Basement

Finishing and Remodeling

A three-article collection highlighting the construction know-how to build beautiful, comfortable living spaces below grade

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Build a Risk-Free Finished Basement

Capturing this additional living space correctly and confidently requires a careful approach to the site and foundation

BY STEVE BACZEK

Finishing a basement can create extra living space with far less cost and complexity than an addition that expands the home's footprint. Perhaps for that reason alone, finishing a basement is a popular project for many homeowners. But a well-designed basement remodel is much more than an assembly of studs and drywall thrown up over a foundation wall, then trimmed and painted. Understanding and managing the risk of moisture and bulk water are imperative to developing a successful basement design, as is getting the insulation and air-sealing details right.

By assessing your site and basement accurately, and detailing your foundation floor and walls appropriately, not only can you improve the comfort, health, and efficiency of your home, but you can tackle the fit and finish of your basement with complete confidence in its durability and longevity.

Economics of performance

As with all construction projects, risk and performance in a basement remodel exist on a sliding rule of cost. Minimizing risk, providing durability, and ensuring proper performance come with a price. But when is good enough really good enough? It is easy to think of a basement as "cheap" space, but if the remodel is not well planned, it could easily be an inexpensive project that leads to expensive problems down the road. Improper water management can lead to health and durability risks; improper thermal management can lead to comfort risks. When it comes to considering the budget for a basement remodel, it's helpful to follow the general guideline that as cost decreases, risk increases. The challenge is to find a suitable balance between cost and risk.

Rating the conditions

Because of the below-grade location of most basements, the existence of water is generally the measuring stick of risk. I typically rate existing foundations as having low, moderate, or high levels of risk. To me, low-risk foundations are not challenged at all by water infiltration. They are most often located in a high, well-drained area, and they have no evidence of water problems from the walls or the slab. Remodels should still be detailed carefully, though, since dramatic weather-related water events could occur at any time. I have also seen basements compromised because site conditions changed naturally, or more frequently, because neighboring properties were developed.

A basement with a moderate risk level has seasonal challenges. In colder climates, water from the spring thaw can saturate the ground. In warmer climates, water might become a problem during the rainy season. Regardless of the source, a moderate-risk scenario has water issues for up to half of the year. If you've lived in the house for a period of time, you certainly know if and when water issues are a problem. If you're working on a home without historical context, look for evidence of bulk water in the basement in the form of stain

MANAGE RISK AND REAP THE REWARDS

Risk is related directly to the threat of water and moisture in the basement. The more water challenging the foundation, the higher the risk level. Because no two basements are alike, each one demands its own method for keeping the space below grade dry and healthy. While finish and furniture selection can be inspired by other projects, it's important to design your finished basement around your specific needs and challenges. The approach to low-, moderate-, and high-risk projects outlined here is not theoretical. It can be trusted in practice. Below are three of the author's designs, built by Two Storey Building of Bolton, Mass., that afforded his clients the additional living space they dreamed of while also offering them peace of mind.

LOW This basement was a 1757-sq.-ft. remodel for clients looking for a family room, a fitness area, and a recreation area. The design is enhanced by a full-height walkout, which allows lots of daylight to enter the family room. This low-risk basement had an existing perimeter drain that emptied to daylight, but there was no evidence or history of water intrusion. The foundation wall was insulated with 2 in. of closed-cell foam, while the wood-framed walkout was insulated to R-19 with cellulose.

MODERATE This 1616-sq.-ft. basement remodel added a media room, a bar and recreation area, a fitness room with a flat-screen TV, and a large pantry at the bottom of the basement stairs for storing bulk items. The homeowners were looking for a casual environment for entertaining and a place for their three children to be with their friends. The basement was at a moderate risk level and required a new perimeter-drain system. In this remodel, the foundation walls were insulated with 2 in. of polyisocyanurate. A 2x4 stud wall was then framed over the rigid foam and filled with R-15 unfaced batts. Finishes in this space are casual and comfortable, and they are easily replaced if needed.

HIGH This design called for a media area, a kitchenette, and a fitness area with a full bath. The remodel was considered high risk, as the space endured occasional water intrusion. To provide proper water management, a drainage curtain was placed on the interior face of the foundation from the mudsill to a new perimeter drain. The walls were insulated with 2 in. of closed-cell spray foam placed between the 2x4 stud wall and the foundation wall. An additional R-15 unfaced batt was placed in the wood-framed stud cavity.

A DRY BASEMENT STARTS WITH SITE MANAGEMENT

Before beginning any basement remodeling work, make the effort to minimize the amount of water challenging the foundation walls. By keeping storm water, snowmelt, and runoff away from your home, you decrease the risk level of the basement renovation, which can help reduce the cost and complexity of the remodeling work. Here are the primary things to keep in mind as you create a strategy for keeping water away from the foundation.

ing on the slab and/or mineral streaks along the foundation walls. Your new neighbors might also be able to provide some insight into existing conditions, but keep in mind that every property is unique. Just because your neighbor's basement is dry doesn't mean yours is.

A high-risk basement faces water infiltration for more than six months of the year. Water might even be a daily challenge. High-risk basement remodels can be managed effectively, but demand a system of water management that requires a perpetual solution.

Site and foundation assessment

The initial steps in designing any finished basement are straightforward. First, if any water exists on the site, try to minimize the amount of water near the foundation as much as you can prior to beginning your work. The less water you have to deal with, the smaller the problem will be, and therefore, the smaller and less expensive the management system needs to be.

