



Best Practices for Crawl Space Insulation



Table of Contents

I - Introduction

II - Step By Step Guide

- 1 - Providing Adequate Drainage
- 2 - Controlling Ground Moisture
(Vapor Barriers)
- 3 - Chosing the Proper Insulation Method
- 4 - Chosing the Right Insulation Type
 - A. Fiberglass
 - B. Cellulose
 - C. Closed Cell Spray Foam
 - D. Rigid Foam Board
- 5 - Control Outside Air Infiltration
(Air Sealing)
- 6 - Control Moisture from Condensation
(Dehumidifiers)



Introduction

Crawl Space insulation is one of the hottest topics in home improvement and home efficiency these days.

Whether they are struggling to diminish the impact of soaring fuel prices in their lives, or racing to cash in government incentives and the Federal Tax Credit for Home Energy Efficiency, homeowners are actively seeking for the best return for their investment.

As they try to decrease their home's energy consumption, lower their utility bills and improve comfort, foundation insulation surfaces among the top priorities – especially for homes built on vented crawl spaces that have dirt floors..

Justifiably so: A dirt-floored, vented crawl space is a huge energy waster. For a home with ductwork running in a vented crawl space, HVAC system efficiency can be reduced by as much as 50%.

According to Advanced Energy, energy loss in these homes is so substantial that they might as well ignore all other attempts to save money and energy until the crawl space problem is solved.



The ill effects of a vented, dirt crawl space can be felt in many other ways besides high heating and cooling costs. Cold drafts come through the floor in the winter, while uncomfortable indoor humidity enters the house during the summer.

Mold compromises indoor air quality and poses health risks to family members, while rot threatens the building's structural integrity.

That said, it is necessary to understand that effective crawl space insulation can not be achieved without proper measures to control moisture in that environment, or without using waterproof materials to insulate the area.

The following is a step-by-step guide to proper crawl space insulation.

Step by Step Guide to Crawl Space Insulation

1. Provide adequate drainage

- Grade the terrain around the house to slope away from the foundation. Keep gutters clean or install them if the house has none.
- Extend the downspouts as far as possible from the house.
- Plants and bushes that need regular watering should be kept away from the foundation, and care must be taken to prevent hoses and outdoor faucets from leaking.

Sometimes, the above measures will not completely keep the water from entering the crawl space. Interior drainage pipe combined with a sump pump might be recommended in these cases, as well as the use of drainage mats underneath the ground cover.

Drainage mats, as shown in the picture to the right, will keep water from getting in and provide a desirable thermal break as well.



Drainage mats also provide a thermal break under the vapor barrier.

2. Control ground moisture with a vapor barrier

A crawl space with adequate drainage will still have moisture problems, coming from two major sources: the ground and the outside air.

Ground water will evaporate into a dirt-floored crawl space and soak the joists and wooden structures. It will also infiltrate concrete walls and floor causing them to be damp most of the time. It is not possible to effectively insulate a crawl space without eliminating these major moisture sources.

Most building codes and contractors will recommend a waterproof ground cover, which will keep some of the ground water from evaporating into the crawl, but will not address the water

that seeps through the walls.

To completely control moisture in the crawl space, both the floor and the walls should be lined with something that acts like a vapor barrier, completely isolating the area from ground and wall moisture.

In warmer areas, the entire space, including the walls, can be lined or encapsulated with a flexible poly sheet vapor barrier and, if the space is properly air sealed and conditioned, there will be no need to add insulation.



The entire crawlspace should be lined with vapor barrier, not just the floor.

In colder climates, a ground vapor barrier can be combined with foam board insulation, to provide both a vapor barrier and thermal protection. We will examine this process a bit further in this article, when discussing different insulation approaches.

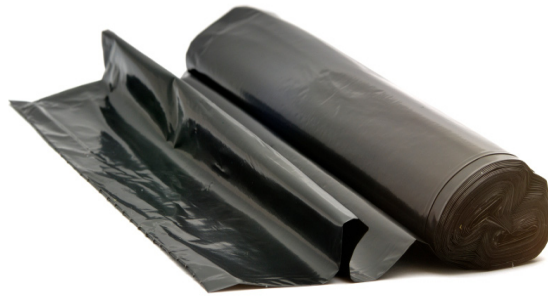
While the norm is to use generic 6mil poly sheet as a crawl space vapor barrier, better, long-lasting results can be obtained by using a 10mil or 20mil crawl space liner instead.

