

Will the Real R-value Please Stand Up

ABSTRACT

This study describes an approach to determine actual R-values in existing wood framed wall construction as compared to component calculated and prescribed R-values. The study examined a recently remodeled 1913 residence in Portland, Oregon. Four exterior framed wall areas, at various locations, were examined and tested to determine their actual R-values. The results and analysis confirmed that the wall assemblies thermally underperformed as compared to the Oregon Dwelling Specialty Code and energy standard requirements. The study provides useful information for designers and contractors when assessing actual thermal wall performance and considering future improvements for existing residential construction.

METHODOLOGY & EQUIPMENT

- Step 1 - Select Wall Test Areas
- Step 2 - Investigate As-Built Conditions
- Step 3 - Record Thermal Images
- Step 4 - Estimate Framing and Cavity Areas
- Step 5 - Determine Air and Surface Temperatures
- Step 6 - Use (ITC and NCI) Chart to Determine Actual R-Value

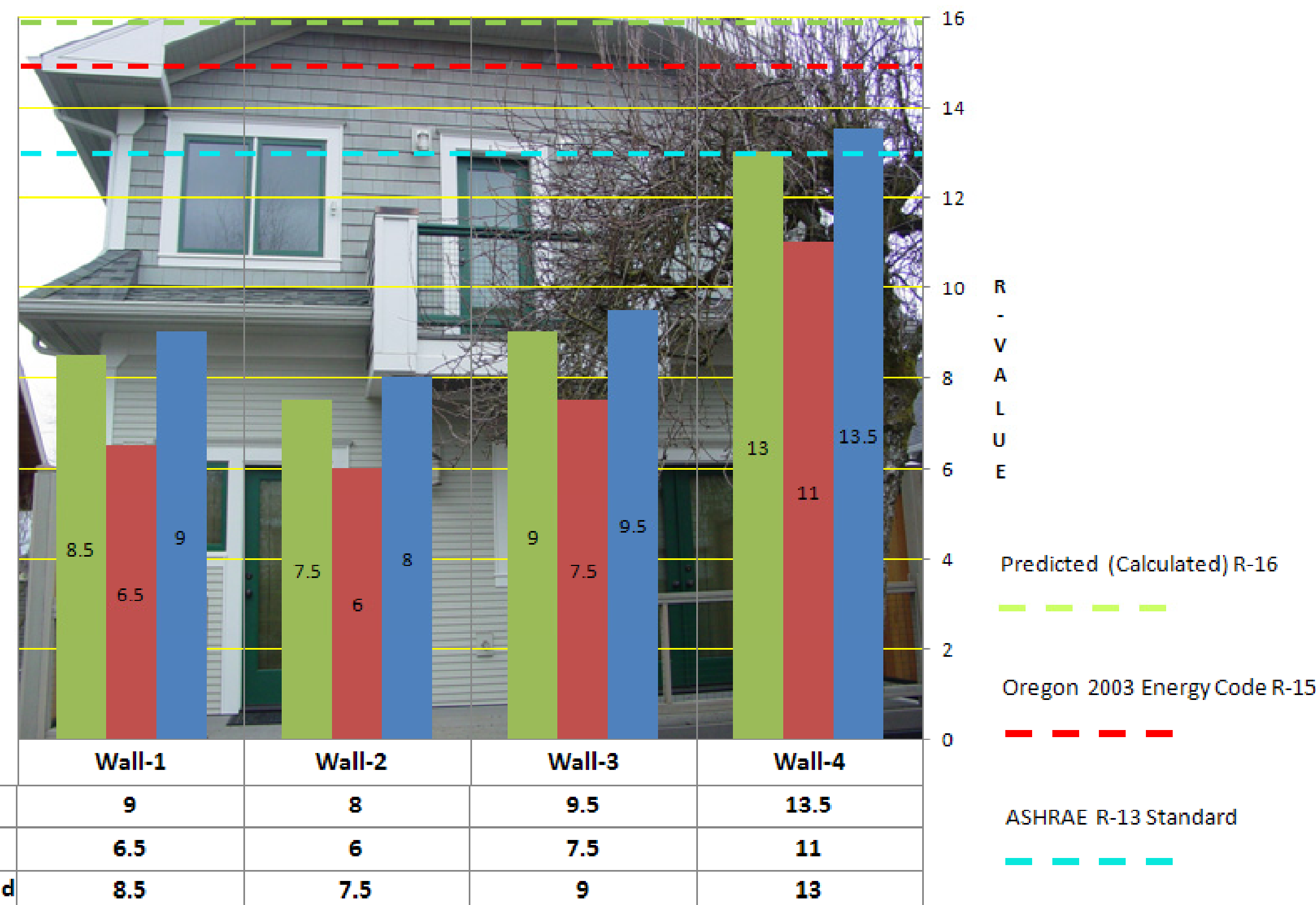


CONCLUSION

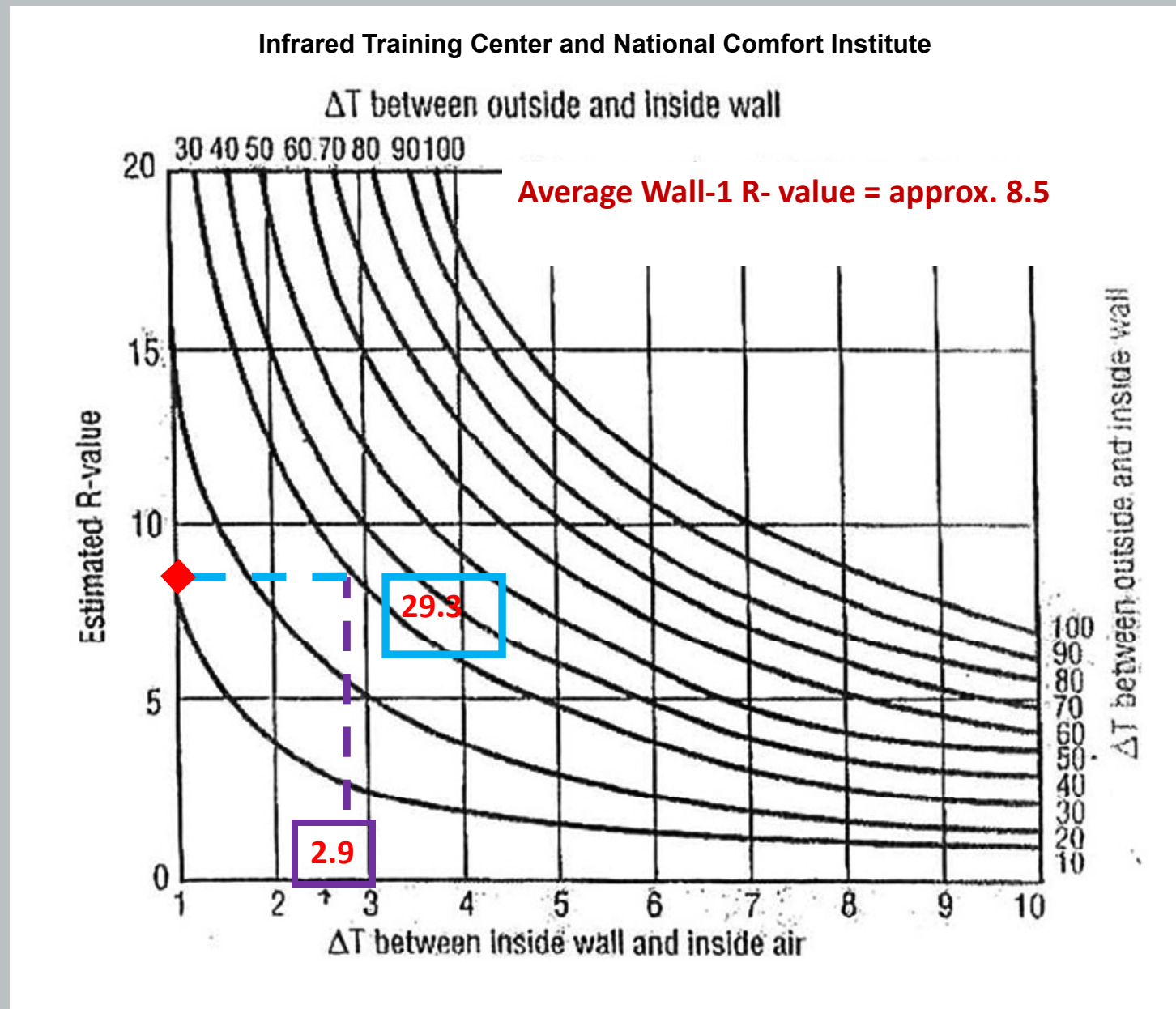
All four wall test areas were shown to be below the whole wall actual R-value when compared to the predicted (calculated) R-16 value and the 2003 Oregon Building Energy Code R-15 requirement. Only Wall-4 met the minimum R-13 ASHRAE insulation standard. The average whole wall R-value for all four walls was R-9.5.

