Insulating Foundation and Floors

General guidelines for foundations

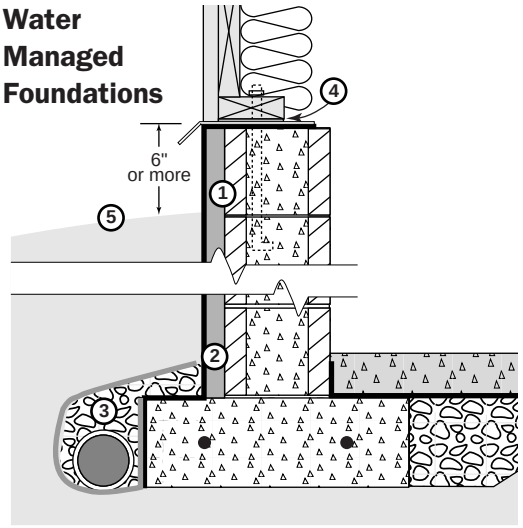
The bottom level of a home, whether slab-on-grade, floor over a crawl space, or underground basement, is susceptible to moisture and deterioration problems due to contact with the earth. The best approaches for preventing these problems will depend on the local climate and style of construction, but the same general rules apply to all foundation systems:

- ❑ Keep all untreated wood materials away from the earth.
- ❑ Provide rain drainage, such as gutters, to conduct rain water away from the house in non-arid climates.
- ❑ Slope the earth away from the house for at least five feet at a minimum 5% grade (3 inches in 5 feet).
- ❑ Provide a water managed foundation drainage system at the bottom of the footing when the foundation floor (interior grade) is below the exterior grade.
- ❑ Insulate between the conditioned and unconditioned portions of the foundation system. In termite-prone areas, extra care should be taken to prevent termites from tunneling through the insulation.

Methods of insulating slab-on-grade floors

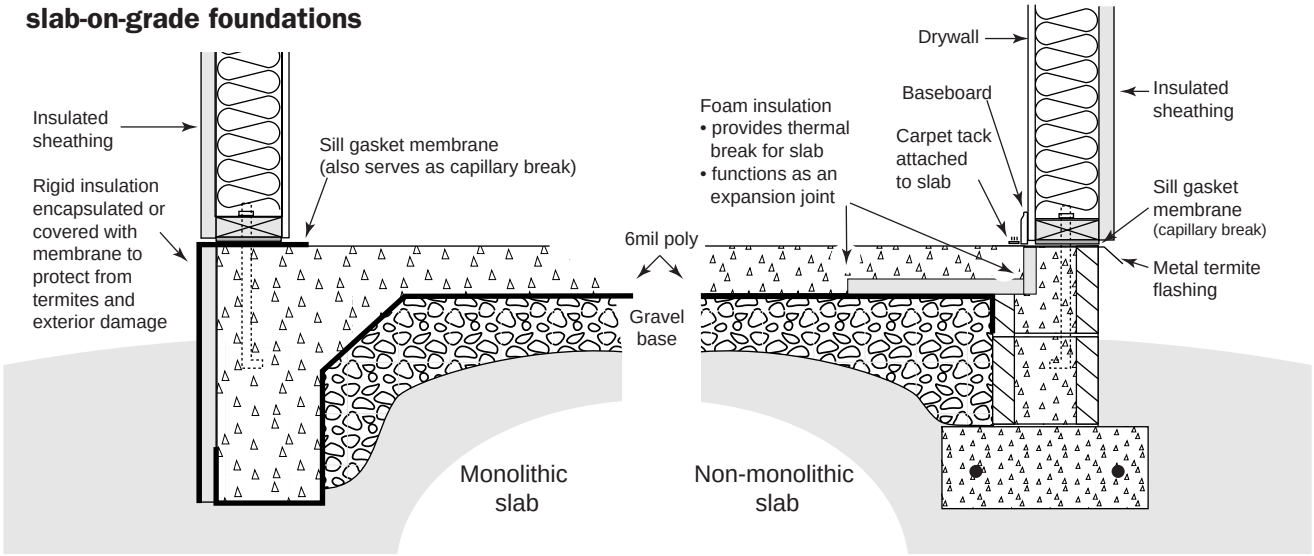
Slabs lose energy primarily due to heat conducted outward and through the perimeter of the slab. Insulating the exterior edge of the slab in most sections of the country can reduce winter heating bills by 10% to 20%. Slab insulation is recommended in many localities by the Model Energy Code or state energy codes.

