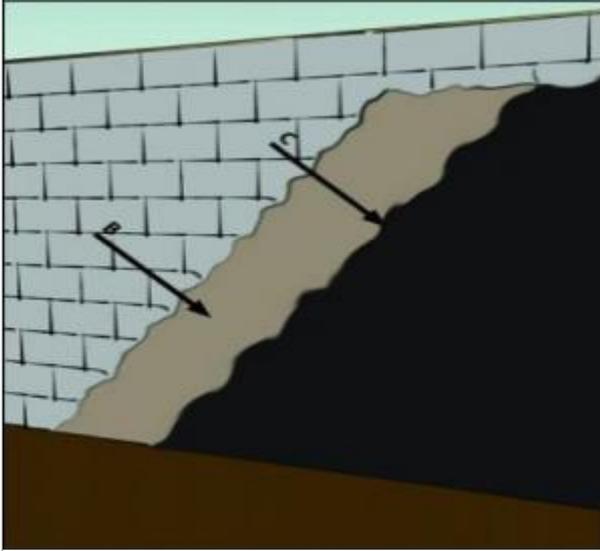


Damp-Proof Exterior Surface of Below-Grade Walls

Last Updated: 03/14/2016

Scope



Damp-proof below-grade concrete block walls by coating the exterior surface with parging and an asphalt emulsion or similar product.

Damp-proof the exterior surface of the below-grade walls of basements and unvented crawlspaces.

Concrete: Cover the exterior surface of poured concrete, concrete masonry, and insulated concrete forms with a damp-proof coating. Additional recommendations are as follows ([EPA 2011](#)):

- Poured concrete - If installing below-grade poured concrete, customize the mixture to make it more impermeable to water migration or apply a damp-proof coating directly to the exterior face of the concrete such as a brush or roller-applied asphalt emulsion or sprayed-on closed-cell polyurethane foam.
- Masonry block - If applying a damp-proof coating to a rough surface such as concrete masonry block walls, coat the exterior surface of the walls with a layer of parging prior to applying the damp-proof coating.
- Insulated concrete forms - If installing below-grade insulated concrete forms, use manufacturer-approved materials for damp-proof coating.

Wood:

- Use preservative-treated lumber and sheathing when installing wood products below-grade.
- Cover the entire exterior surface area with at least a 6-mil polyethylene sheeting that is attached to the wall with the appropriate adhesive.

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

Description

Telltale signs that concrete foundations have water issues include mineral stains, mold, damp or saturated areas, and even puddles on the floor (see Figure 1). There are several steps builders can take to help prevent foundation water issues before they start. For homes with basements or enclosed crawlspaces, covering the exterior surface of the foundation walls with a damp-proofing coating like asphalt emulsion during construction is part of a good water management strategy. Other water management steps include [grading the site](#) so ground surfaces slope away from the foundation, using a house design that includes deep roof overhangs, installing a [foundation drainage system](#), and installing [gutters and downspouts](#) that drain water away from the house. These are some of the steps recommended in a comprehensive water management strategy ([Ueno and Lstiburek 2011](#); [BSC 2009](#); [Aldrich et al. 2012](#); [BSC 2002](#)).

Figure 1 - Moisture infiltrates a concrete basement walls. 

Most foundation and below-grade walls are constructed from poured concrete or concrete masonry block. Concrete products are porous and, unless treated, are not waterproof, allowing water to migrate into the building ([BSC 2006](#)).

A damp-proof coating can be applied directly to the surface of the concrete below-grade walls. This damp-proof coating (shown in Figure 2) consists of an asphalt emulsion that can be brush- or roller-applied, or may take the form of a spray-on coating, or closed-cell polyurethane foam. No damp proof coating is completely water proof, so other steps can be taken to ensure water does not sit against the foundation wall. In addition to proper grading and installation of gutters and downspouts, the soil around the foundation should consist of a free-draining layer of backfill material (see Figure 3) or plastic dimple drainage mat can be installed against the foundation wall as shown in Figure 2. This should direct groundwater downward to a perimeter drain. The [perimeter drain](#) should be located exterior of the footing and should be wrapped in crushed rock and landscape fabric. A crushed stone drainage layer under the basement slab can be connected to this perimeter drain. A [capillary break](#) should be installed between the footing and the foundation wall to stop “rising damp” ([BSC 2006](#)).

Figure 2 - A below-grade foundation wall is coated with a bitumen damp-proof coating. 

