Finishing Basements

Despite the obstacles, converting that dark, scary place into comfortable living space is much cheaper than adding on

BY RICK ARNOLD AND MIKE GUERTIN

Subterranean metamorphosis. Windows and recessed lights brighten a dreary walk-out basement. The archway in the foreground (right) softens the edges of a closet built to enclose a water heater (above).

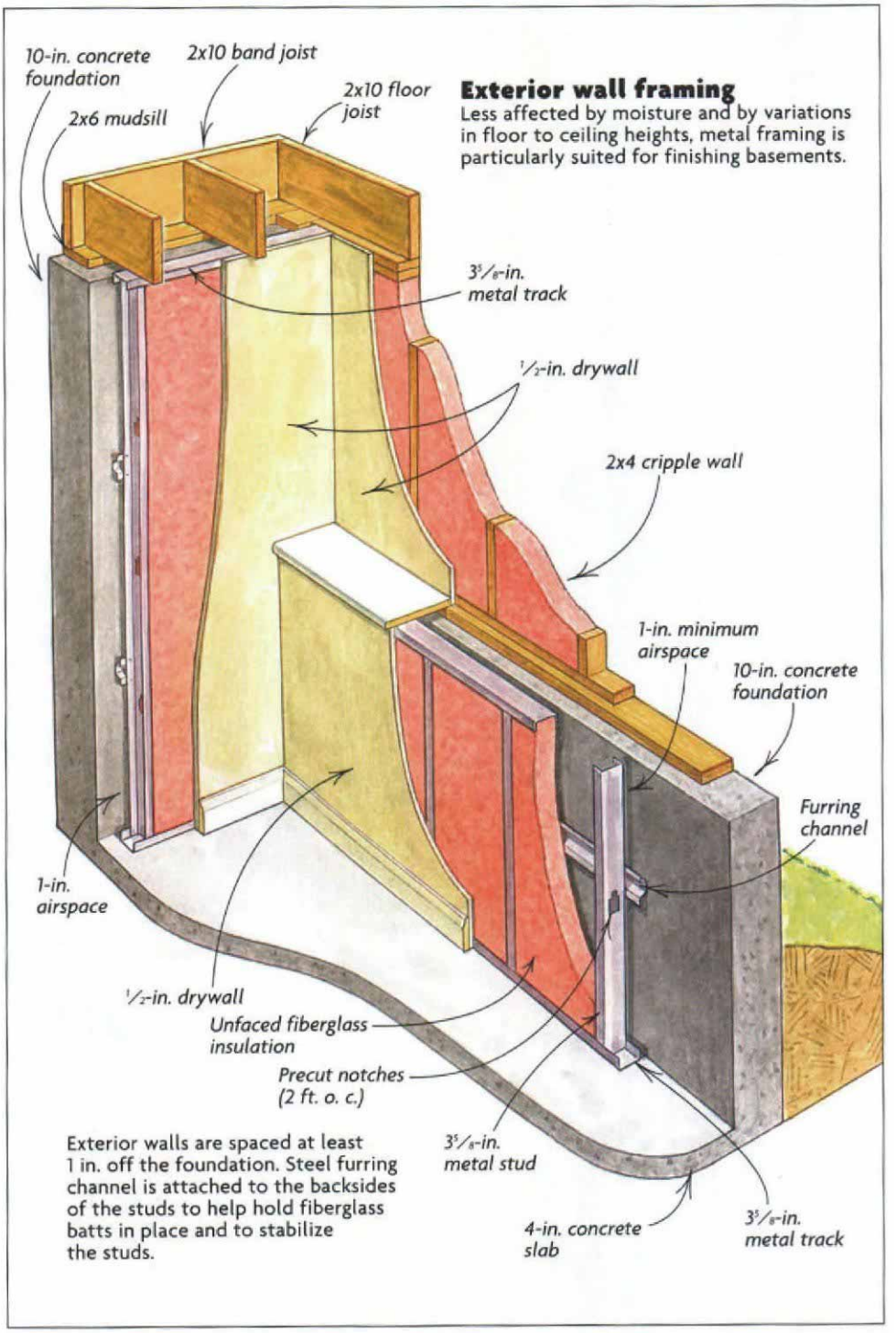
Until we spent some time in Florida, where slab-on-grade and crawlspace foundations are the norm, we didn't realize how good we Northerners have it. The full basements that many of us take for granted—a fringe benefit of having to dig deep, frostproof footings—give us plenty of room for mechanical systems, storage and extra living space.