Water Managed Foundations



1. Damp-proof below-grade portion of foundation wall - this is to seal the wall against ground moisture penetration.
2. Install drainage plane material or gravel against foundation wall - this relieves hydrostatic pressure and channels water to the drain.
3. Cover perforated drain pipe with gravel and cover with filter fabric. Locate drain beside footing, not on top - this creates an underground gutter.
4. Add sill gasket membrane - this serves as a capillary break to reduce wicking of water from the concrete and provides air sealing.
5. When backfilling foundation wall, slope earth away from house 5%.

Insulation approaches to termite-resistant, slab-on-grade foundations



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The controversy with slab insulation

Over the past decade, reports of termite infestations in homes with slab insulation have become more frequent. These pests tunnel undetected through the foam to gain access to the wood framing in the walls. Some insurance companies no longer guarantee homes with slab insulation against termite damage. Recent rulings by national code organizations prohibit installing foam insulation in contact with the ground in several Southern states.

An alternative to slab edge insulation is to create a contained or floating slab with interior foam insulation. This non-monolithic approach provides termite resistance since the insulation is sealed under and above the slab.

Preventing termite problems is a key goal of any building, especially where a visual inspection of the foundation is not possible. Providing effective moisture control systems will help. In addition, make certain to remove all wood from around the foundation before backfilling.

While termite shields are not generally 100% effective, they should be installed continuously under the sill plate of the building to further inhibit termite infestation. The termite shield should extend beyond other building materials to force termites into an exposed area where they can be detected. Before construction, confer with a pest control company to approve the design regarding a termite contract.

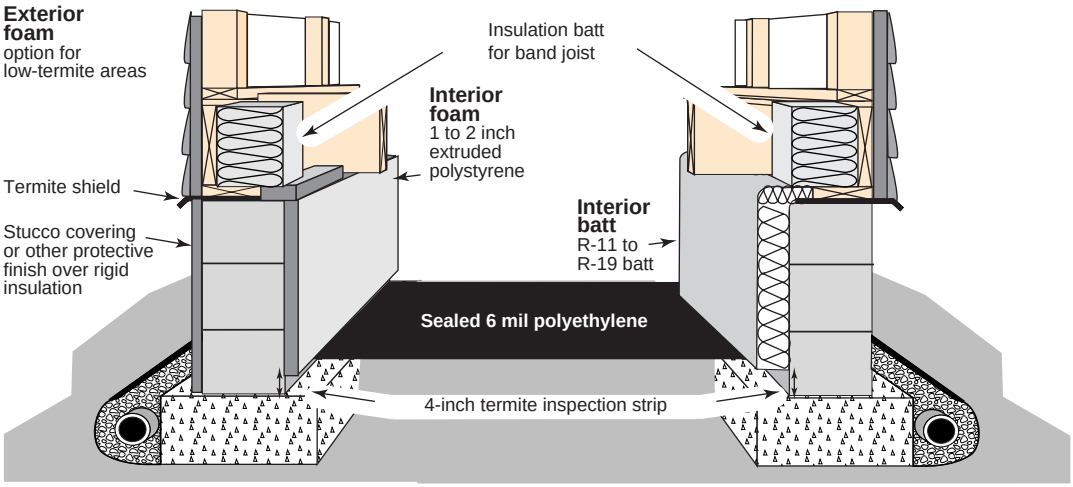
Crawl space insulation

For years, standard building practice was to insulate underneath floors over unheated areas. However, studies performed in Tennessee several years ago found that insulating the walls in *well sealed* crawl spaces and unconditioned basements can be an effective alternative to underfloor insulation.