Once the site is analyzed and a plan for correction or improvement is developed, the foundation itself needs to be assessed. Different foundation types perform differently and can demand different approaches to management. Stone, brick, concrete block, and concrete all have specific characteristics that challenge a finished basement. Stone, brick, and concrete-block foundation walls are all mortared systems. The amount of mortar and the manner in which it was laid (neat and full vs. sloppy and spare) help determine the ability for water to penetrate the foundation wall. Because of their continuous casting, concrete walls offer a more formidable defense to the infiltration of groundwater. Make no mistake, though—if water exists, it will get in eventually.

Managing moisture

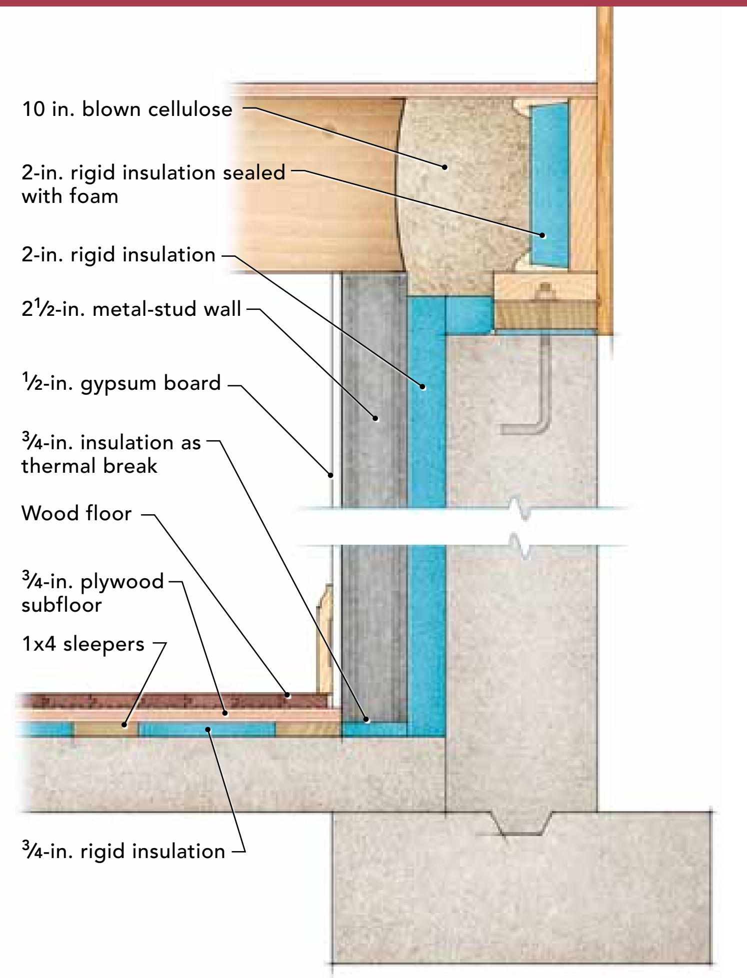
Moisture in its vapor form is usually not a cause for concern in a basement. It only becomes a problem when it is given the opportunity to cool and compress to its saturation limit and condense on cool surfaces. For this reason, controlling surface temperatures in the basement is critical. For example, I recommend thermally breaking the framed walls from the concrete slab with a piece of rigid insulation under the bottom plate. This prevents vapor from permeating through the slab and condensing on the cool wood framing, where it could conceivably cause rot and mold growth.

Some builders try to control vapor by applying vapor barriers between the slab and finish flooring or between the foundation walls and the finished space. In some cases, this approach might be successful, but I tend to stay away from barrier systems in favor of management systems. I typically allow the vapor to migrate into the basement and then manage the level of moisture in the basement air with my mechanicals. A heat-pump water heater, for instance, provides partial dehumidification of the air as it heats the domestic water supply. This appliance, though, needs its own drain line for condensate.