These liners were developed specifically for this application. If mechanically fastened to the walls, a sturdier liner will not rip as easily when people crawl on it, during inspections and maintenance visits.

3. Chose the proper insulation method.

The most popular and widespread method of crawl space insulation, - applying fiberglass insulation bats between the floor joists of a vented crawl space- is also the main cause of most crawl space mold disasters.

Using fiberglass in vented crawl spaces can have disastrous consequences.



Generic 6mil poly sheet, is commonly used in crawl spaces, but not as resilient as 20mil liners designed for this application.

Fiberglass soaks moisture like a sponge, and in contact with water it sags, also supporting mold growth on its paper facing.

To make matters worse, damp fiberglass loses its R-Value, becoming useless as insulation, and as it sags, it opens holes in the insulation blanket, allowing the air to leak into the living area.

The U.S. Department of Energy recommends that rigid foam board insulation be used on the basement walls.

Rigid foam is waterproof, does not absorb moisture, and will not support mold growth, so it's an excellent choice in moist areas like basements and crawl spaces. It's also recommended to install insulation against foundation walls rather than between floor joists,

because this extends the “building envelope” to encompass features like ductwork, water heaters and HVAC equipment.

, Advantages of insulating the wall, rather than the floor include:

- Although foam board is more expensive than fiberglass bats, less insulation is required for the walls.
- The crawl space becomes part of the building envelope of the house, so there is no need to insulate pipes and ductwork running beneath the house for energy efficiency or protection against freezing.
- Air sealing between the house and crawlspace is less critical.

The boards should be attached straight against the walls, using the proper adhesives. The ground vapor barrier should overlap the board at the base and taped over with mastic tape.

A protective membrane should cover the the top of the block wall to allow for termite protection and it should also overlap the board a few inches as well.

Professionally developed crawl space



In this crawl space insulation assembly, performed by Basement Systems, the foam board insulation is attached to the wall. above the drain pipe, which is used to improve drainage in wet crawlspaces.

The drainage mat sits on the dirt floor, additional foam board insulation is added over the mat for optimal energy savings and a vapor barrier is applied on top, overlapping the wall insulation.

encapsulation systems include a transparent cap instead of this protective membrane, to facilitate termite inspections.

It is not always necessary to insulate the floors, specially if you are using a drainage mat, which provides a thermal break.

In colder climates, a lower R-Value foam board can be placed between the mat and the vapor barrier.

4. Chose the right insulation type



Fiberglass insulation:

As we mentioned before, fiberglass insulation is quite popular because it is the most inexpensive insulation material available. However, it is the worst possible choice for a crawl space, because it absorbs moisture and favors mold growth.



Cellulose:

Although modern cellulose insulation is chemically treated to be mold resistant and handle moisture better than fiberglass it is still made with organic materials and there is not enough data to support that it can withstand chronic moisture conditions.



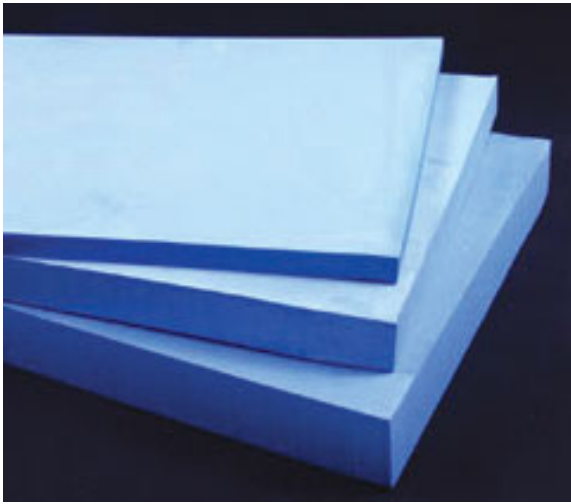
Closed Cell Spray Foam Insulation:

Closed cell spray foam, when properly applied is an excellent choice for crawl spaces. It expands after application, air sealing gaps and fitting snugly around pipes, wiring, ducts and fixtures. When incorrectly applied, however, it can lead to problems.