Crawl space wall insulation considerations

- ❑ Cover the entire earth floor with sealed 6 mil polyethylene (recommended for all crawl spaces).
- ❑ Eliminate or close the foundation vents.
- ❑ Provide outside air for combustion to furnaces or water heaters that are located in these areas via a direct inlet duct from the outside.
- ❑ Leave a four-inch gap at the bottom of the insulation to serve as a termite inspection strip.
- ❑ Insulate and air seal the band joist area.
- ❑ Seal exterior walls; insulate and seal crawl space access doors.
- ❑ Create effective site drainage, this keeps the crawl space dry - some insulation can easily wick water.
- ❑ Review plans for this method of foundation insulation with pest control and local building officials to ensure code compliance.

Insulated Crawl Space Walls - 3 Options



Advantages of crawl space wall insulation

- ❑ Less insulation required (around 400 square feet for a 1,000 square-foot crawl space with 3-foot walls).
- ❑ Piping and ductwork experience little temperature swing so they may not require insulation for energy efficiency or freeze protection.
- ❑ Air sealing between house and crawl space is less critical.
- ❑ Because the crawl space remains cool in summer, the home can conduct heat down into the space if there is no insulation under the floor.

Disadvantages of crawl space wall insulation

- ❑ The insulation may be damaged by rodents or pests.
- ❑ A radon mitigation system will require ventilation of the crawl space to the exterior. Not planning for radon resistant construction may necessitate air sealing the floor in order to mitigate the radon through ventilation.
- ❑ If the crawl space has air leakage with the outside, the home will lose considerably more heat than standard homes with underfloor insulation.

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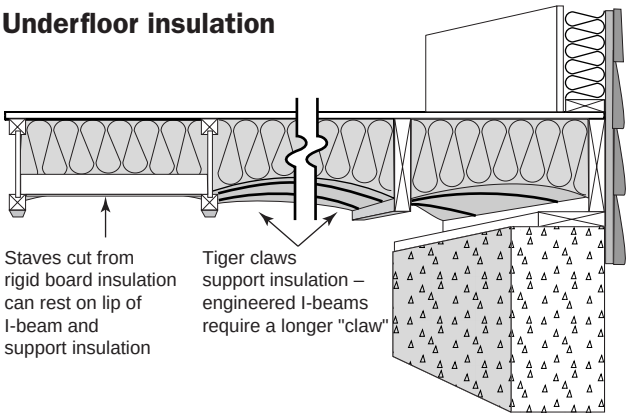
Underfloor insulation



Most floors in conventional homes use 2x10 or 2x12 wood joists, wood I-beams, or trusses over unconditioned crawl spaces or basements. Insulation is usually installed underneath the subfloor between the framing members. To meet the Model Energy Code, homes typically need R-11 to R-19 floor insulation, depending on climatic zone.

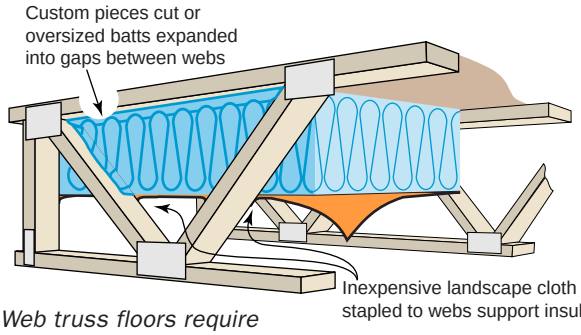
Before insulating floors, make certain to seal all air leaks between the conditioned (heated and cooled) area of the home and the unconditioned space (crawl space or unheated basement). High priority leaks include holes around bathtub drains and other drain lines, plenums for ductwork, framing for basement stairs, as well as penetrations for electrical wiring, plumbing, and ductwork.

