cable stapler, cordless, DEC:42
ceiling cans, how to choose, mark location, and rough-in, MAR:21
floor box kits (P), SEP:58
load center and plug-in circuit breakers (P), AUG:56
mechanicals, complex, organizing and documenting for large houses*, DEC:30
pigtailed and code requirements (Q), APR:13
rough-in wiring, organized approach for efficiency and safety*, JAN:27
sound resistance with sealed outlet boxes, FEB:17

Employees:

managing and training employees to work independently, the importance of, MAR:29
painting training program for high-school students, FEB:9

Energy efficiency: See also Air-sealing; Insulation; Solar power.

A/C coolant loop, pulling waste heat from, to heat swimming pools, AUG:53
aerosol-delivered air-sealing system to meet energy code, low-cost, MAR:31
air barrier, liquid-applied (P), JAN:49
air-sealing details for tight shell and affordability, starting at design phase*, APR:49
air-sealing often-missed locations to get to 3 ACH50*, AUG:31
air-sealing, vapor-open approach for old wood-framed box sill, FEB:17
blower-door test before window installation to test airtightness of shell (Q), JUL:11
dehumidification vs. A/C in tight houses in spring and fall, MAY:26
heat pumps, air-to-water, complications of, understanding and learning from*, OCT:33
LEDs and code, and importance of professional design and products*, MAY:39
net zero house, advanced mechanicals and envelope details for, FEB:27
sheathing, Zip System, proper taping technique for, JAN:15
slab, rigid foam insulation and two-layer floating subfloor, details for*, JUN:49; (L), AUG:5
solar plus storage development in Ariz. helps solve supply and demand swings, JUN:57
solar plus storage system vs. grid-tied, options and economics of, FEB:23
vapor barrier, humidity-adjustable, with directional drying properties, APR:33

Estimating: See Business.

Exteriors: See also Decks; Doors; Porches; Siding; Windows.

brick tie for wider space behind brick and stone veneers (P), OCT:57
cabinets, outdoor, waterproof (P), OCT:57
concrete masonry veneer, mortarless (P), FEB:50
directional vapor barrier membrane on walls and ceilings, installation details for, SEP:15
engineered wood siding, overview, installation details, and review*, MAR:45
filler, exterior-grade (P), JUL:49
flashing, cold-weather (P), JUL:49
flashing tape, repositionable (P), JUN:62
flashing windows correctly, basic principles and how-to, APR:17
garage wall rot and rebuilding curved head flashing for arch-top doors, AUG:15
gutters, copper, and aluminum fascia, and corrosion problems (Q), NOV:11
MDF, exterior-use (P), APR:57
net zero house, advanced mechanicals and envelope details for, FEB:27
perimeter beam in truss system to hide gutters and prevent uplift of wide overhangs in N.C. wind zone, SEP:15
porch flooring, composite, moisture-resistant (P), MAR:59
rainscreen, roll-on (P), AUG:56

rainscreen system, affordable, using strapping, installation details for*, OCT:49
sheathing, Zip System, proper taping technique for, JAN:15
stone veneers with recycled content (P), DEC:38
stucco, basic drainage requirements for, and avoiding buckets*, NOV:35
trim, PVC, with reversible panels (P), JUN:62
trim, PVC, with water-based coating and more color choices (P), SEP:58
windows, replacing in curved wall, with rainscreen system, vapor-open weather barrier, and zinc flashing*, AUG:21
Finish carpentry: See also Stairs; Woodworking.
box beams, building and using for on-site shop, JAN:15
clear finishes on architectural woodwork, techniques for applying*, FEB:45
newel post, salvaged, rebuilding, DEC:11
paneled ceiling with shallow beams and preassembled panels, building and installing*, MAR:37
recessed paneled niche with radius top, steps for building in shop, JUL:41
window stool, how to fit, NOV:7

Fireplaces:

electric (P), DEC:38
gas, with no glass (P), MAR:59

Fire resistance and safety, sprinklers, NFPA rules and materials and methods for installing*, NOV:27

Flooring:

composite, hardwood-look, waterproof, durable (P), OCT:57
concrete slab, and drying time before flooring installation (Q), AUG:11
lamine, wood-look, waterproof (P), MAR:59
sintered stone, FEB:50
tile and carpet transition detail (Q), JAN:11
wood, strip, how to install, step by step, JUL:7
wood, strip, scribing the final board for (Q), OCT:15
vinyl, patterned, affordable (P), JUN:62

Floors:

radiant panel plywood subfloor, installing over concrete and wood-framed floors, MAY:19
squeak-free, how to achieve with proper subfloor installation, OCT:9
tile underlayment, self-leveling, installing, MAY:19
underlayment, self-leveling, leak-sealing (P), OCT:57
underlayment, sound-control (P), DEC:38

Foundations: See also Sitework.

air-sealing, vapor-open approach for old wood-framed box sill, FEB:17
brick and block, opening up for steel door installation, JUN:21
concrete block addition to rowhouse, two-story, installation details for, JUN:21
concrete block, removing efflorescence from before installing rigid foam (Q), AUG:11
concrete slab, preventing cracks with control joints and isolation joints (Q), JUN:17
crawlspace, sealed, moisture problem due to capillary action, MAR:53
crawlspace, vented, 8-foot-tall, or "Texas basement," rebuilding a flooded house over*, NOV:41
frost-protected shallow foundation, installation details for*, AUG:41
net zero house, frost-protected slab for, FEB:27
pier-and-beam, on coastal sites, installation details for*, SEP:29
pre-cast footings, precise installation approach for extra-long porch, APR:17
PT lumber for sills, and code (Q), DEC:9
slab, and drying time before flooring installation (Q), AUG:11
slab-on-grade homes, lifting in flood zones, resetting on columns, and finishing*, SEP:37
slab-on-grade houses built on Long Island after

WWII, MAR:70

slab, rigid foam insulation and two-layer floating subfloor, details for*, JUN:49; (L), AUG:5

Framing: See also Framing, roof; Framing, wall; Structural; Timber framing.

