Reduce Pest Intrusion

Last Updated: 01/29/2018

Scope

Seal all penetrations in the foundation wall and at joints between the foundation and exterior above-grade walls. Seal all cracks around plumbing and wiring penetrations and cover with metal flashing. Take additional precautions in moderate to heavy termite areas including using solid concrete or filled concrete block at the top of foundation walls, reinforcing concrete slabs and walls to minimize cracking, and using treated wood or metal sill plates. Take additional precautions in very heavy termite areas including not installing foam plastic insulation under slabs or on the exterior of below-grade walls, and keeping foam plastic insulation at least 6 inches above the final grade on exterior walls and at least 3 inches below the sill plate on interior conditioned crawlspace walls.

See the Compliance Tab for related codes and standards and criteria to meet the requirements of national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and EPA Indoor airPLUS.
Description

Insects, rodents, and other pests are more than just a nuisance; they can carry diseases, aggravate allergies, and spread germs and they can cause considerable property and structural damage if their activities go undetected for any length of time. Fortunately, many of the air sealing and water management measures associated with energy efficiency and high performance, also help with keeping pests outside of the home.

Mice can squeeze through holes as small as $\frac{1}{4}$ inch and rats can enter holes as small as $\frac{5}{8}$ inch. Rodents can chew through spray foam, wood, and some types of plastic. As a general practice, seal all holes that are greater than $\frac{1}{4}$ inch by $\frac{1}{4}$ inch with corrosion-resistant copper or stainless steel wire mesh to prevent entry by rodents, birds, and bats. Smaller holes can be caulked to seal out insects. To keep insects from getting into walls through air gaps behind siding or draining vents in brick walls, block their entry with wire screens. Seal all cracks around plumbing and wiring penetrations and cover the seal with escutcheons or metal flashing. Do not leave a rough surface that will trigger rodents’ instinctual response to start chewing. Do not leave blown foam exposed to the sun. Exposure to the sun will break it down and insects and rodents may nest in the foam.

For the gap under doors, install door sweeps that touch the ground and go the entire length of the bottom of the door. If properly installed, the sweep will brush the ground, but not hold the door open (a fire hazard). In areas prone to rodent infestation, do not use vinyl sweeps.

Making a house resistant to the entry of pests minimizes both the damage they can cause and the exposure of occupants to pest-related allergies, diseases, and asthma triggers. While the use of chemicals and poisons are common conventional methods for preventing or treating pest infestations, relying on their use increases ongoing maintenance activities and costs for the homeowner and they can contribute to health and safety concerns of their own. There are several steps that builders can take to reduce opportunities for pest intrusion and damage, without relying on chemicals.

Wet wood attracts carpenter ants and is easier for animals to gnaw through so it is important to construct the home so that it stays dry or dries out quickly if some components do get wet. The Building America Solution Center has several guides to help builders properly manage water drainage around the site and foundation; these can be accessed through the [ENERGY STAR Water Management System Builder Checklist](#). The steps that builders take to seal the building envelope to prevent air leakage will also help to keep out insects and rodents. Several of these steps are described in the Building America Solution Center under the [ENERGY STAR Thermal Enclosure System Rater Checklist, TES 5. Air Sealing](#).

In areas with a high likelihood of termite infestation, building codes restrict where and how rigid foam can be installed along the interior and exterior of basement and foundation walls. Although termites don’t eat the foam, they tunnel through it; therefore, its presence can hide their activities from building inspectors. Information about restrictions related to rigid foam is found in the guides [Unvented Crawlsspaces and Conditioned Basements](#) and [Rigid Foam Board Interior Insulation for Existing Foundation Walls](#). Precautions regarding the use of rigid foam insulation in termite-prone areas are listed below.

### How to Reduce Pest Entry through Concrete Foundations

1. Locate all seams, penetrations, and holes in concrete slab, concrete foundation walls, and at wall to slab seam. Brush away any loose dust or debris. Apply a generous and continuous bead of urethane caulk to any cracks, seams, or openings. See Figure 1.

2. Reduce the likelihood of cracks in concrete by using concrete admixtures, welded wire fabric, reinforcing rods, or other technologies designed to reinforce the concrete and help prevent and control cracking. See Figure 2.


4. If using concrete block foundation walls, make the top course solid block, filled block, bond beam, or masonry cap. See Figure 3.

5. If a sump is installed, make sure it has an air-tight sump cover consisting of a mechanically attached cover with a full gasket seal. See the guide [Gasketed/Sealed Sump Pump Covers](#).

6. Install concrete or wire mesh curtain walls along crawlspace foundation walls; the curtain should extend 36 inches below grade.

### Other Steps for Reducing Pest Entry

1. Install pest barrier insect screening at the top and bottom of above-grade walls that have a ventilation gap behind the cladding. See Figure 4.

2. Install metal flashing at the base of doors and a metal threshold under the doors; ensure that doors are tight fitting. Install self-closing doors. Install screen doors that have a heavy kick plate and a solid frame.

