Footing Drain Pipe

Last Updated: 12/20/2017

Scope

Install drain tile (perforated plastic drainage pipe) along the exterior (or interior) of the footings of basement and crawlspace walls to provide drainage around the foundations.

- Install drain pipe to sit outside of, not on top of, the footings and below the bottom of the concrete slab or crawlspace floor.
- Lay the pipe with enough slope to drain to a non-perforated pipe that carries the collected water to daylight, to a drywell, to a storm sewer if approved by the local municipality, or to a sump pump that will transport it to daylight, a storm sewer, or a drywell.
- Lay the drain pipe, perforations down, in a gravel trench with at least 6 inches of ½-inch to ¾-inch washed gravel or stone above the pipe and at least 2 inches below (IRC 2009).
- Install landscape fabric under, around, and over the washed gravel (IRC 2009, ENERGY STAR 2015).

According to the International Residential Code and ENERGY STAR Certified Homes, drain tile is not required when a certified hydrologist, soil scientist, or engineer has determined that a foundation is installed in well-drained ground or sand-gravel mixture soils, as identified in the 2009 IRC, Table R405.1.

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.
Water management is an important part of the design and construction of the home. Keeping water from entering the house is critical to ensure the long-term structural integrity of the building as well as to reduce the chances of mold issues and poor indoor air quality. A complete water management strategy will deflect water that comes in contact with the building envelope and divert that water down and away from the house.

A well-sealed foundation or crawlspace will keep water from entering the home, but to finish the task of water management, you must also create a path for water to flow away from the home and be discharged at a safe distance. Allowing water to collect around the foundation will eventually lead to unacceptable levels of soil saturation and ultimately could overcome any water sealing practices used to protect the foundation.

To carry water away from the foundation, a footing drain system should be installed consisting of a perforated drain pipe (also called drain tile) that is located underground on the exterior side of the footings at a depth below the level of the basement slab or crawlspace floor. The perforations allow any surface or ground water that reaches the footing to flow into the drain tile and be carried away rather than pooling along the foundation wall. To keep the pipe from getting clogged with silt, the pipe is wrapped with filter fabric (Figure 1) then laid in a bed of washed stone that is also wrapped in filter fabric, also called geo-textile or landscape fabric (Figure 2). The pipe surrounds the full perimeter of the house and is laid so that it is slightly sloped, allowing water entering anywhere along the perimeter to drain to a single collection point. That collection point connects to an unperforated pipe that discharges the drain pipe to an above-grade location at least 10 feet away from the foundation or to a suitable alternative such as to a drywell or storm sewer. Or, the drain pipe can discharge into a sump pump located in the floor of the crawlspace or basement. The sump pump will then discharge the water either to daylight or to a suitable alternative such as to a drywell or storm sewer. See [Patio Slabs, Porch Slabs, Walks, and Driveways](#) for more information about discharging water away from the foundation.

A properly installed and functioning footing drain system will keep water moving away from the foundation to help maintain a dry basement or crawlspace. Poor installation of the pipe system often prevents it from accomplishing this important drainage function.

![Figure 1 - Drain tile is flexible perforated pipe that is covered with filter fabric to keep dirt out of the perforations when the hose is installed along the footings of a foundation wall. (Source: EPA Indoor airPLUS)](image-url)
How to Install Drain Tile that Discharges to Daylight

1. Dig a trench large enough to accommodate the filter fabric, drainage tile, and gravel. The trench should allow 6 inches of space around the pipe, which means it will usually have to be at least 16 inches deep and 16 inches wide to fit a standard 4-inch pipe with protective cover. Because the drain tile will be installed at a height that is lower than the bottom of the concrete slab or crawlspace floor, the trench must be at least 10 inches deeper than the top of the footing or slab.

2. Slope or level the trench so that when the drainage tile is installed, water will readily flow to the lowest point (i.e., the discharge pipe).

3. Lay the filter fabric on the bottom of the trench. When complete, the entire drainage tile and gravel bed will be surrounded by filter fabric, so leave ample surplus to ensure there is enough fabric to cover the wrap around over the top of the drain pipe and the 6 inches of rock poured over it.

4. Lay a 6-inch layer of ½- to ¾-inch washed or clean gravel in the trench. It is important that the gravel be free of fines (i.e., clean) because silt and sand in the gravel will eventually clog the drain tile perforations or build up in the bottom of the pipe and reduce the effectiveness of the drainage system.

5. Install the drainage tile. Secure all the connections to make a complete drainage system around the entire foundation. Connect the perforated pipe to a non-perforated pipe that leads to the discharge location. (See Patio Slabs, Porch Slabs, Walks, and Driveways for more information about discharging water away from the foundation.) The discharge pipe must lay at a downward slope and discharge to daylight at least 10 feet from the foundation (Figure 3), or to a suitable alternative such as to a drywell or storm sewer.

