Bungalow

Ice Box Effect

EXISTING CONTEXT:

HYPOTHESIS

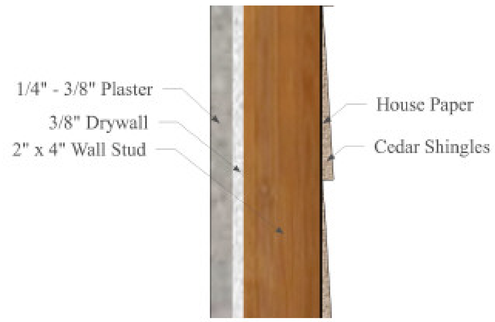
The wall assembly of Jessie's house does not meet ASHRAE Standard 55-2004 for thermal comfort.

TABLE 1: ASHRAE STANDARD 55-2004
(MEEB Table G1)[2]

Envelope Component	Maximum U-Value
Fixed Window	1.22
Light Framed Wall	0.089
Floor	0.066
Roof	0.081

ABSTRACT

The assembly components and thermal conduction of walls of a 1953, 732 square foot bungalow were evaluated with the use of an infra-red digital thermometer, an infra-red camera and visual inspection. The assessment was made to determine if the envelope met ASHRAE standards. Measurements were made with and without home heating on. Following initial measurements a second assessment was made with insulating foam panels placed against the exterior wall of the living room. After calculating u values for the envelope and estimating heat loss, the opportunity costs of insulation purchase was evaluated against CO2 production and natural gas heating costs. Fuel savings over 35 months would cover the cost of installing additional insulation.



TYPICAL EXTERIOR WALL ASSEMBLY

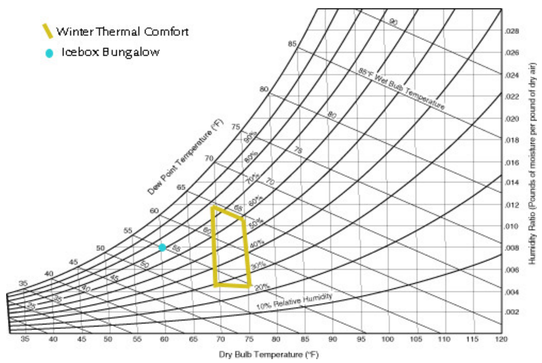
ENVELOPE AND R VALUES

Floor		Wall		Ceiling/Roof	
Materials	R*	Materials	R	Materials	R
0.75" hardwood decking	0.68	Interior air film	0.68	0.25" plaster	0.16
33.6 density tongue and groove	0.99	0.25" lightweight gypsum plaster	0.16	0.5" drywall	0.45
2 x 6 joists R-18 @ 12% framing	2.16	0.5" drywall	0.45	8" blown-in mineral fiber insulation	22.00
R 13 insulation @ .33 of floor	4.30	3.75" airspace (2 x 4 studs	1.10	2.5' average air space	8.80
Total R Value	**8.13**	2 x 4 joists R-18 @ 12% framing	1.32	Interior air film	0.68
		1953 tarpaper	0.5" intermediate density sheathing	2 x 6 joists R-18 @ 12% framing	2.16
		Double layer cedar shingles	1.19	0.5" intermediate density sheathing	1.09
*R= °F/ hft²/Btu (I-P)		**Total R Value**	**5.99**	Asphalt shingles	0.44
				Exterior air film	0.17
				Total R Value	**35.95**

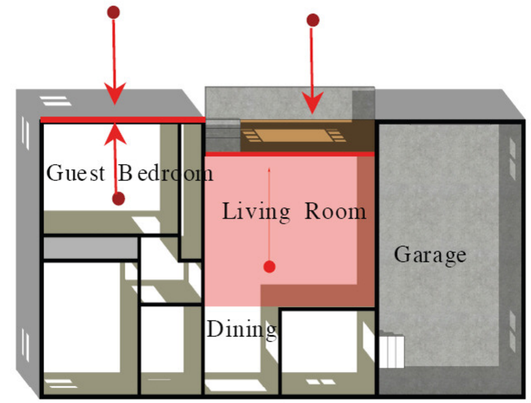
Table 3. TOTAL HEAT LOSS OF THE UNIMPROVED THERMAL ENVELOPE INCLUDING WINDOWS AND DOORS

