Crawl Space Ventilation

By **BRUCE BARKER**, ACI

ONCE AGAIN, The Word invites you to travel into the dark realm of issues that sometimes are misunderstood by home inspectors. The Word hopes you will find this trip informative and maybe a little entertaining.

The Word's term this month is **crawl space ventilation**. The Word finds this term interesting because the current rules for crawl space ventilation may not work as intended to prevent wood rot and mold growth. You might want to know why this is so and what might be done to mitigate the potential problems.

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Current crawl space ventilation rules

The current crawl space ventilation rules are pretty simple. That's not surprising; they were developed in a simpler time. There should be at least 1 square foot of net free-ventilation opening area for every 150 square feet of crawl space ground surface. This ratio may be reduced to 1 square foot to 1,500 square feet if the crawl space ground surface is covered with a Class I vapor retarder, usually six-mil polyethylene.

There should be a ventilation opening within 3 feet from every building corner. These openings should be covered with screens or grates that have openings not more than ¼ inch. These screens or grates take up space in the opening, so the net-free opening area equals the total opening area minus the area of the screens or grates. Screens and grates can reduce the opening area by ⅓ or more.

So what's wrong with the current rules?

It's said that they don't build homes like they used to. That's true. Homes used to be built using natural materials. Insulation, if any, was an afterthought. Air-sealing cracks and openings is only now beginning to appear in the consciousness of builders and the public. Older homes breathed, to put it kindly. In more derogatory terms, older homes leak energy like a sieve. This energy-exchange system between the home and its surroundings is the environment in which the current crawl space ventilation rules were developed. The rules usually work fine if the system isn't changed.

Here's a common-sense fact about systems: When you change a system, you probably will change how that system works. You change the home's energy and water vapor exchange system when you install vapor-impermeable floor covering materials such as vinyl and tile and when you add insulation between the crawl space joists. The energy and water vapor exchange is now different from what usually worked under the old crawl space ventilation rules. The changed system will work differently and probably worse.

Let's find out why.

First, let's do some quick building science. The following conditions exist in many ventilated and uninsulated crawl spaces:

1. the dew point is the temperature at which water vapor in the air condenses into liquid water;
2. warmer air holds more water vapor than cooler air;
3. crawl space-ventilation openings required by current rules don't ventilate the crawl space very well; the openings may allow more water vapor into the crawl space than they

remove; this is particularly true in humid climates;

4. heat energy from the home often keeps the uninsulated floor sheathing and floor joists warm and above the dew point;
5. the crawl space ground surface is almost always colder than the uninsulated floor joists; thus, if any area of the crawl space might be at or below the dew point, it will usually be the crawl space floor; water will probably condense there first;
6. water condensing on the crawl space floor is usually no big deal.

Now, let's change the system by adding insulation between the floor joists. The heat energy exchange that kept the floor joists warm and above the dew point has changed. The floor joist bottoms and the bottom of the insulation now may exchange heat energy with the colder ground instead of with the warmer home. Liquid water will condense on the floor joists and on the insulation if their temperature falls below the dew point.

Hello, wood rot, mold and ineffective wet insulation!

To make things even more interesting, let's throw a vapor retarder like a vinyl floor covering or tile into the system. Energy flows from hot to cold. Water vapor flows from higher to lower vapor pressure. Energy and water vapor will flow from the warmer/wetter crawl space into the cooler/dryer home in the summer and will reverse flow in the winter. A wood floor attached directly to the joists allows some energy and water vapor transfer, mitigating some of the condensation potential. The vinyl or tile floor covering is a vapor retarder on the wrong side of the system (in the summer), which effectively stops this transfer and allows water to condense on the underside of the vinyl. That's what sometimes allows mold growth that causes floor-covering discoloration.

So, what to do?

As we now know, changing the crawl space system, even with good energy-efficiency intentions, can have bad consequences. But the energy inefficiency of an uninsulated crawl space is not acceptable, either. So, what to do? Fortunately, there is an answer: the conditioned crawl space.

Conditioned crawl spaces to the rescue

The option to build conditioned crawl spaces has been available for several years, but so far as The Word is aware, they have not been widely adopted. The physics supporting conditioned crawl spaces is difficult to challenge; however, like any improvement, success requires proper implementation.