Converting a basement into comfortable living space can be a challenge. There are obstacles to wrangle with, building codes to comply with, health and safety concerns to address. And there's moisture.

When we're called in to evaluate a basement, we identify the problems, and we discuss them with the owners before we start wading into the design process. If the basement has any history of flooding or if high levels of radon are present, we call in specialists. Solutions for both moisture and radon problems must be put in place and be tested before any basement-finishing project can begin.

Moisture must be actively controlled

There's about 300 gal. of water in the walls and slab of a freshly poured 1,000-sq. ft. concrete basement. During the first year or two, most moisture will move into the house because the dampproof coating and under-slab vapor retarder limit drying into the earth.



Exterior wall framing
Less affected by moisture and by variations in floor to ceiling heights, metal framing is particularly suited for finishing basements.

Exterior walls are spaced at least 1 in. off the foundation. Steel furring channel is attached to the backsides of the studs to help hold fiberglass batts in place and to stabilize the studs.

It's good to wait at least two years before finishing the basement of a new home.

All the basements we finish have adequate systems in place to prevent bulk water intrusion and flooding, but that's no guarantee they'll stay bone dry. Water vapor from the ground can still permeate the walls and floor, despite dampproof coatings. In the summer, hot, humid air seeps into the relatively cool basement through windows and doors. Once the relative humidity reaches 100%, all this excess moisture is released as condensation. Over time, this moisture can rot framing, deteriorate drywall and promote mold growth, rendering a finished basement too unhealthy and uncomfortable for use.

It's particularly important not to trap moisture vapor within the wall system, where it can do a lot of damage before it's discovered. Research and experience have led us to forgo vapor barriers and to build walls that permit water vapor to pass through both the concrete and the frame wall assembly. This construction allows moisture to dry to the inside or to the outside depending on season, humidity and temperature changes.

Condition basement air to prevent condensation

The best way to keep moisture under control is to ensure that the basement is fully served by the home's HVAC system. Central air conditioning that's properly sized will keep summer humidity under control, as will a high-quality dehumidifier. When we install a dehumidifier, we always put in a direct drain line so that the homeowners won't have to empty the dehumidifier. And we often have to provide additional fans to circulate air fully throughout the basement.

Having dehumidification equipment in place is no guarantee the owners will always use it. For greater peace of mind, we always wrap all cold-water lines with foam insulation (photo top right, p. 102). Cold-water lines are the first place that excess moisture will condense, and the last thing we want is a callback for water stains on the finished ceiling from sweating pipes.

Building-code issues are addressed early on

Egress and headroom are the two places where basement-remodeling projects most often run afoul of local building codes. For safety, the code generally requires us to provide two escape routes in an emergency. Code-compliant stairs between the first floor and the basement are one escape route. A second means of egress can be provided by way of bulkhead stairs, a walk-out doorway or possibly a window. If none of these alternatives exists and installing one is impractical, we are permitted to rely on the stairway alone if we enclose combustion equipment in a 1-hr. fire-rated room or if we install a fire-suppression sprinkler system. When the use of the basement is being changed to living area, we also check with the fire marshal to determine smoke-detector layout.