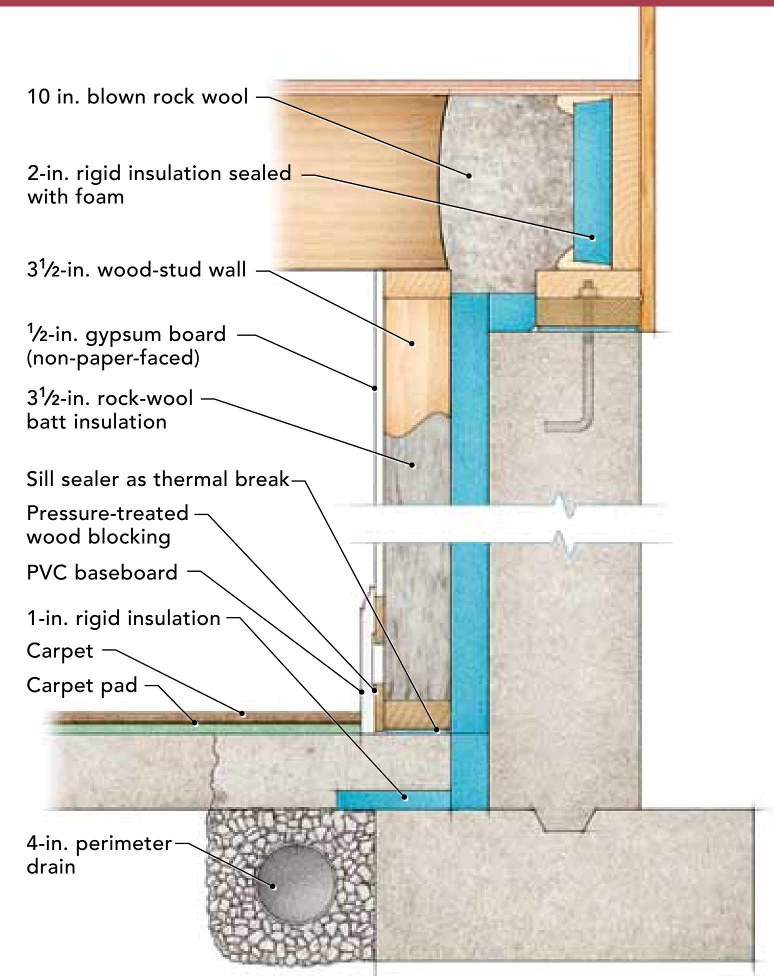
When it comes to managing bulk water infiltrating the basement, the strategy is straightforward. The objective is to manage, collect, and discard water from the basement. Depending on the level of risk and the amount of water infiltration, an appropriate drainage plane must be employed to manage this water. With a moderate level of risk where water moves through the wall by capillarity or saturation, the drainage plane could be as simple as a layer of rigid insulation applied to the foundation wall and its seams taped. At a higher level of risk, where bulk water comes through the wall, a drainage curtain or drainage mat would be needed. A drainage curtain needs to be linked physically to a subslab perimeter-drain system in cases where a footing drain isn't already in place. This is the "collect" part of the strategy. After the infiltrated water is collected, it is directed to a sump pump for discharge. (For more on sump pumps, see "What's the Difference?" on p. 30.) If the exterior grade allows, however, the perimeter drain can be directed to daylight at some point on the prop

BALANCE RISK
WITH THE RIGHT DESIGN

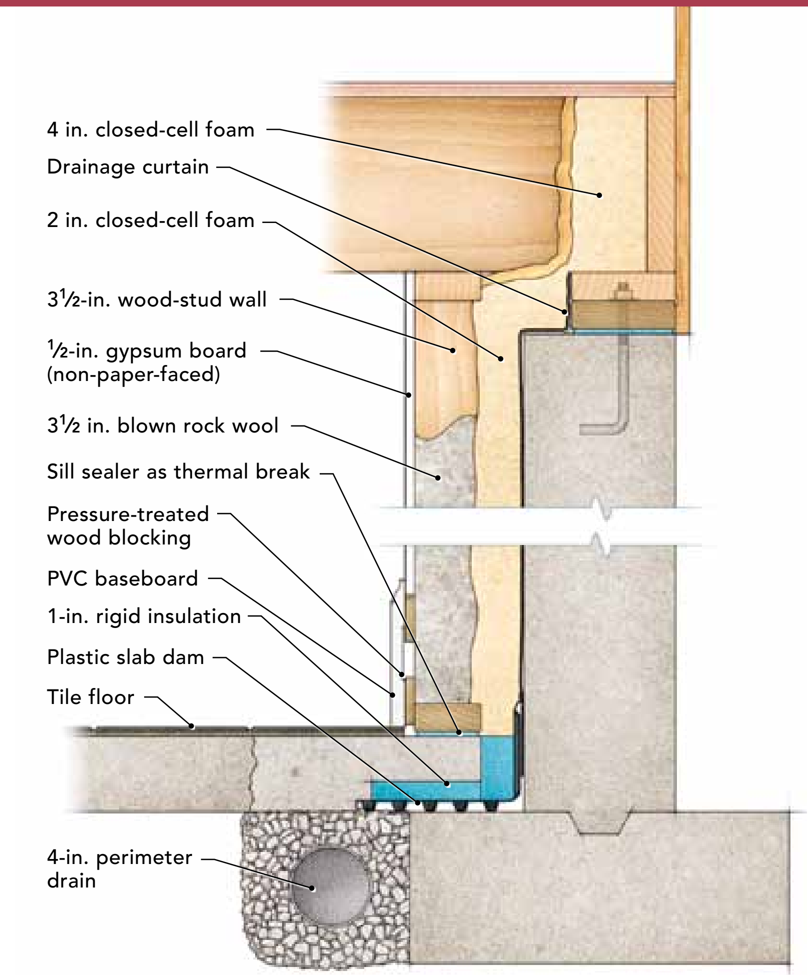
There are two simple rules when it comes to designing a finished basement. First, water is never stopped, halted, or detained; it is managed. Second, Mother Nature and Father Physics are formidable opponents, with a very long history of success. Believing that we can win against their natural forces is simply a fantasy. Water management that aligns with their rules is the path to ultimate success. The following examples illustrate adherence to these rules and insight into the proper approach to waterproofing, insulating, and finishing foundations that vary in risk level.



LOW RISK

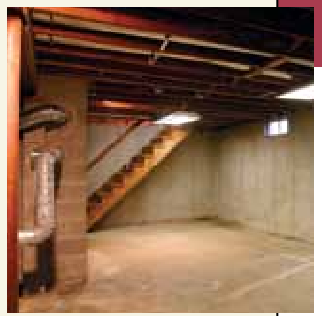


MODERATE RISK



HIGH RISK

Code considerations



Many code requirements for basements apply directly to occupant health and safety. Here are a few worth investigating before moving forward in any basement design.

