

Crawlspace Ventilation

UPDATE



What happens when the builder knows how to do it right, but the codes haven't caught up yet? That's pretty much where we stand right now

with crawlspace construction. Thanks to solid research done in the late 1980s and early 1990s by Princeton Energy Partners, Florida Solar Energy Center, and the University of Illinois's Building Research Council, quality builders know that a crawlspace should be carefully sealed and insulated (see Figure 1, next page). Otherwise, you invite serious moisture problems, especially in hot, humid climates.

"The problem is, most building codes still require ventilation in the crawl-

space," says John Tooley, a building science specialist with Advanced Energy of Raleigh, N.C. "That puts builders in a real bind. Either they build it wrong or they build it illegal."

To get around the problem, a lot of builders install crawlspace vents to satisfy the code, wait until the certificate of occupancy is issued, and then recommend to the new homeowner that

the vents be sealed tight and left that way. The practice has become so common in some areas that a new breed of subcontractor has sprung up, specializing in what might be called postconstruction crawlspace sealing.

Tooley, who is one of the most experienced hands in the country when it comes to troubleshooting and remediating crawlspaces, sees nothing wrong

Code organizations have begun to recognize that sealed, unvented crawlspaces are often best practice



Figure 1. Crawlspace should be insulated and sealed shut, but only after they've been thoroughly dried out. This crawlspace has reflective wall insulation that is sealed where it meets floor plastic.

with sealing a crawlspace after construction is completed so long as it's dry. "There are some situations in which a crawlspace shouldn't be sealed immediately," he says, "because the house hasn't had time to dry out. If there's been a lot of rain during construction and the windows and doors go in quickly, you can have a lot of moisture trapped in the materials." One way to dry a crawlspace out, he says, is to leave it open over the dry winter season and then seal it. If it's summer, the best strategy is to go ahead and seal the crawlspace, but use a dehumidifier to dry it out.

Tooley's golden rule — "never seal a wet crawlspace" — is applicable to both new construction and remediation work. "You've got to make sure that you've eliminated the four moisture transfer mechanisms — liquid flow, capillary action, air transported vapor, and vapor diffusion — and let the crawlspace dry out before you insulate and seal it," he explains. "Otherwise, you're going to have big trouble."

Tooley says that he's seen houses less than a year old with pools of standing water in the crawlspace, floor joists covered with mold, and mushrooms sprouting in the shadows (Figure 2, next page). In one recent remediation job, the floor in a six-year-old house was so rotted over the crawlspace that the linoleum above it was sagging and cracking. The owner feared his foot was going to go through the floor.

Bad as it is, structural damage due to wood rot isn't the worst thing that can come out of a dank and moldy crawlspace. "A lot of fungi you find down there are not your friendly bread mold type," says Tooley, who protects himself on the job with a two-canister respirator. "Some of it will land you in the hospital. It's pretty scary when you find leaky ductwork running through an environment like that, transporting moisture and spores up into the rest of the house."

Tooley's warning coincides with growing public health concerns over fungi and the mycotoxins they produce. Of particular concern at the

Crawlspace Case Study — IBACOS Prototype Design

The Reactions Group of Companies (RGC - Newport Beach, Calif.) is showing the world that crawlspace construction — despite its murky past — can be a thing of beauty when it's done right.

The company, one of four primary builders working on the master-planned Community of Civano, near Tucson, Ariz., recently completed the first of 240 new houses that will feature crawlspace foundations built with insulated concrete forms (ICFs). The design was



developed in cooperation with Integrated Building and Construction Solutions (IBACOS), a consortium sponsored by the U.S. Department of Energy.

The crawlspace on the single-story, 1,200-square-foot prototype house is fully insulated and sealed (no air vents), which makes it a conditioned space. The 14-inch open-web floor joists, manufactured by Space Joist, provide 11 inches of clearance through the web to accommodate the 10-inch diameter heating and cooling ducts. The open webs also provide a handy channel through which to run electrical cable, communications wire, plumbing drains, and the home's flexible polyethylene



water supply lines. All of these systems are easily accessed for service or modification through two panels in the closet floors above.

Wooing the Code Officials

“Though we're working with a lot of new designs and materials in these houses, it's gone remarkably well,” says RGC Chief Executive Officer Jim Murar. “Our main problems have been code-related, especially with the conditioned crawlspace and termite protection.”

