



# Why You Should Insulate Foundations.

There is a science to adding value.





## Built On Science.

STYROFOAM™ extruded polystyrene and polyisocyanurate insulations from Dow are the only rigid insulation products built on the scientific expertise of The Dow Chemical Company, a leading global supplier of chemical, plastic and agricultural products and services.

More than 50 years ago, Dow pioneered STYROFOAM extruded polystyrene insulation, which revolutionized insulation science. Our commitment to innovation continues. Drawing on the vast research, development and technological resources of Dow and an open exchange of information with building professionals, STYROFOAM building materials offer proven thermal envelope solutions for every application.

# Within Every Great Home Is Great Science.

No matter how well you build your home, it isn't complete until you add a layer of rigid foam insulation from Dow. STYROFOAM™ extruded polystyrene and polyisocyanurate insulations from Dow provide the scientific footing to help solve the energy and moisture issues that can compromise building performance.



Whether you build your homes with basements, crawl spaces or slab-on-grade, rigid foam insulation from Dow can help any type of foundation perform better. Depend on the insulation science expertise of Dow

to help you build more value into your homes.



*A microscopic view of rigid foam insulation reveals millions of closed cells that effectively trap air.*



## INSIDE INSULATION

To insulate is to reduce the transfer of heat. Insulations are formed by trapping air in a material. But not all insulating materials are created equal. The more compartments of air across a given span of material, the greater the thermal resistance, or R-value\*\*.

Rigid foam insulations from Dow contain about a million tiny pockets of trapped air in every cubic inch of material. Proprietary formulations and manufacturing processes ensure that these cells are closed, which enables the insulation to resist moisture and maintain R-value.

An insulation's performance is greatly reduced when the trapped air is able to circulate or move freely within the insulation material. This happens primarily through convective air movement. Insulation performance is also reduced when the trapped air is displaced, which can happen through compression or moisture uptake.

Rigid foam insulation from Dow has a closed-cell structure. Air can't infiltrate or circulate within the boards, and they resist moisture. So the trapped air stays trapped ... and the insulating value remains high.

# Below Grade. Top Of Mind.

All buildings have one thing in common: Their foundations must come in contact with the earth. So wherever you build your home, moderating the effects of soil, water, temperature and air on the foundation can impact the performance and integrity of the total structure.

For new construction and retrofit foundation applications, STYROFOAM extruded polystyrene and polyisocyanurate insulations from Dow can help:

- reduce energy loss
- keep foundations drier
- improve occupant comfort



**Continuous insulation from footing to sill plate can reduce the average home heating and cooling bill by hundreds of dollars per year.**

\*\*R means resistance to heat flow. The higher the R-value, the greater the insulating power.



# Reduce Energy Loss.

**Basement walls can be the major source of conductive heat loss in the whole house.**

**In fact, heat loss from an uninsulated, conditioned basement can account for up to 50 percent of total heat loss in an otherwise tightly sealed, well-insulated home<sup>1</sup>.**

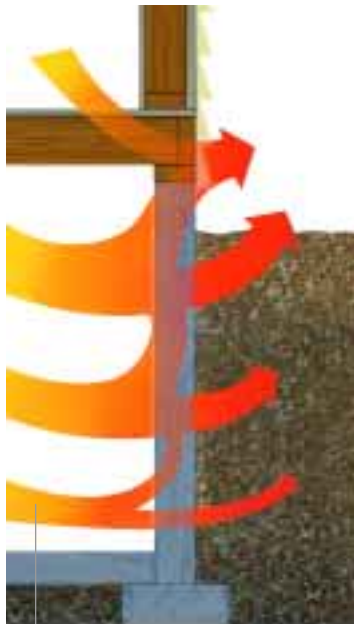
Concrete is a highly heat-conductive material. In an uninsulated or poorly insulated basement, heat escapes through two paths: horizontally through the wall into the earth, and vertically through the concrete wall and into the air above the grade line.

Insulating the outside or inside of the foundation wall slows both vertical and horizontal heat flow through the wall, helping to mitigate conditions that cause energy loss.