Achieving adequate ceiling heights in a basement also can be a challenge. Until recently, the code in effect in our locality required a 7-ft. 6-in. minimum ceiling height for habitable rooms. Strict accordance with these requirements would have ruled out finishing most of the basements in our area. Fortunately, our state amended the code to allow 7-ft. ceiling heights in habitable finished basement space to be used for "recreation rooms."

That amendment gets us by the short ceiling height, but in most cases, we also have to

Drawings: Rick Daskam

Wrapping cold-water pipes with foam insulation prevents condensation and the water stains that result.

Making the beam disappear. A powder-actuated fastening tool quickly anchors the top plate of the wall to the steel beam.

A little bit of wiggle room. Steel track eliminates the need to measure and cut each stud individually.

Creative use of framing. Fastening wood studs to steel track enables these workers to erect non-load-bearing partitions quickly. The 2x6 frame wall in the background will completely enclose the girder and Lally columns.

contend with beams, ductwork, drain pipes and other obstructions that protrude far beneath the ceiling joists. We approach these obstructions in one of three ways. Our first choice is to work them into the design by creating closets and storage areas under them or by framing partition walls under them (photo above). When this option won't work, our second choice is to move the offending hardware. This option can be expensive when we have to move an entire ducted heating system or do extensive drain rerouting. Our final choice is to frame around the obstructions and box them in, even if they drop below the required ceiling height. Before we follow this route, we clearly draft a plan and photograph the space. Then we set up an appointment with the local building official to explain the situation. When we're up front during the planning phase, we usually secure his blessing.

Steel studs work best in basements

Seasonal humidity changes in even the most carefully conditioned basements can wreak havoc with wood framing. For this and other reasons, we prefer to use light-gauge met-

al studs to enclose foundation walls and to frame interior partitions. Because concrete slabs are never perfectly flat, it's faster to frame walls to the undulations in the basement floor with steel. The U-shape track used for steel plates allows enough play to accommodate studs up to an inch short of the actual height. Even when clients insist on wood framing (photo left, facing page), we use steel track for top and bottom plates. This option lets us gang-cut studs to the shortest length on a segment of wall. A screw through the sides of the track holds the wood studs in place (photo bottom right, facing page). If we have to use wood plates, we use pressure-treated lumber on the floor for rot- and insect-resistance: Steel track gives us these benefits without question (for more on steel framing, see *FHB* #97, pp. 72-77).

We try to make walls that fall directly beneath beams thick enough to enclose the beam and its Lally-column supports fully. A standard 2x4 wall will enclose the 3½-in. dia. columns if they are perfectly aligned (we pull stringlines along the tops and bottoms of the columns to check alignment). We've been successful notching the back of the drywall to wrap around slightly misaligned columns, but we're forced to erect a 2x6 wall when columns are severely out of whack.

When we have to maintain an open floor plan, the Lally columns can be simply painted, enclosed with a wood box or wrapped with nylon rope for a nautical look. When clients want columns eliminated at any expense, we have steel or engineered-lumber beams sized to span the area.

Dealing with the ceiling

It's rare to find a basement ceiling where we can hang drywall from the joists without moving or shimming something. Ductwork is the most obvious problem, but electrical wires, gas lines and water pipes are often fastened to the bottoms of the floor joists. Then there are all the junction boxes, plumbing shutoffs and clean-outs, and duct damper levers, none of which can be covered without providing a means of access.

The easiest solution to these problems is an acoustical ceiling. As long as there is enough headroom to allow for a 3-in. or 4-in. drop in the ceiling height, the suspended support grid can be lowered beneath pipes and wires, and the removable ceiling panels permit access to junction boxes, clean-outs and the like. Acoustical ceilings are also a benefit years later if owners decide they want to upgrade utilities or run a new phone line.

