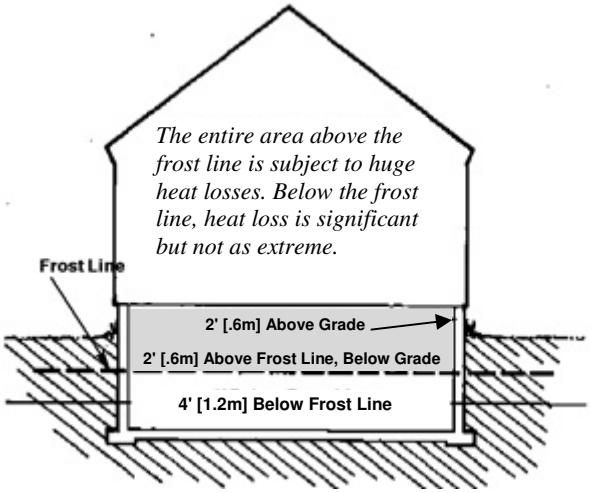
The Value of Basement Insulation in Cold Climates

If you had a 20' x 30' [6m x 9m] basement with concrete or concrete block walls, your heat loss could easily be over 1 million BTUs per day through the walls. Concrete or concrete block walls have the same R-Value as a ¾" [1.9cm] thick particle board.

Measuring Heat Loss

There are two critical factors in determining how much heat you'll keep in your home. The first is the difference in temperature between the inside and the outside of the building. As you'd expect, the greater the difference the greater the heat loss. The second factor is the degree of heat retention in your walls, floors and ceilings. To keep things relatively simple, we will focus on heat retention in the walls.



Temperatures below the frost line are relatively stable at 50°F [10°C]
Heat loss is rapid right down to the frost line.

When looking at heat retention in a basement wall, we have to consider three portions of the wall: the part that is above ground, the part that is below ground but above the frost line, and the part that is below the frost line. Obviously, the portion of the basement wall that is below the frost line will stay warmer than the portions that are exposed or within the frost line. In cold climates, the frost line is typically 2-3' [.6-.9m] below grade. If you are heating an uninsulated basement with concrete walls, the heat loss through the concrete that is above the frost line is astronomical. Consider the following example.

Imagine a 20' x 30' x 8' [6m x 9m x 2.4m] high basement with 8" [20cm] thick concrete walls and 2' [.6m] exposed (above grade). If the temperature inside is 70°F [21°C] and the temperature outside is 20°F [-6°C], the heat loss through just the 2' [.6m] exposed portion of the wall is 15,625 BTUs per hour (370,000 BTUs per day). Let's further imagine that the house is located in a cold winter climate where frost extends 2' [.6m] below grade. This means that the 2' [.6m] above grade and the 2' [.6m] in the frost zone will all essentially be exposed to the

20°F [-6°C] outdoor temperature. The 4' [1.2m] that is below the frost line will be exposed to a relatively balmy ground temperature of 50°F [10°C]. With the upper 4' [1.2m] of the basement wall exposed to 20°F [-6°C], and the bottom 4' [1.2m] exposed to 50° F [10°C], the total heat loss through the cement walls would be 43,750 BTUs per hour (1,050,000 BTUs per day!). This equates to over four cords of oak or sugar maple firewood (at 20% moisture content) to warm only the basement over three winter months.

Keeping the Heat in the House

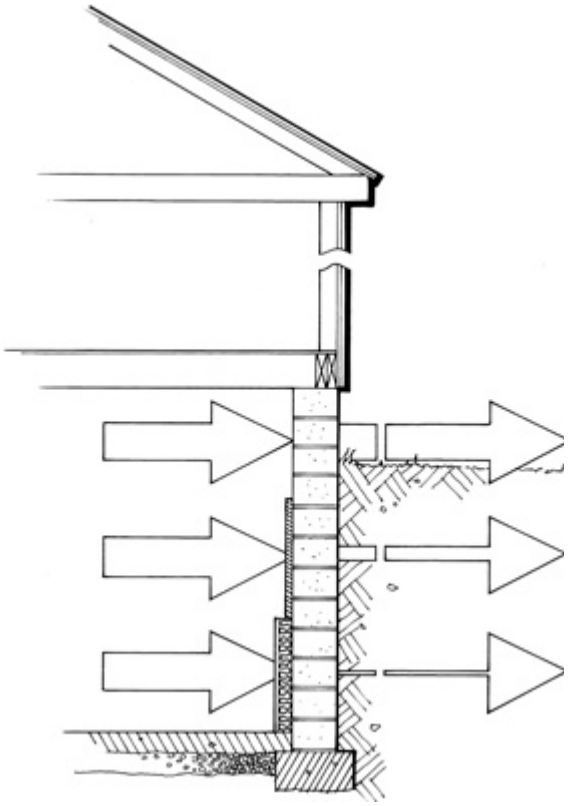
The R-Value of a material is a measure of its thermal resistance. The higher the number, the greater the resistance and the better the insulating value. There are a number of materials used in home construction that have very low R-Values.