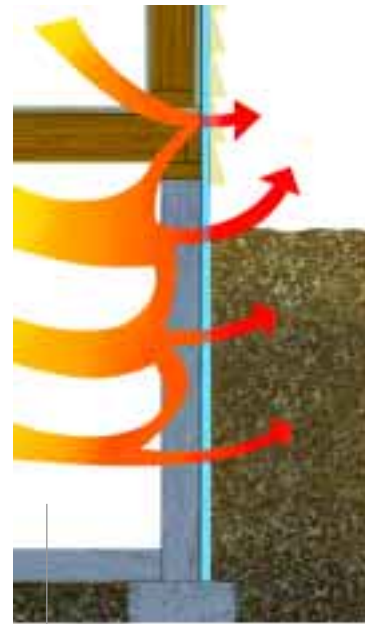


*Alone, concrete offers very little resistance to heat flow. For example, a 7-inch-thick slab of poured concrete has the same R-value as a pane of glass (R-1.5).*

*The gap between the foundation wall and the sill plate of a building can enable significant air infiltration and energy loss. Sealing the gap with STYROFOAM Sill Seal foam gasket reduces air infiltration and moisture wicking from the concrete foundation into the wood sill plate.*



*Heat flows two ways through an uninsulated concrete wall: horizontally into the earth and vertically to the air above the grade line.*



*Insulating with rigid foam (exterior insulation shown here) slows both vertical and horizontal heat flow through the wall.*

<sup>1</sup>Report, Kansas State University and the U.S. Department of Energy



## ENHANCE DAMP-PROOFING AND WATERPROOFING

Both damp-proofing and waterproofing involve applying an impermeable material to foundation walls to help reduce moisture intrusion. This moisture intrusion is most often caused by bulk water movement through cracks, or capillary suction through pores in the concrete wall.

Damp-proofing reduces moisture intrusion due to capillary suction. The typical 10-mil thickness of damp-proofing will not bridge the foundation settling cracks that allow bulk water to enter the structure. Damp-proofing is also easily damaged by backfill, making it susceptible to water driven by hydrostatic pressure.

In comparison, waterproofing consists of a spray-applied flexible membrane bonded to the foundation. Not only does the waterproofing membrane reduce moisture intrusion by capillary action, it also has the ability to bridge small cracks, reducing water penetration through bulk water movement.

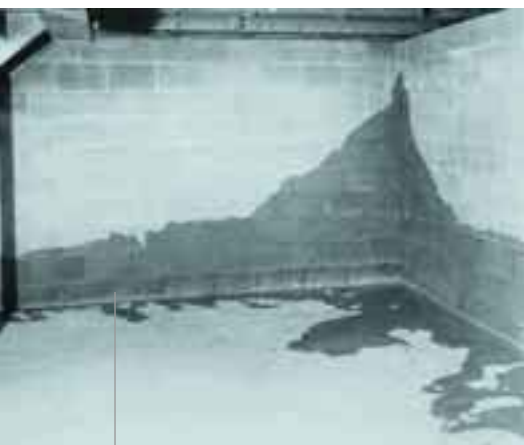
Exterior foam insulation and drainage are an important part of damp-proofing and waterproofing systems. Exterior foam insulation protects waterproofing or the damp-proofing membrane from damage caused by backfill. It also keeps the basement wall warmer, which reduces the potential for condensation on the basement wall. STYROFOAM extruded polystyrene insulation resists water absorption and compression under soil loads, so it retains its insulation value in wet environments. STYROFOAM PERIMATE insulation has patented drainage grooves in the long direction of the board. In addition to protecting the waterproofing membrane and providing insulation, the grooves in the product assist drainage of water away from the foundation.

*STYROFOAM extruded polystyrene insulation is inherently moisture-resistant, helping defend against moisture penetration.*

# Manage Moisture.

Foundation walls exist in a typically wet environment. Soil around the foundation is often wet, due to rain, melting snow or the water table.