The insulation blanket should, for example, end a few inches before the top of the wall, and include a protective, removable protective membrane, or cap, to allow for termite inspection.

When applied on wood, installers should make sure that the wood is dry and healthy (mold free), otherwise you will seal the problem but the mold and rot can still cause the wood to decay under the insulation layer.

Another problem with spray foam insulation is price. It costs from 2 to 3 times more than any other type of insulation in the market.



Rigid Foam Board

The U.S. Department of Energy recommends using rigid foam board to insulate crawl spaces. Less expensive than spray foam, it is impervious to water, inorganic and non absorbent.

There are basically 3 types of foam board insulation with R-Values ranging from 3.8 to 8.7 per inch: Extruded polystyrene (XPS) , Expanded Polystyrene (EPS) and Polyurethane.

Foam board comes in different thicknesses, and board sizes are typically 2x8ft. or 4x8ft. Polyurethane foam has the highest R-Value per inch.

To find out which is the best R-Value for the area you live in, refer to the DOE guidelines found in this map (http://www.energysavers.gov/downloads/r_values_basement.jpg.zip)

Insulation boards are attached directly to the wall with mechanical fasteners, adhesives or a combination of both. A vapor barrier, lining the floor, usually overlaps the base of the board a few inches, and is secured and sealed onto it with mastic tape.

Any gaps and holes are then sealed with tape, caulk or spray foam.

For improved energy savings, a lower R-Value foam board, can be placed under the ground cover or in between the liner and the drainage mat.



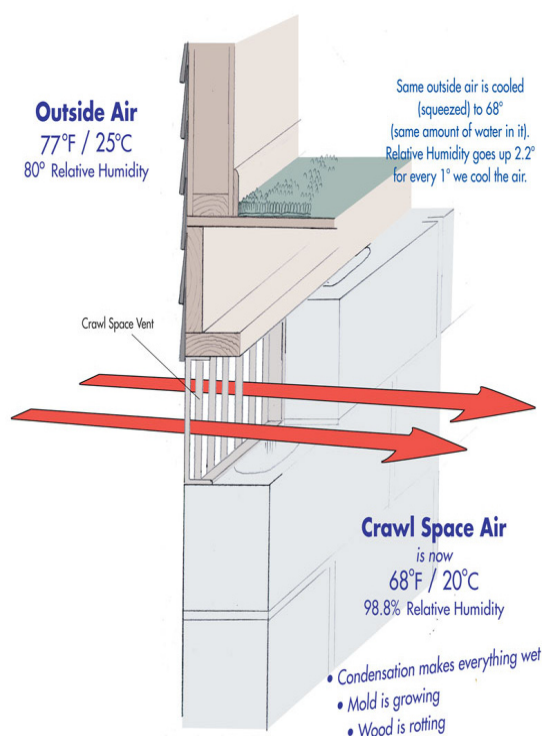
Newly developed, graphite-impregnated EPS boards, with a radiant barrier, like SilverGlo, by Basement Systems, have a higher R-Value than regular EPS. The graphite boosts the R-Value and the radiant barrier reflects heat back toward the living space.

5. Control outside air and moisture infiltration by air sealing the crawl space.

On the warmer days, the outside air, if allowed to enter the crawl space through the vents, will cool down. As it does, relative humidity levels will increase 2.2% for each degree that the outside air is cooled.

A temperature difference of only 10 degrees will cause an increase of over 20% in RH once the outside air enters the crawl space.

How Summer Venting Makes a Crawl Space Moisture Problem Worse



When the RH levels in the crawl space rise to or above 60%, mold is likely to develop. And that happens quite often during summer.

During the winter, RH levels are not much of a concern, but if you have ducts and pipes in the crawl, you can have some condensation issues.

The biggest problem during cold weather is the infiltration of cold air into the living space. Often homeowners complain of cold drafts that can be felt coming from the floors above a crawl space.

This is why air sealing is fundamental, if the goal is to increase energy efficiency. Crawl space insulation without air sealing is not as effective.