I-joists, fire membrane (P), MAY:52
LVL, long, lifting and placing with a telehandler, AUG:15
nail racks, trick for holding together when tossed, OCT:69
Passive house with complex design, using steel, glulams, and LVLs*, APR:39

Framing, roof:

knowledge, experience, and insights from longtime roof cutter, *From the Top Plates Up* book review, JUN:72
LVLs for long ridge, measuring, laying out, and installing*, FEB:37

Framing, wall:

layout square, using white mark to facilitate wall plate layout, DEC:46
net zero house, advanced mechanicals and envelope details for, FEB:27
sound resistance with staggered studs, FEB:17

Garages:

door opener, smart (P), AUG:56
doors, steel, weather-resistant (P), DEC:38
wall rot and rebuilding curved head flashing for arch-top doors, AUG:15

Gutters: See Exteriors; Moisture and moisture control.

Hardware:

door, ceramic-coated, durable (P), JUN:62
floating vanity bracket, heavy-duty (P), AUG:56
for sliding-glass barn doors (P), JAN:49

HVAC: See also Fireplaces; Water heaters.

A/C coolant loop, pulling waste heat from, to heat swimming pools, AUG:53
air conditioning, origins of, at The Buffalo Forge Co., SEP:68
air conditioning unit, ceiling cassette (P), OCT:57
air handler, high-efficiency, quiet (P), JUL:49
boiler, combination, high-efficiency (P), JUL:49
dehumidification vs. A/C in tight houses in spring and fall, MAY:26
ductwork, testing for leaks during construction to prevent future problems*, JUL:27
furnace, gas, compact, non-condensing (P), NOV:48
furnace, gas, low-emission (P), APR:57
heat pumps, air-to-water, complications of, understanding and learning from*, OCT:33
indoor humidity and mold problems, case studies, DEC:20
mechanicals, complex, organizing and documenting for large houses*, DEC:30
radiant panel plywood subfloor, installing over concrete and wood-framed floors, MAY:19
supply fan, humidity-sensing (P), JUN:62
ventilation fan, inline (P), AUG:56
ventilation, smart (P), NOV:48

Indoor air quality:

dehumidification vs. A/C in tight houses in spring and fall, MAY:26
indoor humidity and mold problems, case studies, DEC:20
supply fan, humidity-sensing (P), JUN:62
Insects, removing and rescuing honeybees, JAN:56
Insulation: See also Air-sealing; Energy efficiency.
air-sealing often-missed locations to get to 3 ACH50*, AUG:31
avoiding wet roofs, part one: ventilation, insulation, and moisture control overview*, JUN:41
avoiding wet roofs, part two: accepted code practice vs. new research for unvented roofs*, JUL:35
dense-pack cellulose and solving back-pressure problems (L), JUN:9
fiberglass batts, guidelines and how to install, AUG:7
frost-protected shallow foundation, installation details for*, AUG:41