The porous materials used to build most foundation walls – concrete and cement block – absorb water from the soil and allow it to move through the wall. Much of this movement is due to capillary suction: Water moves from an area of high concentration to low concentration, often against gravity. Water can also pass directly through cracks in the basement wall.



*The most common problem home inspectors find in homes less than 12 years old is basement leaks.*

SOURCE: USA TODAY

## Exterior Insulated Basement

When building a new home, adding a continuous layer of STYROFOAM extruded polystyrene insulation to the exterior of basement walls is one of the most important steps you can take to protect your home from the damaging effects of moisture.

The closed-cell rigid foam does this in three ways:

1. It protects the waterproofing or the damp-proofing membrane (see sidebar)
2. It keeps the wall warm, which reduces the potential for condensation on the inside surface of the wall
3. A specialized drainage insulation product (STYROFOAM PERIMATE\* insulation) features a patented groove design that assists with the drainage of water down and away from the basement wall, which reduces hydrostatic pressure against the wall (see next page)

# Stand Up Under Pressure.

## Hydrostatic Pressure

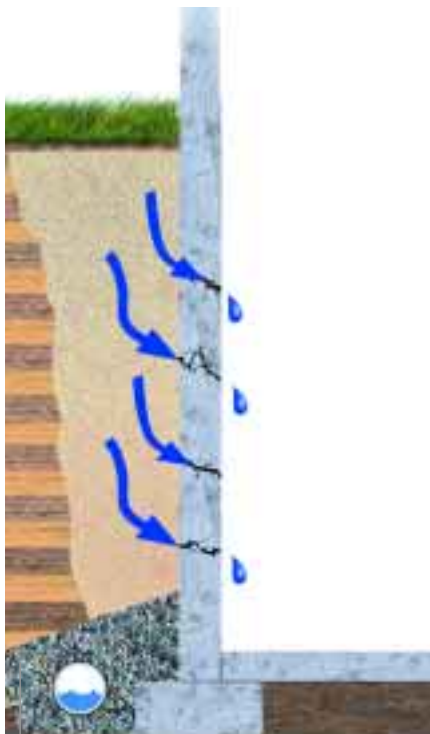
A typical basement can be compared to a boat surrounded by water, because water in the ground behaves in a manner similar to other bodies of water. Groundwater exerts hydrostatic pressure on submerged objects (like the basement wall), and that pressure must be managed.

Hydrostatic pressure increases at greater depths. So the pressure exerted on the

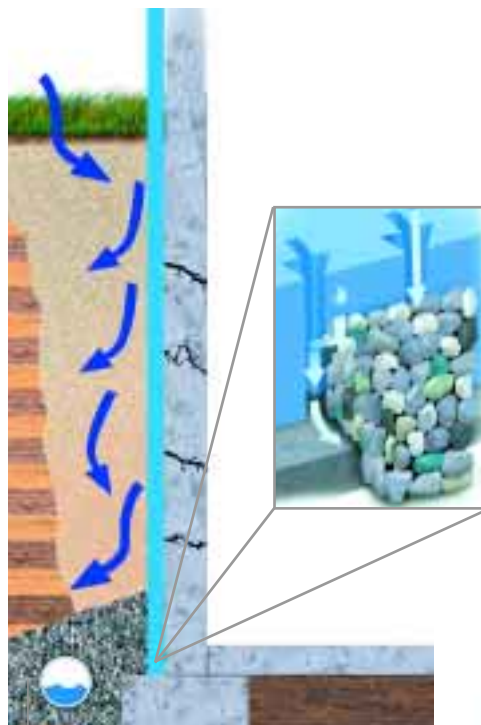
bottom of a foundation wall – at the footer – is much greater than at the ground level. Without proper drainage, water can pool at the lowest point on the wall. Pressure builds up, and the water seeks the path of least resistance – right through cracks in the foundation wall.

Waterproofing can resist hydrostatic pressure, but a more effective way to manage the pressure is to drain the water away from the foundation.