Most builders use insulation batts with an attached vapor barrier for insulating framed floors. The batts should be installed upwards – flush against the subfloor – to eliminate any gaps which may serve as passageways for cold air to flow between the insulation and the subfloor.

The orientation of the vapor barrier depends on the home's location. In most of the country, the vapor barrier should face upwards. However, in certain regions of the Gulf states and other areas with mild winters and hot summers, it should face downward.

Steps in installing underfloor insulation

- ❑ During the early phases of construction, meet with the mechanical subcontractors (plumbing, electrical, and heating/cooling) to inform them of the importance of keeping the space between floor joists as clear as possible.
- ❑ Run drain lines, electrical wiring, and ductwork below the bottom of the insulation so that a continuous layer can be installed. Be certain to insulate all duct work in unconditioned spaces. For freeze protection, supply plumbing may be located within the insulation. The best approach is to run supply plumbing together in a few joist spaces. The insulation can be split and run around the piping.
- ❑ Install a sealed layer of 6-mil polyethylene on the floor to reduce moisture levels in the crawl space. Lap polyethylene 6" up walls, overlap sections 12", and tape seams.
- ❑ Seal all holes and penetrations between the crawl space or unheated basement and the house.
- ❑ Obtain insulation for the proper joist spacing of the floor being insulated. Complete coverage is essential - leave no insulation voids and be certain to insulate the band joist area.

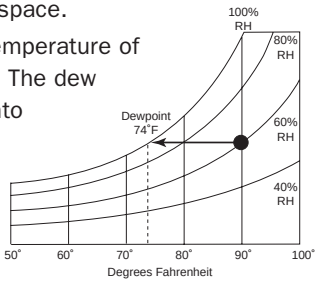


Web truss floors require a unique solution to supporting insulation under the floor.

Are Foundation Vents Necessary?

Most building codes require crawl space vents to aid in removing moisture from the crawlspace. However, ventilation in the winter is undesired in order to keep crawlspaces warmer. Furthermore, warm, moist outdoor air brought into the crawl space through foundation vents is often unable to dehumidify a crawl space in many summer conditions and, in fact, can lead to increased moisture levels in the crawl space.

For example, a crawl space kept cool by the ground in the summer may have a temperature of 65°F and 90% relative humidity (RH) – the dew point temperature of the air is 62°F. The dew point of outdoor air at 90°F and 60% RH is about 74°F. Thus, outdoor air brought into the crawlspace will actually increase the moisture level until water condenses out on cool crawlspace surfaces such as floor joists and foundation walls. As framing stays moist, mold grows and dry rot develops.



Venting crawlspaces which have air conditioning ducts is a particular concern. Typically, the ductwork is leaky, poorly insulated, and creates a cold surface below the air's dew point that causes moisture in the air to condense. Often, water accumulates in the duct insulation. Many building professionals are now recognizing that an unvented crawlspace (or closing crawlspace vents after the crawlspace has had time to dry out after construction) is the best option in homes using proper moisture control and exterior drainage techniques. However, get local code approval before omitting vents.

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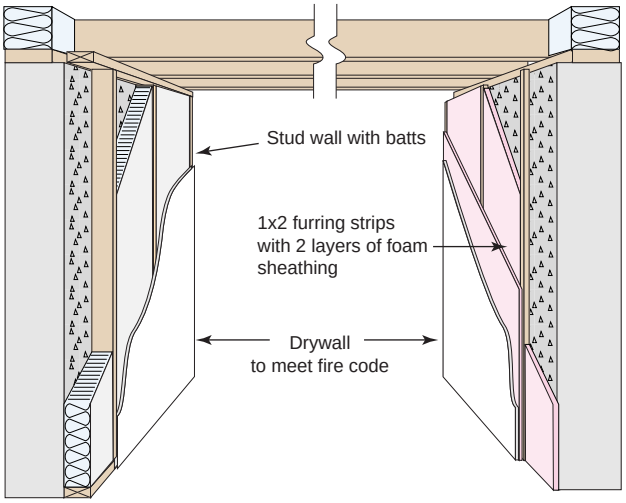


Insulate basement walls with either a stud wall with batt insulation or a furred-out wall with rigid board insulation.