- slab foundation, rigid foam insulation and floating two-layer subfloor, details for*, JUN:49; **(L)** AUG:5
- sound resistance with wool soundproofing batts, FEB:17
- spray foam, efficient **(P)**, MAY:52
- spray foam, high-yield, low VOC **(P)**, AUG:56
- Interiors:**
- beam accessories, wood-look **(P)**, APR:57
- clear finishes on architectural woodwork, techniques for applying*, FEB:45
- flashing tape for small wall penetrations **(P)**, JUL:49
- flooring, wall cladding and countertops, sintered stone, FEB:50
- high-quality finish for interior trim, steps for achieving*, MAY:31
- paneled ceiling with shallow beams and preassembled panels, building and installing*, MAR:37
- plaster, ornamental, profile in repairing, NOV:13
- subfloor panels, composite, moisture-resistant **(P)**, FEB:50
- Jobsite:** See also Safety, jobsite.
- box beams, building and using for on-site finish carpentry shop, JAN:15
- Kitchens:** See also Appliances; Cabinets.
- ceilings, out-of-level, how to deal with on remodel, OCT:19
- faucet, pull-down, wave-on **(P)**, AUG:56
- faucet, touchless **(P)**, APR:57
- shelves, floating, with hollow planks and steel dowels, JUL:15
- sink, farmhouse, with reversible apron front **(P)**, OCT:57
- sink, with interchangeable aprons **(P)**, MAR:59
- Lighting:**
- ceiling cans, how to choose, mark location, and rough in, MAR:21
- LED, bacteria-killing, recessed **(P)**, NOV:48
- LED downlight, energy-efficient, snap-in **(P)**, MAR:59
- LEDs and code, and importance of professional design and products*, MAY:39
- LED, slim profile, for easier air-sealing **(P)**, OCT:57
- system combining task, ambient, and accent lighting **(P)**, JAN:49
- Locks.** See Security and lock systems.
- Lumber and wood:**
- PT lumber for sills, and code **(Q)**, DEC:9
- shiplap boards, pine, primed **(P)**, MAY:52
- Masonry:**
- brick and block foundation, opening up for steel door installation, JUN:21
- brick façade, clay, thin, exterior and interior **(P)**, MAY:52
- Materials:**
- asbestos mines in the U.S. and in Vermont, OCT:72
- engineered wood siding, overview, installation details, and review*, MAR:45
- masking, liquid **(P)**, OCT:57
- MDF, moisture-resistant **(P)**, MAY:52
- sheathing, Zip System, proper taping technique for, JAN:15
- sheet stock, how to measure and cut with circ saw, JAN:7
- Moisture and moisture control:**
- avoiding wet roofs, part one: ventilation, insulation, and moisture control overview*, JUN:41
- avoiding wet roofs, part two: accepted code practice vs. new research for unvented roofs*, JUL:35
- concrete block, removing efflorescence from before installing rigid foam **(Q)**, AUG:11
- concrete slab, and drying time before flooring installation **(Q)**, AUG:11
- crawlspace, sealed, moisture problem due to capillary action, MAR:53
- directional vapor barrier membrane on walls and ceilings, installation details for, SEP:15
- drip-edge code requirements, wind resistance and choosing profile type for asphalt shingles, MAY:49
- flashing windows correctly, basic principles and how-to, APR:17
- garage wall rot and rebuilding curved head flashing for arch-top doors, AUG:15
- gutters, copper, and aluminum fascia, and corrosion problems **(Q)**, NOV:11
- ice barrier membrane, installation height and code **(Q)**, FEB:13
- ice barrier membrane and correct way to install drip edge per code **(Q)**, MAR:17
- indoor humidity and mold problems, case studies, DEC:20
- perforated pipe, heavy-duty, how to place **(Q)**, FEB:13
- perimeter beam in truss system to hide gutters and prevent uplift of wide overhangs in N.C. wind zone, SEP:15
- rainscreen system, affordable, using strapping, installation details for*, OCT:49
- stucco exteriors, basic drainage requirements for, and avoiding buckets*, NOV:35
- under-deck water management system **(P)**, DEC:38
- vapor barrier, humidity-adjustable, with directional drying properties, APR:33
- waterproofing membrane, minimizing layers to prevent uneven surfaces, JUN:21
- Nailers:**
- cordless, gas-powered, for fastening rigid foam to concrete, NOV:52
- finish, 18V, cordless, NOV:52
- framing, cordless, brushless, review, APR:60
- framing, pneumatic, how to tear down and rebuild, step by step*, DEC:24
- nail racks, trick for holding together when tossed, OCT:69
- pneumatic, mini palm **(P)**, FEB:50
- Paints and finishes:**
- clear finishes on architectural woodwork, techniques for applying*, FEB:45
- deck stain, reflective, temperature-reducing **(P)**, JUL:49
- high-quality finish for interior trim, steps for achieving*, MAY:31
- lead-paint removal with infrared radiation stripping tool, review, MAR:21
- paint, high-volume **(P)**, JUL:49
- painting training program for high-school students, FEB:9
- stain-blocking primer/sealer **(P)**, OCT:57
- Plumbing:**
- mechanicals, complex, organizing and documenting for large houses*, DEC:30
- PEX valve, no-crimp **(P)**, NOV:48
- Porches:**
- pre-cast footings, precise installation approach for extra-long porch, APR:17
- screen system, heavy-duty **(P)**, MAR:59
- Rainscreens:** See Exteriors; Siding.
- Remodeling and restoration:**
- concrete block addition to rowhouse, two-story, installation details for, JUN:21
- jig for cutting baseboard in old houses, NOV:55
- kitchen ceilings, out-of-level, how to deal with on remodel, OCT:19
- rebuilding a flooded house over an 8-foot-tall vented crawlspace, or "Texas basement"*, NOV:41
- Roofing:**
- asphalt shingles, faster-install **(P)**, AUG:56
- asphalt shingles, guidelines for installing, MAY:11
- coal tar pitch built-up roofing, vs. asphalt, explained and dangers of, MAY:62
- composite shingles, weathered-look **(P)**, MAY:52
- concrete roof tile in beach-inspired colors **(P)**, JUL:49
- fiberglass shingles, algae-resistant **(P)**, SEP:58
- Roofs:** See also Framing, roof.
- asphalt, drip edge code requirements, wind resistance and choosing profile type for, MAY:49
- avoiding wet roofs, part one: ventilation, insulation, and moisture control overview*, JUN:41
- avoiding wet roofs, part two: accepted code practice vs. new research for unvented roofs*, JUL:35
- ice barrier membrane and correct way to install drip edge per code **(Q)**, MAR:17
- ice barrier membrane, installation height and code **(Q)**, FEB:13
- net zero house, advanced mechanicals and envelope details for, FEB:27
- soffit vent with low resistance backdraft damper **(P)**, FEB:50
- solar shingles **(P)**, NOV:48
- Safety, jobsite:** See also Fire resistance and safety.
- coal tar pitch built-up roofing, vs. asphalt, explained and dangers of, MAY:62
- fall protection, overview and rock climbing and arborist equipment, MAR:21; **(Q)**, MAY:15
- silica dust, OSHA rules for working with and how to comply, MAR:65
- Saws:**
- chain saw for carpentry, DEC:42
- circular saws, how to measure and cut sheet stock with, JAN:7
- compound miter, sliding, cordless, 10-inch, review, JUN:66
- compound miter, sliding, dual-bevel, 10-inch, comparison and review*, SEP:45
- jigsaw, cordless, D-grip **(P)**, NOV:52
- miter saws, method for tuning up in shop or on jobsite, DEC:11
- recip, cordless, compact, review, OCT:63
- reciprocating, cordless, uses and how to use, overview for new carpenters, MAR:11; JUN:9
- sidewinder, 15-amp, OCT:63
- table, 18V, cordless, OCT:63
- wormdrive, cordless, rear-handle, review, MAY:56
- wormdrive table saw, heavy-duty, review, MAY:56
- Security and lock systems:**
- hardware for multi-point locking systems **(P)**, APR:57
- lock network module for voice control via remote or mobile app **(P)**, OCT:57
- Showers and tubs:**
- control panel and valve, smart **(P)**, JUL:49
- drains, stainless steel, screwless **(P)**, MAR:59
- showerheads, touch-control **(P)**, APR:57
- showerheads, ultra-thin **(P)**, MAR:59
- shower niche, fiber-cement **(P)**, AUG:56
- shower trays, curbless **(P)**, NOV:48
- valve system, easy-install **(P)**, SEP:58
- waterproof panel, membrane, and sealing kit **(P)**, JUL:49
- Siding:** See also Exteriors; Moisture and moisture control.
- cedar shingles, drainage plane and installation details for, JUN:11
- composite, accessories **(P)**, AUG:56
- concrete masonry veneer, mortarless **(P)**, FEB:50
- corner trim with integrated nailing flange **(P)**, MAY:52
- engineered, vertical, cedar-texture **(P)**, APR:57
- fiber cement, in modern styles **(P)**, FEB:50
- sidewall shingles, fastening with nails vs. staples **(Q)**, SEP:11
- SmartSide engineered wood, overview, installation details, and review*, MAR:45; **(L)**, JUN:9
- vinyl, and soffits and accessories **(P)**, OCT:57
- vinyl, with UV protection **(P)**, AUG:56
- Sitework:** See also Foundations.
- perforated pipe, heavy-duty, how to place **(Q)**, FEB:13
- well pit / water-pump bunker for well head and pump at slab-on-grade site, JUL:15
- Solar power:**
- net zero house, advanced mechanicals and envelope details for, FEB:27
- solar plus storage development in Ariz. helps solve supply and demand swings, JUN:57
- solar plus storage system vs. grid-tied, options

and economics of, FEB:23

Sound resistance:
polymer sheets transform acoustical energy (P), MAR:59
underlayment, sound-control (P), DEC:38
with staggered studs, sealed outlet boxes, insulation, and double drywall, FEB:17

