#5383

The Effectiveness of Attic "Convection Blankets"

How effective are protective coverings or "convection blankets" for reducing air convection in loose-fill attic insulation? Six years ago, Chris Bullock tried to answer that question as part of a high-school science project. His tests, performed using a simple heated box with various insulation systems on the top, showed that a perforated film could greatly improve the performance of fiberglass batts. Although viewed skeptically by industry and the research community, Bullock's results were published in the proceedings of the Third Annual Symposium on Improving Building Energy Efficiency in Hot and Humid Climates. They also led Bullock and his father Tom to start a company that would sell a perforated plastic "convection blanket" for attic insulation called "Attic Seal" (see ***EDU***, June 1988).

Last year Attic Seal Inc. hired Oak Ridge National Laboratory to test the effectiveness of the product in Oak Ridge's Large Scale Climatic Simulator (LSCS), which can measure the thermal performance of whole attic insulation systems. The results, which were presented at the ASTM Symposium on Thermal Insulation this month, show that Attic Seal alone is only minimally effective, but that other types of protective blankets can significantly improve the performance of loose-fill fiberglass insulation.

Baby diapers, shiny Tyvek, and fiberglass pillows

Oak Ridge scientists tested four different types of convection blankets over a 6-inch layer of cubed loose-fill fiberglass. Before any covering was installed, the R-value of the insulation alone was measured at cold attic temperature to measure the effect of convection. At -4°F, the measured R-value of the nominal R-19 insulation dropped to R-10.6. Using that as a base case, Oak Ridge researchers then installed the four types of convection blankets, looking for improvement in R-value. The results are shown in Figures 2 through 5.

The first covering tested was metalized Tyvek (Figure 2), which Dupont has been test marketing as a radiant barrier. It raised the measured R-value about 24% from R-10.6 to R-13.2 at -4°F.

Project Leader Ken Wilkes explained that the Tyvek improves performance because it prevents attic air from penetrating into the insulation, but that some internal air circulation still occurs within the insulation. That is why the measured R-value was still well below R-19.

[When Tyvek was first introduced in 1981, it was sold as an attic insulation blanket. Dupont stopped recommending it for attic use due to concern over moisture problems.]

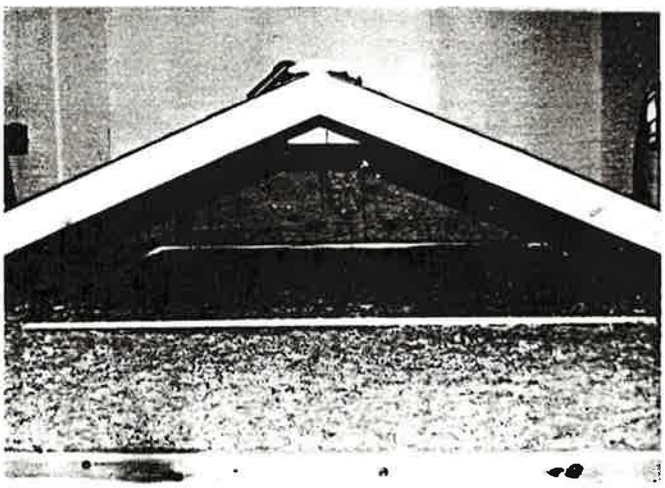

Figure 1 — Cubed loose-fill fiberglass in the Oak Ridge Large Scale Climatic Simulator with a nominal R-value of R-19 showed a measured R-10.6 at -4°F.