Should basement walls have insulation?

In most of the country, all walls between unheated space (such as the outdoors, crawl spaces, and unfinished basements) and heated rooms should be insulated. Therefore, rules for insulating basements are as follows:

- ❑ Determine if the basement is conditioned – heated and/or cooled. A conditioned basement either contains uninsulated ductwork, has supply registers from a central heating or cooling system, or has its own source of heating or cooling, such as a space heater or window air conditioner.
- ❑ If the basement is unconditioned, either insulate the exterior walls or insulate between the basement and the conditioned rooms of the house (remember to insulate any ductwork in unconditioned spaces). Typical areas to insulate include the basement ceiling and any walls between the unconditioned portion of the basement and adjacent conditioned rooms.
- ❑ If the basement is conditioned, insulate the exterior walls. A variety of approaches exist for insulating basement walls. The drawing shows two techniques for insulating the interior of the basement wall – one with batt insulation installed in a conventional stud wall and the other with two layers of foam insulation installed on the inside of the concrete block. Furring strips should be anchored to the block wall using standard masonry attachment hardware such that one layer of foam is between the furring strips and the second layer covers them completely.
- ❑ In areas with little termite threat, foam insulation can be used on the exterior. Exterior foam may be less expensive than interior foam or building interior stud walls with batt insulation. New insulated concrete foundation (ICF) systems create stay-in-place foam forms that insulate the interior and exterior.

Build in radon resistance

Radon is a radioactive gas that occurs in some soils. It can enter a home through the foundation and floor system. If it occurs in significant concentrations (greater than 4 pico-curies per liter), it may pose a severe health risk to the home occupants. To guard against radon problems:

Slab-on-grade or basement

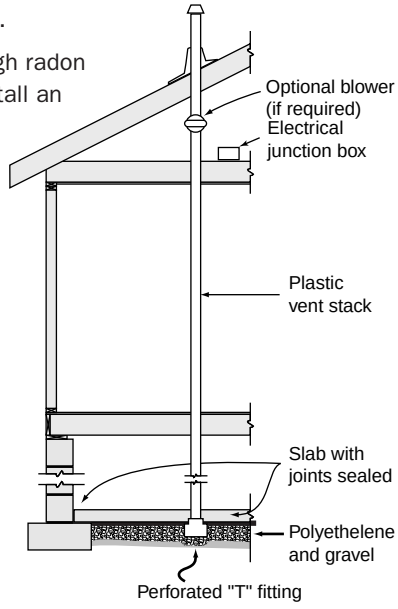
- ❑ Use a 4-6" gravel base.
- ❑ Install continuous layer of 6-mil polyethylene.
- ❑ Stub in Tee below polyethylene that protrudes through polyethylene and extends above poured floor height.
- ❑ Pour slab or basement floor.
- ❑ Seal slab joints with caulk.

Crawl space

- ❑ Install sealed, continuous layer of 6-mil polyethylene.
- ❑ Install Tee below polyethylene that protrudes through polyethylene.

All foundations

- ❑ Install a vertical 3-inch PVC pipe from the foundation to the roof through an interior wall.
- ❑ Connect the Tee to the vertical 3-inch PVC pipe for passive mitigation.
- ❑ Have electrician stub-in junction box in attic.
- ❑ Test the bottom conditioned room for radon with an EPA-listed radon test kit or hire a qualified technician.
- ❑ If the house has high radon concentrations, install an active radon mitigation system by attaching a small blower to the PVC pipe in the attic to expel the gasses to the outside.
- ❑ Contact the Environmental Protection Agency for more information.



Planned radon resistant construction is an inexpensive first-cost. If needed, it can easily be upgraded if active mitigation is later required to cure a high radon problem.

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