In meetings with Tucson code officials, Murar and Oberg successfully made the case for a sealed, insulated crawlspace, presenting support materials from Energy Efficient Building Association's *Hot-Dry Climate Builder's Guide*, the University of Minnesota's *Building Design Foundation Handbook*, and ASHRAE's *1997 Handbook of Fundamentals*. “If we hadn't been able to persuade them to let us seal and insulate the crawlspace, we would have abandoned the design,” Oberg says.

A second — and even thornier — code issue was termite protection. Past experience with ICFs and other wall designs that use exterior foam has shown that termites can tunnel up through the foam — out of sight — to reach wooden sill plates and floor joists above.

IBACOS' crawlspace design protects against termites by removing the top 8 inches of foam around the exterior of the crawlspace, leaving the ICF's concrete core exposed as a termite break. An elastomeric cap protects the top of the foam on the inside of the wall. That, in turn, is capped by a metal termite shield (flashing). The Tucson code officials liked and approved the plan. Better still, the pest control company was so enthused with the design — because the space can be easily accessed for inspections — that it's offering 10-year termite warranties to the new owners.

—D.B.



moment is a fungus called *stachybotrys chartarum*, which has been associated with idiopathic pulmonary hemorrhage in infants. Some health officials believe that the worrisome rise in asthma and allergies in the U.S. is related to poor indoor air quality, with fungus spores playing a leading role.

How to Woo Your Local Code Official

Despite the potential for trouble, crawlspace construction is gaining popularity in some parts of the country, because it costs less than building a full-size basement while still providing an out-of-the-way place to put plumbing, electrical wiring, and ductwork. "It's an okay way to build a house so long as it's done right," says Tooley. "The problem is, it's usually not."

Tooley and other building scientists have been working for years to educate builders and code officials on the right way to build a crawlspace. Their collective efforts paid off when the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) decided to eliminate the crawlspace ventilation requirement from the 1997 *Handbook of Fundamentals*. But regional and local codes, for the most part, have not yet followed suit.

"One thing's for sure," says Tooley. "You can't change the code by making the code officials look bad or telling them that their science is crappy. You've got to build a relationship. When code officials get the right information — backed by good research — they begin to make the right changes."

Tooley says he spent two years building relationships with code officials in North Carolina before he began to see meaningful changes. Along the way, he and other instructors from Advanced Energy made sure that they invited state and local officials to attend their builder training seminars, especially those sessions that focused on crawlspace construction. Gradually, the North Carolina code has changed, from originally requiring vents with no vapor retarder, to requiring vents with an 80% vapor retarder, to the latest ver-



Figure 2. Trapped crawlspace moisture causes big problems as seen in this example where mold, mushrooms, and rot have overtaken joists and the underside of a subfloor.

sion, which permits builders to seal the crawlspace and use a full vapor retarder.

Tooley describes himself as "close to being happy" with the current North Carolina code. "There's a requirement in there for a small exhaust fan — sized at 1 cfm per 50 square feet of crawlspace area — that I don't think is necessary," he explains. "But this is a process of incremental change. If you try to make sweeping changes all at once, you're not only going to get resistance from all the code officials, you're going to get resistance from the practitioners. And it's the practitioners who make things happen."


Now that the code issue has been (nearly) resolved in North Carolina, Tooley wants to take the battle into neighboring South Carolina and Virginia, where vented crawlspaces are still required. He's planning a series of crawlspace moisture seminars in Virginia. At the top of his list of invitees are — you guessed it — Virginia building code officials.

A Little Gap in the Research

Though numerous groups and individuals have studied crawlspace construction, one piece of building science still seems to be missing: a side-by-side comparison of energy consumption in a vented assembly versus a sealed assembly.

"We're working with a code official here in Delaware who has seen the new ASHRAE guidelines and is ready to let us seal the crawlspaces in new homes," reports Ed Minch, with Energy Services Group (Wilmington, Del.). "But he wants to see documentation that the change is going to save energy."

So far, Minch has not been able to find such documentation. And neither have we.

"We know anecdotally that by sealing the crawlspace you reduce infiltration, and that reduces both the sensible and the latent heat load on air conditioning systems," says Tooley. "I'm sure that sealing the crawlspace will also provide savings in a mixed climate, which is a nice advantage. Unfortunately, I don't know that anyone has done careful research to document it." 

Don Best is the editor of Energy Design Update (EDU). This article was adapted with permission from two articles that ran in EDU in November '98 and January '99. EDU is a monthly newsletter (\$337 per year from Cutter Information Corp., 37 Broadway, Suite 1, Arlington, MA 02474; 800/964-5118; www.cutter.com/energy/) that comprehensively covers energy-efficient construction, building science, materials, and techniques.