

Crawlspaces and Moisture Control

Left untreated, crawlspace moisture can wreak havoc on a house.

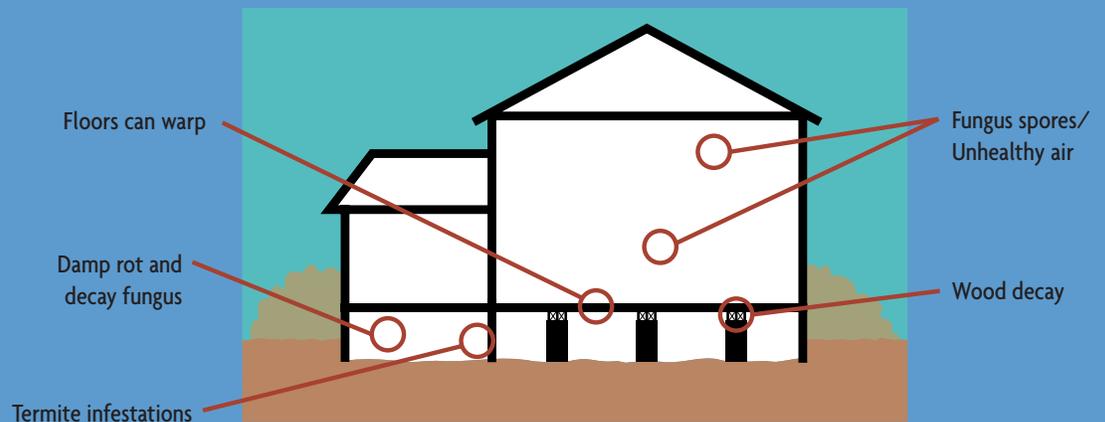
Crawlspace construction is a popular practice in many areas of the country. However, one of the inherent problems with crawlspace construction is the control of moisture under the house. Moisture can contribute to conditions that can lead to a number of problems — some with serious and expensive consequences, including:

- The growth of spores and fungus
- Warped wood that can cause floors to buckle and squeak
- Mold and mildew
- Wet insulation that loses its R-value
- An irritating musty smell
- An attractive environment for termites

What's the best way to control this moisture? This bulletin will examine several options and will look at where the moisture comes from.

Crawlspace Moisture Damage

An unventilated crawlspace can hold moisture from the ground and other sources. This can create an environment that can be attractive to insect populations and can contribute to the conditions that can cause mold, mildew, and wood decay.



Identifying Moisture Sources

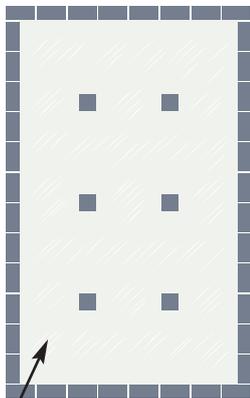
Moisture in the crawlspace can come from a number of sources, including the ground itself. Moisture can also result from poor drainage, grade problems that allow moisture to seep under the home rather than away from it, landscaping that holds water around the house, and improperly located gutters and downspouts.

In addition, any plumbing pipes under the home that leak can become sources of high moisture levels. Finally, humid outside air entering a cooler environment under the house can cause condensation that can contribute to moisture buildup.

Once identified, moisture sources should be remedied.

- Plumbing should be checked and any leaks repaired
- Downspouts should be directed away from the crawlspace
- The grade should slope away from the house
- Landscaping should be trimmed

One of the biggest sources of moisture is the ground itself. Moisture is present in and moves up through the ground. That's why a *vapor retarder* is recommended for all crawlspaces. Vapor retarders should cover 100% of the ground, forcing moisture to the outside.



Vapor retarders can reduce the amount of moisture rising from the ground. They should be installed on 100% of the floor of the foundation.

A vapor retarder will not eliminate moisture. But it will help slow the evaporation of it into the crawlspace and direct it to where you want it to exit, so that it's more easily controlled.