Stairs:
newel post, salvaged, rebuilding, DEC:11
squeak-free, materials and installation techniques for*, JAN:41

Storage:
closet, adjustable with hidden hardware (P), AUG:56
closet, shelf and rod system to maximize space (P), JUN:62

Storms: See Climate and construction.

Structural:
anchor kit for lateral loads (P), JUL:49
failed girder, correcting with fabricated steel bracket, OCT:27
framing a Passive house with complex design using steel, glulams, and LVLs*, APR:39
LVL, long, lifting and placing with a telehandler, AUG:15
slab-on-grade homes, lifting in flood zones, resetting on columns, and finishing*, SEP:37

Technology:
aerial measuring tool for roofs and solar (P), DEC:38
ceiling fan, smart (P), JUN:62
garage door opener, remote, smart (P), AUG:56
hearing protection/ear muffs, Bluetooth-enabled, review, JUN:66
labor costs, tracking with Google smartphone form and processing in Excel, JUN:31
range hood and cooktop with wireless communication (P), FEB:50
smart home control panel (P), NOV:48
vacuum system, cordless, with wireless auto-start, FEB:54
voice control for bathroom fixtures (P), JUN:62
water monitor, smart (P), DEC:38
water security and management system, smart (P), FEB:50
wood post anchor with steel base plate (P), SEP:58

Tile:
ceramic, natural colors (P), SEP:58
limestone or marble, Mediterranean-style (P), NOV:48
transition detail for meeting carpet (Q), JAN:11
underlayment, self-leveling, installing, MAY:19
waterproofing membrane, minimizing layers to prevent uneven surfaces, JUN:21

Timber framing, topping out a frame with a wetting bush, origins of, DEC:48

Toilets, low-flow, vacuum-assist, compact (P), FEB:50

Tools & Equipment: See also Materials; Nailers; Saws.
barrier system magnetic door, ZipWall, review, JAN:52
block planes and chisels, how to tune and sharpen, JUL:53
cable stapler, cordless, DEC:42
compressor, cordless, pancake-style, review, NOV:52
compressor, high-pressure, 5.7-gallon, review, JUL:53
CT extractor with remote and Bluetooth start capability, AUG:60
deck board clamp, drill-powered (P), MAR:59
drill/driver and impact driver, subcompact, brushless, review, FEB:54
drill/driver, compact, review, JAN:52
dust barrier system with wall mount (P), JUN:62
dust particle separator, cyclonic, OCT:63
fall protection, overview and rock climbing and arborist equipment, MAR:21; (Q), MAY:15
hearing protection/ear muffs, Bluetooth-enabled, review, JUN:66
Hitachi name change to Metabo and new line of multi-volt tools, DEC:42

ladder, multi-position, lighter-weight, DEC:42
ladders, step and extension combo, and leaning ladder, APR:60
layout square, titanium, with extra layout options, OCT:63
layout square, using white mark to facilitate wall plate layout, DEC:46
lead paint removal with infrared-radiation stripping tool, review, MAR:21
level and plumb gauge (P), FEB:54
levels, concrete, 3-in-1, AUG:60
miter snips for molding (P), SEP:58
radio and speaker, smart-phone compatible, AUG:60
router, palm, compact, cordless, AUG:60
sander, random orbital, dual-mode, with dust extraction port, review, AUG:60
screws, collated (P), JAN:49
screws, wood, high-strength (P), APR:57
tape measure with U-shape belt clip, review, JAN:52
telehandler, lifting and placing long LVL with, AUG:15
utility knives, new models (P), SEP:58
vacuum cleaner, cordless, handheld (P), JUN:62
vacuum, cordless, OSHA silica Table 1-compliant (P), NOV:52
vacuum system, cordless, with wireless auto-start, FEB:54
work boots, wedge-style, review, DEC:42
work gloves, cut-resistant (P), JAN:49
work shoes, basketball-style, review, JUN:66

Trim. See Finish carpentry; Interiors; Exteriors.

Ventilation, mechanical: See Bathrooms; HVAC.

Ventilation, roof. See Roofs.

Vinyl. See Flooring; Siding; Windows.

Water heaters:
boiler, combination, high-efficiency (P), JUL:49
tankless, recirculating, on demand (P), FEB:50

Wind and wind loads: See Climate and construction; Structural.

Windows:
air-sealing, why and how-to, step by step, APR:9
blower door test before window installation to test airtightness of shell (Q), JUL:11
casing, how to install, DEC:6
flashing, basic principles and how-to, APR:17
folding, panelized, removable (P), APR:57
joining systems for large window combinations (P), DEC:38
privacy, patterned (P), JAN:49
replacing in curved wall, with rainscreen system, vapor-open WRB, and zinc flashing*, AUG:21
stool, how to install, NOV:7
window seat and tempered glass, IRC vs. assessment of safety, SEP:11

Woodworking. See also Finish carpentry.
box beams, building and using for on-site shop, JAN:15
carpentry, the role of in *Moby Dick*, AUG:64

Professional Deck Builder Index

Business:
reputation, building and managing through customer satisfaction and reviews, MAY:21
welcome kit as referral generator, MAR:7
wintertime building, strategies for operating efficiently and comfortably, DEC:13

Code:
cantilevered members, uplift, and joist hangers, code compliance for (Q), MAR:11
decorative railings and code compliance (Q), MAR:11
flush decks, code, and feasibility (Q), DEC:5
guard-post connections and need for ICC guideline, MAR:17
outdoor kitchens and IRC requirements for gas, electrical, and water, SEP:19