STYROFOAM PERIMATE insulation is an important part of a drainage system to help relieve hydrostatic pressure on foundation walls. The insulation boards have high compressive strength, resisting increased pressures near the bottom of the wall. And the patented drainage grooves help direct water movement toward the drainage tile, reducing hydrostatic pressure and pooling of water near the foundation base.



*Underground water exerts hydrostatic pressure, which can push water through foundation walls.*



*STYROFOAM PERIMATE insulation provides a path of least resistance to water under high pressure, directing it away from foundation walls toward the drainage tiles. Plus, it warms the wall to reduce condensation on the interior and protects the waterproofing.*

## Soil Loads

Below grade, soil exerts a pressure both downward and horizontally (laterally). The deeper the soil, the greater the pressure. At eight feet below grade, this lateral soil pressure against the basement wall can be as much as 1,000 lbs/ft<sup>2</sup>. So to resist compression and loss of R-value, foundation insulation must be able to withstand this pressure.

STYROFOAM extruded polystyrene insulation products have the necessary compressive strength to fully resist soil

pressures over the life of the building. Long-term performance of STYROFOAM extruded polystyrene insulation below grade helps to save energy and reduce moisture problems in basements.

Table 1 illustrates the importance of compressive strength as it relates to an insulation's drainage ability. Compared to a typical fiberglass drainage product, STYROFOAM PERIMATE insulation is far better at maintaining high water drainage rates under increasing soil pressures.

TABLE 1

Drainage Rate Comparison <sup>(1),(2)</sup> STYROFOAM PERIMATE Insulation vs. Fiberglass Board		
Soil Pressure, lb/ft <sup>2</sup>	1" STYROFOAM PERIMATE gal/hr/linear foot, 1.0 gradient	1-3/16" Fiberglass, gal/hr/linear foot 1.0 gradient
600	366	63
800	357	39
1,000	363	32

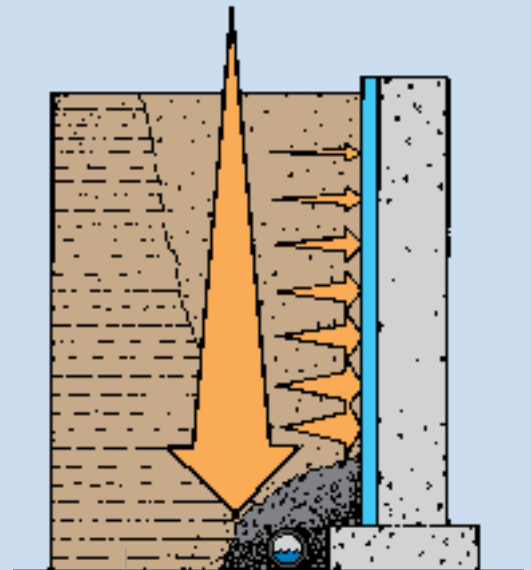
(1) Figures based on average soil pressures at average basement depths

(2) Third-party testing by STS Consultants using ASTM D4716



## LATERAL EARTH PRESSURE

Soil weighs about 80 to 120 pounds per cubic foot. The pressure at any given depth in the soil is a result of the weight of all the soil above that depth. As this soil weight presses downward, it also exerts a horizontal, or lateral pressure. This lateral pressure places a force on any insulation or drainage material placed on the foundation. Materials without sufficient compressive strength are unable to resist this pressure. And as they compress to a smaller thickness, R-value and drainage capability are reduced.



*The high compressive strength of STYROFOAM extruded polystyrene insulation resists lateral earth pressure, protecting the integrity of the foundation wall and maintaining long-term thermal performance.*



# Design Fundamentals.

## Crawl Spaces

Crawl spaces are prone to moisture problems and heat loss due to their proximity to the soil. The practice of adding vents to crawl space walls is meant to address these moisture problems and help dry out the crawl space area. However, the vents actually allow moisture to enter the crawl space, and they do little to help it dry out.

Moisture that enters through the crawl space vents clings to floor joists, batt insulation, heating/cooling equipment and plumbing fixtures. In this moist environment, mold and mildew can quickly degrade the integrity of the crawl space's contents, as well as compromise indoor air quality. And moisture isn't the only thing to worry about. Wood-eating insects, dust mites and other small creatures can crawl in through the vents to take up permanent residence.

