Sealing a Crawlspace

Close the vents and let a heavy-duty vapor barrier keep moisture, mold and radon out of the living space

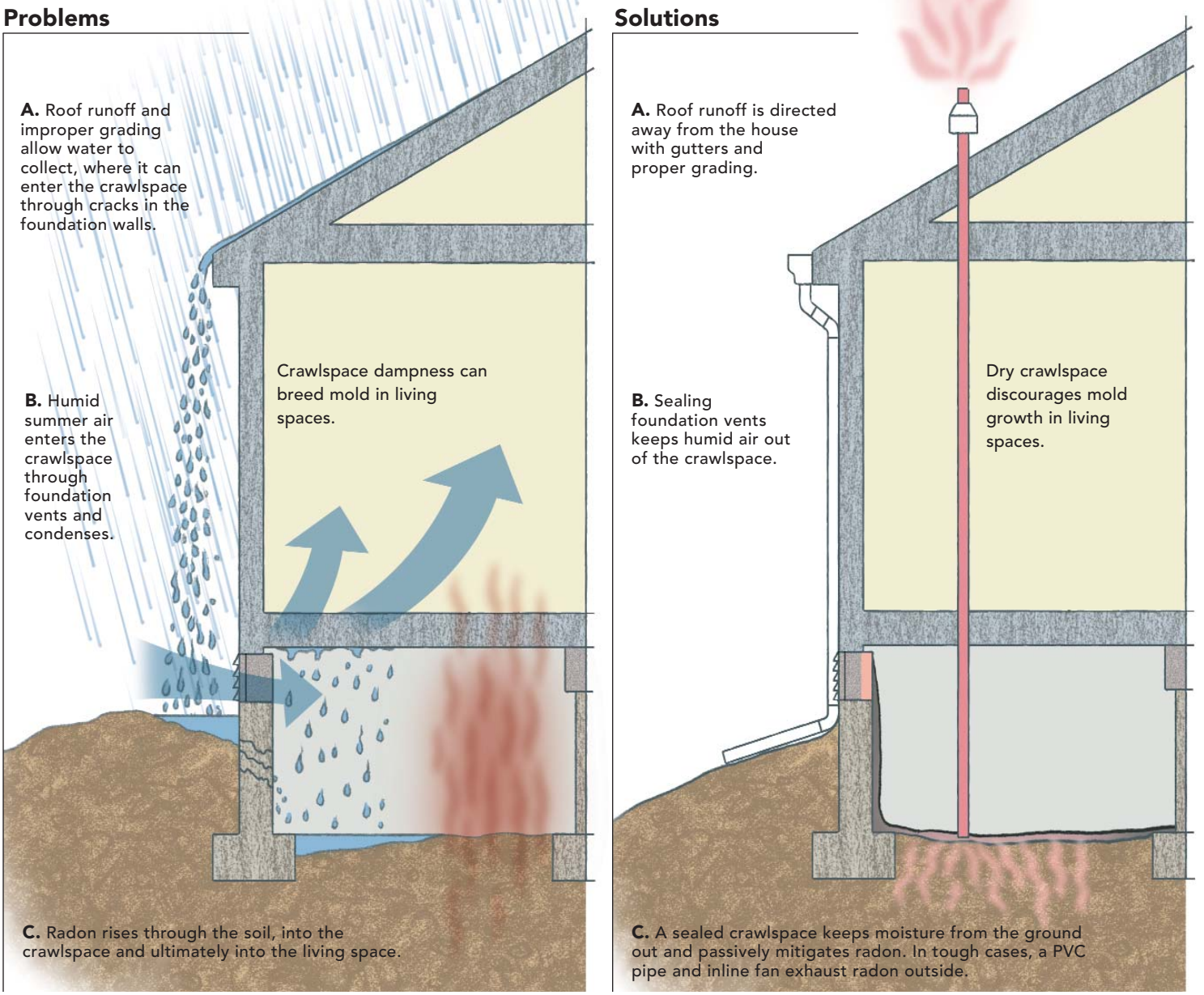
BY LARRY JANESKY



Dramatic transformation. *Proper detailing changed this crawlspace from a spelunker's nightmare (inset photo) into a bright, clean, dry storage space.*

IF IT'S IN YOUR CRAWLSPACE, IT'S IN YOUR HOUSE

As warm air rises inside the house, replacement air enters from the lowest part, often the crawlspace. Properly sealing the crawlspace and channeling rainwater away from the house can provide mold-free and radon-free living spaces.



