Final Grade Slopes Away from Foundation

Scope

To direct storm water runoff away from the foundation

- Slope the final grade away from the house at least 0.5 inch per foot for 10 feet.
- Tamp (mechanically compact) the back-fill to prevent later settling.
- If setbacks limit the space to less than 10 feet, install either swales or drains designed to carry water away from the foundation (ENERGY STAR 2015).

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

Because no waterproofing system is 100% foolproof, the best defense against water intrusion through the foundation is to prevent water from saturating the soil around the foundation. This can be done by constructing the foundation and grading the site so that water drains away from the house on all sides (see Figure 1).

Figure 1 - The final grade around the house slopes away from the foundation. Proper selection of backfill soils, filter fabric-covered footing drains set in gravel, and a capillary break protect the home’s foundation from water intrusion.

How to Grade the Site

1. Grade to build up the site before construction, if needed, to create a slope that will carry water down and away from the foundation on all four sides.

2. After construction, back-fill to the foundation walls, grade the slope, cap the top layer of the grade with 2 to 4 inches of silty clay, and mechanically compact the soils to prevent later settling.

The 2009, 2012, and 2015 International Residential Code requires impervious surfaces within 10 feet of the building’s foundation to have a slope of 2% away from the foundation. ENERGY STAR Certified Homes requires a final grade slope of 0.5 inch per
foot away from home for 10 feet. ENERGY STAR also states

- Tamping of the back-fill is not required if either: proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer; OR, the builder has scheduled a site visit to provide in-fill and final grading after settling has occurred (e.g., after the first rainy season).
- If setbacks limit the space on any side of the home to less than 10 feet, or if walls, slopes or other physical barriers prevent the construction of slopes away from the foundation, then install either swales or perimeter drains designed to carry water away from the foundation. (See the discussion of swales and drains below.)

Swales
A swale is a trapezoidal channel that is dug to receive storm water overflow, allowing it a path to flow away from the home (Figure 2). Swales can provide a means to slow water runoff and allow natural percolation into the soil on site. They are typically located along property boundaries along a natural grade; they will also draw in water that would otherwise sit in a flat yard and they can divert water flowing toward the house from an upward sloping yard. Swales are typically planted with specific types of vegetation to reduce erosion, to help remove any pollutants found in the storm water runoff, and to improve the aesthetics of the design. While each site is unique, the following steps provide general guidance for constructing a swale to divert water down and away from the house (EPA 2006).

![Swales are trapezoidal channels dug to receive storm water overflow, with specific vegetation planted to improve aesthetics, filter storm water runoff, and prevent erosion.](image)

**Figure 2** - Swales are trapezoidal channels dug to receive storm water overflow, with specific vegetation planted to improve aesthetics, filter storm water runoff, and prevent erosion.

**How to Construct a Swale**

1. Do not construct vegetated swales in gravelly and coarse sandy soils that cannot easily support dense vegetation. If available, use alkaline soils and sub-soils to promote the removal and retention of metals. Use non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer. Know that the following factors will decrease the effectiveness of a swale: compacted soils, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities, and high discharge rates.

2. Do not compact the soil in the swale trench. Soil infiltration rates should be greater than 0.2 millimeters per second (one-half inch per hour); therefore, care must be taken to avoid compacting the soil during construction.

3. Choose plants that will aide in filtration. A fine, close-growing, water-resistant grass should be selected for use in vegetated swales, because increasing the surface area of the vegetation exposed to the runoff improves the effectiveness of the swale system. Pollutant removal efficiencies vary greatly depending on the specific plants involved so the vegetation should be selected with pollution control objectives in mind. In addition, care should be taken to choose plants that will be able to thrive at the site. Examples of vegetation appropriate for swales include reed canary grass, grass-legume mixtures, and red fescue. The best plants to use in a swale will depend on the region and location. Local cooperative extension programs based at land grant universities often have a list of plants that will work well in a swale. See [www.extension.org](http://www.extension.org) for the extension office in your climate zone.

4. Construct the swale in a parabolic or trapezoidal cross-section with side slopes no steeper than a 3:1 width-to-height ratio. The overall slope of the swale (the longitudinal channel or from water-entry point to water exit point) should slope consistently between a 2% and 4% grade. Slopes less than 2% can lead to pooling; slopes greater than 4% can lead to excessive water velocity and contribute to soil erosion (West Virginia 2012).