A solution to this problem is gaining popularity: the non-vented, conditioned and properly insulated crawl space. This type of foundation



Photos courtesy of Jeff Tooley, owner of The Healthy Building Company

construction can be a big contributor to a home's overall energy efficiency and comfort.

Rigid foam insulation is an important component of a non-vented crawl space – it helps to keep the crawl space dry and energy-efficient. And THERMAX\* Sheathing polyisocyanurate insulation from Dow is the only rigid foam insulation product that can be left exposed on crawl space walls, as stated in the ICC code report NER-681.

*Crawl space moisture problems don't stay in the crawl space for long. Moist air can migrate into the interior of the home, increasing indoor humidity levels. One consequence of increased humidity is wood components and furnishings absorbing moisture, which causes warping and swelling.*



*Rigid foam insulation on the interior of non-vented crawl space walls keeps the crawl space warmer. This reduces the potential for condensation and related moisture problems.*

**Poorly constructed crawl spaces are a major source of moisture problems and a big contributor to poor indoor air quality in many of today's homes.**

## Slab-On-Grade

Digging a conventional deep foundation is not always feasible or desired. Building codes require that a foundation extend below the local frost line. In cold climates, this can mean digging a foundation more than 60" below grade.

### FROST-PROTECTED SHALLOW FOUNDATION

STYROFOAM extruded polystyrene insulation as part of a frost-protected shallow



*When soil under the foundation freezes, it expands with great force and can cause foundations to shift and crack.*

foundation design\*\* allows the construction of a much shallower foundation, which saves on building costs. The insulation regulates heat loss and changes the depth of frost penetration into the soil, resisting frost penetration into the building foundation.

### RADIANT FLOORS

In a slab-on-grade radiant floor heating design, radiant heat tubes are installed in the slab and concrete becomes the conductive medium, dispersing hot water heat across the surface of the floor. But without adequate insulation, this heat can be lost as it flows horizontally to the edges of the slab and the outside of the building, or downward to the soil beneath the slab.

Rigid foam insulation at floor edges and under the slab helps maintain a comfortable floor temperature, and keeps heat in the house to save energy.



*Rigid foam insulation at floor edges and under the slab helps radiant floor heat stay in the building, enhancing comfort and saving energy.*

*As part of a frost-protected shallow foundation, STYROFOAM extruded polystyrene insulation regulates heat loss and changes the depth of frost penetration into the soil. This allows a much shallower footing to be used in the foundation.*

\*\*As found in section R403.3 of the International Residential Code.

In states with heavy termite infestation (Florida, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Eastern Texas, California and Hawaii), rigid foam in new construction is not allowed in contact with the soil on the exterior foundations of homes or light construction where wood is found in the structural components of construction. Your Dow representative can provide recommendations for alternative insulation methods for these areas.



## Just Right Inside. . .

### Interior Insulated Basement

Installing rigid foam insulation on interior basement walls is a fast and easy way to extend the living space of your home. But when insulating a basement, it's important to do it right.

Rigid foam insulations from Dow can be installed right over masonry walls with no need for studs or a vapor barrier, providing a solid wall of moisture-resistant insulating comfort, without cavities or thermal bridges.

Specially designed and formulated insulation products from Dow are available to help meet specific application needs. For example, STYROFOAM WALLMATE\* extruded polystyrene insulation with slotted vertical edges is installed with furring strips and covered with gypsum board for a finished appearance. For areas such as a laundry room or storage space, THERMAX Sheathing, with its reflective foil facers, can be left exposed without a thermal barrier, for a semi-finished appearance.



*STYROFOAM WALLMATE insulation is designed for easy installation. The required drywall finish is easily attached to the furring strips slotted into the insulation.*

## Insulated Concrete Wall Systems

Today, precast, poured-in-place, tilt-up and other types of insulated concrete wall systems are being used to construct energy-efficient foundation walls and entire homes.