Dirt crawlspaces are never-ending sources of moisture. Even if the dirt's surface is dry, digging down a little bit reveals moist earth. Moisture ruins houses by providing a hospitable environment for the fungi, mold and insects that destroy wood framing. Moisture in a crawlspace affects not only the floor system directly above it but also the entire house. Warm air in a heated building rises. As it rises, replacement air is sucked from the lowest part of a house. This natural air movement, called the stack effect, is how chimneys work. Consequently, whatever is in the air at the lowest point eventually flows through the upper sections of living space (drawing above). If mold spores and radon are present in the crawlspace, you can bet they're in the living space as well.

Separate the house from the earth, and keep out the weather

With little headroom, light and habitability, the crawlspace may not seem to be an important part of the house. In fact, it's very important. Moist crawlspaces may be a bigger problem than wet basements (see "Keeping a Basement Dry," *FHB* #140, pp. 64-69) because they can produce an unseen moisture stream through the building envelope (drawing above).

To avoid moisture's negative effects, a crawlspace should be fully sealed and isolated from the ground and the outside. Part of my technique involves placing a 20-mil, 7-ply sandwich of high- and low-density polyeth-

Drawings: Mark Hannon

Got water? Pump it out

If gutters and exterior grading won't stop water from coming in, a trench, perforated drainpipe and a sump pump may be required to move it out. A water-removal strategy could be one of the following scenarios.

Plan views

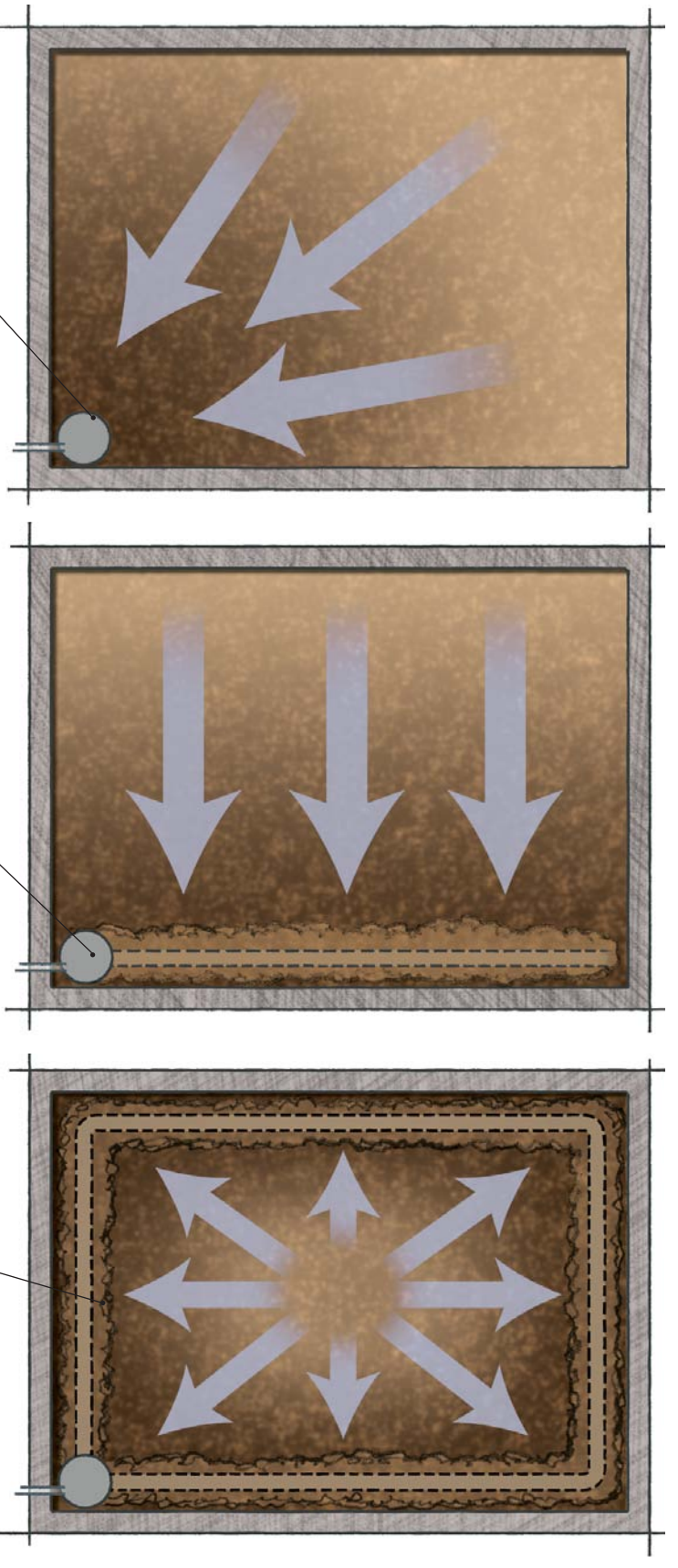


If the ground slopes to one corner, install a sump in the lowest corner.