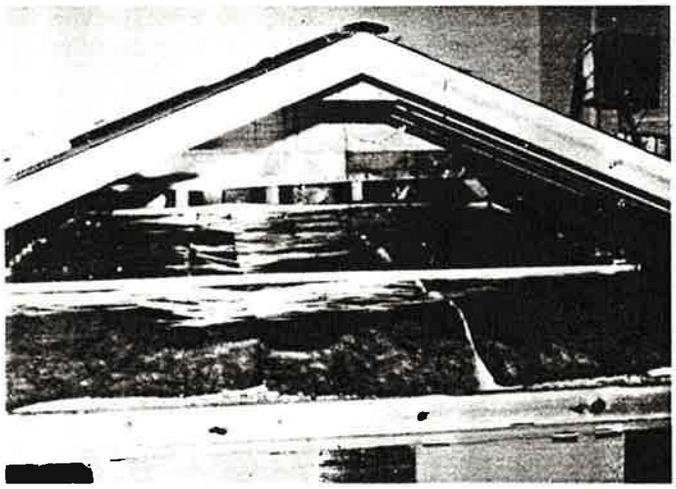

Figure 2 — Tyvek radiant barrier
24% IMPROVEMENT
R-13.2

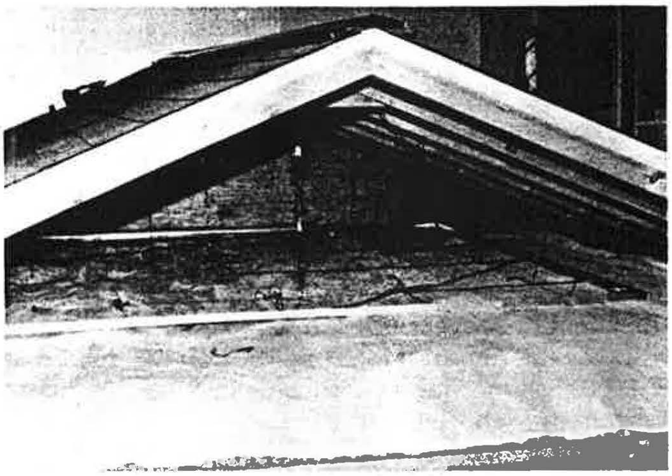

Figure 3 — Attic Seal perforated polyethylene
5% IMPROVEMENT
R-11.1

The second material tested was the Attic Seal product (Figure 3), which is described as a white, perforated polyethylene film similar to that used for disposable diapers. It didn't work as well as Tyvek, causing only a slight increase in R-value from R-10.6 to R-11.1 at -4°F. Apparently the perforations allow too much air exchange between the insulation and the attic space.

The third covering was an insulation "pillow" (Figure 4), which consisted of one-inch-thick, high-density (0.8 lb/ft^3) fiberglass sandwiched between two layers of perforated polyethylene film. This caused significant improvement, nearly doubling the R-value from R-10.6 to R-20.8.

Wilkes speculates that the pillow restores the insulation performance through four mechanisms:

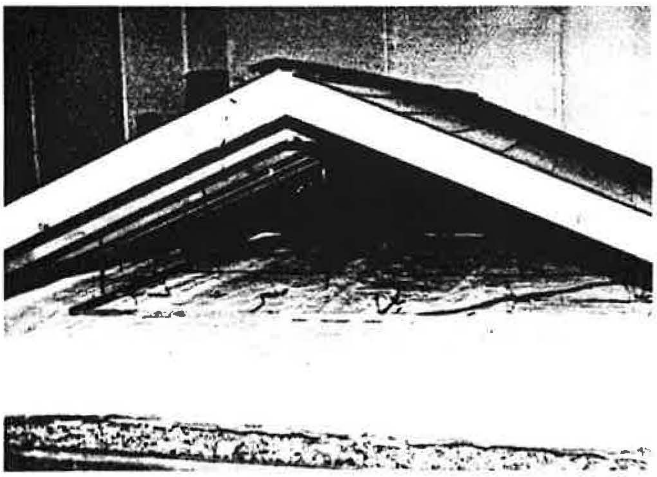

Figure 4 — Fiberglass "pillow"
96% IMPROVEMENT
R-20.8

1) It isolates the loose-fill from the attic air, thus preventing air intrusion;

2) It warms the loose-fill, thus reducing the potential for internal convection;

3) It compresses the loose-fill, thus further reducing the potential for internal convection by increasing density; and

4) It adds to the overall R-value due to the inherent R-value of the high density fiberglass (about R- 4.0).

The fourth and most effective material tested was a one-inch-thick, high-density (1.0 lb/ft^3) fiberglass blanket (Figure 5) similar to that used for the "pillow," but without the perforated polyethylene and with a slightly higher density. This covering boosted the overall R-value of the system to R-23 at -4°F. The better performance of this covering compared to the pillow is probably due to the slightly higher density and R-value of the fiberglass blanket compared to that used to make the pillow.