- Ceiling height or beam height is always a challenge in basements, especially in older homes. According to IRC R304.3, minimum ceiling height of a habitable space is 7 ft.
- Egress demands increase dramatically when the basement remodel includes adding bedrooms. Refer to IRC 310.1.
- Proper alarms for smoke, fire, and carbon monoxide should be installed and maintained in accordance with IRC R314 and R315.
- Sealed-combustion mechanical equipment that separates the combustion air within the device from the basement air is required in some jurisdictions and is a good idea in all of them.
- Natural ventilation is a calculated requirement in many jurisdictions. Start by researching section R303 in the IRC.
- Radon testing and mitigation are required in some jurisdictions. Radon can become a problem as a basement gets tighter.

erty. By virtue of its subslab position, the perimeter drain handles any groundwater challenging the slab from below.

Insulation and air-sealing

In most unfinished basements, moisture issues cause few problems because a leaky above-grade envelope allows the moisture to dry. In many homes, though, attempts have been made to separate the basement from the conditioned living space above with batt insulation installed in the first-floor joist bays. These attempts usually fail, since air movement between the floors goes unchecked. In addition, as the lowest point in the house, the basement is subject to the hightest negative pressure (air infiltration) due to the stack effect. Whether the basement is insulated or not, the mechanical system located there is unavoidably tasked with conditioning the basement. In many cases, adding a proper thermal barrier in the basement allows the mechanical system to work less and still be able to provide the required heating or cooling of the insulated basement.

When it comes to insulating the basement, there are code-minimum R-values that vary based on where the home is located. My approach is to provide an R-value that is proportional to my thermal goals above grade. I typically strive for a basement-wall R-value that is at least half of my above-grade wall-insulation value. My target slab R-value is typically at least half of my basement-wall R-value. At a minimum, these numbers usually work out to an R-10 slab and an R-20 foundation.

Rigid insulation, spray foam, blown insulation, and batt insulation all have their place in certain basements. I typically consider batt or blown insulation to be an additional level of insulation rather than my primary insulating method. I refrain from putting any of them directly against the foundation wall for a couple of reasons. First, they allow air movement between the foundation and the wall assembly, making it more difficult to control the surface temperature of the framing and drywall. Second, water permeating the foundation can easily move through the insulation and damage the framing and drywall.

I like to control the surface temperature of the foundation wall with rigid foam or spray foam. After one of them has been installed, I determine the risk of adding batt or blown insulation. I tend to avoid batt or blown insulation in high-risk basements, and I use it sparingly or as bulk-fill insulation in lower-risk basements.

In terms of air leakage, the concrete walls and slab do a fine job of providing air-barrier continuity along their surfaces. With a stone, brick, or concrete-block foundation, the air barrier becomes more of a challenge. In these cases, I tend to use a drainage curtain, rigid insulation with sealed joints, or spray foam as the primary air barrier linking the slab to the mudsill.

Fit and finish

When it comes to finish materials in the basement, I have heard hundreds of opinions on which ones to use, where to use them, and why. I rely on my initial risk assessment to guide me in material selection with my clients, but I try to accommodate their wishes. In most cases, the installation methods of the selected materials are of prime importance, not the materials themselves. For example, if drywall is to be used in a moderate- or high-risk basement, then I will install a tall (8-in. or 10-in.) synthetic baseboard and hold the bottom edge of the drywall just under the top of the baseboard, which I will fasten to blocking. If the basement incurs a flood, the drywall is likely not to be part of the resulting problem. If a client desires carpet in a low-risk basement, I probably won't have a problem with installing it wall-to-wall. In basements of moderate and high risk, a better option is either an engineered-wood floor or a tile floor with large area rugs. Area rugs are easy to remove, clean, and reuse if they are part of a flood.

In summary, my approach is pretty simple: As risk increases, materials used in a finish basement should be less permanent or more resistant to moisture and water. □

Steve Baczek is an architect in Redding, Mass. Photos by David Fell, except where noted.

Replace a Rotten Lally Column

A proper footing and post add floor support that will never fail again

BY EMANUEL SILVA

As a restoration and remodeling carpenter in and around Boston, I get to work on a lot of old homes. The years have not been good to many of these old structures. Over the past 15 years, I've been called to address sagging floor joists and their support beams so often that shoring them up has almost become routine. Many of these older floor systems were supported by inferior, hollow Lally columns—steel pipes typically filled with concrete for increased durability and load-bearing capacity—temporary jack posts, and even tree trunks. To make matters worse, they were typically set atop equally inferior footings, or on no footing at all.

By temporarily supporting and jacking up the beam just enough to loosen the existing column, I can create enough workspace to install a proper footing and Lally column. I don't attempt to fix sagging or otherwise unlevel floors (sidebar p. 43). My goal is simply to prevent further settling.

The house shown here has moisture problems as well, thanks to surrounding properties that seem to channel all their rainwater toward its foundation. While the concrete Lally columns will likely survive occasional flooding, I decided to anchor them atop small piers for longevity. However, the process is roughly the same whether you want columns raised or set flush to the slab. □

Emanuel Silva runs Silva Lightning Builders in North Andover, Mass. Photos by Rob Yagid.