There are many decorative ceiling tiles that greatly enhance the look of the finished

Let the boiler breathe

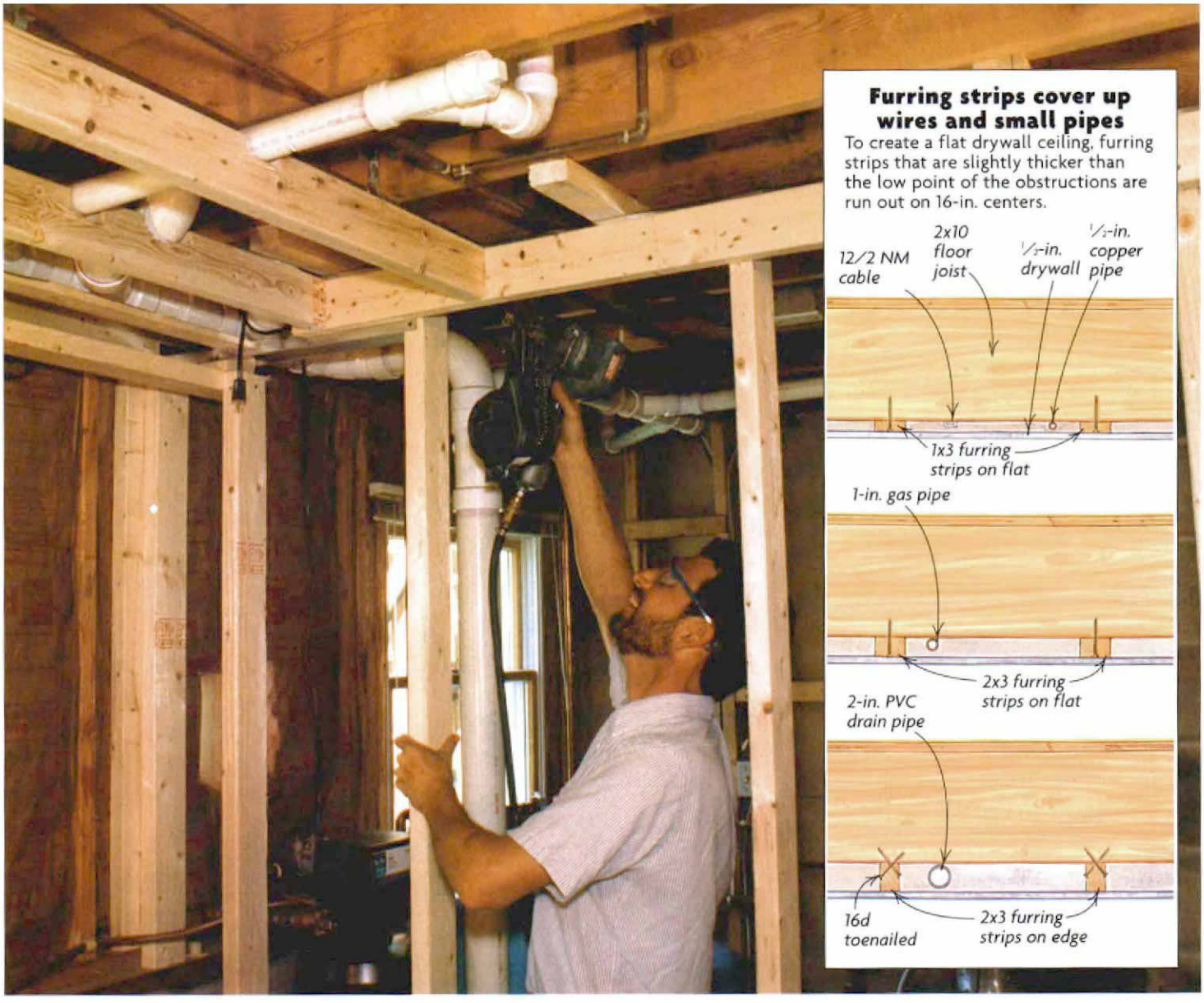
Providing makeup air. When wall framing reduces air circulation, outside air is ducted to gas-fueled appliances (photo above). A dryer vent hood (with flapper removed) terminates the duct, and a piece of filter material keeps out unwelcome varmints (photo left).