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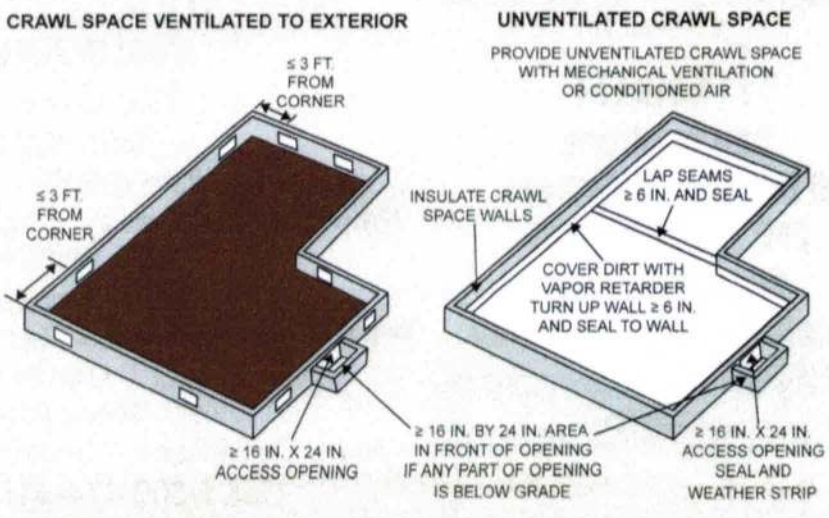
Here are the basic requirements.

A dirt-covered crawl space floor will almost always emit some water vapor into the crawl space, so it must be sealed as well as possible. A Class I vapor retarder such as 6-mil polyethylene should cover the entire floor. Seams should be lapped at least 6 inches and sealed with a compatible sealant. The vapor retarder should turn up the crawl space wall, with the end secured and sealed to the wall. Don't forget the Radon mitigation if you're in a Radon-prone area.

Air still needs to circulate in the crawl space. One solution is continuous mechanical exhaust at 1 cubic foot per minute per 50 square feet of crawl space ground surface. The other solution is to provide conditioned air to the crawl space at 1 cubic foot per minute for every 50 square feet of crawl space ground surface.

A pressure-relief opening into the home is required for both solutions. A simple, unpressurized opening in the floor or a duct is intended. This opening or duct should not be connected directly to the forced-air return duct or plenum because of the potential for ▸▸



Ventilated and Unventilated Crawl Spaces

unintended pressure differences between the crawl space and the home. The airflow rate should be maintained near the recommended rate, again because of the potential for unintended pressure difference between the crawl space and the home. The airflow rate is a case where more airflow isn't necessarily better.

Because the crawl space is now conditioned space, gaps and penetrations to the outdoors should be air-sealed. Sill sealant under the sill is the preferred method for air-sealing the sill in new construction. A good bead of caulk will suffice in a retrofit. Don't forget to seal and insulate the crawl space access opening in the home's floor or in the crawl space wall. This is like air-sealing and insulating the attic access opening.

Then, instead of insulating between the floor joists, the exterior crawl space walls should be insulated. R10 rigid foam on the concrete or masonry walls and R13 insulation in any crawl space wall framing will satisfy current energy-efficiency requirements and is more than required in warm climates.

The bottom line

The ASHI Standard of Practice requires us to inspect insulation, vapor retarders and ventilation in unfinished areas. The crawl space certainly qualifies as an unfinished area. It also requires us to report systems that are not functioning properly or are significantly deficient. As we've discovered, a crawl space with insulation between the floor joists may not be functioning properly. Damp wood, wood rot, mold and wet insulation are signs of an improperly functioning crawl space. Now you know a little about why this might be happening and what might be done to cure the problem.

Memo to the crawl space gods (or monsters that may reside therein): The Word does not reside on Mt. Olympus (just at its base) and welcomes other viewpoints. Send your lightning bolts or emails to inspectorbruce@cox.net. The thoughts contained herein are those of The Word. They are not ASHI standards or policies.

The Word thanks Joseph W. Lstiburek and Building Science for some of the information in this article, for his excellent work and for his willingness to share his insights with the rest of us. ■

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