The Pennsylvania Housing Research Center

Insulating Basements: Part 3
Basement Wall Systems

Builder Brief: BB0710

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INTRODUCTION

The perception of a basement has changed significantly over the years from basic utility space to a space that is habitable or can easily be converted to a habitable space. With this in mind, it is important to understand what options are available for constructing insulated basements in order to provide homeowners with an efficient and cost effective home.

Insulating Basements consists of three PHRC Builder Briefs addressing fundamental building physics, basement wall materials, and basement wall systems. This document is the third PHRC Builder Brief in that series, describing code requirements pertaining to basement wall systems and common basement wall configurations. An overall analysis of pros and cons of each system is presented.

CODE REQUIREMENTS

Building codes such as the International Residential Code have served as a basis for residential construction for years. The requirements in such a code document can be viewed as either straightforward design standards or as minimum design requirements. In the case of basement wall construction, code requirements must be viewed as strictly a minimum in order to legally comply with current industry standards. In many cases, a basement must be designed well above minimum code requirements in order to perform well over time as a habitable or potentially habitable space.

Code requirements address basement wall construction in a variety of ways. The following list is a summary of typical requirements as of the 2009 code cycle:

- Foundation walls that retain earth must be damp-proofed from the top of the footing to the finished grade
- Masonry walls shall have a minimum of 3/8” portland cement parging on the exterior of the wall.
- Class I or II vapor retarders are not required for basement walls or below-grade portions of walls.
- Exterior basements walls associated with conditioned space shall be insulated from the top of the basement wall down to 10’ below-grade or to the basement floor, whichever is less
- Basement wall insulation must have a minimum R-10 thermal resistance for continuous insulation and R-13 for cavity insulation.

It is important to refer to current applicable code documents for minimum requirements.

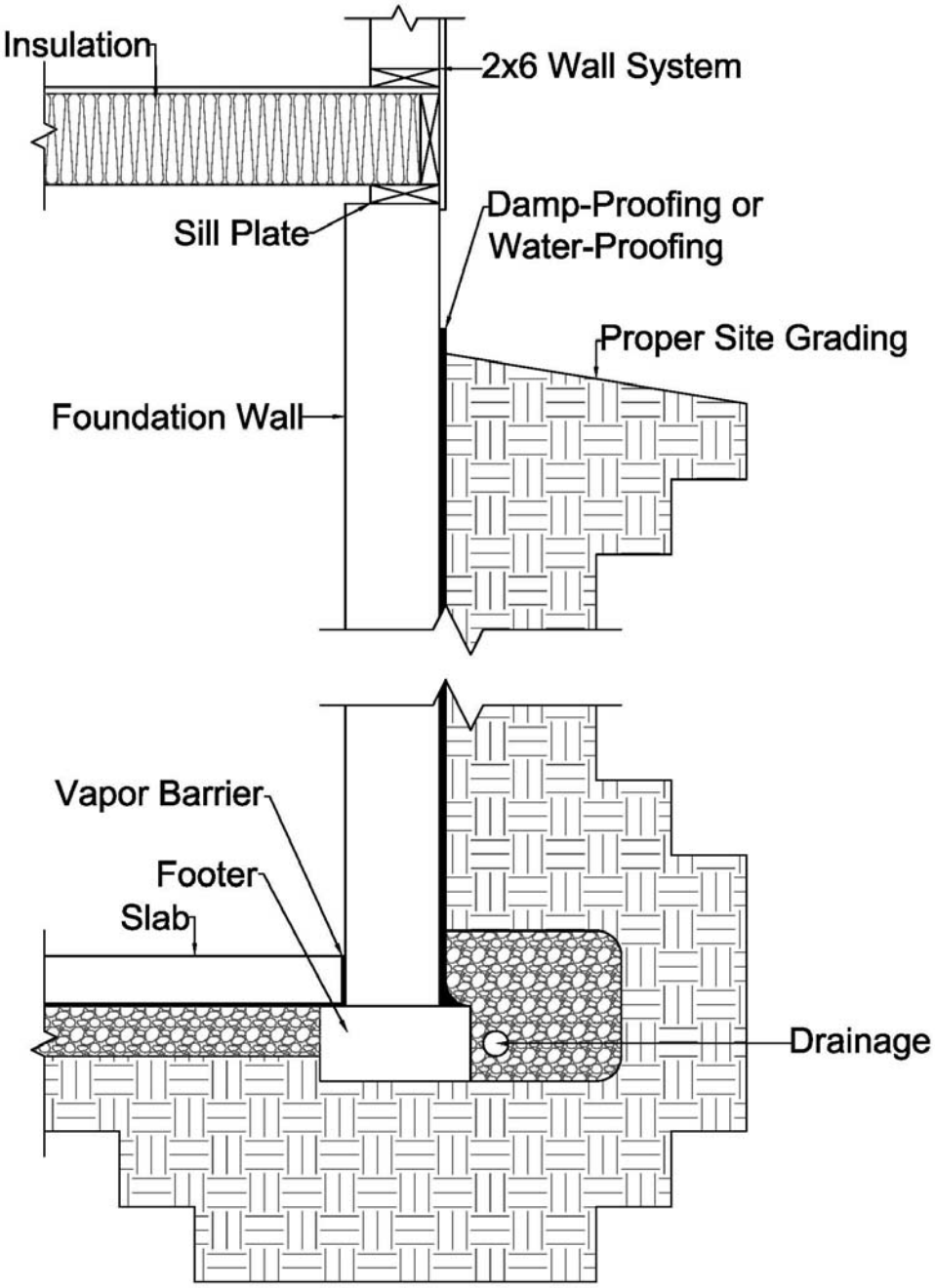
The requirements listed above do not adequately address the flow of heat and moisture through a basement wall. The overall system (both above and below-grade) must be taken into account when designed a basement wall. Components such as sufficient overhangs and proper drainage must compliment the design of basements, as discussed in the first PHRC Builder Brief in this series.