Insulated concrete walls eliminate many of the challenges of frame wall assemblies. Sandwiching rigid foam insulation between layers of concrete puts the insulation in the optimum position to help maximize the thermal mass of the concrete. And, insulated concrete wall assemblies minimize construction time, maximize a home's interior usable space and offer a variety of attractive, fast and easy finish options.

Rigid foam insulation from Dow can be used in all types of insulated concrete panels or "sandwich walls." Dow also offers complete systems of rigid foam insulation, patented composite fiber connectors, software and technical service, as well as licensing opportunities.



*Rigid foam insulation within insulated concrete walls helps maintain interior comfort – above and below grade. The insulated wall mass also contributes to superior sound dampening.*

*Insulated concrete foundations create a thermally efficient, below-grade wall that can save construction time and materials.*



Continuous foam insulation – from footer to sill plate – is the most effective way to reduce foundation energy loss up to 75 percent. In addition to offering reliable R-values from 5.0 to 6.5 per inch, rigid foam insulations from Dow:

- enhance drainage
- insulate the below-grade wall to reduce condensation
- protect the damp-proofing/waterproofing membrane
- resist movement of bulk water and water vapor through foundation walls above and below grade
- provide a more comfortable environment throughout the home

Learn more about building value into your homes with rigid foam insulation. Call your Dow representative today.



## Build Green With Dow

Dow supports initiatives that help preserve our environment, and we strive for environmental sensitivity in our manufacturing processes and in our products. Dow produces insulating foams that:

- contain no CFCs
- are formaldehyde-free
- are not a known food source for mold or insects
- contain post-industrial recycled content
- are recyclable (extruded polystyrene)

Ask your Dow representative for more information.

NOTICE: Changes to the International Residential Code require the installation of a weather-resistive barrier (WRB) within most exterior wall assemblies in residential construction. The following Dow insulated sheathing products qualify as a WRB when installed according to the installation instructions developed for "installation of foam sheathing as a weather-resistive barrier": STYROFOAM™ DURAMATE™ Plus, STYROFOAM Residential Sheathing, STYROFOAM Tongue and Groove, STYROFOAM Square Edge, STYROFOAM Residing Board, THERMAX™, TUFF-R™ and Super TUFF-R and therefore do not require the use of a building paper or a housewrap as a WRB. When a WRB is not needed, these Dow foam sheathings may be installed according to standard installation instructions for foam sheathing from Dow. Be sure products and installation instructions meet code requirements for your particular location. Note: STYROFOAM WEATHERMATE™ and WEATHERMATE Plus housewraps have already qualified as weather-resistive alternatives to the prescribed felt (see Evaluation Reports NER 593 and NER 640 for approved alternative).

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### STYROFOAM™ Extruded Polystyrene and Dow Polyisocyanurate Insulation Other Than THERMAX™ Products

COMBUSTIBLE: Protect from high heat sources. Local building codes may require a protective or thermal barrier. For more information, consult MSDS, call Dow at 1-866-583-BLUE (2583) or contact your local building inspector. In an emergency, call 1-989-636-4400.

### THERMAX™ Products

COMBUSTIBLE: THERMAX products should be used only in strict accordance with product application instructions. THERMAX products, when used in a building containing combustible materials, may contribute to the spread of fire. For more information, consult MSDS and/or call Dow at 1-866-583-BLUE (2583). In an emergency, call 1-989-636-4400.

WARNING: THERMAX insulation does not constitute a working walkable surface or qualify as a fall protection product.

Building and/or construction practices unrelated to insulation or housewrap could greatly affect moisture and the potential for mold formation. No material supplier including Dow can give assurance that mold will not develop in any specific system.

THE DOW CHEMICAL COMPANY • Building & Construction • 200 Larkin • Midland, MI 48674  
FOR TECHNICAL INFORMATION: 1-866-583-BLUE (2583) • FOR SALES INFORMATION: 1-800-232-2436  
[www.insulateyourhome.com](http://www.insulateyourhome.com)