3. Install solid blocking material around pipes to seal off holes.
Figure 1. Caulk the seam between the slab and foundation wall (Image courtesy of BSC).

Figure 2. Reinforce concrete slab and foundation walls to minimize future cracks that could let in pests (Image courtesy of EPA).
Figure 3. Install termite shields and use solid concrete or filled concrete block for the top of foundation walls to deter termites and other pests (Image courtesy of EPA).

Figure 4. Install mesh insect barrier along the top of the rain screen behind the exterior cladding of above-grade walls (Image courtesy of EPA).
How to Minimize Termite Entry

1. Install physical barriers such as termite-resistant mesh over joints in foundation.

2. Install termite-resistant barriers beneath the slab.

3. Install termite shields between the foundation wall and the sill plate. Ensure that the metal is chemically compatible with the treated wood sill plate (many post 2004 non-arsenic wood treatments are corrosive to steel); or install sill seal or peel and stick membrane between the termite shield and the wood sill plate to prevent the metal from corroding.

4. Choose the termite-resistant heartwood of durable species such as western red cedar, redwood, incense cedar, Port Orford cedar, black locust, northern white cedar, and Alaska cedar.

5. See the Termite Infestation Probability Map, Figure R301.2(6) in the 2009 International Residential Code to determine the termite probability for your location and take the following additional precautions as necessary.
   a. If in areas classified as “Moderate to Heavy” on the termite infestation probability map, taking the following precautions:
      i. Foundation walls should be solid concrete or masonry with a top course of solid block, bond beam, or concrete-filled block.
      ii. Interior concrete slabs should be constructed with 6 x 6 in. welded wire fabric, or the equivalent, and concrete walls should be constructed with reinforcing rods to reduce cracking.
      iii. Sill plates should be made of metal or preservative-treated wood.
   b. If in areas classified as “Very Heavy” on the termite infestation probability map (i.e., Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina and parts of California and Texas), take the following additional precautions:
      i. Foam plastic insulation should not be installed on the exterior face of below-grade foundation walls or under slabs.
      ii. Foam plastic insulation installed on the exterior of above-grade foundation walls should be kept a minimum of 6 in. above the final grade and any landscape bedding materials and should be covered with moisture-resistant, pest-proof material (e.g., fiber cement board or galvanized insect screen at the bottom-edge of openings).
      iii. Foam plastic insulation applied to the interior side of conditioned crawlspace walls should be kept a minimum of 3 in. below the sill plate.
Ensuring Success

Clean areas to air seal prior to caulking to ensure a good seal. Inspect for air leakage afterwards, visually or with a blower door.

To ensure worker health, ventilation may be needed during the application of sealants and pest treatments.

Follow code requirements regarding the installation of foam insulation around foundations in termite-prone areas.
Climate

Consult the International Residential Code’s “Termite Infestation Probability Map” (2009 IRC Figure R301.2(6)) to determine if the home will be constructed in areas of very heavy, moderate-to-heavy, slight-to-moderate, or none-to-slight termite infestation. Additional precautions should be taken in areas classified Moderate to Heavy and Very heavy (see Compliance tab).
Training

Right and Wrong Images

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None Available
Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

DOE Zero Energy Ready Home

The U.S. Department of Energy (DOE) Zero Energy Ready Home National Program Requirements includes as a mandatory requirement (Exhibit 1, Item 6) that all homes meet the U.S. Environmental Protection Agency Indoor airPLUS Construction Specifications. The Specifications note that the requirement “Seal all penetrations and joints between the foundation and exterior wall assemblies” is now met by the ENERGY STAR Certified Homes checklist (TES 5) but the specifications provide several advisories regarding pest proofing construction.

Advisories:

1. When sealing larger gaps that provide potential points of entry for rodents, stuff cracks with copper or stainless steel wool then cover with spray foam.

2. Additional precautions should be taken in areas classified as “Moderate to Heavy” termite infestation probability (as identified by 2009 IRC Figure 301.2(6)):
   i. Foundation walls should be solid concrete or masonry with a top course of solid block, bond beam, or concrete-filled block.
   ii. Interior concrete slabs should be constructed with 6 x 6 in. welded wire fabric, or the equivalent, and concrete walls should be constructed with reinforcing rods to reduce cracking.
   iii. Sill plates should be made of metal or preservative-treated wood.

3. Additional precautions should be taken in areas classified as “Very Heavy” termite infestation probability (as identified by 2009 IRC Figure 301.2(6)) i.e., Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina and parts of California and Texas:
   i. Foam plastic insulation should not be installed on the exterior face of below-grade foundation walls or under slabs.
   ii. Foam plastic insulation installed on the exterior of above-grade foundation walls should be kept a minimum of 6 in. above the final grade and any landscape bedding materials and should be covered with moisture-resistant, pest-proof material (e.g., fiber cement board or galvanized insect screen at the bottom-edge of openings).
   iii. Foam plastic insulation applied to the interior side of conditioned crawlspace walls should be kept a minimum of 3 in. below the sill plate.

