Basement Installations

<u>*Uninsulated basements are subject to massive heat loss*</u>

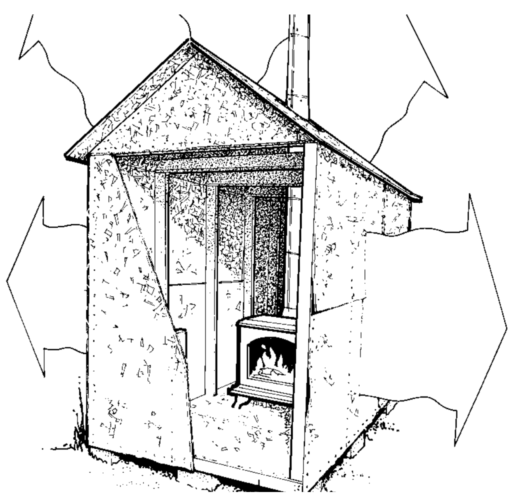
- Keep the Heat in your House -

Woodstove in the Basement?

At first glance, the basement seems like the perfect spot for a woodstove. You don't have to worry about cleaning up woodchips and dust in your living room, the floor of the level above will be toasty warm, and your basement installation might put your stove closer to your woodpile - for less hauling! Unfortunately, many stove owners are sorely disappointed when they find themselves continually feeding the basement stove without getting much heat upstairs in the living area.

> If you had a 20′ x 30′ basement with concrete or concrete block walls, your heat loss could easily be <u>over 1 million BTUs per day</u> through the walls (see page 3). Concrete or concrete block walls have the same R-value as a 3/4″ thick particle board.

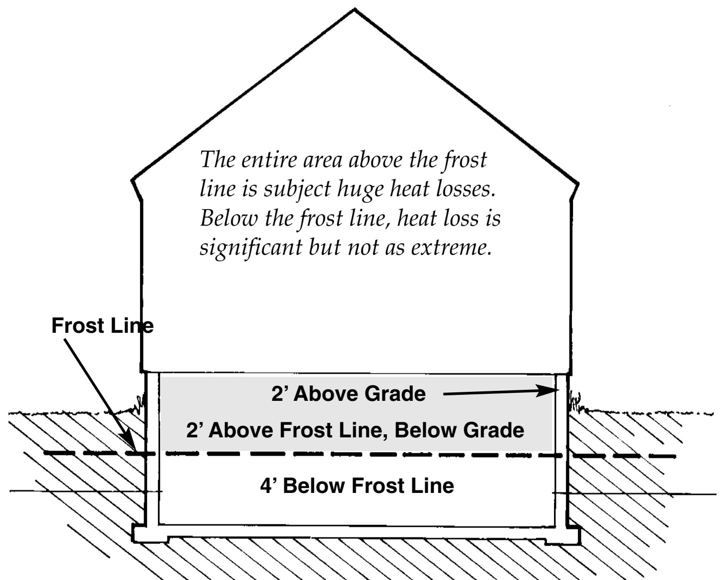
If your basement is truly part of your living area and is insulated and finished, it can be treated like any other area of your home concerning stove placement. Many basements, however, are either partially finished or not finished at all. If this is your situation and you plan to install a woodstove in the basement in order to heat the upstairs, this article is for you. The focus of the article is on how to make the basement an effective and efficient spot for a woodstove installation.



The heat loss from an uninsulated beasement is similar to heat loss from a shed built with 1/2″ particleboard walls (R-1.31) and no insulation. You are heating the great outdoors.

A. Measuring Heat Loss

No matter what the BTU rating of your stove may be, the other half of the heating equation is the amount of heat loss out from your home over a given period of time. 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°. 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 frostline, and the part that is below the frostline. 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′ 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′high basement with 8″ thick concrete walls and two feet exposed (above grade). If the

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temperature inside is 70° and the temperature outside is 20°, the heat loss through just the 2′ 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′ below grade. This means that the 2′ above grade and the 2′ feet in the frost zone will all essentially be exposed to the 20° outdoor temperature. The 4′ that is below the frost line will be exposed to a relatively balmy ground temperature of 50°. With the upper 4′ of the basement wall exposed to 20°, and the bottom 4′ exposed to 50°, the total heat loss through the cement walls would be 43,750 BTUs per hour (1,050,000 BTUs per day!). <u>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.</u>

