Crawlspace Solutions

Crawlspaces in climates that have temperatures below 32ºF are minibasements and should not be treated otherwise.

by Vic Aleshire

You can't address crawlspace problems through building codes that try to fight the laws of physics.

My company, The Comfort Company, is located in south central Ohio—one of the very flat regions within the state. Crawlspaces are standard construction for our area, and basements are a rarity. Part of the reason why builders do not build basements is, of course, the cost factor. But builders believe that the overriding reason to build with crawlspaces is to avoid problems with groundwater. Well, everybody is entitled to an opinion. The truth of the matter is that crawlspaces in climates that have temperatures below 32ºF are minibasements and should not be treated otherwise. Water lines will freeze and burst when the temperature in a crawlspace is below freezing, and you can't get heat from a duct system that is set outside in the middle of winter.

Building codes for years have tried to address crawlspace problems through ventilation strategies that try to fight physics. We developed strategies for crawlspaces based on the work of Joe Lstiburek and the Energy and Environmental Builders Association (EEBA) *Builder's Guide*, both of which—initially—were completely outside the building codes in our area. Our strategy incorporated the systems approach for controlling the moisture first and the air infiltration second.

Most of the time we were granted variances by code officials—but we were then able to point out that what we were doing was actually printed in more recent building codes, such as the 2000 International Energy Conservation Code (IEEC). We also had to prove to code officials that our crawlspaces were going to be drier and better ventilated with our strategy than they would be if we were using the standard practice.

JIM LARUE

This crawlspace "before" picture may be familiar to *Home Energy* readers.

Moisture

In south central Ohio we have an extremely unpredictable water table. In some years the ground water will be very low, and in others it can be within a few feet of the surface. Groundwater is one of the sources of moisture, in vapor form, within the crawlspace. In 2000, standard potable water wells were between 25 and 30 ft and maintained a water height of 12 ft below the surface. In recent code changes, the well depth minimum was changed to 50 ft. This was done to address concerns about contamination from fertilizers and different nitrates; but the water level is still constant at 12 ft from the surface in the middle of summer. In the spring and late fall, the water levels may be less than 8 ft from the top of the well casing.

The initial practice for dealing with groundwater was to spread 4 inches of aggregate over the ground. The stone usually became part of the mud within the first couple of years. After this attempt at controlling moisture in the vapor form, builders and code officials decided that it was best to put the aggregate over a poly barrier. This is fine as long as no one crawls, walks, or rolls over the stone and perforates the barrier. Recently, they have begun to adopt a policy of placing stone over poly, with a final barrier installed once all the debris has been removed and there is no further work scheduled in the area. This has been a massive stride forward, but it isn't quite there yet. The barriers need to be sealed around all penetrations and to the foundation wall in order to be complete.

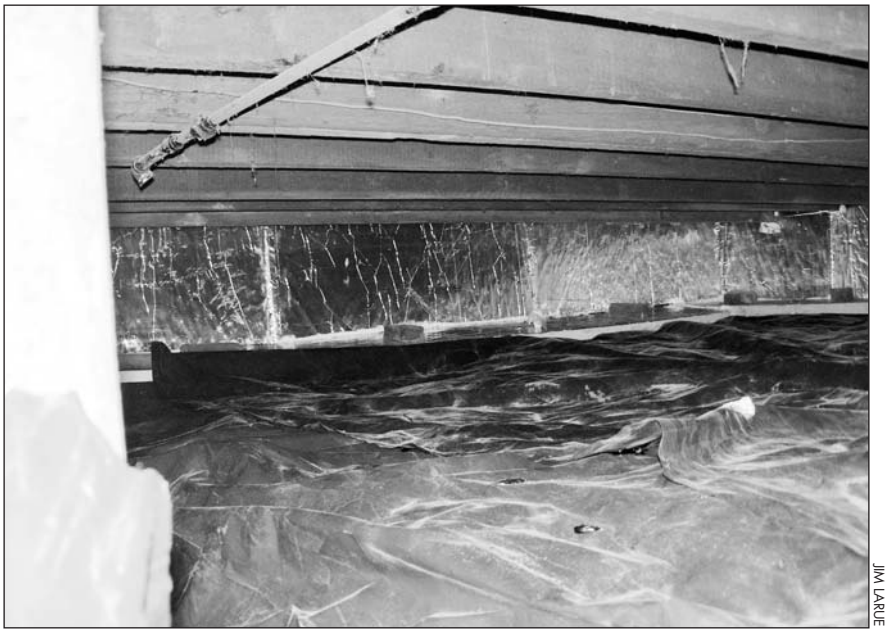
A problem arose concerning the closure of crawlspace vents. Officials and builders decided that it was best to seal all penetrations. This is a great idea, but what happens if moisture vapor does get in the crawlspace? We found that by putting a continuously running, low-volume, high-efficiency fan in the area, we could effectively remove water

vapor from the crawlspace. I didn't say anything about removing water in its liquid form.

Water in a crawlspace is a disaster waiting to happen. Water is the life source for a host of things we don't want in a crawlspace. When you find water in a crawlspace, you'll have to ask yourself a series of questions: Where did it come from? What is the dominant source? How do you remove it effectively? What is your plan to prevent further contamination? We researched this problem extensively and formed a general consensus that there is only one way to move water in the liquid form from one area to another effectively and efficiently. You need a pump.