For poured concrete walls, a damp-proof coating can be applied directly to the surface; however, for masonry block walls and below-grade insulated concrete forms the surfaces must first be prepared.

Preparing Masonry Block Walls for Exterior Damp-Proof Coating

The surfaces of concrete masonry block walls must be coated with a layer of parging before damp-proofing can be applied. Parging is a mortar applied to the surface of a masonry wall to create a smooth, continuous surface free of holes. It will provide a smooth surface that will provide better adhesion for the damp-proof coating.

Mix the parging material per the manufacturer’s directions and use a trowel to apply the parging directly to the exterior of the masonry or rough surface wall, creating a smooth, even plane. Allow the parging to dry, per manufacturer’s recommendations, prior to applying the damp-proof coating.

Insulated concrete forms (ICFs) can be used to create a foundation wall with integrated insulation layers. ICFS consist of hollow blocks composed of two layers of rigid foam that are held apart 4 or 6 inches by plastic spacers. The blocks are stacked like bricks and reinforcing rebar is installed, then the hollow center of the wall is filled with concrete which hardens in place to form a solid insulated wall (see Insulated Concrete Forms). If installing a damp-proof coating on the exterior of an ICF foundation wall, contact the manufacturer or refer to the manufacturer’s documentation to identify a chemically compatible damp-proofing material as some coatings may dissolve the foam form.

Customize Below-Grade Concrete Mixture for More Water Impermeability

With poured concrete walls, the concrete formula can be adjusted to increase the water-resistance of the concrete. Concrete is composed of water, cement, sand, and aggregate and typically has a compression rating of 3,000 to 4,000 pounds per square inch (PSI). By adjusting the ratio, greater strength can be achieved; the higher the PSI, the more water-resistant the concrete will be once it is cured.

Additives called admixtures can also be incorporated into the concrete before it is poured that can alter curing time, improve freeze protection, and improve water impermeability. When determining the PSI and admixtures for concrete, it is important to make decisions based on climate and local building codes. Because increasing the PSI and water impermeability of the concrete will also increase the cost of the material, you may consider increasing the PSI for only the foundation or below-grade walls and selecting a lesser PSI concrete mix for other parts of the house like sidewalks, parking areas, and patios.

Finishing the Exterior Surface of Below-Grade Walls that are Wood

The 2012 International Residential Code (IRC) allows wood foundation walls, although this is not considered a Building America best practice. If using wood as a below-grade wall, be sure to do the following for the exterior finish:

- First, refer to local and national codes and Authority Having Jurisdiction (AHJ) instructions regarding the required preservative-treated lumber and moisture barrier for your climate zone.

- Select the materials that meet all regulations and are recommended for below-grade construction.
- Install per specifications.

The following overall steps are to be considered within the specific code and AHJ instructions.

1. Install preservative-treated lumber for all below-grade walls. This lumber is immersed in a liquid preservative and placed in a pressure chamber to force the chemical into the wood. It is important to select wood for below-grade applications that has been pressure-treated with an appropriate and code- or jurisdiction-approved preservative for the specific climate zone and application.
2. Ensure the lumber panel joints are sealed the full length with a caulking compound that produces a moisture-proof seal.
3. Cover all below-grade lumber with a moisture barrier:
 - Apply 6-mil-thick polyethylene sheeting or a self-adhesive waterproof membrane to the entire exterior side of the below-grade walls before backfilling.
 - Lap the joints by 6 inches and seal with manufacturer-recommended adhesive.

Note: Do not nail or otherwise puncture the sheeting as this allows moisture to contact the concrete.

Figure 3 - A Complete Water Management Strategy for a Below-Grade Wall 

Ensuring Success

Damp-proofing the surface of below-grade walls is only one small part of a whole-house water management strategy and should be conducted in conjunction with other good site management practices including site grading, a footing drainage system, gutters and downspouts, and water-resistant wall and roof construction techniques.

Damp-proofing products vary; follow the manufacturer's instructions for installation.

Climate

No climate specific information applies.

Training

Right and Wrong Images



Display Image: [ES_WMSBC_1.5_PG20_29b_32311_0.jpg](#)

Reference: [Water Management System Builder Checklist Guide](#)

Author(s): EPA

Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.



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Reference: [Water Management System Builder Checklist Guide](#)

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Reference: [Water Management System Builder Checklist Guide](#)

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Reference: [Water Management System Builder Checklist Guide](#)

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Reference: [Water Management System Builder Checklist Guide](#)

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Reference: [Water Management System Builder Checklist Guide](#)

Author(s): EPA

Organization(s): EPA

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CAD

None Available

Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and 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.