B. 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. Concrete has a very low R-value.

<u>For example:</u>

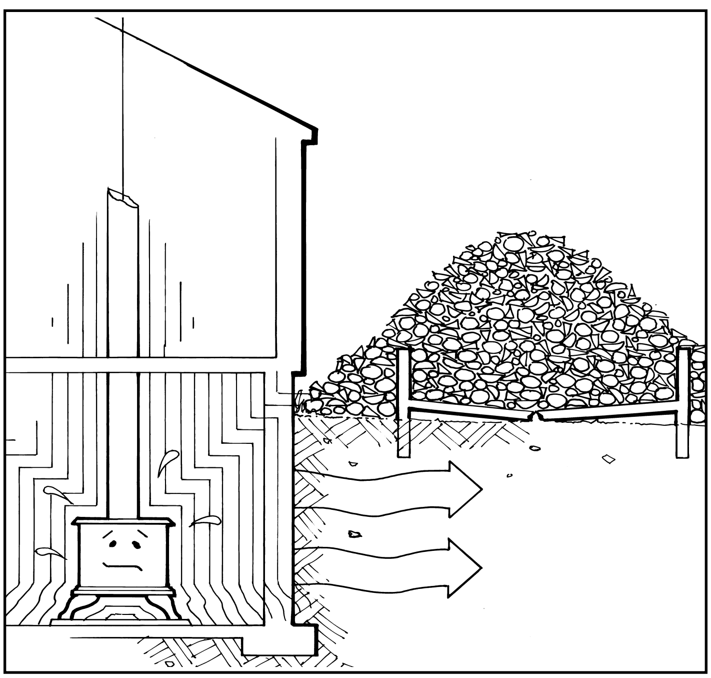
R-value of 8″ concrete block:…………..... 1.11
R-value of 12″ concrete block…………..... 1.28
R value of 8″ poured concrete:………....... 0.64
R-value of 4″brick……………………….... 0.80
R-value of ½″ sheetrock………………..... 0.45
R-value of ½″ sheathing........................... 1.31

<u>For comparison:</u>

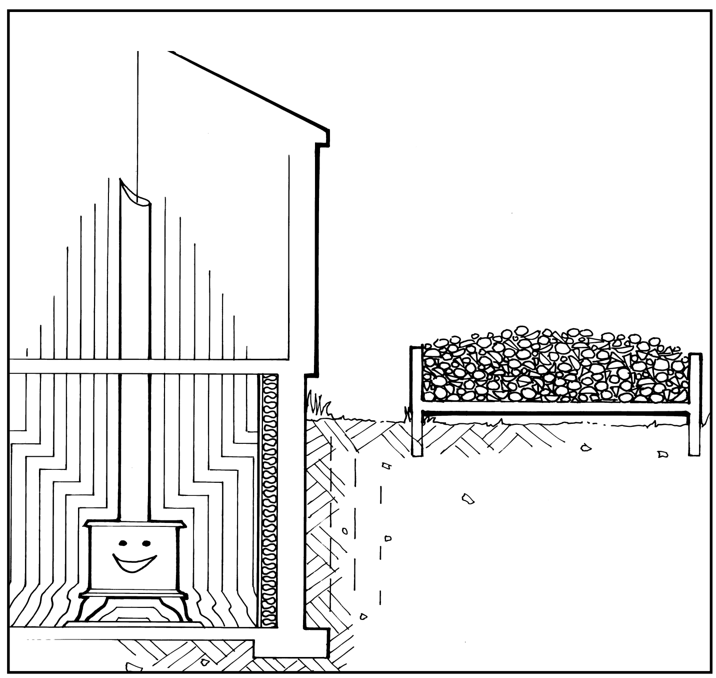
R-value of single pane glass………….... 0.91
R-value of 2″ of Expanded Polystyrene (beadboard)………....................................... 8.00
R-value of 3 ½″ Fiberglass Batt……….... 11.00
R-value of ½″ Polyisocyanurate Foil-Faced Foam(Thermax™)….............. 3.30

R-values are cumulative. For example, if you were to insulate a wall with R-11 fiberglass batts and sheath it with ½″ sheets of Thermax™ and ½″ 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". Insulated 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.