Design:
clients, consulting with on aesthetics, economy, and function, DEC:9
coastal decks and the stacked effect, MAY:13
flush decks, code, and feasibility (Q), DEC:5

home designed as steamship with multi-level decks and cable rail infill, JUL:44
large project with sauna, pergola, and sunken lounge, MAR:40
National Deck Competition, 2018 winning projects*, DEC:16
pool house, second-story addition for, JUL:15
privacy fence for pool with metalwork panels, red cedar posts, and trelliswork, MAY:42
replacing hardscaping with PVC deck and tempered glass panel railings with built-in LEDs, SEP:44
replacing old wooden deck with freestanding frame and stone pavers*, MAY:27

Dock and boathouse, laying out, setting pilings, framing, and installing, JUL:33

Editor's letter: *Professional Deck Builder* magazine, history, online content, and section in *JLC*, MAR:3

Foundations, metal hardware systems for freestanding decks, two case studies*, SEP:33

Framing: engineered lumber and use in outdoor applications (Q), JUL:11

Guardrails and railings:
cable railings, swaged and swageless, explained and pros and cons of (Q), SEP:13
decorative railings and code compliance (Q), MAR:11
guard-post connections and need for ICC guideline, MAR:17
home designed as steamship with multi-level decks and cable rail infill, JUL:44
replacing hardscaping with PVC deck and tempered glass panel railings with built-in LEDs, SEP:44

Methods and materials:
curved decks, cutting radius decking vs. heating and bending Trex for affordability, JUL:23
low-voltage wiring, and solution for mice damage, SEP:7
water level, old-fashioned, how to use, DEC:3

Moisture and moisture damage:
leak repair and revealed wall damage, structural rot, and concrete pier defect*, SEP:23
ledger and flashing problems, correcting on rebuild, DEC:24

Outdoor living spaces:
large project with sauna, pergola, and sunken lounge, MAR:40
privacy fence for pool with metalwork panels, red cedar posts, and trelliswork, MAY:42
stone deck with concrete retaining wall planters, garden wall, and hot tub*, MAY:27

Pergolas:
cedar, prefabricated, designing, cutting with CNC machine, and installing*, MAR:29
large project with sauna, pergola, and sunken lounge, MAR:40

Posts, protecting from soil with composite sleeves, hardware, and backfill, MAY:7

Saunas and spas:
foundation, framing, and installation details for large swim spa in deck*, MAR:21
large project with sauna, pergola, and sunken lounge, MAR:40

Stairs:
attaching with 2x12 into the rim joist, JUL:7
bracketed stringers for width and strength, layout and installation*, MAY:35

Storm resistance, pilings, cross-bracing, and hardware for coastal storm-resistance, MAY:13

Structural:
cantilevered members, uplift, and joist hangers, code compliance for (Q), MAR:11
guard-post connections and need for ICC guideline, MAR:17
ledger and flashing problems, correcting on rebuild, DEC:24
pilings, cross-bracing, and hardware for coastal storm-resistance, MAY:13
stone deck with freestanding framing and concrete work, designing and installing*, MAY:27

Technology, baluster spacing and joist layout app, MAR:38

Tools, circular saw, left-blade, review, SEP:43

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BY SYMONE GARVETT



1. Fireclay Sinks

Italian kitchen designer Bocchi's product line, recently introduced to the U.S., includes four kitchen-sink design series. Made from natural and recyclable fireclay that's kiln-fired at 2,000°F, Classico, Contempo, and Vigneto sinks feature a farmhouse style with apron fronts, while Sotto sinks have an undermount design. Bocchi says that a glaze coating fused with the fireclay creates a nonporous surface that resists scratches, stains, and calcium deposits. Sinks include a removable protective bottom grid and are available in nine finishes. Pricing ranges from \$350 to \$2,200. bocchiusa.com



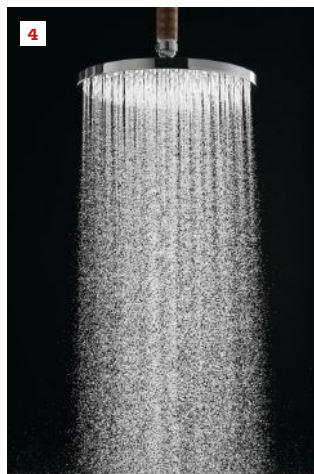
2. Residential Glass Rinser

Delta Faucet, with the help of Indiegogo's Enterprise Services, has reimagined a common bar and restaurant fixture—the glass rinser—for residential use. The rinser may be installed alongside a new or existing sink or faucet. When the user presses a drinking vessel onto the rinser, a center-positioned spray will jet in several directions to rinse off residue or dust. Runoff water then funnels into the sink below. The rinser is slated for potential release next year and is preselling for \$95. www.deltafaucet.com



3. Energy-Efficient Boiler

Weil-McLain's new wall-mount line of combination and heat-only boilers, the AquaBalance Series 2, combines an AFUE rating of 95% with on-demand domestic hot water and a space-saving, easy-to-install package. AquaBalance comes in three sizes (80, 120, and 155 mbh input), in both combi and heat-only versions. It produces a constant supply of hot water up to 4 gpm at 70°F temperature rise. The company says that simple, user-friendly controls make installation and operation easy. Pricing starts around \$2,700. weil-mclain.com



4. Soft Rain Showerhead

Hansgrohe's PowderRain shower spray, newly available on a range of Hansgrohe's Raindance showerheads, is designed to produce a spray of "micro-fine" water droplets. PowderRain showerheads incorporate multiple fine openings in each nozzle, which the company says creates a powder-like sensation, reduces splashing, and retains warmth on the skin. All are available in chrome and brushed-nickel finishes. Pricing ranges from \$160 to \$830. hansgrohe-usa.com