BASEMENT WALL SYSTEMS

The following pages outline the main components of common insulated basement wall systems. The tables included in the descriptions present pros and cons based on whether or not the basement is habitable or potentially habitable.

UNINSULATED BASEMENT WALL

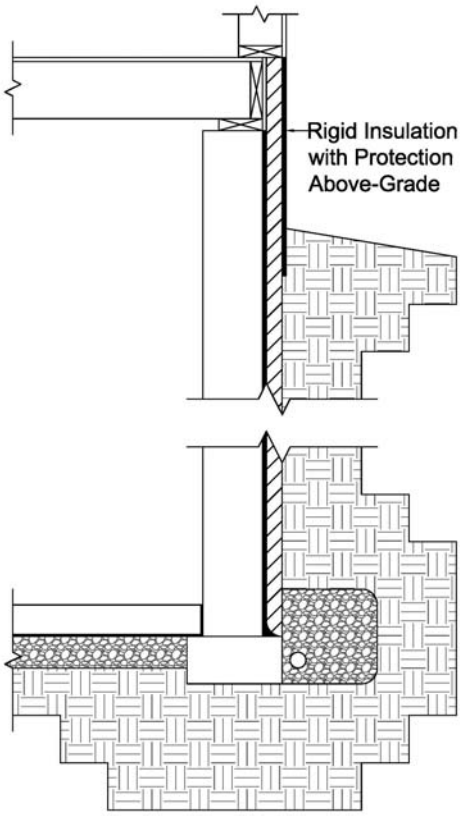
The detail below shows common features of an uninsulated basement wall. The main components are labeled. These components are common to all systems featured in this document, except for the placement of insulation.



HABITABLE AND POTENTIALLY HABITABLE BASEMENTS

The following pages refer to the differences between habitable and potentially habitable basements. A habitable basement is essentially “move-in ready” with all appropriate finishes installed. Potentially habitable basements are insulated and contain all code required components, yet may not be finished. Some work and additional components may be required to consider a potentially habitable space a finished basement.