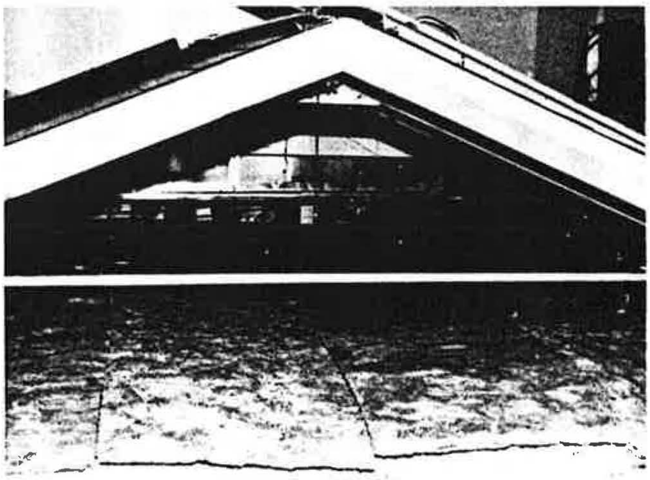

Figure 5 — Fiberglass blanket, no poly
121% IMPROVEMENT
R-23.4

Good news, bad news, and expensive news

A summary of the Oak Ridge tests is plotted in the graph in Figure 6. The good news is that these tests demonstrate that loose-fill fiberglass can perform perfectly well in cold climates if covered with an effective "convection blanket." The bad news is that a simple covering like Attic Seal's perforated polyethylene product alone is not very effective. Nor is a spun-bonded polyethylene such as Tyvek. The only material with demonstrated effectiveness is high-density fiberglass blankets, which are expensive and difficult to install over thick loose-fill insulation.

For more information, contact Ken Wilkes, Oak Ridge National Laboratory, Box 2008, Building 4508, Oak Ridge, TN 37831-6092; (615) 574-5931, or William Rose, Building Research Council, University of Illinois at Urbana-Champaign, One East Saint Mary's Road, Champaign, IL 61820; (217) 333-1801.

Wilkes' and Rose's reports are published in the proceedings of the ASTM symposium, (*ASTM STP 1116*, Graves/Wysocki, editors), available from ASTM, 1916 Race St., Philadelphia, PA 19103; (215) 299-5400.♦

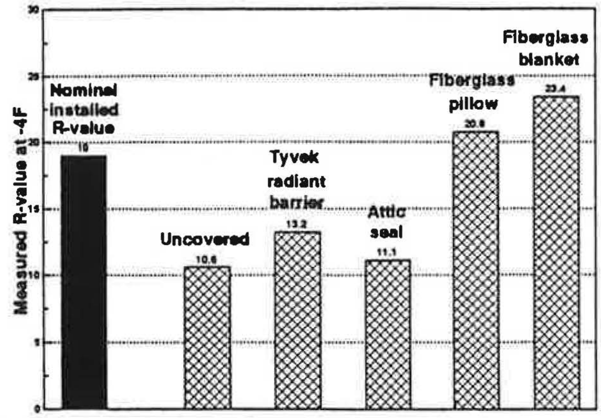

Figure 6 — Measured R-value of nominal R-19 loose-fill fiberglass attic insulation covered with four different types of "convection blankets" under cold (-4°F) conditions.

Foundation Insulation — The New DOE Handbook Guidelines

The new builder's version of the Department of Energy handbook on residential foundations is now available. In addition to a detailed tutorial on foundation construction, the *Builder's Foundation Handbook* includes an easy-to-use set of guidelines on cost-effective levels of foundation insulation for various foundation types, fuel prices, and climates.

Tables 1 and 2 below are reproduced from the handbook. To determine recommended foundation insulation for a specific situation, the user first selects a climatic zone column from the top row, according to heating degree days (hdd). The five choices range from 0 to 2,000 hdd (Los Angeles) to 8,000 to 10,000 hdd (Minneapolis).

The next step is to select fuel price range — low, medium, or high. The prices for specific fuels in each price range are shown in Table 3. The recommended insulation system is indicated by the black circle under the selected fuel price.

Table 1 gives recommended insulation levels for *unconditioned* basements; Table 2 for *fully* conditioned basements. [Note: Due to space limitations, we do not present the entire tables as published in the DOE handbook. The complete tables include insulation for wood foundations and ceiling insulation over unconditioned basements.]

