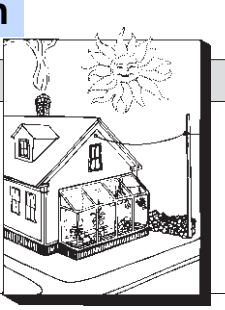
FOCUS ON ENERGY



Crawlspaces: To Vent or Not?

by Terry Brennan

Ever build or remodel houses with crawlspaces? Or put an addition on a crawlspace? Ever wonder about how to insulate them? Or how to keep them dry enough so the wood doesn't rot? I have. Here are my most recent thoughts.

The Old Way

Traditionally, moisture control in crawlspaces has consisted of screened vents to the outside—sometimes with an added ground cover of plastic film. The idea is to get outside air to carry away the moisture. The ground cover is there to slow the rate at which moisture enters the crawlspace air from the earth.

The CABO and BOCA codes both require crawlspaces to have 1 square foot of *free vent area* for every 150 square feet of floor area. The codes also say that the vents should be on all four walls, close to corners, and covered with 1/4-inch to 1/2-inch "noncorrosive screening" (whatever that means). Remember that 1 square foot of free vent area is a 1-square-foot hole with no screen. Put screen on it and you need at least 2 square feet of vent area. So for a 1,500-square-foot house you'd need 22 block-sized vents.

However, the code also says that if you place a ground cover of polyethylene film over the dirt, you can cut the vent area by a factor of ten and have only three block-sized vents. (Of course, the three-vent approach is often taken *without* the ground cover.)

BOCA also allows a power vent option. Passive vents are not needed when mechanical ventilation is supplied at a rate of .02 cfm per square foot of crawlspace floor area. That's 30 cfm for the 1,500-square-foot ranch house.

CABO says that an attached crawlspace that is vented into a basement does not require passive or mechanical ventilation to the outside.

Added Insulation, Added Problems

When energy prices got high enough, we began insulating crawlspaces to cut down on heating costs. We tried to do it in a way that would not mess up the ventilation, so we insulated between the floor joists. It wasn't always easy, and there were code issues to contend with. For example, two often overlooked code requirements are a minimum 18-inch clearance between the dirt and the floor joists and an access opening of at least 18x24 inches.

After figuring out how to get the floors insulated, we realized that the crawlspace was now going to be colder in winter. So now we had to insulate any heating ducts so they wouldn't lose heat, and water pipes so they wouldn't freeze. This was also not easy: there's nothing like trying to duct tape and insulate heating ducts in a crawlspace on a remodeling job, eh?

And then there are vapor retarders. In a crawlspace, should the vapor retarder be up, down, on both sides, or nowhere at all? I've heard all kinds of theories over the years and have seen a panel of moisture-in-buildings experts reduced to hurling insults over the issue. To be honest, I've seen moisture problems in crawlspaces with any of those details. It seems to depend mostly on whether or not there is a strong source of moisture.

Heat and Moisture Related

Thermal protection and moisture protection details affect each other. They really shouldn't be thought of separately. Here's why. The warmer a portion of a building is, the lower is its relative humidity. So if nothing else changes, a crawlspace can be made drier by keeping it warmer. You can do that by insulating the walls of the crawlspace. Take 40°F crawlspace air at 20% relative humidity and raise it to 50°F and the relative humidity drops to around 14%.

The effects of sealing a crawlspace are less clear. This will warm the space, but at the same time lower its ventilation rate. The net effect could be to increase the relative humidity. A study done by Princeton University, however, found that the moisture content of the wood framing in a crawlspace was the highest during the summertime when the vents were open and the lowest in the winter when the vents were closed. In the summer, the ventilation air may have actually carried moisture *into* the crawlspace.

This runs contrary to the conventional wisdom that more ventilation tends to dry out a crawlspace. The study also found that crawlspaces with the walls insulated, vents caulked closed, and a carefully installed ground cover had, on average, moisture levels of 6 percentage points lower in the wood framing (11% instead of 17%) than the houses with ventilated crawlspaces with no insulation on the crawlspace walls and no ground cover. The lower moisture levels are probably accounted for by a combination of warming the crawlspace and reducing the amount of moisture that entered from the soil. Incidentally, damage to framing because of decay usually happens when the moisture content of the wood is greater than 20%. That 6 percentage points could make the difference.