- Predicted (calculated): R-16 compared to R-9.5 = 41%
- 2003 Oregon State Building Code: R-15 compared to R-9.5 = 37%
- ASHRAE Standard 90.1-2007: R-13 compared to R-9.5 = 27%

WALL R-VALUE COMPARISON

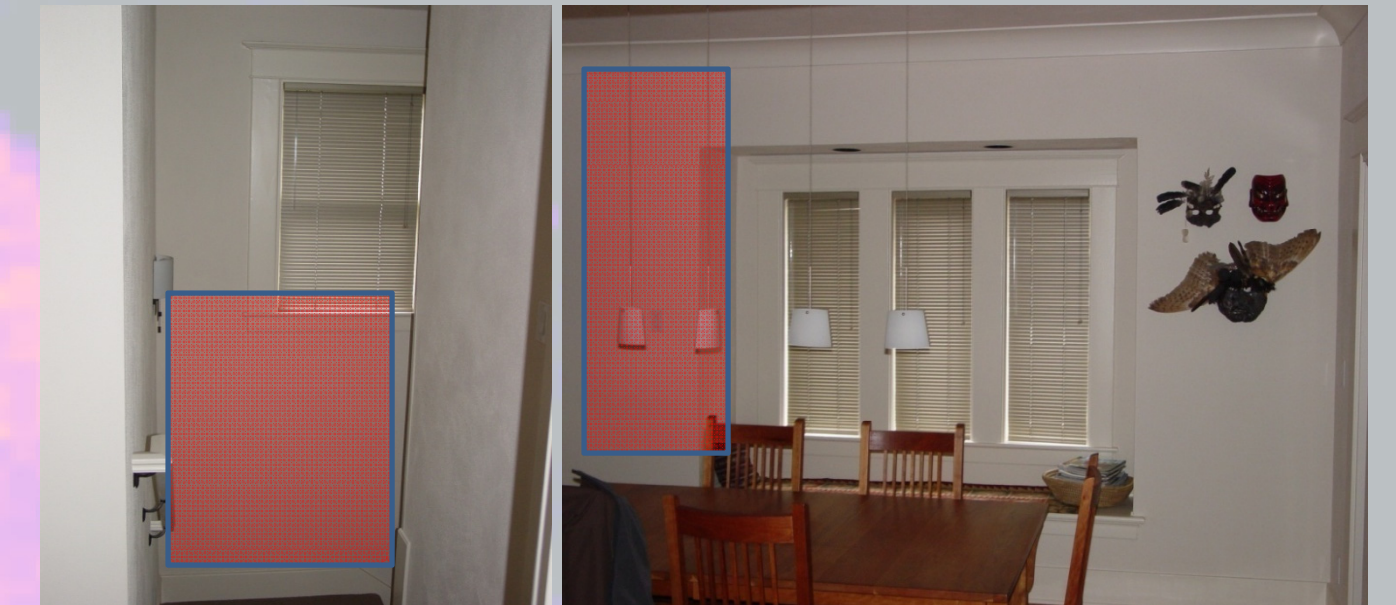
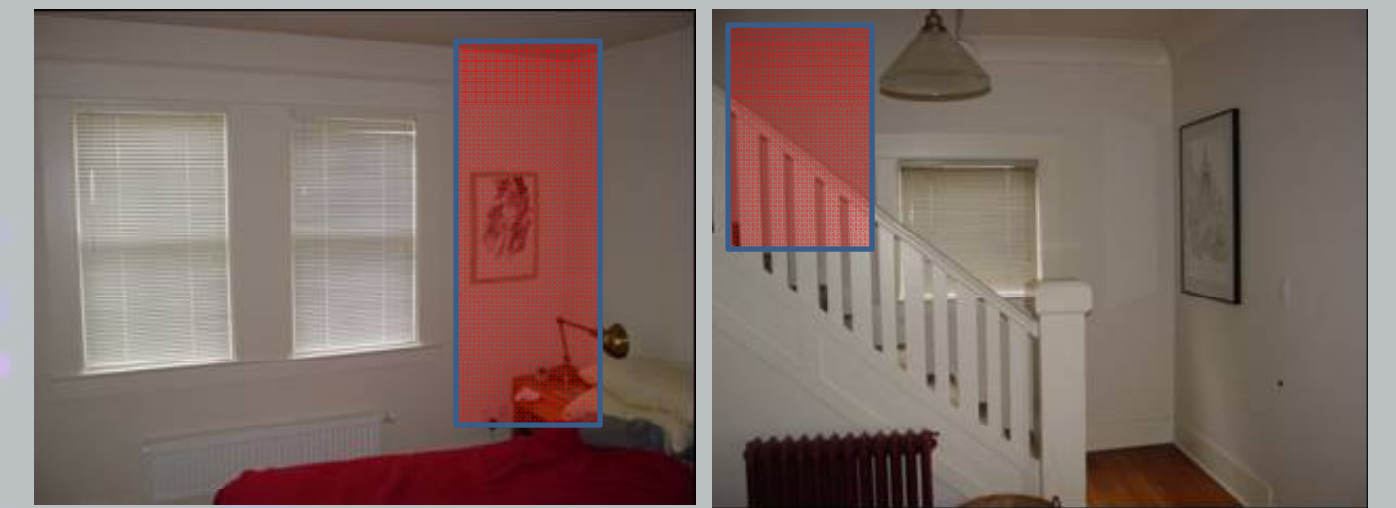
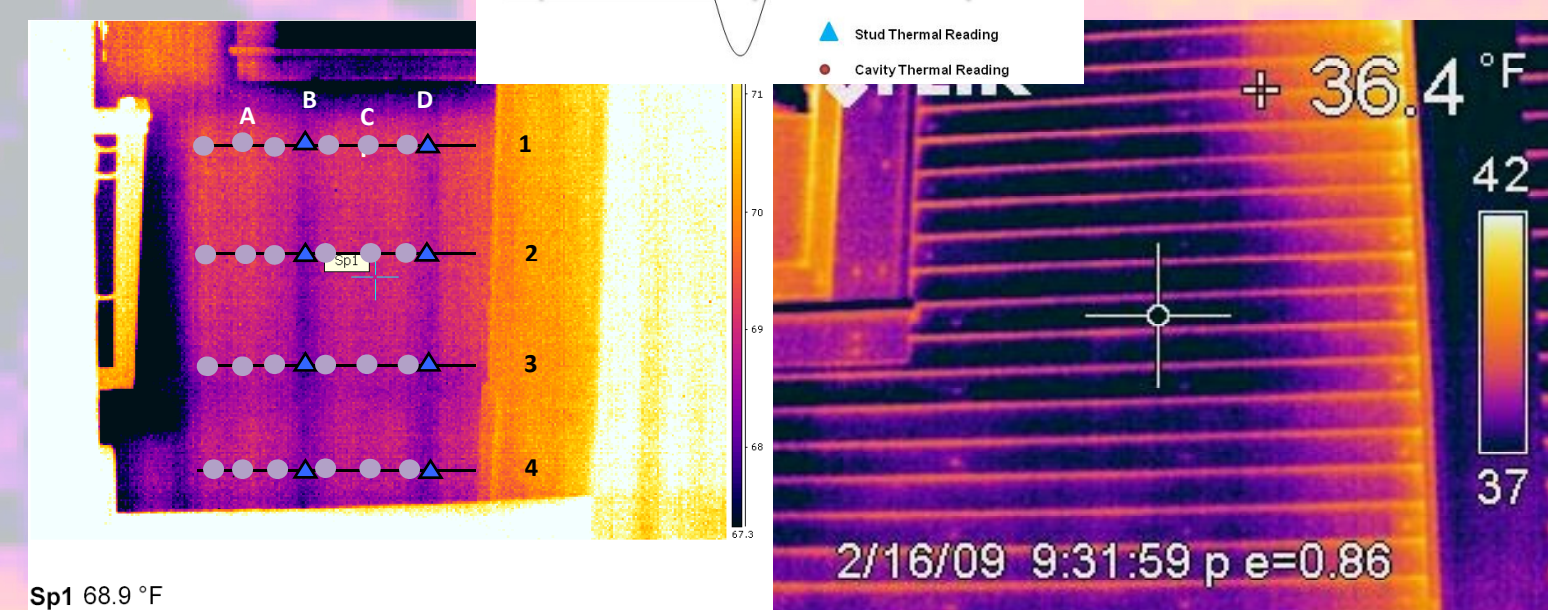
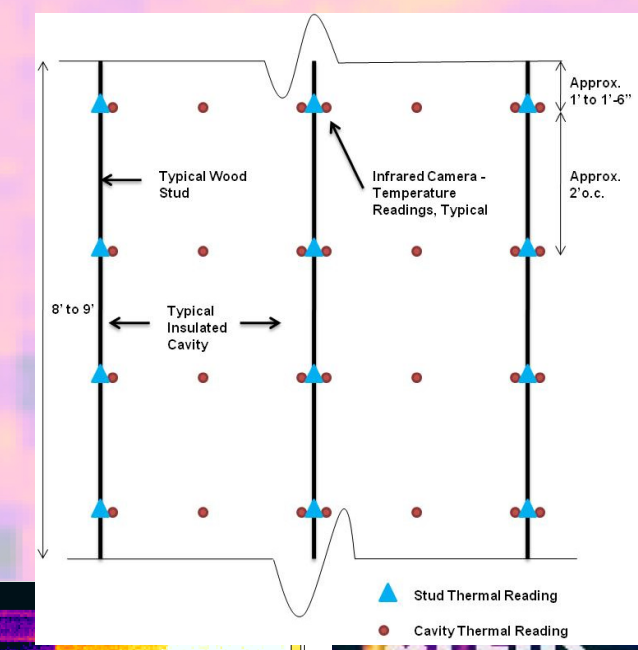