BUILD CRIBBING TO SUPPORT TEMPORARY POSTS

When removing an existing column, it's imperative that the temporary supports are as strong as the new columns being installed. Because most of the homes I work on have slabs that are in poor condition, I try to spread the load by building cribbing. The cribbing serves as a strong, level base in which I can place screw jacks. With the jacks in place, I can use 4x4 pressure-treated posts to raise the beam safely. It's best to install these supports roughly 1½ ft. from the location of the new footing. This lends the support you need and allows comfortable working room.

Start level, stay straight. *Use small scraps of lumber to bring two 3-ft.-long 4x4 pieces of pressure-treated lumber to level. The next two pieces are stacked perpendicular to the first two. The top layer then is screwed to the bottom.*

Twist to lift. *Prior to cranking on the jacks, plumb the post, and secure it to the beam with toenailed screws. If someone accidentally bumps into a post, it will stay put. Raise the jacks to relieve enough pressure on the old posts so that they can be removed easily, but no higher.*

PUNCH A SQUARE HOLE IN THE OLD SLAB

This slab was in bad shape and, at 2½ in. thick, thinner than the slabs poured nowadays. From my experience, I knew that if a footing existed, it would be little more than stones thrown in a hole. I was right. Not all footings have to be rebuilt, though. Assess the condition of the slab, and look for signs that the home was built to high standards. When in complete doubt, dig.

Measure out, plumb down, and dig. *According to code, there must be a support column along this beam every 8 ft. Take measurements from the foundation wall, and mark them in the center of the beam. Then plumb down from each mark to locate the center of the footings. From this point on the slab, measure 1 ft. out in four directions. With a framing square, connect the points to create a 2-ft. by 2-ft. square. Use a cold chisel to score the perimeter line, and then use a jackhammer or a sledgehammer to break through the slab. Dig down 1 ft.*

Why shouldn't I level the beam?

Wood, drywall, and plaster are viscoelastic. (Think of Silly Putty as an extreme case.) They act elastically under short-duration loads and act plastically under sustained, long-term loads. As such, it is difficult to jack all of the sag out of a beam that has crept over the years unless it is done slowly over time.

Although it may be possible to bring a beam back to level, the question of whether sag should be jacked out of a beam is difficult to answer. It depends largely on the framing above the floor. If there are plaster or drywall walls above, then it may be possible to remove only a small amount of sag from the beam. Drywall and plaster creep over time and do not like to be moved. I have seen contractors literally jack a house off its foundation before getting any sag out of a beam.

If the beam is in an open expanse of floor, then raising it is an easier proposition. I have even recommended that contractors kerf stubborn beams in several locations. The beam, and subsequently the floor, then can be raised easily. The beam itself can be sistered up with additional lumber to restore its integrity.

—Rob Munach is a professional engineer in Carrboro, N.C. (www.robmunachpe.com).

POUR A BOMBPROOF FOOTING

Because we wanted to elevate the new column's base above the slab, I incorporated a builder's tube into the footing to create a pier. I reinforced the pier with six pieces of #4 rebar. You can bypass this step if you'd like and install the posts so that they're flush with the slab. To do that, simply lay a grid of rebar 3 in. from the bottom of the footing, and install another grid 3 in. from the top of the footing.

Add concrete. *Make sure the soil is compacted. Then cover the bottom of the hole with 3 in. of concrete rated for 4000 psi. Place two pieces of rebar parallel to each other on top of the wet concrete and 6 in. from each wall of the hole.*

Create the pier support. *Into the wet concrete, set a 16-in.-long, 12-in.-wide builder's tube fitted with two pieces of rebar that protrude 6 in. from each side, and level it. The exposed rebar, which sits a few inches below the height of the slab surface, helps to tie the pier to the rest of the footing.*

Fill it up, and screed it away. *Pour concrete in and around the builder's tube until the concrete is slightly proud of the slab and the lip of the builder's tube. Push two 16-in.-long pieces of rebar into the pier—so that their top end is 2 in. to 3 in. below the finished concrete—prior to screeding off the excess concrete and feathering the surrounding concrete into the slab. During the pour, make sure you're maintaining center by checking the pier location with a plumb bob.*

TOOL TIP

Hang a retractable plumb bob, such as this one made by Tajima (www.tajimatool.com), from the beam to mark the center of the footing. It can be raised when it gets in the way and lowered regularly to check center.

INSTALL THE NEW COLUMN

I like to use $3\frac{1}{2}$-in. concrete-filled Lally columns. Manufacturers say that the color—red or gray—is no indication of performance or application differences. A variety of cap and base plates is available. I use the standard plates that come with the columns from the lumberyard.

Tap it into place. *After cutting the column to length (be sure to consider the thickness of the plates when measuring for length), place the column on the bottom plate. Add the top plate to the column, and tap the assembly into place with a sledgehammer. Check to be sure the column is plumb.*

Secure the plates. *Drill pilot holes through the screw holes of the bottom plate, and secure the plate with 3-in. Tapcon screws or concrete anchors. Attach the top plate to the beam with $2\frac{1}{2}$-in. lags, never with nails.*

Finish the pier. *Remove the exposed builder's tube by scoring it with a utility knife where it meets the slab. Masonry caulk, such as Quikrete Concrete Repair (www.quikrete.com), cleans up and protects the seam.*

TOOL TIP

You can cut a Lally column with a specialty column cutter. However, I find it easier to hold the column in place with a large pipe wrench and cut it with a pipe cutter that has the capacity to cut 4-in. pipe. I clean up the cut edge by chipping away any concrete with a cold chisel.