Most of the homes in our area have natural-draft combustion heating equipment in the basement; these units use the surrounding air to support combustion. Breaking up the basement space into separate rooms or enclosing the appliance in a small mechanical closet can severely reduce the quantity of available air. Starving a heating appliance for air diminishes its efficiency and also increases the potential for backdraft, which can pull exhaust gases such as carbon monoxide into the house's living space.

There are several ways to provide makeup air to a heating appliance. But the best and safest way is to duct fresh, outside air directly to the appliance (photos above). We always check with our local code official to calculate the number, size and location of ducts needed for the situation.

Another solution is to replace the old appliance altogether and install induced-draft direct-vent heating equipment. These units have their own fan-assisted fresh-air intake. Not many homeowners want to replace functioning heating equipment, but we discuss the options and safety issues with them. Perhaps it's something to consider when the existing conventional equipment needs replacement.

—R. A. and M. G.



Drop ceiling hides drain pipes. Inside a small basement bathroom, 2x4 ceiling joists conceal overhead drain pipes that could not be relocated or hidden by simply nailing furring strips to the floor joists.

space, but many clients hate the thought of a commercial-looking ceiling in their home and insist on drywall. Rather than moving the offending wires and pipes, we create a flat surface for drywall by furring down the ceiling level with appropriately sized lumber (photo above). Whatever object sticks out the farthest below the bottom of the floor joists determines the furring thickness (drawings above): Wiring and ½-in. copper pipe can be furred in with 1x3s; 1-in. gas pipe with 2x3s; and 2-in. PVC with 2x3s toenailed on edge into the joists.

As we attach the furring strips, we highlight clean-outs, shutoffs and junction boxes with bright-colored spray paint so that we don't forget about them. We keep on hand several sizes of plastic access panels (available at most building supplies or home centers) so that we can size the opening to fit the panel. The hole is framed with furring strips to guide a drywall saw when hanging drywall and to provide a base to fasten the rim of the panel (top photo, facing page).