1. EXTERIOR CONTINUOUS (Foam Board, Fiberglass Board, Mineral Wool)



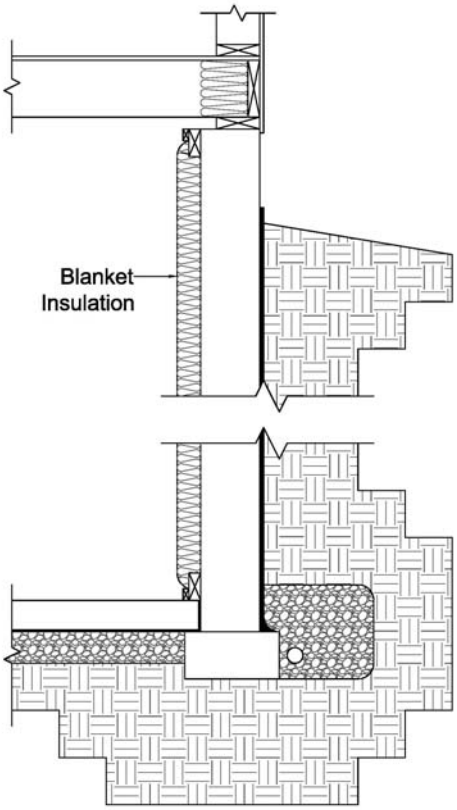
Exterior basement insulation systems provide a potentially habitable space to occupants. These systems can easily be converted to a habitable basement by installing a stud wall without any additional insulation. In general, basements with exterior insulation serve as well performing utility space with the option to finish.

POTENTIALLY HABITABLE SPACE
PROS
Low condensation potential (warmer wall)
Enhances drainage on exterior
Protects damp-proofing / water-proofing
Higher drying potential
Interior finish not required
Provides capillary break on exterior surface of wall
CONS
Vulnerable to physical damage above-grade
Potential insect and rodent issues with foam

RECOMMENDATIONS
Ensure that the insulation is not damaged during backfilling

2. INTERIOR DRAPED (Fiberglass Blanket or Batt)

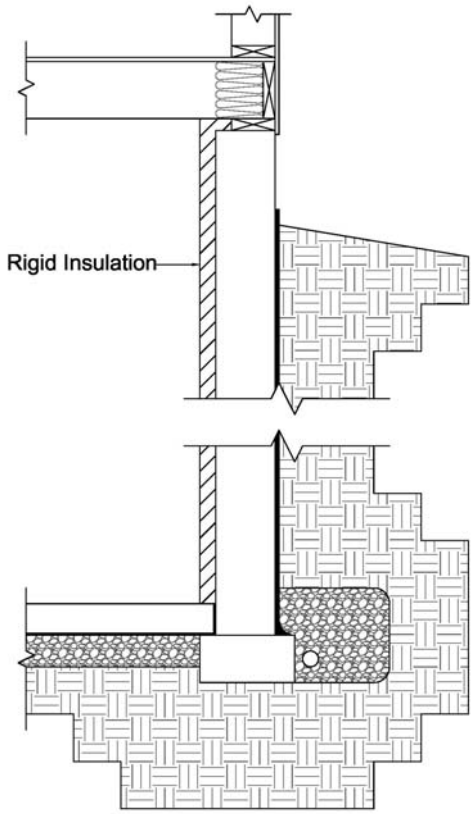
Interior draped insulation serves as an unfinished system only and must be removed in order to finish the space. Although easy to install and with lower cost, this system puts the basement at risk for moisture issues. The interior vapor barrier does not allow the basement wall to dry toward the interior space.



POTENTIALLY HABITABLE SPACE
PROS
Lower cost
Easy to install
CONS
Higher condensation potential (interior vapor barrier)
Higher condensation potential (cold wall)
Must be removed in order to finish the basement

RECOMMENDATIONS
Avoid using draped batts

3. INTERIOR CONTINUOUS (Foam Board)



Installing foam board on the interior of the foundation provides a continuous layer of insulation. This limits thermal bridging yet makes running utilities difficult. Due to flame spread requirements, continuous foam board must be covered except for some foil-faced products.

HABITABLE SPACE
PROS
Limits thermal bridging
Foam not moisture sensitive
Limits moisture movement from interior
CONS
Higher condensation potential (cold wall)
Difficult to run utilities (Plumbing, electrical, etc.)
Foams must be covered (Flame spread)
Low drying potential