[ENERGY STAR Certified Homes](#)

ENERGY STAR Certified Homes (Version 3/3.1, Revision 08), Water Management System Builder Requirements

1. Water-Managed Site and Foundation:

1.5 Exterior surface of below-grade walls of basements & unvented crawlspaces finished as follows: a) For poured concrete, masonry, & insulated concrete forms, finish with damp-proofing coating.⁶ b) For wood framed walls, finish with polyethylene and adhesive or other equivalent waterproofing.

Footnotes:

(6) Interior surface of an existing below-grade wall (e.g., in a home undergoing a gut rehab.) listed in Item 1.5a is permitted to be finished by:

- Installing a continuous and sealed drainage plane, capillary break, Class I Vapor Retarder (per Footnote 7) and air barrier that terminates into a foundation drainage system as specified in Item 1.8; OR
- If a drain tile is not required as specified in Footnote 8, adhering a capillary break and Class I Vapor Retarder (per Footnote 7) directly to the wall with the edges taped/sealed to make it continuous.

(8) Alternatively, either a drain tile that is pre-wrapped with a fabric filter or a Composite Foundation Drainage System (CFDS) that has been evaluated by ICC-ES per AC 243 are permitted to be used. Note that the CFDS must include a soil strip drain or another ICC-ES evaluated perimeter drainage system to be eligible for use. In an existing home (e.g., in a home undergoing a gut rehab) a drain tile installed only on the interior side of the footing without a channel is permitted. Additionally, a drain tile is not required when a certified hydrologist, soil scientist, or engineer has determined that a crawlspace foundation, or an existing basement foundation (e.g., in a home undergoing a gut rehab) is installed in Group I Soils (i.e., well-drained ground or sand-gravel mixtures), as defined by 2009 IRC Table R405.1.

(9) These Items not required for existing structural masonry walls (e.g., in a home undergoing a gut rehabilitation). Note this exemption does not extend to existing wall assemblies with masonry veneers.

Note that no alternative compliance option is provided for existing below-grade wood-framed walls in Item 1.5b.

Builders Responsibilities: It is the exclusive responsibility of builders to ensure that each certified home is constructed to meet these requirements. While builders are not required to maintain documentation demonstrating compliance for each individual certified home, builders are required to develop a process to ensure compliance for each certified home (e.g., incorporate these requirements into the Scope of Work for relevant sub-contractors, require the site supervisor to inspect each home for these requirements, and / or sub-contract the verification of these requirements to a Rater). In the event that the EPA determines that a certified home was constructed without meeting these requirements, the home may be decertified.

ENERGY STAR Revision 08 requirements are required for homes permitted starting 07/01/2016.

DOE Zero Energy Ready Home National Program Requirements

The U.S. Department of Energy (DOE) [Zero Energy Ready Home National Program Requirements](#) requires (Exhibit 1, Item 1) that all homes meet ENERGY STAR Certified Homes Version 3 or 3.1

[EPA Indoor airPLUS](#)

The U.S. Environmental Protection Agency ([EPA Indoor airPLUS Construction Specifications](#)) requires homes to meet the ENERGY STAR Certified Homes requirements, which fulfills Indoor airPLUS requirements for damp-proofing below-grade exterior walls.

[2009, 2012, and 2015 IRC](#)

Section R406.1 Concrete and masonry foundation damp-proofing. Foundation walls that retain earth and enclose interior spaces and floors below grade must be damp-proofed from the top of the footing to the finished grade. Masonry walls must have at least 3/8 inch Portland cement parging applied to the exterior. The parging is to be damp-proofed per one of the following:

- bituminous coating;
- three pounds per square yard of acrylic modified cement;
- 1/8-inch coat of surface-bonding cement per ASTM C 887;
- any material approved per Section R406.2; and

- any other approved means.

Exception: parging of unit masonry walls isn't required where a material is approved for direct application to the masonry.

Concrete walls are to be dampproofed using one of these methods or any listed in Section R406.2 for waterproofing. Section R406.2 Concrete and masonry foundation waterproofing. Where there is a high water table or other severe soil-water conditions are known to exist, exterior foundation walls that retain earth and enclose interior spaces and floors below grade to be waterproofed from the top of the footing to the finished grade.