The access to the crawl space should be through an outside entry that can be effectively air-sealed when not in use.

Note: in areas in which radon is a concern, such a crawl space encapsulation system acts as a passive mitigation system, but tests should be conducted to determine if there is the need for an additional radon mitigation system, which can be easily installed to work with the vapor barrier.

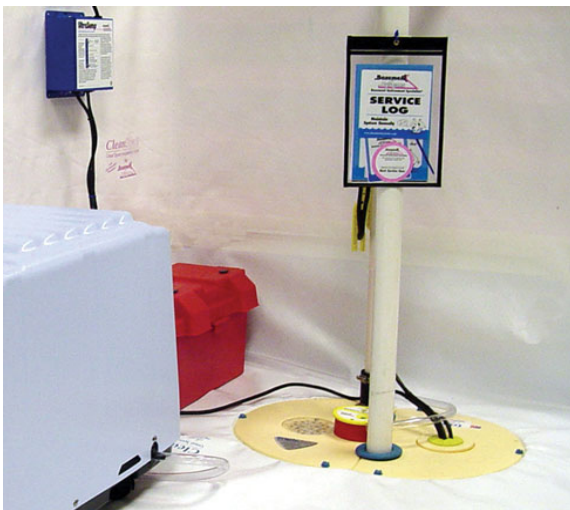
6. Control moisture from condensation with a dehumidifier

With the space is completely isolated from ground and outside air, some condensation may still occur due to temperature differences between the crawl space and its surroundings.

That moisture should be addressed with a crawl space dehumidifier.

A dehumidifier will draw any moisture present in the air before condensation happens.

Good crawl space dehumidifiers are energy efficient and require little maintenance, as they monitor RH levels, turn on and off as needed, and empty the collected moisture into the sump pit.



These two Energy-Star Rated SaniDry dehumidifiers, were developed specifically for crawl space and basement dehumidification, offering the best performance with lower energy consumption

An encapsulated and properly insulated crawl space can significantly decrease a home's energy consumption, protect its structural integrity and improve the lives of its inhabitants. Crawl space insulation is one of the home improvements that bring the best results and the most savings per each dollar invested.

Good dehumidifiers for crawl spaces, discharge the collected moisture into the sump pit, saving homeowners the trouble of emptying the trays regularly.

Sources and Information

Advanced Energy

<http://www.crawlspaces.org>

US. Department of Energy - Energy Efficiency and Renewable Energy

Crawl Space Best Practices - Consider the Crawl

http://www.eere.energy.gov/buildings/building_america/pdfs/db/35379.pdf

Crawl Space Insulation

http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/29238.pdf

US DOE - Energy Savers

Insulation and Air Sealing

http://www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11480?print

Forest Products Laboratory

Crawl Space Ventilation

<http://www.fpl.fs.fed.us/documnts/techline/crawl-space-ventilation.pdf>

SouthFace.Org

Radon Resistant Construction

http://www.southface.org/web/resources&services/publications/factsheets/30_radon-resistantconst.pdf

Crawlspce Insulation

[www.southface.org-factsheets-CI-Crawlspce 00-774.pdf](http://www.southface.org-factsheets-CI-Crawlspce-00-774.pdf)

RLC Engineering

The Fallacies of Venting Crawl Spaces - Craig DeWitt, PhD, PE

<http://www.rlcengineering.com/csfallacies.htm>

Best of Building Science

Closed Crawl Spaces do Double Duty

[www.bestofbuildingscience.com-pdf-Closed crawlspaces do double duty HEM_SP05_p32-36.pdf](http://www.bestofbuildingscience.com-pdf-Closed-crawlspaces-do-double-duty-HEM_SP05_p32-36.pdf)

Building Science Corp

New Light in Crawl Spaces

www.buildingscience.com-documents-insights-bsi-009-new-light-in-crawlspaces-files-BSI-009_Crawlspc_2010r2.pdf

Basement Systems Inc

Crawl Space Learning Center

<http://www.basementsystems.com/crawl-space/crawl-space-learning-center.html>

Doctor Energy Saver

Crawl Space Insulation

<http://www.drenergysaver.com/insulation/crawl-space-insulation.html>