6. Once the drainage tile is connected, cover the system with a 6-inch layer of ½- to ¾-inch washed or clean gravel.

7. Wrap the drainage tile and gravel in the filter fabric to further protect the system from silt and sand.
How to Install Drain Tile that Discharges to a Sump Pit

1. Prior to pouring the concrete slab or foundation, establish where the sump pit will be located and extend a piece of 4-inch non-perforated pipe from the pit to the exterior of the house, leaving at least 12 inches of pipe to extend beyond the footing. The pipe should be imbedded in the gravel capillary break below the foundation or slab.

2. Pour the foundation, taking care to not damage the drainage pipe.

3. After the concrete has set, follow the instructions listed above for installing the drain tile, with one exception: In step 5 above, install the non-perforated pipe to lead to the sump pit, as shown in the Figure 4. The sump pump should send the water to a discharge pipe that slopes downward at least 1/2-inch per foot for 10 feet (Figure 5) before discharging the water to daylight or to a suitable alternative such as a drywell or storm sewer. (See Patio Slabs, Porch Slabs, Walks, and Driveways for more information about discharging water away from the foundation.)
Figure 5 - This drain tile directs the collected water to a sump pit that pushes the water to a discharge pipe which releases it 10 feet from the foundation.
Ensuring Success

In order to ensure the drainage system is installed properly, it is important that only clean gravel, free of fines, be used in the trench around the drain tile. Gravel that has sand or silt will foul the perforations in the drain tile and eventually diminish the system’s ability to divert water away from the foundation.

Also, a properly installed drain tile works in combination with the discharge of the water away from the foundation. Therefore, see 
Patio Slabs, Porch Slabs, Walks, and Driveways for additional guidance in discharging water away from the foundation.
Climate

No climate-specific information applies.
Training

Right and Wrong Images

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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.

1.8 Drain tile installed at basement and crawlspace walls, with the top of the drain tile pipe below the bottom of the concrete slab or crawlspace floor. Drain tile surrounded with 6 to 8 inches of washed or clean gravel and with gravel layer fully wrapped with fabric cloth. Drain tile level or sloped to discharge to outside grade (daylight) or to a sump pump. If drain tile is on interior side of footing, then channel provided through footing to exterior side.

Footnote 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.

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.


Section R405.1 Concrete or masonry foundations. Drains must be provided around all enclosed concrete or masonry foundations that enclose habitable or usable spaces and retain earth. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved means must be installed at or below the area to be protected and must discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains to extent at least 1 foot beyond the outside edge of the footing and 6 inches above the top of the footing and covered with an approved filter membrane material. The top of drain tile open joints must be protected with strips of building paper, and the drainage tiles or perforate pipe must be placed on a minimum of 2 inches of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with at least 6 inches of the same material. Exception: a drainage system isn’t required when the foundation is on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I Soils as detailed in Table R405.1.


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.
Case Studies
None Available

References and Resources*

1. **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.

2. **2012 IRC - International Residential Code for One and Two Family Dwellings**
   - Author(s): International Code Council
   - Organization(s): ICC
   - Publication Date: January, 2012
   - 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.

3. **2015 IRC - International Residential Code for One and Two Family Dwellings**
   - Author(s): International Code Council
   - Organization(s): ICC
   - Publication Date: May, 2014
   - 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.

4. **2018 IRC - International Residential Code for One and Two Family Dwellings**
   - Author(s): International Code Council
   - Organization(s): ICC
   - Publication Date: August, 2017
   - 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.

5. **DOE Zero Energy Ready Home National Program Requirements (Rev. 07)**
   - Author(s): U.S. Department of Energy
   - Organization(s): DOE
   - Publication Date: May, 2019
   - Standard requirements for DOE's Zero Energy Ready Home national program certification.

6. **ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09) National Program Requirements**
   - Author(s): U.S. Environmental Protection Agency
   - Organization(s): EPA
   - Publication Date: September, 2018
   - Webpage with links to documents providing the program requirements and checklists for ENERGY STAR Certified Homes (Ver. 3/3.1, Rev. 09).

7. **EPA Indoor airPLUS Construction Specifications, Version 1 (Rev. 04)**
   - Author(s): U.S. Environmental Protection Agency
   - Organization(s): EPA
   - Publication Date: February, 2018
   - Website providing the technical specifications and related documents for home builders, subcontractors, architects, and other housing professionals interested in certifying a home to the EPA’s Indoor airPLUS program requirements.
Multi-Year Advanced Residential Building Systems Research - Revisions to Quality Management Products
Author(s): NAHB Research Center
Organization(s): NAHB Research Center, National Renewable Energy Laboratory
Publication Date: December, 2008
Report discussing development of scopes of work and quality management for builders in mixed-humid climates.

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 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.

Pacific Northwest National Laboratory
U.S. Environmental Protection Agency