For example:	**R-Value**
R-Value of 8" [20cm] concrete block	1.11
R-Value of 12" [30cm] concrete block	1.28
R value of 8" [20cm] poured concrete	0.64
R-Value of 4" [10cm] brick	0.80
R-Value of ½" [1.3cm] sheetrock	0.45
R-Value of ½" [1.3cm] sheathing	1.31
For comparison:	
R-Value of single pane glass	0.91
R-Value of 2" [5cm] of Expanded Polystyrene (EPS)	8.00
R-Value of 3½" [9cm] Fiberglass Batt	11.00
R-Value of ½" [1.3cm] Polyisocyanurate Foil-Faced Foam(Thermax™)	3.30
Quad-Lock R-ETRO 4¼" [11cm] EPS Panel	18.00

R-Values are cumulative. For example, if you were to insulate a wall with R-11 fiberglass batt and sheath it with ½" [1.3cm] sheets of Thermax™ and ½" [1.3cm] sheetrock, the total R-Value would be 14.75. The minimum insulation (R-Value) recommended by the Department of Energy for horizontal below grade surfaces in cold climates is R-10 to R-15. In addition, the DOE recommends R-10 to R-20 insulation for under a slab, which we have not taken into consideration for this article.

If you are building your house, you have the advantage of being able to insulate properly right from the start. There are many excellent methods for creating a well insulated basement. One method is to install rigid-board Styrofoam® on the outside of the walls, which will include the concrete or block in the “thermal envelope”. Insulating concrete forms provide another option, one which incorporates the rigid foam insulation into the basement wall structure when the foundation is poured. But even if you are working with an existing basement, you can do wonders by adding insulation inside or out, wherever and however you can.

Analysis of a Basement Wall



The calculations below assume a 20′ x 30′ [6m x 9m] basement with 2' [.6m] above grade and uniform 8” [20 cm] concrete walls. Doors or windows in poorly insulated homes would generally make the heat loss calculations worse. The calculations are averaged to take into consideration the fact that outside temperatures are warmer below grade.

Concrete with no insulation (R-1.11): 20' x 30' [6m x 9m] basement has an average heat loss of 43,750 BTU/hr or 1,050,000 BTU/day.

Insulated basement with 2" [5cm] bead board (R-8.0): 20' x 30' [6m x 9m] basement has an average heat loss of 3,240 BTU/hr or 77,760 BTU/day (93% decrease in heat loss from concrete wall).

Insulated basement with 3½" [9cm] fiberglass batting (R-11.0): 20' x 30' [6m x 9m] basement has an average heat loss of 2,334 BTU/hr or 56,016 BTU/day (95% decrease in heat loss from concrete wall).

Adding even a modest layer of insulation to your basement walls will result in an incredible reduction in heat lost through the concrete walls. The results will be felt immediately - both in less fuel used and in more heat in the home.

Let’s return to our 20' x 30' x 8' [6m x 9m x 2.4m] high basement with 8" [20cm] thick concrete walls and 2' [.6m] exposed (above grade). If you were to insulate this basement with 2" [5cm] of expanded polystyrene “bead board” (R-8), the heat loss at 20°F [-6°C] outdoors would be decreased from 43,750 BTUs to 3,240 BTUs/hr. At 0°F [-17°C] outdoors, the loss would be reduced from 56,250 BTUs to about 4,200 BTUs/hr. If you were to build 2" x 4" [5cm x 10cm] stud walls against the concrete walls, insulate them with 3½" [9cm] fiberglass batt, and finish them with ½" [1.3cm] sheetrock, you would increase the R-Value to 12. Going back to our 20°F [-6°C] outdoor temperature, you now reduce the heat loss even further, from 43,750 BTUs to 2,334 BTUs/hr. At 0°F [-17°C] outdoors, the loss would be reduced from 56,250 BTUs to 3,000 BTUs/hr.

Adding insulation is one of the most cost-effective improvements you can make to your home. The benefits are immediate, both in terms of economics and comfort, no matter what fuel you use to heat. With a wood stove, these benefits are even more noticeable because you aren’t depending on a central heating system that uses energy to move energy. No circulators, blowers, ductwork, or plumbing are required to enjoy the radiant warmth from a soapstone stove. Just be sure to make the most of it by keeping the heat inside, especially in a basement.