Products

5. Composite Ipe Siding

Tropical Ipe Décor #PU30, Trespa's new option in its Pura NFC siding line, is designed to look like untreated ipe but require less maintenance. Trespa Pura NFC composites are made from up to 70% natural fibers, which are infused with thermosetting resins. According to the manufacturer, the siding's closed surface is designed for UV stability and weather resistance and doesn't need to be painted or lacquered. Contact a local distributor for pricing. trespa.com

6. Handheld Thermal Camera

Seek Thermal has created a handheld thermal camera for professional use. The Seek Shot and Seek ShotPro cameras allow users to detect heat sources—including leaks, electrical shorts, mechanical faults, and energy loss—inside or around walls without damaging the envelope. Its touchscreens allow the user to capture images in a number of colors or use the device's "SeekFusion technology" to adjust the blend between visible and thermal images. The Seek Shot features a 206x156 thermal sensor, while the Seek ShotPro features a 320x240 sensor. Both measure temperatures from -40°F to 626°F. The Seek Shot retails for \$500, and the Seek ShotPro for \$700. thermal.com

7. Wood Moisture Meters

Wagner Meters' has introduced a new line of Orion wood moisture meters for professional wood flooring installers and inspectors, quality-control managers, and woodworkers. The new pinless Orion line measures both in and on the wood, according to the manufacturer. The meters build off their MMC/MMI predecessors by adding dual-depth measurement and in-the-field calibration with an integral rubber protective boot and rugged case design. Prices range from \$320 to \$480. wagnermeters.com

8. Induction Cooktop With Touchscreen Control

BlueStar's 36-inch Touch Induction Cooktop features touchscreen controls rather than knobs. The electric cooktop lies flush with any countertop and has five 5,500-watt burners, each with three levels of heating performance, which the company claims heat up faster than a gas burner. A seamless two-burner bridge function allows users to grill with an add-on, dual-zone griddle. Safety features include a safety lock, pan detection, and hot-surface indicator light. The maker says that the black ceramic glass surface is scratch and stain resistant. Pricing starts at \$3,000. bluestarcooking.com



9



9. Smart Touchscreen Thermostat

Johnson Controls' Glas smart thermostat uses a translucent OLED touchscreen display to control its functions. Users can touch the screen to change the temperature, monitor indoor and outdoor air quality, and track energy savings. Alternatively, the unit can be controlled by mobile app or voice, via Microsoft's Cortana. Glas can also report humidity, total VOCs, and equivalent carbon dioxide. When connected to the internet, the unit can monitor pollen count and UV index and can turn on ventilation equipment when air quality falls below moderate levels. Pricing starts at \$320. johnsoncontrols.com

10



10. Skylights for Metal Roofs

Metal-roofing manufacturer Architectural Metal Supply has developed a product to help roofers and builders flash a skylight in a metal roof. The patent-pending product, dubbed EZ Curb, aims to save workers' time and ensure a watertight installation, according to the company. EZ Curbs are made with 12-gauge aluminum and an integrated diverter. They come in three standard sizes, with custom sizing available upon request, as well as in an array of colors. Pricing for standard sizes and colors ranges from \$415 to \$530. archmetsupply.com

11



11. Stainless Steel Counters

Federal Brace has recently announced the return of Stainless Steel Island Countertops to its residential product line. The countertop material boasts a contemporary, modern flair that would look at home in a chef's kitchen. Stainless steel is durable, stain-resistant, nonporous, and heat tolerant, and it also provides fast and easy cleanup, according to the manufacturer. The prep surface is sold in the standard island size of 50-by-26-by-1.5 inches, but custom sizes are also available. Pricing for the counter starts at \$870. federalbrace.com

12



12. Kitchen Hardware

The knobs and handles in Amerock's newest hardware collection, Carrione, are inspired by Italian Carrara marble. The metallic bases feature two geometric rings that cross over the top of the marble-look handle, which pairs angular textures with rounded ends. The collection is available as a 2 1/2-inch knob and 3 3/4-inch, 5 1/16-inch, and 6 5/16-inch pulls. The zinc knobs and pulls come in a marble-white base color with a choice of five metallic handle and accent finishes. Pricing ranges from \$15 to \$40. amerock.com



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TOOLS OF THE TRADE

Jumbo-Sized Beam Saw

BY MICHAEL SPRINGER

When cutting thick timbers and beams, carpenters commonly make one full-depth cut with a circular saw across one side, carefully flip the piece over (without breaking it at the cut), make a second full-depth cut in line with the first, and then connect the two saw kerfs with a recip saw. For rough-cut faces that end up hidden from view, this method may suffice, but for straighter, smoother, and faster cuts, a beam saw is the tool for the job. Enter Skilsaw's new Super Sawsquatch.

I recently used this big saw to cut 5x5 and 6x6 landscape timbers, 5 1/4-inch LVLs, and 5 1/8-inch glulam beams. The Super Sawsquatch (Model SPT70V-11; \$700) comes with a 16 5/16-inch (414mm) blade and will cut to a depth of 6 3/8 inches straight down and about 4 1/4 inches at a 45-degree bevel.

The Super Sawsquatch tilts to 47 degrees, and to make sure the cutting angle stays set securely over its length, the saw features pivots with locking levers at both the front and rear of the upper guard. For accurately setting the saw for 90-degree perpendicular cuts, there are adjustable stops at the front and rear also.



The Super Sawsquatch can cut a 6x6 in a single pass, and has a built-in clutch and an electric brake for safety. It comes with a plastic base to protect the lower guard when you set the saw down, and also to securely contain the saw during transport.

According to Skilsaw, the wormdrive motor on the Super Sawsquatch is the largest the company has ever made for a saw; it's even stronger than the one on Skilsaw's full-size portable table saw. The no-load speed of the saw is 2,500 rpm, which moves its big blade 12.5% faster than a 7 1/4-inch wormdrive Skilsaw running at 5,300 rpm. This allows the saw to move at a surprisingly quick pace through 5-inch-plus-thick wood, and I never had the feeling that the saw was holding me back from cutting as fast as I wanted, regardless of the material. An electric brake quickly slows the big blade down after the cut.