If the ground slopes to one side, dig a trench to channel water to the sump.

If the ground slopes more than one way, trench in a perforated pipe around the perimeter to carry water to the sump.





ylene with polyester-cord reinforcement on the dirt floor and up the walls. I have this pool-liner-like sheeting made specially for my system (www.basementsystems.com; 800-541-0487). It is easily strong enough to crawl on and to store materials on. Its bright white color makes the crawlspace a light, relatively pleasant place to be (photo p. 94). A vapor barrier such as Tu-Tuf (Sto-Cote Products Inc.; 800-435-2621) also could be used, but it offers less durability, UV-resistance and fire-resistance. Some contractors solve the problem of moist crawlspaces by pumping in concrete. But for this method to work, the concrete needs a vapor barrier. Even with a vapor barrier, this alternative doesn't address water-vapor diffusion through the walls. If the vapor barrier is doing all the work, then why use expensive concrete?

Despite what the building code says, many colleagues and I believe that venting crawlspaces is a bad idea. Code requires 1 sq. ft. of ventilation for every 150 sq. ft. of dirt floor. Using a vapor barrier over the dirt floor reduces the ventilation requirement to 1 ft. per 1500 sq. ft. of floor space. The intent is to vent out the humidity that the exposed earth lets in.

But venting creates its own problems. In winter, there's an energy penalty: cold floors and higher heating costs. In summer, vents actually admit moisture in the form of warm, humid air. Warm air can hold more moisture than cool air. Warm air entering a cool crawlspace can reach its dew point and give up its moisture as condensation. Relative humidity, dew point and the stack effect combine to make crawlspace vents more likely to compound a moisture problem than to alleviate it.

For these reasons, I close the vents outside and seal them from the inside with 2-in. thick foam insulation and polyurethane caulk. And yes, I sleep well at night because I am doing the right thing for my clients.

Wet crawlspaces need drainage

In addition to water vapor, many crawlspaces leak groundwater. Such cases require a drainage system appropriate to the details of the crawlspace. Outside, I make sure downspouts are directed away from the house. Inside, I grade to one corner and install a sump and a pump with a sealed lid. Groundwater that leaks in can make its way from the dirt floor into the sump and be pumped out (photo left).

If a lot of water is leaking in, I create a swale in the dirt at the perimeter to channel water



HEAVY-DUTY LINER IS CUT TO SIZE IN THE DAYLIGHT





Plastic liner is more easily handled in the driveway. *After the plastic is cut to size and rolled up, it can be installed in sections in the crawlspace (photo above). The author has liner material custom-made, but lighter plastic such as Tu-Tuf (800-435-2621) also can work.*

Damp crawlspaces can make your living room moldy

Almost weekly, we see news stories about mold spores. Molds and individual tolerances to mold species vary. Some mold has little effect other than an unpleasant odor, but some can be toxic (most notably *Stachybotrys chartarum*; see "Cross Section," *FHB* #150, pp. 46, 48).

Mold needs organic material, moderate temperatures and moisture to grow. Remove one factor, and mold can't grow. Of these factors, moisture is the easiest to control. Mold thrives in damp environments. Using a hygrometer, we routinely find humidity readings well above 50% in dirt crawlspaces. Some are as high as 80%. This is compared with readings around 27% in conditioned space. According to the Environmental Protection Agency (EPA), relative humidity should be kept below 60% (ideally between 30% and 50%) to control mold. Properly sealing a damp crawlspace lowers relative humidity to within these levels.

For more information on mold prevention, contact the EPA Indoor Air Quality Information Clearinghouse (www.epa.gov/iaq/molds/; 800-438-4318).

—L. J.

NYLON FASTENERS SECURE LINER TO FOUNDATION



To keep water *and insects away from floor framing, the liner is cut in place 2 in. below the top of the wall.*



Holes are drilled *through the liner into the foundation (photo above), and nylon expansion fasteners are driven into the holes (photo right).*





into the sump more directly. As another option, I can trench in a perforated pipe around the perimeter pitched to the sump. To prevent the pipe from clogging with silt, I slip a filter-fabric sleeve over it (photo p. 96). Except in cases where there's extreme flooding or where a concrete floor will be poured, I avoid using crushed stone on perimeter drains because it's heavy and it's hard to lug through small openings.

I do one more thing before installing the liner: clean the dirt. All sharp or large rocks are buried when I regrade, thrown around the sump liner or removed along with any wood or other organic material.