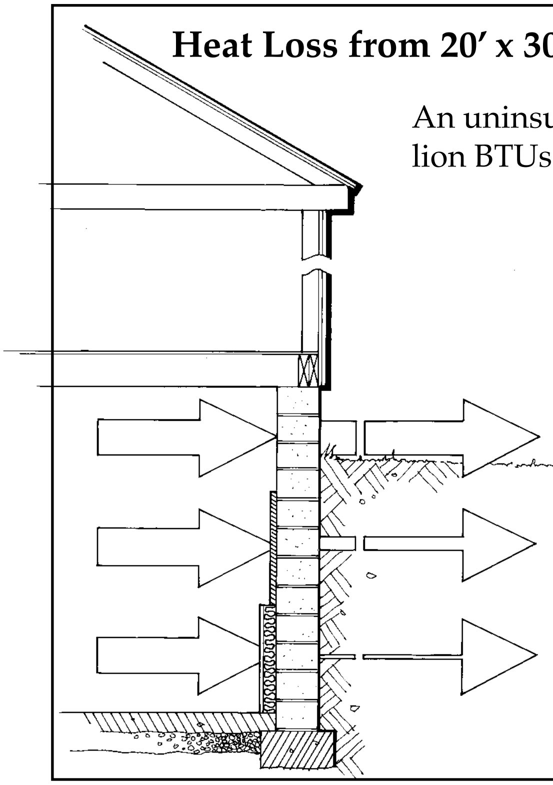


Uninsulated basements make for overworked stoves that consume mass quantities of cordwood and provide little useful heat in the living area.



Insulating your basement walls to R-12 will reduce wood consumption by as much as 16 times in addition to allowing more of your hard won heat to move up into the living areas.

Heat Loss from 20′ x 30′ Basement at 20° F Outdoor Temperature



An uninsulated basement in a cold climate can lose over 1 million BTUs/day. Insulation can reduce this heat loss by 95 %.

The calculations below assume a 20′ x 30′ basement with 2′ above grade and uniform 8′ 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′ basement has an average heat loss of 43,750 btu/hr or 1,050,000 btu/day.

Insulate basement with two inches beadboard (R-8.0): 20′ x 30′ basement has an average heat loss of 3,240 btu/hr or 77,760 btu/day (93% decrease in heat loss from concrete wall)

Insulate basement with 3 1/2″ fiberglass batting (R-11.0): 20′ x 30′ 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.

C. An Insulated House Makes a Happy Stove

Let's return to our 20′ x 30′ x 8′high basement with 8″ thick concrete walls and two feet exposed (above grade). If you were to insulate this basement with 2″ of expanded polystyrene "bead board" (R-8), the heat loss at **20°F** outdoors would be decreased from 43,750 BTUsto 3,240 BTUs per hour. At **0°** outdoors, the loss would be reduced from 56,250 BTUs to about 4,200 BTUs per hour. If you were to build 2″ x 4″ stud walls against the concrete walls, insulate them with 3½″ fiberglass batts, and finish them with ½″ sheetrock, you would increase the R value to 12. Going back to our **20°** outdoor temperature, you now reduce the heat loss even further, from 43,750 BTUs to 2,334 BTUs per hour. At **0°** outdoors, the loss would be reduced from 56,250 BTUs to 3,000 BTUs per hour. Your wood usage during periods of 20° weather would be reduced from over 4 cords for a cold three month period to about ¼ cord, ***that's a decrease of 16 times!***

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.

A few words about wood and efficiency...

Because different types of wood have different densities, weight matters more than volume. A cord of good hardwood at 20% moisture content contains a potential of ***21,500,000 BTUs****. A cord of a soft wood such as white pine weighs less, and has about 30% fewer BTUs (or 30% less heat value) than a cord of oak or sugar maple.*

When wood is first cut, 50% or more of its weight is water. If wood is stored and allowed to dry, this "moisture content" gets reduced to about 20%. If wood is not allowed to dry, much of the heat value is wasted evaporating water from the wood. The difference in heat value between a cord of wood that is "wet" and one that is "dry" is considerable - about 20%.

Thus, simply by getting firewood that is (1) dry and (2) hardwood, you can increase efficiency by up to 50%.

For comparison purposes, a gallon of propane contains ***91,500 BTUs****. A gallon of heating oil contains* ***139,000 BTUs.***

Additional Resources:

www.eere.energy.gov: The U.S. Department of Energy's website on energy efficiency

www.doityourself.com: An independent home improvement and repair website

www.ColoradoENERGY.org: A coalition of Colorado Energy organizations.

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