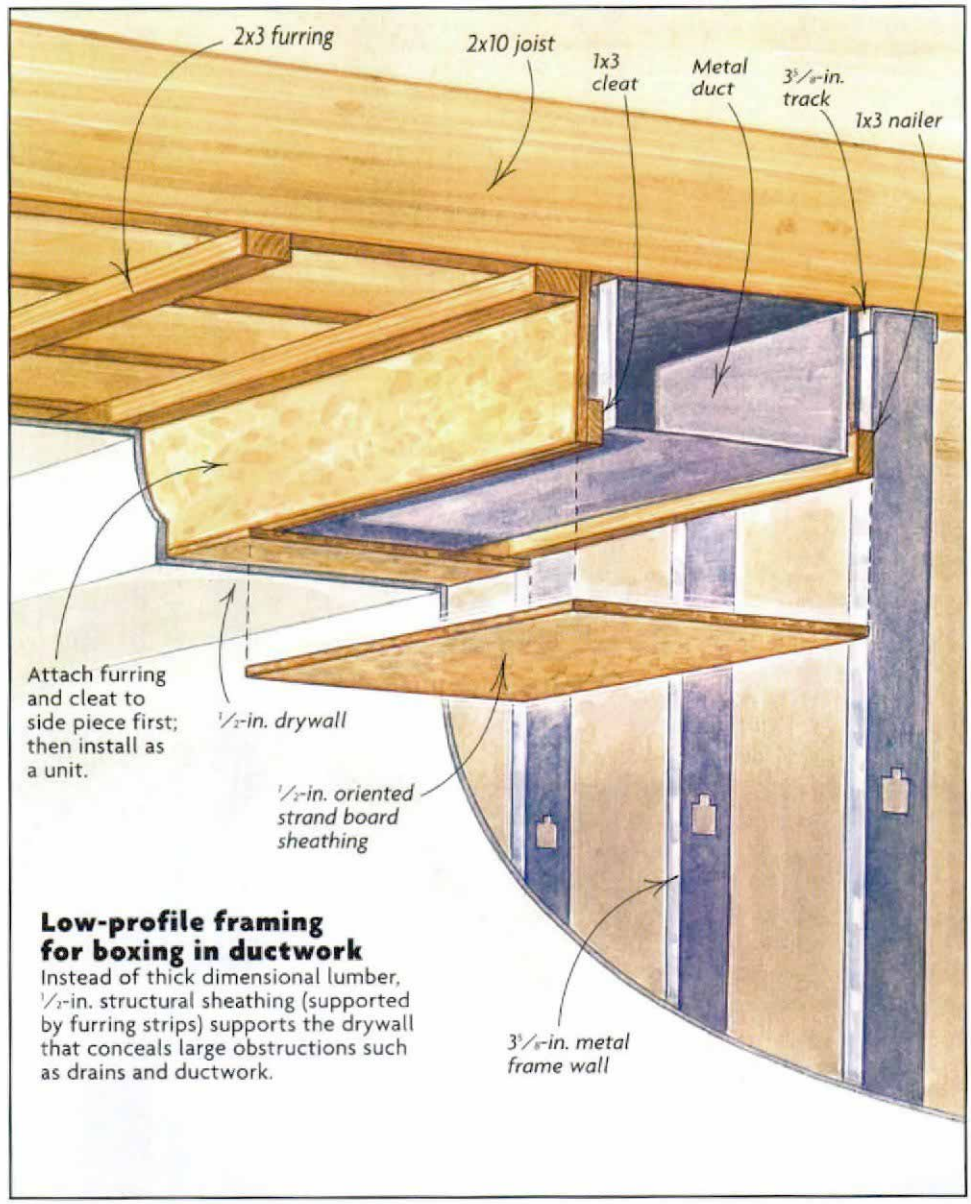
Unfortunately, not everything on the ceiling can simply be furred over. Smoke detectors and sprinkler heads must be lowered to the new ceiling level. Large drain pipes and ductwork must be moved or boxed in. There's nothing wrong with leaving ductwork exposed and painting it, but most people want a more finished look for their living space. Boxing in ductwork requires some type of structural framing around the ducts to support drywall. Rather than using 2x framing lumber, we try to use ½-in. structural sheathing supported by simple blocking to minimize the ceiling area lost (drawing facing page). We save scraps from framing jobs to box in ductwork. Ducts are commonly 8 in. deep, so any 8-in. or larger scraps can fill a new purpose rather than go to the landfill.

Brighten up the space to disguise where you are

To brighten up these inherently dark places, we maximize natural light and add plenty of artificial light. The best opportunities to boost natural lighting include a walk-out basement with a full-height frame wall on one side or a raised ranch with a frame cripple wall all the way around. These situations allow us to install larger windows or replace solid doors with glass doors (photo right, p. 100).

It's more difficult to boost natural lighting in a subterranean basement, but even small windows formed into many foundations can be framed to emphasize the light they bring to the basement; this is done by splaying out drywall returns that run from the corners of

Store-bought access panels. Because the drain clean-out must remain accessible, ¾-in. furring strips are installed as support for a plastic access panel that goes on after the drywall.



Low-profile framing for boxing in ductwork
Instead of thick dimensional lumber, ½-in. structural sheathing (supported by furring strips) supports the drywall that conceals large obstructions such as drains and ductwork.

the window to the face of the wall. To boost natural lighting significantly, larger windows can be cut into the foundation wall and the earth held back by terraced window wells.

Regardless of how much we increase natural lighting, we always install more artificial lighting in a basement than we do in above-grade space. We rely on recessed lighting in basements because, literally and figuratively, they don't bring down the ceiling the way surface-mounted fixtures do. Recessed lights can be supplemented with wall-mounted fixtures and floor lamps wired to independent, dimmable switches to give the owners complete control of their lighting needs.