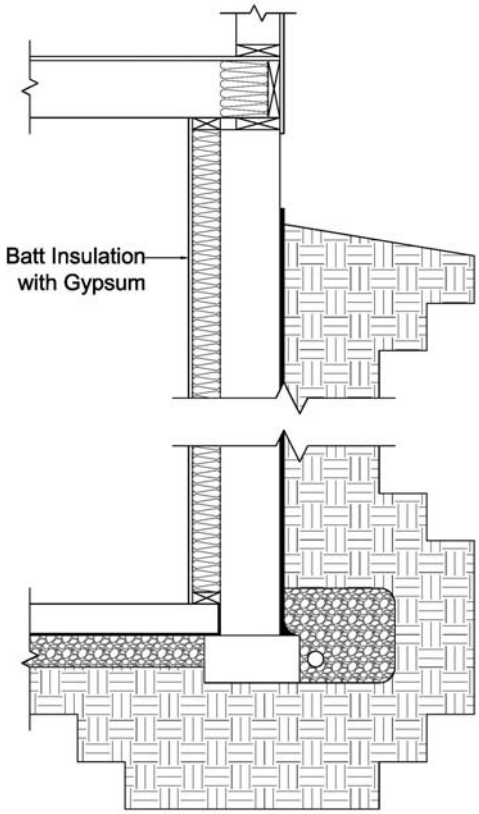
RECOMMENDATIONS
Use water-proofing instead of damp-proofing

4. INTERIOR CAVITY (Fiberglass Batt)

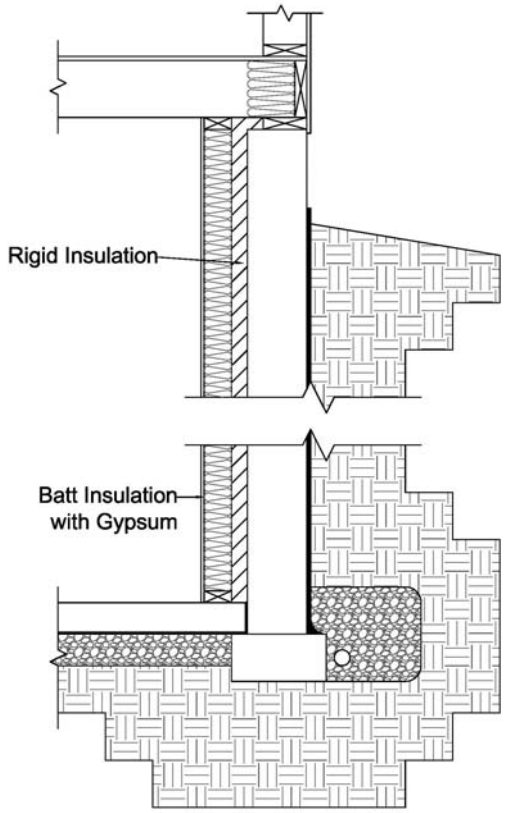
Interior cavity insulation systems offer a traditional approach to insulating a basement. Using a stud wall on the interior introduces issues with thermal bridging and moisture. Flame spread issues require the wall to be covered, providing a finished system.

HABITABLE SPACE
PROS
Traditional system
Utilities easily run (Plumbing, electrical, etc.)
CONS
Higher condensation potential (cold wall)
Thermal bridging
Studs sensitive to moisture (mold growth, structural degradation)

RECOMMENDATIONS
Ensure penetrations in finish system are properly sealed



5. INTERIOR CONTINUOUS / CAVITY (See individual systems for insulation options)



Combining continuous and cavity insulation systems offer a highly efficient basement wall. By installing a stud wall on the interior of the continuous insulation board, a finished system is provided. Thermal bridging is limited by the continuous layer but still is present. Thickness of the system becomes an issue.

HABITABLE SPACE
PROS
Limits thermal bridging
Energy efficient system
Utilities easily run (Plumbing, electrical, etc.)
Foam not moisture sensitive
CONS
Higher condensation potential (cold wall)
Thick system
Higher cost
Low drying potential

RECOMMENDATIONS
Ensure penetrations in finish system are properly sealed

SUMMARY TABLE

The table below shows a comparison of four different characteristics of insulated basement wall systems. For the categories of Condensation Potential, Constructability, and Thermal Efficiency, each "+" represents a positive attribute, while each "-" represents a negative aspect of the wall system. For the Cost category, more dollar signs ($) represent higher cost, while fewer represent lower cost.

	Condensation Potential	Constructability	Cost	Thermal Efficiency
Exterior Continuous	++	--	$$$	++
Interior Continuous	+	-	$$	-
Interior Cavity	-	-	$$	-
Interior Continuous / Cavity	+	--	$$$	+
Interior Draped	--	+	$	-