The only time the saw felt like it was pushing back was when the lower guard was running into a lot of resistance. The guard has a nice curved lobe on its right side to help push it open against the material being cut without snagging, and as long as I cut with the dropoff to the left during thin shave cuts, I didn't experience any hangups. But the amount of force the extra-large guard takes to open against the material can stop you dead in your tracks at times. Because of the guard's strong return spring and the friction that rough timbers and laminated beams apply to the guard's nose, I found the best way to ensure that the guard didn't get stuck was to manually hold it open at the beginning of a cut.

The blade-left configuration of this saw provides very good visibility of the blade at the cutline, so I never had to rely on the multiple guide notches in the cast magnesium base. But the 90-degree markers seemed accurate enough whenever I glanced at them during a cut.

With the saw tilted to a 45-degree angle, it was like wrestling with a different beast. It took a slow and deliberate approach to make sure the saw's shoe was planted flat on the wood, and despite my best efforts to ensure stability, freehand bevel cutting was the only time I bound the blade and enacted the blade's rudimentary safety clutch.

I did most of my testing with the stock 32-tooth carbide blade that comes with the saw, which is fine for general cutting. Diablo offers a finer, 60-tooth blade that may be a better choice for exposed cut ends and timber-frame-type joinery cuts.

Michael Springer works from his office and shop in Boulder County, Colo. He specializes in tool testing and industry coverage for professional construction, woodworking, and DIY publications.

Photo: Michael Springer

Craftsman V20 Impact Driver

BY MARK CLEMENT

Under the ownership of Stanley Black & Decker, the iconic Craftsman brand has relaunched, bringing with it its famous lifetime warranty for hand and mechanic's tools and an industry-standard 3-year limited warranty for most power tools. Recently, while building a deck, I used a Craftsman CMCF820 20-volt impact driver to see if its Porter-Cable DNA translated into a pro-level tool.

The driver is light, but not light duty. I drove pounds of screws, ranging from #10 x 1 1/2-inch to #10 x 3-inch to 5/16 x 6-inch lags for posts, and found the power was up to the task in every case but one: I buried a 6-inch lag 3 inches deep into a post when the battery died. A new battery wouldn't move the frozen lag, but another impact driver did. So, it's not the most powerful tool, but it makes up for it with smooth engagement, light weight—I can carry it on my nail bags and almost not know it's there—and a handy belt hook.

Often, it's doing the weird stuff that shows you the thought that goes into a tool's design. Fastening joist hangers on a low-to-the-ground deck—with umpteen angles of attack required to set screws—qualifies. The Craftsman was nimble, with a grip that was equal parts easy to hold and easy to slide around in my hand. Its profile is less clunky than on other brands, and the DeWalt-inspired three-point work light is especially handy.

The trigger is easy to goose to set a screw just so, while the noise level is on a par with other brands I've used. It has three speeds and a welcome battery fuel gauge. The forward/reverse switch is just OK.

The battery exchange is a little stiff on the tool and charger. But the charger is easy to decipher, with a solid green, easy-to-see-in-a-pile-of-stuff light that means "charged."

The 1/4-inch hex drive is awesome in one regard: You can slot the bit without pulling



the collar back. Conversely, there's play. If you drink coffee or are straining to hold a joist on layout while setting a screw into a hanger and don't have surgeon's hands, you'll notice it.

It's great to see a legacy brand back in the game with a tool that lives up to the name. \$100 (tool only); \$250 (CMCK220D2 kit with charger and two batteries). craftsman.com

Mark Clement is a builder and writer in Ambler, Pa.

Bosch Customizable Bit Set System

BY CHRIS ERMIDES

A while ago, Bosch released a new line of bit sets housed in a newly designed line of cases. It's tough to be excited about bits, but I've been impressed with the design of the cases. I have had numerous bit cases from several manufacturers over the years and the most frustrating thing about all of them is getting the bits out of and then back into their proper places. Until using the Bosch cases, I hadn't used a case design that made removing and replacing the



bits easy. Inevitably, over time, I pulled the individual holders out of the cases and just threw a bunch of loose bits in them, making it difficult to keep inventory on what I had. I know it's a common issue because I've seen many other trades do the same thing.

What's nice about the Bosch case system is that the bits clip easily into the red holders. You don't have to put them in at just the right angle or fiddle around with them, and they come out easily too. The red bars that house the bits come out easily as well, so I'm able to pull a whole row out and keep it in my tool bags while I'm using it. This feature makes the cases themselves customizable.

The case has rubber bumpers and a spring-style latch (there's no extra spring; the design keeps tension on the latch to keep it closed). I like the latch design better than slide-style latches because it makes accessing the bits easier. On the other hand, the latch can pop off if it gets banged around inside a toolbox, so keep an eye out for it.

The sets come equipped with Bosch's Impact Tough bits. They're available in four configurations: DDMS20 Drill/Drive (20 pieces), SDMS24 Screwdriving (24 pieces), DDMS40 Drill/Drive (40 pieces), and SDMS44 Screwdriving (44 pieces). boschtools.com

Chris Ermides is editor of Tools of the Trade.

Milwaukee M18 Fuel Cordless D-Handle Jigsaw

BY JEREMY KASSEL

When I first got my hands on the Milwaukee M18 Fuel D-Handle Cordless Jigsaw kit (2737-21; \$300 for the kit, which includes one battery, a charger, a carrying case, and accessories), I actually breathed a huge sigh of relief. I had been using a 12-year-old DeWalt corded jigsaw, and it was pretty much on its last leg. While the DeWalt jigsaw served its purpose for many years, over time it became evident that it was outdated and just plain clunky. We all know that cordless, brushless jobsite tools are the way to go, particularly for tools like grinders, circular saws, routers, and, of course, jigsaws that fit in one hand. I couldn't wait to start using Milwaukee's new jigsaw.

My first impression was that the tool was "plasticky." As such, I was worried that it wouldn't be sturdy enough to hold up to jobsite abuse, but those fears disappeared as soon as I started working with the saw. It feels substantial in the hand but without feeling heavy.