Table 1 — Insulation Recommendations for Unconditioned Deep Basements

A: Concrete or Masonry Foundation Walls with Exterior Insulation

CONFIGURATION	DESCRIPTION	RECOMMENDED CONFIGURATIONS AT THREE FUEL PRICE LEVELS: 0-2000 HDD (LOS ANG) L	M	H	2-4000 HDD (FT WORTH) L	M	H	4-6000 HDD (KAN CITY) L	M	H	6-8000 HDD (CHICAGO) L	M	H	8-10000 HDD (MPLS) L	M	H
EXTERIOR: HALF WALL	NO INSULATION	●	●	●	●	●	●	●	●	○	●	○	○	○	○	○
	4 FT: R-5 RIGID	○	○	○	○	○	○	○	○	●	○	●	●	●	●	○
	4 FT: R-10 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
EXTERIOR: FULL WALL	8 FT: R-5 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT: R-10 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
	8 FT: R-15 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT: R-20 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

B: Concrete or Masonry Foundation Walls with Interior Insulation (Costs do not include interior finish material)

CONFIGURATION	DESCRIPTION	0-2000 HDD (LOS ANG) L	M	H	2-4000 HDD (FT WORTH) L	M	H	4-6000 HDD (KAN CITY) L	M	H	6-8000 HDD (CHICAGO) L	M	H	8-10000 HDD (MPLS) L	M	H
INTERIOR: FULL WALL	NO INSULATION	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○
	8 FT: R-6 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT: R-8 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT: R-11 BATT	○	○	○	○	○	○	○	●	●	●	●	●	●	●	●
	8 FT: R-19 BATT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Insulate

Table 2 — Insulation Recommendations for Fully Conditioned Deep Basements

A: Concrete or Masonry Foundation Walls with Exterior Insulation

CONFIGURATION	DESCRIPTION	RECOMMENDED CONFIGURATIONS AT THREE FUEL PRICE LEVELS														
		0-2000 HDD (LOS ANG)			2-4000 HDD (FT WORTH)			4-6000 HDD (KAN CITY)			6-8000 HDD (CHICAGO)			8-10000 HDD (MPLS)		
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
EXTERIOR: HALF WALL	NO INSULATION	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
	4 FT R-5 RIGID	○	○	●	●	○	○	○	○	○	○	○	○	○	○	○
	4 FT R-10 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
EXTERIOR: FULL WALL	8 FT R-5 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT R-10 RIGID	○	○	○	○	●	●	●	●	○	●	●	○	●	○	○
	8 FT R-15 RIGID	○	○	○	○	○	○	○	○	●	○	○	●	○	●	●
	8 FT R-20 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

B: Concrete or Masonry Foundation Walls with Interior Insulation (Costs do not include interior finish material)

INTERIOR: FULL WALL	NO INSULATION	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT R-6 RIGID	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT R-8 RIGID	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	8 FT R-11 BATT	○	●	●	●	●	●	●	○	○	●	○	○	○	○	○
	8 FT R-19 BATT	○	○	○	○	○	○	○	●	●	○	●	●	●	●	●

Unconditioned basements rarely need insulation

Notice in Table 1 that full-height, exterior, rigid-foam insulation is never recommended for unconditioned basements, except for one instance of high fuel costs in Minneapolis. In moderate climates (4,000 hdd or less), no foundation insulation is recommended for unconditioned basements at any fuel price.

These results fly in the face of current building practice, utility incentive programs, and building codes that require minimum R-5 foundation insulation, even for unconditioned basements. One argument for those guidelines is that unconditioned basements often get finished and heated after the house is built.

Economic assumptions

The recommendations in Tables 1 and 2 are based on life-cycle cost analyses in which the lowest 30-year cost is determined taking into account installation costs, mortgage rates, HVAC efficiencies, and fuel escalation rates. The DOE workbook also includes a simple worksheet for performing custom analyses with different economic assumptions.

For more information, the *Builder's Foundation Handbook*, written by John Carmody, Jeff Christian, and Ken Labs, is available from the National Technical Information Service (NTIS), US Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650, or contact Jeff Christian, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831; (615) 574-5207. ♦

Table 3 — Representative prices of various fuels in three price ranges. Source: DOE *Builder's Foundation Handbook*.