Installing and sealing the liner

Once the crawlspace is cleaned out and drainage issues are solved, I install the liner. The liner material comes in a 24-ft. by 50-ft. accordion-folded roll. It's much easier to handle the 105-lb. roll outside than in the crawlspace, so I roll it out on the driveway to cut it to size (photo p. 97). I then fold and roll up the liner like a carpet, black side out, and bring it into the crawlspace.

I start with a piece of liner wide enough to cover the floor from the center row of piers to the perimeter, and up to the top of the wall. Next, I cover the other three walls, making sure the liner is long enough to overlap the floor by about 1 ft. Then I cut the remaining floor piece. After I roll out the liner, I take off my boots for the rest of the job to keep the liner clean.

Now, I turn back to the walls. I cut the liner 2 in. from the top of the wall (photo top left) and fasten it with nylon expansion fasteners (Outwater Plastics; www.outwater.com) that press in ¼-in. holes that I drill every 3 ft. or

Fastener photo: Roe A. Osborn

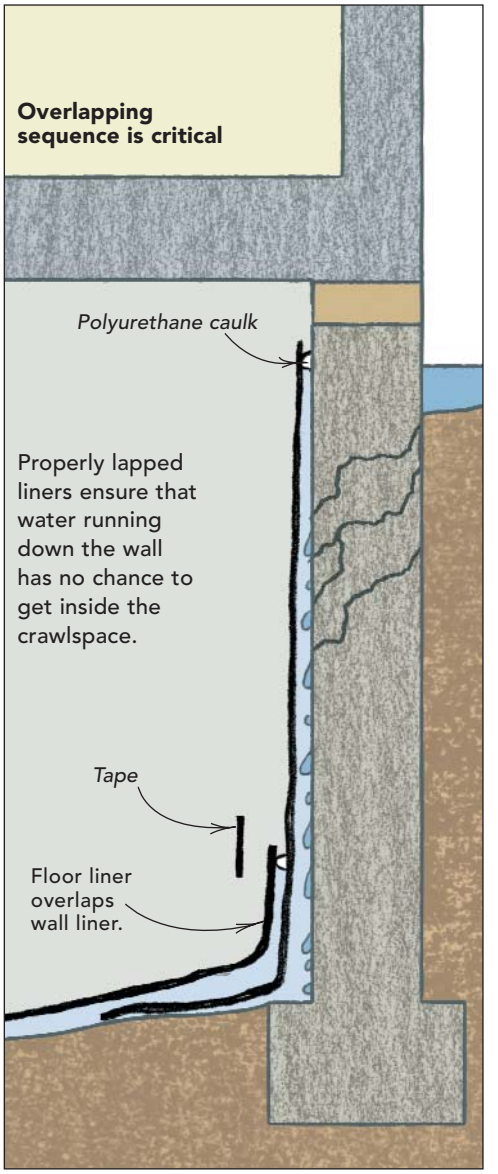


Seal the liner *to the foundation with polyurethane caulk.*



Seems like a single sheet, but it's not. *Overlapping seams of the liner sections are sealed with caulk and matching tape for a seamless barrier.*

POLYURETHANE CAULK AND PLASTIC TAPE SEAL THE DEAL



4 ft. along the top edge (photo bottom left, facing page). I install the fasteners 3 in. down from the top of the liner (photo right, facing page) so that I can pull down the liner to seal it to the wall with polyurethane caulk (top photo). Polyurethane caulk is the only caulk I use on my projects; it sticks to anything and lasts for ages. I use Bostik 916 (800-472-9430; www.bostikfindley-us.com) or Vulkem 116 (www.roancorp.com; 800-321-7906).

I never seal the liner to the sill plate because doing so gives water vapor a path to the wood and can be a route for termites and other insects to get to the house framing. Leaving the liner 2 in. down from the top of the wall allows a routine termite inspection.

At wood posts, I lift the weight with a hydraulic jack, if possible, and slide the liner under. If I can lift the post only a bit, I slide a piece of aluminum flashing under the post and seal the liner to the edges of the flashing with caulk. At masonry piers or columns, I cut slits and wrap the liner up 6 in. or so, then caulk. At seams, I caulk under the overlap and use a 4-in. wide peel-and-stick tape made from a matching material, which makes the seams disappear. A high-quality builders' tape such as Tyvek tape (www.tyvek.com; 800-448-9835) also would work.

The finished system looks fantastic. My customers are pleasantly shocked when they see the end product. The white color reflects light, and it's clean and mold-free. Indoor-air quality is improved, and the crawlspace can be used for storage. □

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