Permeable walls and durable floor coverings finish the job

We prefer to see owners choose a drywall or plaster finish for walls rather than manufactured wood paneling. This preference isn't just aesthetic. As we mentioned earlier, we want moisture vapor to migrate through walls and not become trapped and condense. Gypsum wallboard painted with latex paint is semipermeable; vinyl wall coverings and most 4x8 sheets of paneling are impermeable.

We want to allow vapor diffusion through the wall, but we don't want air leaks. Rapidly flowing warm, moist air can reach the saturation point quickly as it cools. Reducing air leaks limits the possibility of overwhelming the humidity balance through the wall assembly. So we do our best to make the drywall an air barrier: sealing penetrations around windows, doors, electrical boxes, etc.

Unfortunately, weather—not to mention plumbing—is unpredictable, and there is always the possibility that a basement can flood, even one that has a perfectly dry track record. Wet wall-to-wall carpet is a drag to dry out, and wood floors never recover from extensive water damage. For these reasons, we urge homeowners to choose moisture-resistant floor coverings. Vinyl, tile, floating laminate floors and even stained exposed concrete are the best choices. Area rugs can be spread over these floors to quiet a room or make it warmer. And if the rugs get wet, they can be sent to the cleaners.

We compared unit costs for some of our recent projects. Additions from 500 sq. ft. to 1,500 sq. ft. generally cost between $110 and 1150 per sq. ft. Similarly outfitted basements run between $25 and $40 per sq. ft.

Fine Homebuilding contributing editors Rick Arnold and Mike Guertin are builders and construction consultants in North Kingstown and East Greenwich, Rhode Island, Photos by Tom O'Brien.

SEE ERRATA AT END OF ARTICLE

ERRATA

Second thoughts from an author of the basement-finishing article

The day that *FHB* #132 (with the article Rick Arnold and I wrote, "Finishing Basements") arrived in my mailbox, I attended a daylong presentation by Joe Lstiburek of Building Science Corporation, and author of the *Builder's Guide* series of books recently published by The Taunton Press. During Joe's presentation, I learned that the method I used to frame and insulate the exterior-wall assemblies in the project may be problematic in some situations.

The problem with the walls I framed is that the surface of the concrete wall will be the first cold surface moist air will touch. The potential for condensation here is greatest. By leaving an airspace and using fiberglass insulation, I'm permitting air to come in direct contact with cold concrete.

A better way to insulate the walls, and one recommended by Joe, is to apply polystyrene foamboard insulation directly to the concrete. Around pipes or other obstructions that may be in the way, the insulation can be fitted as well as possible and caulked or spray-foamed for a tight seal. This method prevents moisture-laden air from ever coming in contact with concrete. The dew-point temperature ends up being somewhere within the foam, so the inside face of the foam is warm and not subject to condensation. To finish the wall surface, furring strips can be fastened over the foamboard and into the concrete, or a frame wall could be built.

The other problem with the wall assembly is the steel studs. The steel will tend to be cold and a potential condensing surface because it cannot absorb or release moisture as wood can. It would be okay to use steel studs within the conditioned space of a basement, but not close to uninsulated concrete as illustrated in the article.

Fortunately, the basement I finished in the article was in a house that Rick Arnold and I built. The exterior of the concrete foundation walls is well insulated and drained so that the framing and insulating system I used will not be problematic because the inside face of the concrete is warm. Still, the foamboard solution would eliminate potential condensation problems.

It is important to consider each basement-finishing project individually. Try to discover how the exterior of the foundation walls is treated as well as the underside of the concrete slab. Determine if there is insulation, waterproofing or dampproofing, drainage piping, well-drained backfill, etc. Basement-finishing projects don't lend themselves to a one-size-fits-all solution.

—Mike Guertin, East Greenwich, R.I.