Neo–Terra
Experiments in Healthy Living

CASE 4. CALCULATING WALL R-VALUES

R value measures the resistance to heat flow, so the higher the value, the better the wall. One of the challenges in improving wall insulation is calculating the R values of your present walls. I use the plural here; with the older home which has sustained renovations or additions, you may find different wall treatments with different construction and insulating materials and therefore different R values. Our 1938 house with a 1957 addition turned out to have four different wall treatments.

Determining what materials were used in a given wall can be challenging. Sometimes you can find a crawl space, closet, open attic area behind a knee wall, open stud cavities resting on a cellar sill plate, air vents or other opening through which you can determine the wall materials. Exercising care, you may be able to pry off a piece of wall board on the inside or siding on the outside to view what is underneath. Other times you may have to drill a small hole using a circular bit (1 ½" works well). Save the layers to repair the opening. You may have to drill from both the inside and the outside. Find an inconspicuous place to drill – a closet or cupboard wall for example.

For two walls we retrofitted during the fall of 2008 we determined the materials and dimensions as shown in the table below. We adopted Kachadorian's methodology and his table of R values to complete the table.[1] For internet sources, search under "R values for building materials." One I found that is useful is at http://www.buildex.com/smartwall/tables/tpovbm.html .

East Wall. Examining the two alternatives, it was clear that we could get a better wall with less work and cost by taking off the vinyl siding (and saving it for re-installation) and adding two layers of 1" foamboard. Otherwise, we would have had to take the entire wall apart, vacuum up rock wool, itself a challenge, spray in urethane foam using another contractor, and replace the wall. Too much work for a limited gain.

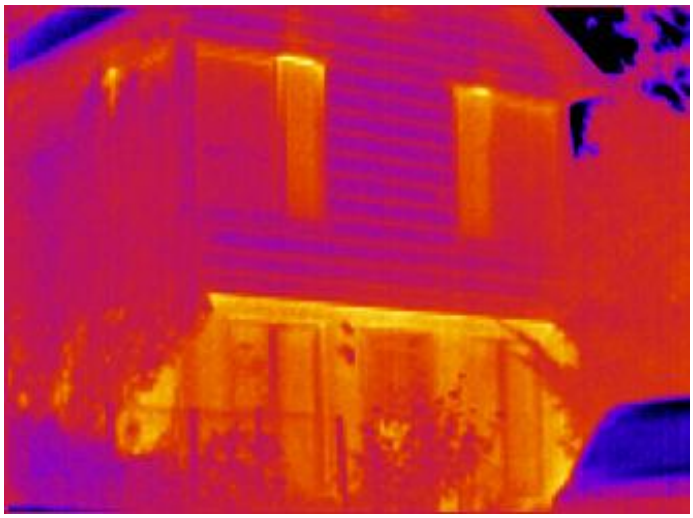
South Wall. Once we knew the insulation was fiberglass, we knew we wanted to take it out. The amount was inadequate to start with, and with age had pulled away from the studs, and become matted and riven by rodents. Fiberglass batting is no longer the insulation material of choice. Its performance declines at temperature extremes, either hot or cold. It can trap moisture, and is toxic. What remained for us was the choice between icynene and urethane. We went with the latter because it has a higher R value. Since we were rebuilding the wall, we decided to incorporate two hot air collectors as part of the south wall. Consequently, we were able to salvage enough of the old growth cedar siding to cover the remaining area outside the collector boxes.

Table 1 below summarizes the R-value calculations for each wall and their retrofit options. A photo summary of the retrofits follows.

Table. Comparison of Wall Insulation Options

East Wall R values	As Is	Alternative 1: replace insulation w urethane foam	Alternative 2: add 2" foam board
15 mph wind	0.17	0.17	0.17
Vinyl siding	-	-	-
¼" Styrofoam	1.25	-	1.25
1" foam board	-	5.00	-
2" foam board (1" over 1")	-	-	10.00
¾" wood siding	0.75	-	0.75
1" brown board sheathing	1.00	-	1.00
½" CDX	-	0.50	-
3 5/8" urethane foam	-	18.13	-
3 5/8" rock wool (but some has settled!)	13.84	-	13.84
½" gypsum	0.45	0.45	0.45
Still airspace inside	0.68	0.68	0.68
Total R	**18.14**	**24.9**	**28.1**
Cost	0	$6,000	$3,282
Net change in thickness		-0.50"	Adds 2"
South Wall R values	**As Is**	**Alternative 1: replace insulation w urethane foam**	**Alternative 2: add 2" foam board**
15 mph wind	0.17	0.17	0.17
½" cedar	0.65	0.65	0.65
1" foam board	-	5.00	-
2" foam board (1" over 1")	-	-	10.00
2 layers felt paper	0.12	-	0.12
¾" wood siding	0.75	-	0.75
½" CDX	-	0.50	-
3 5/8" urethane foam	-	18.13	-
2" fiberglass bat	7.60	-	7.60
3/8" plywood	0.47	0.47	0.47
¾" inside paneling	0.75	0.75	0.75
Still airspace inside	0.68	0.68	0.68
Total R	**11.2**	**26.35**	**21.2**
Cost (include cost of replacement cedar siding)	0	$2,660	Non-starter
Net change in thickness		Adds 0.75"	Adds 2"

Right: Picture 1. East wall retrofit: adding two 1" layers of foamboard after removal of vinyl siding



Left: Picture 2. Using an infrared camera can help indicate where your heat leaks are, and the effectiveness of your improvements. Here we show the effectiveness of the new wall with icynene foam and the effect of the two large shutters in the big windows compared with the two bright yellow narrower windows without shutters

Right: Picture 3. South wall retrofit: Tania and Gene in front of wall cleaned down to studs, with holes for hot air collector vents framed

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Left: Picture 4. Urethane foam being sprayed into stud cavities

Above: Picture 5. Gene working with Howard Kephart, contractor. We nailed sheathing over foam-filled stud cavities, installed frames for hot air collectors, and are now nailing 1" foamboard. We will nail siding over this.

[1] James Kachadorian, The Passive Solar House. Chelsea Green Publishing Co. White River Junction, VT, 1997. Page 64 for the methodology, page 184-5 for R values.