The Stay-Dry, No-Mold
Finished Basement

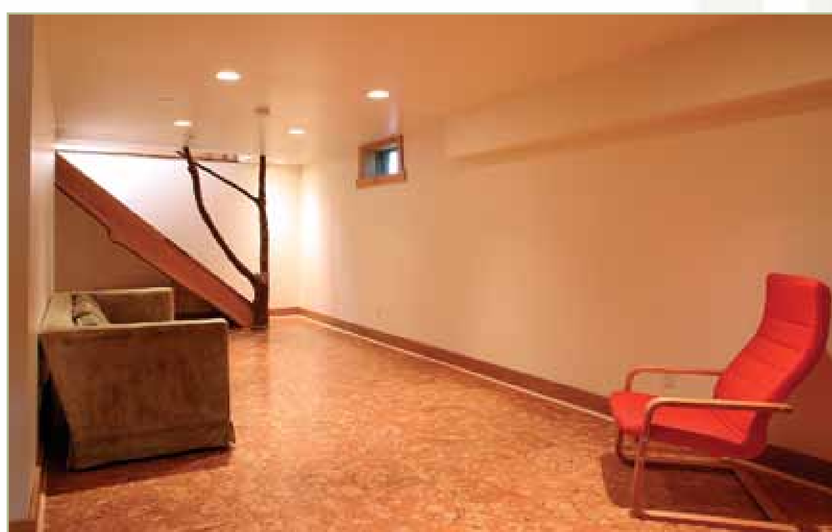
Rigid-foam insulation is the key to a comfortable living space

BY ANDY ENGEL

Finished-basement projects usually begin with visions of a game room for the kids or of a secluded spot for Dad to watch Sunday football games with his cronies. Just about as frequently, these projects end badly with black spots of mold, crumbling drywall, and a smell reminiscent of a dungeon. What goes wrong? In most cases, water becomes trapped behind a wood wall or floor and nurtures a bloom of rot.

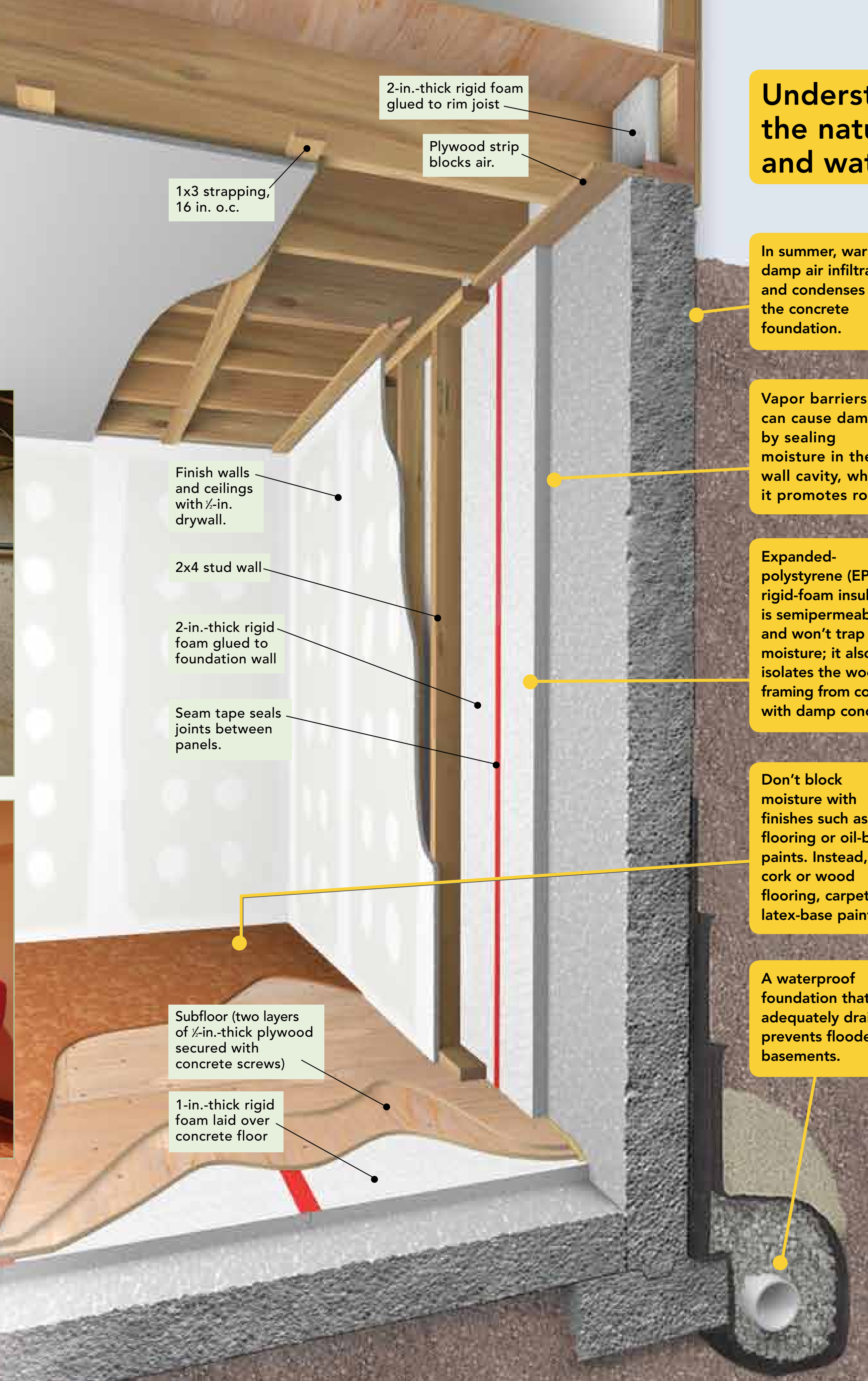
However, it probably isn't a flood that causes the problem. Yes, bulk water, the kind that flows across the floor, needs to be eliminated before an attempt is made to finish a basement. (Some common measures include exterior waterproofing, functioning gutters, and/or an internal drain system.) But even if your basement looks dry, you easily can have problems when you enclose the concrete with a framed wall. The real villain here is water vapor, the invisible moisture that keeps concrete damp and makes cold-water pipes drip with condensation in the summer. This water is always present. To reduce mold growth, water's contact with cellulose (paper, wood, etc.) has to be limited, and the water has to be allowed to escape.