Walls to be waterproofed per one of the following:

- two-ply hot-mopped felts;
- 55 pound roll roofing;
- 6-mil polyvinyl chloride;
- 6-mil polyethylene;
- 40-mil polymer-modified asphalt;
- 60-mil flexible polymer cement;
- 1/8-inch cement-based, fiber-reinforced, waterproof coating;
- 60-mil solvent-free liquid-applied synthetic rubber.

Exception: organic-solvent-based products such as hydrocarbons, chlorinated hydrocarbons, ketones and esters cannot be used for ICF walls with expanded polystyrene form material. Use of plastic roofing cements, acrylic coatings, latex coatings, mortars and pargings to seal ICF walls is allowed. Cold-setting asphalt or hot asphalt to conform to type C of ASTM D 499. Hot asphalt to be applied at a temperature less than 200°F. All joints in membrane waterproofing to be lapped and sealed with a membrane-compatible adhesive.

Section R406.3 Damp-proofing for wood foundations. Wood foundations enclosing habitable or usable spaces below grade to be damp-proofed per R406.3.1 through R406.3.4.

Section R406.3.1 Panel joint sealed. Plywood panel joints to be sealed full length with caulking compound capable of producing a moisture-proof seal.

Section R406.3.2 Below-grade moisture barrier. 6-mil polyethylene film to be applied over below-grade portions of exterior foundation walls before backfilling. Joints in the film to be lapped 6 inches and sealed with adhesive. Top edge of film to be bonded to the sheathing to form a seal. Film areas at grade level to be protected from mechanical damage and exposure by a pressure-preservatively treated lumber or plywood strip attached to the wall several inches above finish grade level and extending approximately 9 inches below grade. The joint between the strip and the wall to be caulked full length prior to fastening the strip to the wall. Other approved coverings may be used. The film must extend down to the bottom of the wood footing plate but not overlap or extend into the gravel or crushed stone footing. Section R406.3.3 Porous fill. The space between the excavation and the foundation wall to be backfilled with the same material used for the footings; for well-drained sites, up to a height of 1 foot or ½ the total backfill height for poorly drained sites. The porous fill must be covered with strips of 30-pound asphalt paper or 6-mil polyethylene to permit water seepage while avoiding fine soil infiltration. Section R406.3.4 Backfill. The remainder of the excavated area must be backfilled with same type of soil that was removed.*

*Due to copyright restrictions, exact code text is not provided. For specific code text, refer to the applicable code.

More Info.

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

1. [New Whole-House Solutions Case Study: New Traditions Homes, Landover Commons, Vancouver, WA](#)
(873 KB)
Author(s): PNNL
Organization(s): PNNL
Publication Date: April, 2012
Case study about energy efficient new home construction that also incorporated moisture management techniques for durability in the damp Northwest climate.

References and Resources*

1. [Basement Insulation Systems](#)
Author(s): BSC
Organization(s): BSC
Publication Date: January, 2002
Report describing approaches to insulating basements in homes built to meet Energy Star.
2. [Bulk Water Control Methods for Foundations](#)
Author(s): Ueno, Lstiburek
Organization(s): BSC
Publication Date: January, 2011
Report about the fundamental concepts that must be understood at the planning or initial inspection of existing homes regarding surface and ground water management.
3. [DOE Zero Energy Ready Home National Program Requirements](#)
Author(s): DOE
Organization(s): DOE
Publication Date: August, 2015
Standard requirements for DOE's Zero Energy Ready Home national program certification.
4. [ENERGY STAR Certified Homes, Version 3 \(Rev. 08\) National Program Requirements](#)
Author(s): EPA
Organization(s): EPA
Publication Date: September, 2015
Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 08).
5. [Groundwater Control](#)
Author(s): BSC
Organization(s): BSC
Publication Date: May, 2009
Information sheet about groundwater control.
6. [Measure Guideline: Basement Insulation Basics](#)
Author(s): Aldrich, Mantha, Puttagunta
Organization(s): CARB, NREL
Publication Date: October, 2012
Document describing good practices for insulating basements in new and existing homes.
7. [The New American Home 2007 Orlando, Florida](#)
Author(s): DOE
Organization(s): DOE
Publication Date: December, 2006
Case study of new home construction in the hot-humid climate.
- 8.

Understanding Basements

Author(s): Lstiburek

Organization(s): BSC

Publication Date: October, 2006

Information sheet with methods for constructing or retrofitting basements to reduce moisture issues.

9. Water Management System Builder Checklist Guide

Author(s): EPA

Organization(s): EPA

Publication Date: February, 2011

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

The following Building America Teams contributed to the content in this Guide.

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