Fuel Type	Low Price Level	Medium Price Level	High Price Level
Natural gas	.374/ccf	.561/ccf	.842/ccf
Fuel oil	.527/gal	.791/gal	1.187/gal
Propane	.344/gal	.516/gal	.775/gal
Electricity	.051/kWh	.076/kWh	.114/kWh

Air Cleaner Energy Savings

The promotional literature for Honeywell electronic air cleaners claims that they help energy performance of central air conditioners and heat pumps by keeping dirt out of the indoor coils. That claim appears to be supported by a recent field study conducted by Pacific Gas & Electric (PG&E).

Performed by Proctor Engineering of San Francisco, California, the PG&E study found that dirt on coils is a common cause of insufficient air flow and that a 10% reduction in air flow increases energy use by 6.6%. Twenty-four heat pumps in the study showed an average 5.6% improvement in performance after correction for low air flow.

For more information, contact John Proctor, Proctor Engineering Group, 45 Massasoit St., Suite 102, San Francisco, CA [illegible] (415) 647-5052.♦

Another Blow for "Ceramic" Insulating Paints and Coatings

The first peer-reviewed research paper on the effectiveness of "ceramic" insulating paints and coatings shows that they are no more effective than conventional white coatings when applied to roof surfaces and that they provide no measurable insulating properties when applied to interior surfaces of building walls or ceilings. These findings were presented at the ASTM Symposium on Insulation Materials in Gatlinburg, Tennessee, this month.

Manufacturers of some ceramic coatings claim that because of the ceramic components, their products can have insulating capabilities equivalent to several inches of foam, and in some cases an "equivalent" R-value as high as R-30. A few examples of brand names used for ceramic coatings are Energywave, Astec, Thermo-Lok, and ThermShield.

Robert Anderson, principal investigator of the study, which was funded by the US Department of Energy, explained that white roof coatings can be effective for reducing heat gain into a building by reflecting solar radiation, but that the so-called "ceramic" coatings were no more effective than other white coatings. Anderson told ***EDU*** that he has been unable to determine exactly what the "ceramic" component in ceramic paint consists of.

For more information, contact Robert Anderson at (612) 474-2362. Anderson's paper is published in the proceedings of the ASTM Symposium (*ASTM STP 1116*, Graves/Wysocki, editors), which are available from ASTM, 1916 Race St., Philadelphia, PA 19103; (215) 299-5400.♦

Fiberglass Batts — How Well Do They Loft?

When removed from compressed packaging, thin fiberglass batts tend to loft to at least their label thickness, but thicker batts tend to fall somewhat short. This is according to the results of an interlaboratory comparison of testing performed according to ASTM C167 *Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.*

Supervised by Oak Ridge National Laboratory, the project looked at batts manufactured by Owens-Corning Fiberglas, Manville, Knauf, and CertainTeed. On average, R-11 batts lofted to 12% *above* label thickness, but R-19 batts averaged 3% below label thickness and R-30 batts were 6%-12% below label thickness

To measure loft, a 4-foot sample section of batt is grasped with both hands and dropped twice onto its long edges from 18 inches above the floor. The sample is then laid flat and measured for thickness.

For more information on the interlaboratory comparison, contact Tom Kollie, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831; (615) 574-5207. For a copy of the ASTM test procedure, contact ASTM, 1916 Race St., Philadelphia, PA 19103; (215) 299-5400.♦

PRODUCTS

Lifetime Guaranteed Water Heater from Mor-Flo

First there was "Duron," then came "Marathon," "Survivor," and "Titan." And now there is "Infinity." All are electric water heaters with lifetime warranties against tank failure.

The Mor-Flo "Infinity" (also sold under the Craftmaster brand name in retail outlets), the newest lifetime heater on the market, has a few unique features that set it apart from its competitors.

Promoted as an "electronic" water heater, the Infinity has three LED readout lights indicating power connection, heating mode, and temperature.

From the home occupant perspective, one of the most attractive features is that the temperature controller is accessible and operable without any tools. Unlike most water heaters, with which the user must remove an access panel and use a screwdriver to adjust temperature, the Infinity temperature controller is a knob located behind