Before



After

A rec room that will last. *Built with conventional wall framing, a plywood subfloor, and rigid-foam insulation, this basement remodel doesn't trap moisture that can cause problems later. (By the way, the stair railing isn't finished.)*



Understanding the nature of basements and water

Moisture moves from wet to dry and from warm to cool. In the summer, damp soils and warm air outside make the moisture drive mostly inward. Humid outside air enters the basement and condenses on anything below its dew point: cold-water pipes, concrete walls, and floors. In particular, carpeted concrete floors can be a problem because they easily can become wet enough to support mold and dust mites.

Most basements dry out only in the winter when interior heat sucks the available moisture out of the basement and drives some moisture outward through the exposed portion of the foundation. There's also some drive-out through the foundation itself because the basement is warmer than the surrounding soil. The trouble is that the soil tends to be wet, and so has a limited capacity for drying.

There's a significant energy cost in moving this water through the foundation. The traditional response has been to frame walls next to the foundation, fill them with fiberglass, and seal them with a plastic vapor barrier. But a basement vapor barrier can trap moisture and promote rot. Basement floors built with a similar system fare no better.

PLYWOOD SUBFLOOR IS SUPPORTED AND INSULATED WITH RIGID FOAM

Through research published by Building Science Corporation (sources below), I've found that rigid-foam insulation both thermally protects the basement and breaks the contact between framing and concrete. To avoid trapping moisture, I never install a vapor barrier. Instead, I use materials and finishes that allow moisture to diffuse. You can get rid of this diffused water by installing a dehumidifier or by extending the air-conditioning ductwork into the basement. I'm no expert in this area, so let an HVAC contractor figure out the specifics.

Isolate and insulate the concrete

I use 2-in.-thick expanded-polystyrene foam (EPS, or styrofoam) on the walls and 1-in.-thick EPS below the plywood subfloor. This rigid-foam insulation is sufficient to make a noticeable temperature difference in the basement without crowding in the walls or the ceiling height. EPS is cheap, effective, and vapor permeable. Believe it or not, it also has the compressive strength to support a two-layer plywood subfloor without the use of sleepers.

After insulating the rim joist, I cover the floor with a layer of 1-in.-thick EPS. On top of this, I lay the subfloor, then build a

Use rigid foam instead of wood for sleepers

To isolate the wood from moisture in the concrete, full sheets of EPS are laid on the concrete floor. Seam tape and expanding foam seal the seams against the infiltration of moist air.

SOURCES OF SUPPLY AND INFORMATION

The foam gun, canisters of expanding-foam sealant, seam tape, and low-pressure dampers are available from The Energy Federation Inc. (800-379-4121; www.efi.org).

Expanded-polystyrene (EPS) rigid foam is available at most lumberyards and home centers.

Much of the information in this article was obtained from the consulting firm Building Science Corporation; its Web site (www.buildingscience.com) has a wealth of information on building technology.

Two layers of plywood go down with screws

After drilling and countersinking pilot holes **(1, 2)**, the author attaches the first layer of ½-in.-thick plywood with 2½-in.-long concrete screws **(3)**. To allow for expansion, ⅛-in. gaps are left between each sheet and around the room's perimeter. Laid at right angles to the first layer, a second layer of plywood is fastened with 1⅝-in. drywall screws and spans the joints between sheets to make a stronger floor. **(4)**.


1


2


3


4

regular stud wall against the foam on the walls.

Keeping wood from contacting concrete is critical. Fail here, and you're inviting water in through capillary action. You could use pressure-treated plywood and framing lumber, but I think that's false security and an unnecessary expense. If you've got enough moisture in the wall or the floor to cause rot, then you've also got the right conditions for mold growth, something that pressure-treated lumber won't prevent.

