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HOUSECALL

Closing the Crawl

Q: When a home is built over a crawl space foundation, what are the advantages, if any, of sealing the vents versus leaving them open?

A: About 200,000 new homes are built over crawl spaces each year, most of them in a band from Northern Florida to Southern Indiana and Ohio. The reasons usually have less to do with building science than with what the local market considers a better house. "In some places, people think slabs are indicative of a poor quality house, where in others, people think the same way about crawl spaces," says Bruce Davis, former research director at Advanced Energy, a Raleigh, N.C., building science consulting company.

Whatever the reasons for building them, crawl spaces are notoriously damp. Their high moisture levels can cause complaints including mold growth, high humidity, and buckled hardwood flooring.

Most crawl spaces are built with foundation vents, which are supposed to keep moisture problems to a minimum. Building scientists have long asserted that the vents bring in more moisture than they let out. Davis, along with building science associate Cyrus Dastur, just finished a study that looked at whether those assertions were true, and whether it would make more sense to enclose a crawl space. "We wanted to see if we could do something different in the construction of crawl space foundations that would solve moisture problems and not cost more energy consumption," says Davis.

The study consisted of 12 houses being built on the same street in Princeville, N.C. Davis and Dastur divided the homes into three groups of four homes each and tried different crawl space techniques on each group, as follows.

"Almost all vented crawl spaces have mold. We call them mold amplification and delivery devices. ... [And] mold is an asthma trigger."—Bruce Davis

Group 1: The first four homes—the control group—were built with what Davis calls "the best vented crawl spaces possible." The homes didn't have any drainage problems. A good plastic vapor retarder was laid on the ground, and R-19 insulation was installed between the first-floor joists.

Group 2: In the next four houses, they left the R-19 insulation between the joists, but sealed all the foundation vents, sealed all the seams in the vapor retarder, and extended the vapor retarder up the perimeter walls. They ran a 4-inch duct from the home's HVAC supply trunk line to the crawl space. The duct put 35 cfm of air into the crawl space whenever the air handler was running.

Group 3: In the last four homes, they didn't install the R-19 insulation, but instead put 2 inches of R-13 foil-faced polyisocyanurate foam on the crawl space walls. As with Group 2, they sealed the vents, sealed the vapor retarder seams, extended the vapor retarder, and ran a duct from the supply trunk to the crawl space.

In each home, small, battery-operated data loggers installed in multiple places took readings every 15 minutes. They measured temperature and relative humidity in all crawl spaces, as well as inside and outside the house. Each house was conditioned by a packaged unit heat pump, so the researchers installed meters that measured the heat pumps' electrical use. The researchers also monitored wood moisture content, taking readings from 10 places in every crawl space every 60 days.

WHAT THEY FOUND

Davis and Dastur found that the vented crawl spaces in Group 1 were indeed moisture traps, with routine relative humidity (RH) over 70 percent from early spring to late fall and over 90 percent in the summer. "The temperatures in the crawls were actually cooler than the dew point of the outside air," says Davis, which meant that any air brought into the crawl would condense on the cooler surfaces. This created a fertile ground for mold growth.

"Almost all vented crawl spaces have mold," says Davis. "We call them MADD, or mold amplification and delivery devices. And because, in most homes, the crawl space is connected to the house via leakage, we estimate that of all the air in the house, 50 per-

cent had been in the crawl space at one time. Mold is an asthma trigger, so a closed crawl can be a risk-reduction technique."

On the other hand, the closed crawl spaces in Groups 2 and 3 maintained an RH below 60 percent and actually became drier over the course of the summer. The results for the two types of insulation were so close as to be interchangeable.

The closed crawls also used less energy. "We found we were able to actually reduce energy consumption by about 15 percent to 18 percent, saving $87 to $100 per year," says Davis.

As for cost, Davis says the rule of thumb was $2 per square foot for new construction. Systems that include a dedicated dehumidifier can bring costs up to $6.50 per square foot.

CASE CLOSED: Researchers Bruce Davis (left) and Cyrus Dastur of Advanced Energy recently field tested three crawl space designs, one vented and two unvented. Their data support building scientists' long-held assertion that closed crawl spaces should be drier and more energy efficient.

TO SEAL OR NOT

What does this mean for the average builder? If you're currently using a crawl space foundation system, look to see if you're having moisture problems, says Davis. Do you get complaints of buckling hardwoods? Or water in the floor insulation? Or water on the ductwork? Quite often, subcontractors point the finger at each other for these problems. The HVAC guy says the insulation is bad because it has moisture in it. The insulator blames the HVAC guy. But the real problem might be the crawl space itself, and a closed crawl may be the solution.

If you decide you want to build an unvented crawl space, expect some initial resistance. Davis says that one particular hurdle was the pest control industry. Pest control contractors traditionally vent crawl spaces, which they believe will reduce the possibility of termites by reducing moisture problems. "When you tell them you want to close crawl spaces, they think you're telling them the stupidest thing in the world, and they want to stop you," says Davis. But he says they came around when they saw the evidence: "Because of our research data, we have managed to develop a positive perception on their part about closed crawl spaces."

Davis and Dastur's research has already had an impact in North Carolina: The findings led to a change in the North Carolina building code that made it easier to build closed crawl spaces. But do the findings apply to other climates? To find out, they have started a project that will include two new sites: one in a hot-humid climate, one in a climate dominated by winter. The final results should be available in late 2008. **B**

Charles Wardell is a freelance writer based in Vineyard Haven, Mass.