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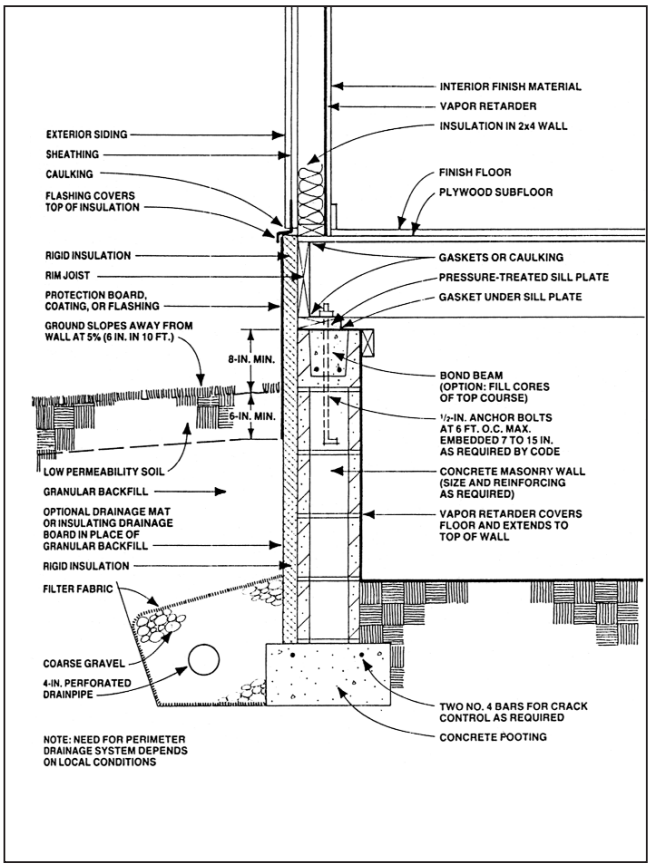

Research indicates that an insulated, unvented crawlspace can perform at least as well as a traditionally ventilated space. The detail, above, from DOE's Building Foundation Design Handbook, *shows one option for an insulated crawlspace. The insulation can also go on the inside of the wall.*

What About Radon?

What about radon building up in a newly sealed crawlspace and getting upstairs? If this is a problem, use the mechanical ventilation option in the BOCA code and exhaust the crawlspace with a small fan. This will lower the air pressure in the crawlspace relative to the air pressure upstairs and air will flow from the living area into the crawlspace. This prevents not only radon from getting into the house but any other air contaminant that may be present in the crawlspace. Musty odors and water vapor are the most common things, but occasionally insecticides, methane, and gasoline fumes move through the soil too.

In order for the crawlspace to be depressurized enough, you'll need around 100 cfm for each square foot of *effective leakage area* (ELA) in the crawlspace. (The ELA is the size of a hole in the wall that's equivalent to all the air leaks added together.) Since the bulk of leakage in crawlspaces is from the screened vents, it is easy enough to find and seal that portion. Without too much trouble you should be able to get a crawlspace sealed up to about half a square foot of ELA.

You can also use the crawlspace ventilation system to provide whole-house ventilation in a small house. For example, if a fan is used that moves 100 cfm, and half of it comes from upstairs, then you've got 50 cfm of conditioned air being exhausted from the living space. This meets the ASHRAE recommended ventilation rate for a 1,200-square-foot house.

Recommendations

So here's what I'm suggesting, and have been doing in crawlspaces since 1980:

- Put a ground cover on the earth to control water vapor entry.
- Insulate the crawlspace walls (inside or out).
- Seal the crawlspace as airtight as you can without getting crazy.
- Ventilate the crawlspace to an attached, insulated basement; or
- Ventilate the crawlspace with a small exhaust fan to the outdoors.

I think these steps will have the following benefits:

- No pipe freeze problems.
- Easier installation of insulation (on walls than on the floor overhead).
- Reduced risk of moisture problems in crawlspace.
- Reduced radon entry when active exhaust ventilation is used.

The traditional approach to thermal and moisture protection in crawlspaces can work well in many cases. The new approach, however, works at least as well and has a number of additional benefits. ■

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