ENERGY STAR Certified Homes (Version 3, Rev. 08)

The ENERGY STAR Rater Field Checklist Section 4 requires air sealing of all penetrations, cracks, and other openings in the building envelope. Item 4.3 Above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor. Gasket also placed beneath above-grade sill plate if resting atop concrete/masonry and adjacent to conditioned space (25, 26)

25. Existing sill plates (e.g., in a home undergoing a gut rehabilitation) on the interior side of structural masonry or monolithic walls are exempt from this Item. In addition, other existing sill plates resting atop concrete or masonry and adjacent to conditioned space are permitted, in lieu of using a gasket, to be sealed with caulk, foam, or equivalent material at both the interior seam between the sill plate and the subfloor and the seam between the top of the sill plate and the sheathing.

26. In Climate Zones 1 through 3, a continuous stucco cladding system adjacent to sill and bottom plates is permitted to be used in lieu of sealing plates to foundation or sub-floor with caulk, foam, or equivalent material.


Sections R318.1 – R318.3 describe control methods including field-applied chemical treatments for soil and wood and metal or plastic barriers including shields on top of foundation walls. Section R318.4 notes that in areas indicated as having a very heavy probability of termite infestation, as shown in the termite probability map in 2009 IRC Figure R301.2(6) (R301.2(7) in 2018 IRC), rigid foam including extruded or expanded polystyrene, polyisocyanurate and other foam plastics should not be installed on the exterior face of foundation walls or under foundation walls or slabs below grade and, if foam is applied on exterior above-grade walls, there must be at least six inches of clearance between the foam and the soil surface. There are exceptions to this restriction: if all structural members of the building are made of noncombustible or pressure-preservative-treated wood, or the foam is protected by some approved method, or if the foam is installed on the interior of basement walls.


Section N1101.3 (Section N1107.1.1 in 2015 and 2018 IRC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

Appendix J regulates the repair, renovation, alteration, and reconstruction of existing buildings and is intended to encourage their
continued safe use.

**2009 IECC**

Section R402.2.8 notes that slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

Section R402.4 specifies that the home should be constructed to limit air leakage. Section 402.4.1 indicates specific areas to be caulked, gasketed, or sealed, including all joints, seams, and penetrations. Section 402.4.2 specifies that air leakage should be tested with an extensive visual inspection or with a blower door test with a maximum air leakage of <7 ACH 50.

**2012, 2015, and 2018 IECC**

Section R402.2.9 (R402.2.10 in 2015 and 2018 IECC) notes that slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

Section R402.4 specifies that the home should be constructed to limit air leakage and should be blower door tested to confirm air leakage is <5 ACH 50 in Climate Zones 1-2 and <3 in Climate Zones 3-8. Table R402.4.1.1 specifies the installation of a continuous air barrier and notes specific air barrier details.


Section R101.4.3 (Section R501.1.1 in 2015 and 2018 IECC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)
Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

None Available

References and Resources*

1. **2009 IECC - International Energy Conservation Code**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** January, 2009
   - Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.

2. **2009 IRC - International Residential Code for One and Two Family Dwellings**
   - **Author(s):** International Code Council
   - **Organization(s):** ICC
   - **Publication Date:** January, 2009
   - Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.

   - **Author(s):** Cooperative Extension Service
   - **Organization(s):** New York State Department of Environmental Conservation, Cornell Cooperative Extension, New York State Integrated Pest Management Program
   - **Publication Date:** February, 2008
   - Web-based manual providing guidance for removal and preventing entry of nuisance wildlife.

4. **Healthy and Affordable Housing: Practical Recommendations for Building, Renovating and Maintaining Housing**
   - **Author(s):** Lstiburek, Brennan
   - **Organization(s):** Building Science Corporation
   - **Publication Date:** January, 2001
   - Document providing guidance about building healthy homes using building science principles.

5. **Integrated Pest Management Toolkit for Building Owners, Managers, and Staff**
   - **Author(s):** Northeastern IPM Center
   - **Organization(s):** New York City Department of Health and Mental Hygiene
   - **Publication Date:** August, 2017
   - Website providing information about rodents and how to prevent rodent entry in homes.

6. **Pest Prevention by Design: Authoritative Guidelines for Designing Pests out of Structures**
   - **Author(s):** SF Environment
   - **Organization(s):** SF Environment, International Code Council
   - **Publication Date:** November, 2012
   - Report providing strategies for designing structures to prevent pest entry.

7. **Slab Happy**
   - **Author(s):** Lstiburek
   - **Organization(s):** Building Science Corporation
   - **Publication Date:** April, 2012
   - How hard can it be to insulate a flat sheet of concrete? I mean you only have three choices – on the top, on the bottom, or on the edge. OK, you might have some combination of the three as well.
Website providing information on all types of pest management for multi-family housing.

Contributors to this Guide

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