During my first "walk around" with the Milwaukee jigsaw, I noticed that it had a ton of features that my older, DeWalt corded model did not:

- An LED light that illuminates the cutting area and that stays lit for about 10 seconds even after the trigger is released. This is helpful for finding the cut line without continually engaging the trigger.
- A switch for engaging a blower to keep sawdust off the cutting area. The blower works effectively, even for larger bits of wet pressure-treated lumber.
- Toolless blade changes, thanks to a sliding lever on the front of the saw. While the lever action isn't exactly smooth, it is nice to not need an Allen wrench to change blades.
- A removable plastic footplate, which I am reserving for trim carpentry and finish work.
- A large lever between the motor housing and the footplate that unlocks the footplate and allows it to bevel. Again, a nice feature is that it doesn't require an Allen wrench. Detents are found at 0, 15, 30, and 45 degrees.
- Four settings of orbital cutting action.
- A dust-collection port for connection to a vacuum.

Cutting with the Milwaukee cordless jigsaw is a pleasure. Thanks to its Red Lithium XC 5.0-Ah battery and brushless motor, this saw has a ton of power, yet cuts very smoothly.

The saw doesn't have a variable speed adjustment dial, which some trim carpenters might find off-putting, but I found its variable speed trigger to work just fine for my needs. I don't do a lot of trim carpentry, so I use a jigsaw mostly for general carpentry work, some framing, and notching sheet goods. The D-handle is comfortable, familiar to nearly all users, and grippy thanks to a nice rubber over-mold. All of the features work well and capture their intended purpose, except the dust collection, which was essentially ineffective.

WORTHY INVESTMENT?

While there seems to be a lot of excitement surrounding the barrel-grip version of this saw (2737B-21), there is absolutely a place in the market for a traditional D-handle jigsaw. If you already are in the Milwaukee M18 platform, this tool is a no-brainer, particularly if you are looking for a cordless upgrade from a corded jigsaw. The features of this D-handle saw might not seem innovative, new, or exciting to a trim carpenter, but they are certainly welcoming for someone needing a jigsaw upgrade. There's a lot to like about this jigsaw: It has great features, feels good in my hand, and just plain does what I need it to do. milwaukeeetool.com.

Jeremy Kassel is the owner/operator of Kassel Construction in Glenmont, N.Y., as well as the co-host of the House Calls Podcast. He can be found on Instagram @kasselconstruction.



With a brushless motor and a 5.0-Ah battery, Milwaukee's new D-handle M18 Fuel cordless jigsaw offers plenty of cutting power in a lightweight and compact package.

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January Advertising Index

Advertiser	Page #
Adrian Steel	12
AdvanTech	C3
Boccia	54
Chief Architect	C2
DAP Products Inc.	13
Dryerbox	10
GEICO Commercial	6
Grabber Construction Products	18
Jesse H. Neal Awards	4
JLC Field Guide	28
JLC Website	50
Kozy Kollar	54
Lowe's Companies, Inc.	3
Mark E. Industries	10
Maze Nails	25
National Remodeling Foundation	46
Polyguard Products, Inc.	14
Protective Products	54
Simpson Strong-Tie	5, C4
Tamlyn	41
The Work Truck Show 2019	27
ZIP Systems by Huber Engineered Woods	22
Zipwall	13

BY PAUL DERKSEN

Framing for the Long Haul

Editor's note: This tip made immediate sense to many of us with bad backs, shoulders, and knees born of jobsite injuries and the stresses of lifting heavy materials. Even if you're still young and fit, consider what it will take to stay in the game for the long haul. Making one of these and using it to haul around the big stuff might help.

I picked up this tip when training at the Yestermorrow Design/Build School years ago to learn more about timber framing: To move heavy beams and posts, I now always use a timber cart. I built my own cart out of scrap lumber, a 5/8-inch steel axle rod from an old garden cart, and a pair of 26-inch-diameter wheels.

The key to using the cart is to balance heavy loads over the cart's midpoint, the axle. I use it to move 24-foot staging planks, ladders, beams, and piles of framing lumber.

My homemade version is approximately the same height as my sawhorses. By pushing down on one end of the cart, I can raise a timber or staging plank high enough to easily set one end on my truck's ladder rack or on a set of staging, and then slide it up into place.

Homebuilder Paul Derksen owns TurningLeaf Housewrights, based in Norwich, Vt.



Send us your tips: JLC, in partnership with our sister publication *Tools of the Trade* and Milwaukee Tools, is giving away a power tool each issue to the reader who sends us the best trade tip. (Next month, we'll give away a Milwaukee M18 Rocket Tower Light/Charger Kit, shown at right). Send tips to JLC-Editorial@hanleywood.com with "Trade Tip" in the subject line. Any building trade qualifies. Don't sweat the grammar or writing; that's what JLC editors get paid for. But please send us high-quality photos, and, if needed, a rough sketch to explain your tip.



BY TED CUSHMAN



Clockwise from top left: Mystic Seaport shipwrights Brett Land drilling holes for trunnels, Anthony Daniels fairing the hull, Greg See installing waterways, and Anthony Matt hand-planing a plank.

Restoring the Mayflower

If you love working with wood, it's hard to imagine a cooler job than restoring an old-time wooden sailing ship. Just ask Matthew Majewski. He's a shipwright at the Henry B. DuPont Preservation Shipyard at the Mystic Seaport Museum in Mystic, Conn., and these days, Majewski is working on a stem-to-stern rehab of the Mayflower II, a historically authentic replica of the original Mayflower that brought the Pilgrims to America in 1620.

Like many of his fellow shipwrights, Majewski's a graduate of the International Yacht Restoration School (iyr.edu) in

Newport, R.I. How much fun are they having? Just check out Majewski's Instagram (@silkywoodboy_), where he posts cool photos of work in progress.

The lumber includes domestic yellow pine and purple-heart, along with some white oak cultivated in the royal forest in Denmark. The crew steam-bends pieces as big as 6 by 10 inches, and uses everything from a chain saw to a hand plane to make extreme bevels. "We also have two motorized ship saws for rolling bevels," says Majewski. "Some pieces it takes all eight of us to bend into place and clamp on."

Photos by Matthew Majewski and Nathan Gould

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