Installing a sump basin and pump in a crawlspace is not one of the most enjoyable tasks. You will need a variety of digging equipment in different sizes. The average basin is 40 inches deep. The dirt that is removed for the basin can be used to shape the ground to help the water to find the basin, but by far the best method is to tile through the low areas to create a path of least resistance. The sump cannot discharge into the sanitary sewer, so it must be diverted away from the home. We use tile to move the water to the curb sewers or away from the structure to a dry well.

This does not solve the question, Where did it come from? When determining the source, we always check the gutters and downspouts first. Often these dump directly against the foundation or into splash blocks that travel less than 2 ft from the structure. The worst place for downspouts is inside a perforated tile system. This will flood a crawlspace—usually with less than 1 inch of rain. Ground slope is the other culprit for creating wet crawlspaces. There needs to be a 5° slope from the structure to remove water. Builders often set the final grade considerably less than 5° and count on perimeter tile to remove the water as it seeps into the area. Unfortunately, most perimeter tile we have found doesn't go anywhere. It will wrap around the structure and end less than 4 ft from the structure. It's always perforated, so when the water finds a point of lower resistance, it will readily move through the area to the foundation.



JIM LARUE

A crawlspace "after" picture is a pretty sight.

Different Foundation Materials, Different Techniques

Foundations have been made out of a host of materials over the years. Usually they are made of the most abundant material in the area. We have found homes with rubble and mortar foundations and homes with block limestone foundations laid together without any mortar joints. There are homes with central stones and large beams and homes with sandstone slabs that are over 8 ft long. Structurally, all of these materials are doing the same thing as current poured concrete walls or block walls. The difference is in how they repel water or at what rate they absorb water. Keeping the moisture out is the key to building a good crawlspace, but just as important is having a plan for getting rid of it if that fails.

Rubble or fieldstone foundations. Water will move readily through rubble of fieldstone. We have found it best to set a tile at the bottom of the wall, usually about 1 ft deep, with aggregate filling the remainder of the trench. This terminates in a sump basin and is exhausted away from the property. A layer of two-part foam is applied to the surface to an average thickness of 2 inches. The foam layer should also encompass the band joist area. (In various jurisdictions, it's required that the sill plate areas be exposed for termite inspections.) The vapor barrier is incorporated with the foam against the wall and sealed in.

Laid stone and slabs. Water removal is the priority with laid stone and slabs. This style of foundation usually does not have a smooth surface. Without the smooth surface, a rigid material cannot be applied. Closed-cell foam is the best option for insulation and air sealing. This will force the moisture to the tile at the base of the wall, and on to the removal system. Again, incorporate the vapor barrier in the foam for a secure adaptation.

Glazed tile (dairy tile). Glazed tile was used to divert water through the cooling room in dairy facilities. It will allow air and water to move virtually unrestricted in the chambers. The mortar joints also offer little resistance.

Care has to be taken in establishing a drainage plane. If this plane is broken, or if there is no exit point for the water, there will be problems with the retrofit. A rigid board can be used if the surface is smooth, with all seams and joints sealed. The vapor barrier has to be behind the board to create a vapor seal.

Poured concrete, block, and brick. Concrete materials have a smooth surface that can easily accommodate a rigid insulation board. The insulation board is applied to the concrete with the band joist area sealed.

Insulation

Techniques for insulating basement walls have changed in new construction as different materials have become available. Currently, we are finding new homes with a combination drainage plane and insulation board installed on the outer surface of the basement and crawlspace walls. So far this combination seems to be working well, especially when sump and tile systems are used to remove liquid water.

At this point, I want to make a special note about insulating crawlspace and basement walls. As I mentioned above, we will incorporate only closed-cell products for any retrofits. This is considerably more expensive than using a fiberglass or cellulose product for the insulation. We use only closed-cell products because moisture can migrate through a porous material. Concrete, brick, mortar, and stone are all porous. Each of these materials will allow moisture to move easily from a higher concentration to a lower concentration in a surprisingly short period of time.

VIC ALESHIRE

This is an example of a wet crawlspace—notice the water dripping off of the pipe insulation.

VIC ALESHIRE

Obviously, moisture intrusion is a problem in this crawlspace.

VIC ALESHIRE

Where did all the beetles come from? There must be air leaks here.

Because moisture can migrate, it is extremely important that any insulation material in contact with a masonry surface not be fibrous or be able to wick moisture. Moisture accumulating behind drywall and insulation is a recipe for disaster over the life of the structure. Another concern that arises regarding the use of foam insulation is that most jurisdictions require foam products in living areas to be covered with a noncombustible surface. We have covered foam products with gypsum materials and have also used a material similar to thinned mastic. It is in your best interest to consult local officials prior to doing any such retrofit.

Meeting the Crawlspace Challenge

Crawlspaces and basements are extremely misunderstood, and quite often they are the most poorly constructed part of a structure. This is not due to the materials used to build the foundation; rather, it is due to the technique used to keep the area dry. It is very possible for a retrofitter to specialize in nothing but repair to these areas. The first priority is always moisture removal. Removal systems include pumps and tiling and ventilation. If the moisture cannot be removed from the crawlspace it would be in your best interest not to do any other work in that area. Once the moisture is removed, next comes air sealing and insulation, and finally finish. Remember always to include a contingency plan for the worst case. If you don't have a backup plan, you may find out how important they are the hard way.

Vic Aleshire is president and owner of The Comfort Company, in Washington Court House, Ohio. He can be reached by telephone at (740)335-3852, and by e-mail at ww0243@dragonbbs.com.