R-value Cavity	9	8	9.5	13.5
R-value Stud	6.5	6	7.5	11
Average R-value Cavity/Stud	8.5	7.5	9	13



	Wall-1	Wall-2	Wall-3	Wall-4
Exterior Wall - Inside Wall Surface Temperature	67.1	66.7	67.5	68.0
Exterior Wall - Exterior Surface Temperature	37.8	37.8	37.7	37.7
Interior Ambient Air Temperature	70.0	70.0	70.1	69.9
ΔT = Ambient Air - Inside Surface	2.9	3.3	2.6	1.9
ΔT = Inside Surface - Exterior Surface	29.3	28.9	29.8	30.3

ROW #	Cavity (Left) A	Cavity (Center) A	Cavity (Right) A	Framing Stud B	Cavity (Left) C	Cavity (Center) C	Cavity (Right) C	Framing Stud D
1	67.1	67.4	67.1	66.6	67.4	67.5	67.4	66.9
2	67.1	67.4	67.2	66.3	67.1	67.4	67.4	67.1
3	67.0	67.1	66.9	66.3	66.4	67.2	67.2	66.7
4	67.1	67.2	67.2	66.3	67.0	67.2	67.3	66.5



R-VALUE for 2X4 WALL at STUD AREAS		
Component	Thickness	R-Value
Inside Air Film	-	0.68
Interior Plaster	3/4"	0.45
2x4 Nominal Stud Framing	4"	4.56
Horizontal Sheathing Boards	3/4"	0.93
Plywood Sheathing	1/2"	0.62
60 Min. Building Paper	nil	0.06
Cedar Drop-Lap Siding	1/2"	0.81
Exterior Air Film	-	0.17
TOTAL R-VALUE (STUD WALL AREA)		8.28

R-VALUE for 2X4 WALL at CAVITY AREAS (Cellulose)		
Component	Thickness	R-Value
Inside Air Film	-	0.68
Interior Plaster	3/4"	0.45
Cellulose Insulation	4"	13.68
Horizontal Sheathing Boards	3/4"	0.93
Plywood Sheathing	1/2"	0.62
60 Min. Building Paper	nil	0.06
Cedar Drop-Lap Siding	1/2"	0.81
Exterior Air Film	-	0.17
TOTAL R-VALUE (CAVITY WALL AREA)		17.4

Predicted Whole Wall R-value = % Stud Area x (Stud R-Value) + % Cavity Area x (Cavity R-value)

For walls filled with blown-in cellulose insulation the total R-value = .17(8.28) + .83(17.4) = 16

For walls filled with fiberglass insulation the total R-value = .17(8.28) + .83(20.88) = 18.5