Materials	U *	Area ft²	Q **
Door	0.25	40.50	202.50
Single pane window with storm	0.51	87.10	888.42
Double pane vinyl window	0.51	75.72	772.34
Floor Assembly	0.12	731.50	1755.6
Wall Assembly	0.17	624.20	2122.28
Ceiling/Roof Assembly	0.028	731.50	409.64
Infiltration (medium, (Δ T 28°F, wind speed 15mph, 66.75 cfm, ACH 0.73)			1468.49
		Sum of Q	7619.274
Total Heat Loss: Btu Per day (24 x Sum of Q)			182,862.58
Total Therms per day (99.954 Btu/therm)			1.83
*U=1/R or Btu/°F hft² **Q=Btu/h Δ T = 20 ° F			

EXISTING CONDITION OF UNDER FLOOR INSULATION

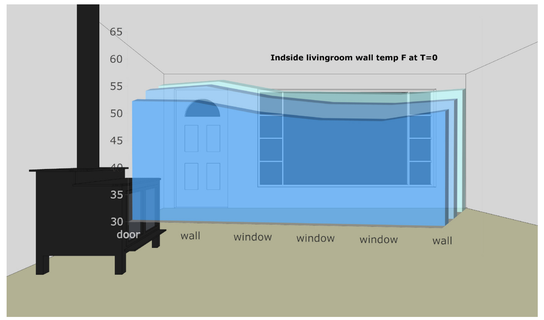


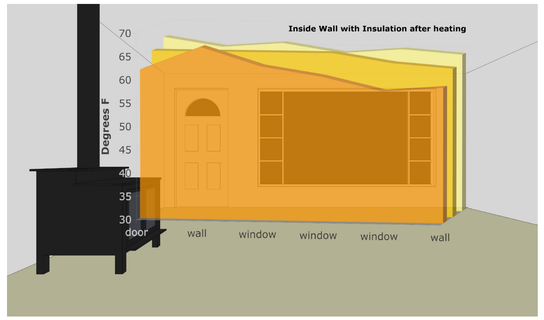
TESTING & RESULTS:

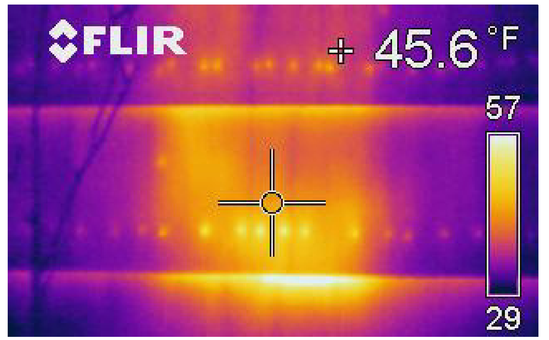


● - Researcher position taking sling psychrometer and IR thermometer measurements

— - Wall being tested







MELTING THE ICE BOX:
INCREASING ENERGY SAVINGS

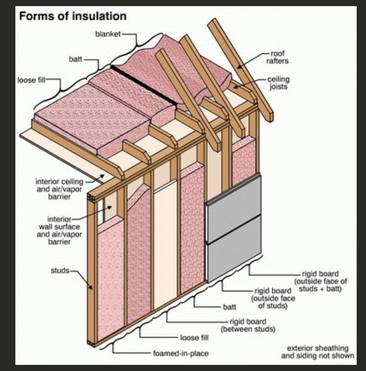


TABLE 4. HOMEOWNER COST/BENEFIT ANALYSIS OF INSTALLING INSULATION

Cost benefit analysis of installing insulation								
	Material Added	Old Q	New Q*	% Savings in Btu	Cost ($/ft²)	NW Natural Rebate ($/ft²)	Total cost after rebate	Pay back time months **
Floor	R-1 fiberglass batt insulation	1755.6	784.45	55%	0.70	0.25	329.12	31
Wall	R-19 Cementitious foam insulation through wall membrane	2122.28	577.43	73%	1.80	0.45	842.64	56
*calculations not shown ** @ cost of $1.05/therm								

Envelope Component	Maximum U-Value	Existing U Values	U Values With Added Insulation
Floor	0.066	0.12	0.054
Light Framed Wall	0.089	0.17	0.046
Fixed Window	1.22	0.51	No Change
Roof	0.081	0.028	No Change

Arch 591: ECS Final Case Study Project

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Winter 2008