Moisture can also be formed by condensation. Condensation forms when warm, moist air hits cooler surfaces that are at or below the dew point temperature of the air. For example, if the temperature of the air is 90 degrees and the relative humidity is 70%, we know from psychometrics that the dew point is 78 degrees — and any surface cooler than that can experience condensation.

This is why it is important to insulate any exposed pipes in the crawlspace as well as insulate between the floor joists of the living space above. Not only will it reduce the energy losses from the living space and the piping, but it will reduce the possibility of condensation.

Measuring and monitoring moisture levels

After the moisture sources have been remedied, it's important to measure the moisture level in the crawlspace and monitor it regularly.

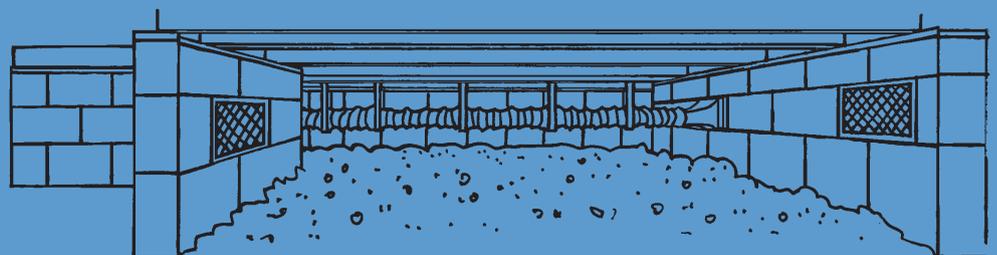
Acceptable moisture levels are different for different regions of the country and even different areas within a region. It also depends on the time of the year.

A moisture meter should be used to measure the moisture content of the wood in the crawlspace. When wood reaches the fiber saturation point — approximately 20% — it can support the growth of fungus and mold. A reading at or above 20% signals that there is a moisture problem and corrective action should be taken.

A hygrometer can measure the relative humidity in the crawlspace. Generally, the humidity level inside the crawlspace should be at or below the humidity conditions outside.

Ventilating Hard to Reach Places

A flexible duct system can provide ventilation for hard-to-reach or obstructed areas of the crawlspace. The system works by combining a powered vent with a duct adapter and a flexible duct. The vent pulls damp, moist air from the problem area, through the duct and exhausts it.



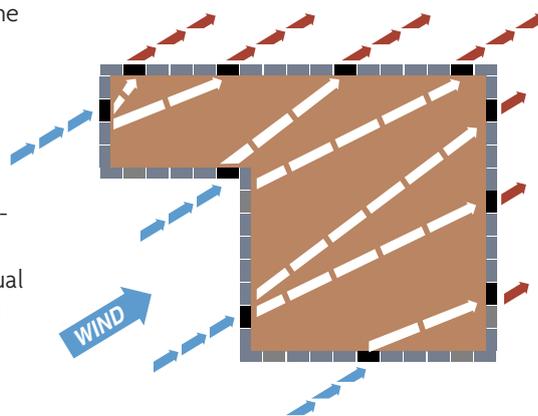
Strategies to Control Moisture

Ventilate the crawlspace

Several strategies can be used to help control moisture levels under the home. The most practical and usually least expensive is *ventilation*.

Ventilation should be designed as a system to create a movement of fresh air through the space. Air movement, even if the air is not completely dry, helps remove moisture. For example, if the temperature and humidity levels are identical, water in a puddle or in a pool evaporates faster if it's windy — if air is moving — than when the air is still.

Once the vents are installed, monitor the progress. Make regular inspections of the crawlspace and the home for early signs of moisture problems, decay and termites. Continue to use monitoring equipment and possibly install a humidity meter in the home to alert the occupants of situations where high humidity is present in the crawlspace. Be mindful of the moisture control and prevention techniques used on individual homes, making sure that the recommended methods continue to be applied.