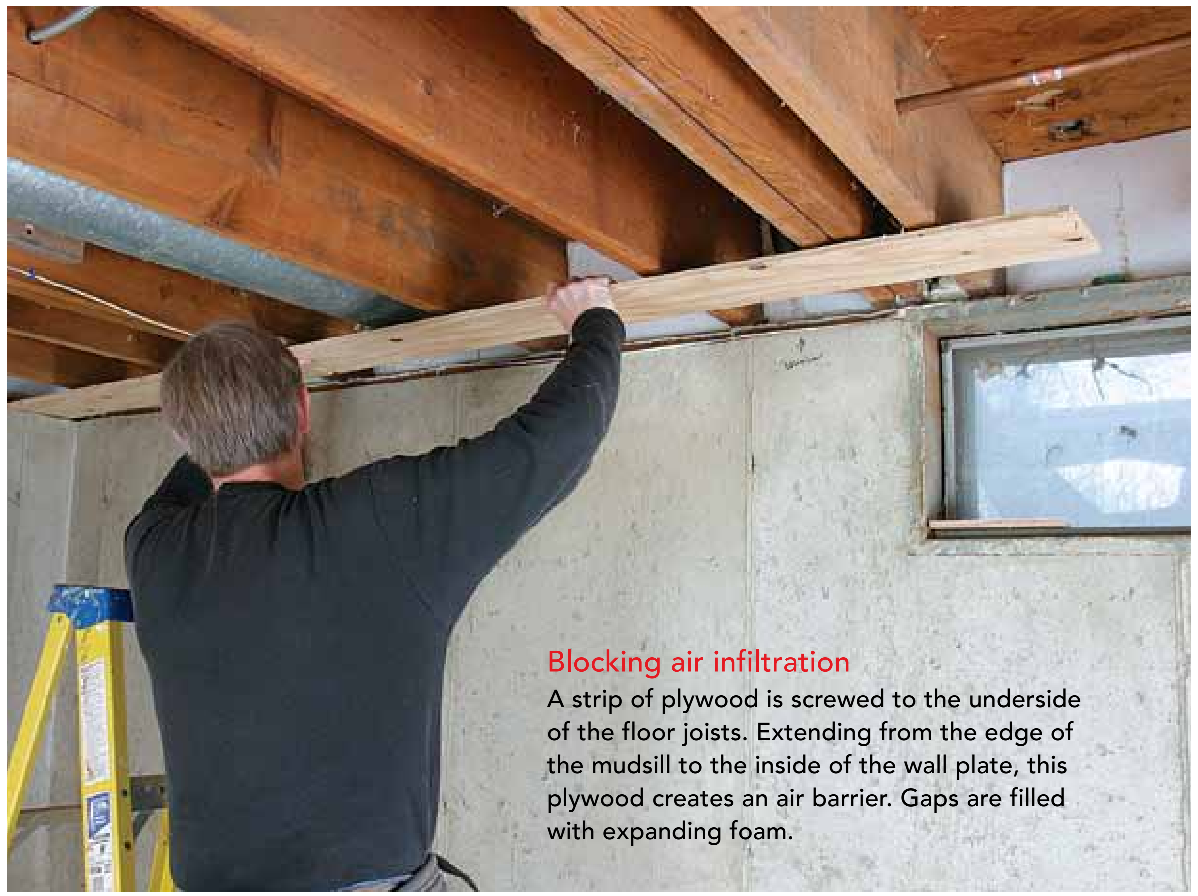
It's also possible to skip the stud wall and to screw furring strips to the concrete through the foam, but I don't like that approach for two reasons. First, I haven't seen many basement walls that are as plumb or as straight as I can build a stud wall. Unless you want to spend days playing with shims, the furring strips will mimic the defects of the foundation. Second, furring strips don't have the depth that allows easy installation of electrical boxes. □

Andy Engel is a builder and writer who lives in Roxbury, Conn. Photos by Charles Bickford.

FRAMED WALLS ARE ISOLATED FROM THE FOUNDATION'S MOISTURE

An insulated band joist stops thermal bridging

Insulating the joist bays with 2-in.-thick EPS will keep air leaks and cold spots to a minimum. Minimal amounts of expanding foam applied around the edges of each piece act as both a sealant and an adhesive.



Blocking air infiltration

A strip of plywood is screwed to the underside of the floor joists. Extending from the edge of the mudsill to the inside of the wall plate, this plywood creates an air barrier. Gaps are filled with expanding foam.

Make the foam on the walls as tight as possible

After the floor is done, the walls are insulated with EPS sheets trimmed for a friction fit and glued to the foundation with expanding foam (1, 2). Seams and gaps are filled with the foam and taped. Plywood scraps keep the sheets in place until the glue sets (3). Unlike furring strips, a stud wall goes in plumb and straight, and allows room to run any utilities normally (4).

1


2


3


4


Air quality and fire safety in the basement

One of the effects of finishing a basement is to cut off leaks that may have been supplying combustion air for the boiler, furnace, or water heater. Failure to replace this air supply could contribute to backdrafting and the possible buildup of lethal amounts of carbon monoxide.

Unless the appliance manufacturer provides specs that say otherwise, the rule of thumb is to provide makeup-air ducts leading to the outside that are twice the size of the combined flues. In this basement, the boiler and water heater share a 6-in.-dia. flue. I provided two 6-in. supplies, one that ended at the ceiling level and one that ended near the floor in the mechanical room. To prevent these ducts from chimneying nice, warm air to the outside, they were fitted with fabric dampers (photo facing page; sources p. 80) made for this low-pressure application.

One other safety consideration is basement egress. Most building codes require habitable basements to have two exits in case of fire. This basement already had two doors, so that requirement wasn't an issue. Lacking the second door, I'd have had to provide a code-approved egress window (a 5.2-sq.-ft. opening within 44 in. of the floor, leading to a 36-in. by 36-in. well with ladder rungs leading to grade). Last, if your home isn't already so equipped, install hard-wired smoke and carbon-monoxide detectors in the basement.