5. Build the swale large enough (deep and wide) to comfortably divert the volume of water occurrence (rain fall or snowmelt runoff) expected for a 6-month-frequency, 24-hour storm event. To determine the rain volume for this type of storm event in your location, contact the U.S. Geological Survey. Swales are generally not used where the maximum flow rate exceeds 140 liters/second (5 cubic feet per second).

6. Schedule a site visit to fill in soil and conduct final grading after settling has occurred (e.g., after the first rainy season).

Drains
Another alternative for storm water management are drains, which can be installed to collect and direct surface water away from the foundation. Metal grated drains can be installed at the base of driveways that slope toward the house. Perforated drain pipe can be buried in rock-filled trenches up slope from the house. These drains can be piped to carry water runoff underground to a drywell, storm sewer, or another approved discharge point. Information about gutters and downspouts is covered in depth in the guide Gutters and Downspouts.
Ensuring Success
Visually inspect that back-fill has been tamped and final grade sloped 0.5 inches per foot away from home for 10 feet. Where setbacks limit space to less than 10 feet, see that swales or drains are installed to carry water from the foundation.
Climate

No climate specific information applies.
Training

Right and Wrong Images

Display Image: ES_WMSBC_1.1_1.2_PG12_2b_32311_0.jpg
CAD
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.

ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09)

Water Management System Builder Requirements

1. Water-Managed Site and Foundation.
   1.2 Back-fill has been tamped and final grade sloped ? 0.5 in. per ft. away from home for ? 10 ft. Alternatives in Footnote.²

Footnote 2) Swales or drains designed to carry water from foundation are permitted to be provided as an alternative to the slope requirements for any home, and shall be provided for a home where setbacks limit space to less than 10 ft. Also, tamping of back-fill is not required if either: proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer; OR, the builder has scheduled a site visit to provide in-fill and final grading after settling has occurred (e.g., after the first rainy season).

Please see the ENERGY STAR Certified Homes Implementation Timeline for the program version and revision currently applicable in your state.

DOE Zero Energy Ready Home (Revision 07)

Exhibit 1 Mandatory Requirements.

Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.

EPA Indoor airPLUS (Revision 04)

Certified under ENERGY STAR Qualified Homes Version 3 or 3.1.

No additional Indoor airPLUS requirements.


Section R401.3 Drainage. This requires that surface water should drain to a storm sewer conveyance or another approved collection point that doesn’t create a hazard. Lots must be graded to drain water away from the foundation walls and the grade should fall at least 6 inches within the first 10 feet. If physical barriers such as walls, slopes, or the lot lines limit the ability to achieve 6 inches of slope within 10 feet of the foundation, then drainage can be achieved by installing drains or swales.

Section R405.1. Footing drains of drain tile, gravel, crushed stone, perforated pipe, or some other approved systems must be installed at the footing perimeter of any building with concrete or masonry foundations that has a basement. The drainage pipe must sit on a bed of gravel 2 or more inches thick that extends at least a foot from the edge of the footing. The drain pipe should be covered with an approved filter fabric then be topped with 6 or more inches of washed crushed gravel or crushed rock. This drain pipe must discharge by gravity or mechanical means into an approved drainage system. A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel soils designated as Group 1 soils by the United Soil Classification System.

Section R408.6. Finished Grade, permits the finished grade of the crawlspace floor to be level with the bottom of the foundation wall footings. However, if there is evidence that the groundwater table can rise to within 6 inches of the finished floor of the building perimeter or if there is evidence that surface water is not readily draining from the building site, then level of the crawlspace dirt floor must be as high as the outside finished grade, unless an approved drainage system is provided.


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.
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
   (873KB)
   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. Groundwater Control
   Author(s): Building Science Corporation
   Organization(s): Building Science Corporation
   Publication Date: May, 2009
   Information sheet about groundwater control.

2. Water Management System Builder Checklist Guide
   Author(s): U.S. Environmental Protection Agency
   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 Date: May, 2012
   Manual showing how to properly use grass swales to manage excess water runoff.

*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 authors and organizations contributed to the content in this Guide.

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