Ventilation is a system of intake and exhaust. Vents should be installed on all sides of the crawlspace to allow a free flow of air through the space.

Close in the crawlspace

New theories for moisture control that are being tested and have found their way into the codes, call for completely enclosing the crawlspace to moisture and air. This is being tried in new construction and has shown some positive results. The theory is sound: eliminate all sources of moisture and there will not be any problems with the crawlspace. However, the practice is more difficult.

There are numerous steps involved in closing in a crawlspace, with a cumulative effect of achieving the following results:

- Install an air-tight ground cover to eliminate moisture migration from the crawlspace floor.
- Prevent all other air leakages into and out of the crawlspace.
- Provide drains and possibly a dehumidifier to remove water/moisture in the event of accidental water entry — including the plumbing of condensate lines and overflow pans to the outside. If the crawlspace is too far below grade a sump and sump pump may be required.
- Condition the crawlspace. This requires the HVAC system to be coupled with the crawlspace.
- Insulate the crawlspace. This requires the application of insulation to the inside of the crawlspace walls. **NOTE:** If you are considering this option, check local building codes for more details on requirements.

Here's how to design a crawlspace ventilation system:

1) **Locate potential causes of excess moisture.** It is important that all sources of water entrance to the crawlspace be determined and reduced or eliminated when possible.

A drainage issue due to a grade problem may not be easily remedied; however, directing/ extending a downspout away from the crawlspace may rectify the moisture problem immediately.

2) **Assess the ventilation needs.**

Most building codes require 1 square foot of open ventilation area for every 150 square feet of crawlspace. One exception is when using a vapor retarder on the ground; the ventilation requirement may be reduced to 1/1500. A crawlspace that is difficult to access may require the use of the 1/150 ventilation ratio because a vapor retarder on the ground may be difficult to install. However, we recommend the use of a *vapor retarder and ventilation to the 1/1500 ratio* as the best course of action for a crawlspace.

In some cases where passive ventilation may not be sufficient, a power system can be used which will increase the amount of air changes in the crawlspace.

3) **Select the most suitable products for the situation.**

Many types of vents are available and in some cases local codes may require that special vents be used, such as flood vents. It's important that the vent will not warp or bow over time — defects which could affect their performance.

Choosing the Best Strategy

Whether you choose to ventilate the crawlspace or to close it in entirely one thing is certain: it is much easier to accomplish either in new construction than in retrofit applications. Both approaches can work when applied properly; the difference is the cost and application.

Ultimately, it's the homeowner who decides which method is best. Why spend time and money providing conditioned air supply, air seals, sump pumps, etc. in order to eliminate vents, when simply redirecting a downspout may eliminate the problem. In fact, in most cases taking one or two steps, such as redirecting downspouts, adding a ground vapor retarder, or adding vents to provide a cross flow of air are enough to eliminate the effects of excess moisture in a crawlspace.

Thousands of homes exist and perform well using traditional ventilation and other moisture control methods. If the existing strategy continues to work, then there is no need to change methods. However, in situations where a problem is apparent the best approach is to determine the source of the moisture and minimize its affects. **There is no point closing in a crawlspace or even adding additional ventilation if the source of moisture is not eliminated because it may actually lead to additional problems.**

Additional factors

Some additional factors to keep in mind when deciding whether to ventilate the crawlspace or completely close it in:

- 1) It is very difficult to completely eliminate moisture
- 2) Initial costs to provide a sealed crawlspace can be substantial
- 3) Once the crawlspace is closed in, the ability to monitor the home for pest control is altered
- 4) Vents may be required in flood hazard areas
- 5) Ventilation is recommended to mitigate excess radon levels in homes



TEMP-VENT®

4117 Pinnacle Point Drive, Suite 400
Dallas, TX 75211

1 800 525-3271
FAX 1 800 635-7006
www.tempvent.com

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