result in a 50% loss of effectiveness of the radiant barrier system.

For more information

A report on this study will be presented at the June ASHRAE meeting in Vancouver. To obtain a copy, contact American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329; (404)636-8400.

Moisture and Radiant Barriers — Good News?

A controlled experiment on three unoccupied houses in Tennessee and another informal examination of 16 houses in Chicago suggest that moisture accumulation on attic radiant barriers may not be as much of a problem as previously thought.

The Oak Ridge tests — no problem in Tennessee

The first controlled experiment to explore moisture on radiant barriers was sponsored by the Reflective Insulation Manufacturers Association (RIMA), Tennessee Valley Authority (TVA), and the Electric Power Research Institute (EPRI) at Oak Ridge National Laboratory.

During the winter of 1985-86, three unoccupied houses with radiant barriers were run at 40% relative humidity for a six-week period. Moisture accumulation was noticed on the underside of the radiant barrier on cold mornings, but it dissipated during mild afternoons. When the indoor humidity was raised to 60% in one house for a three-day period, the moisture did not dissipate, but when the humidity was returned to 40%, the radiant barrier dried off after a few days.

A second series of tests were run the following winter to look at what would happen under long-term high humidity conditions. One house was maintained at 45% indoor relative humidity and a second at 55% humidity. A combination of instrumented monitoring and visual observations were used to detect and quantify moisture accumulation underneath the barrier. Wood moisture content of the truss bottom chords was also measured.

The results showed that moisture condensation occurred whenever the outdoor temperature dropped below 35°F. During most of the test period, the moisture dissipated in the afternoon as in the previous winter's tests. However, during one week of testing (January 7-14), when the average outdoor temperature at the Oak Ridge site was 23°F, condensation was continuously present on the bottom surface of the foil and did not dissipate in the afternoon.

These tests simulated near worst case conditions. The houses were kept at very high humidity and the ceilings did not have vapor retarders installed. The results suggest that radiant barriers installed on the floors of attic would probably not cause moisture problems in Tennessee winters. The Oak Ridge study authors do caution, however, that any conclusions drawn from these tests are only applicable to the Tennessee climate and that the situation may be quite different in colder climates where afternoon temperatures may not be sufficiently high to dry out the moisture.

Chicago

As part of a research project on dust problems with radiant barriers (see page 6), David Yarbrough of Tennessee Technological University inspected 16 houses in the Chicago area that had radiant barrier installations which were at least four years old. In none of the attics were there any signs of present or past moisture problems.

Unfortunately, since the inspections were all performed during the summer months and since Yarbrough's group was not looking specifically for moisture condensation, only very limited conclusions can be drawn from

this study. However, if severe condensation had been occurring in these houses for four years, one would expect some visible evidence such as water stains or matted insulation. The fact that nothing was noticed in this cold climate suggests that at least in these sixteen houses, severe moisture condensation was not occurring.

High permeance the explanation?

All radiant barrier products sold for attic installation are perforated to allow water vapor to pass through. An examination of manufacturers' spec sheets for about 40 products showed that measured permeance to water vapor is usually at least 10 perms and in some cases as high as 30 perms. Depending on the amount of air leakage into the attic and the humidity of the indoor air, those permeance levels may be sufficient to prevent moisture accumulation under the radiant barrier.

Another factor to consider is that attic radiant barriers are loosely placed on the attic floor, leaving gaps and airspaces through which moisture can escape.

Conclusion, remaining questions, and practical implications

Despite theoretical predictions and strong warnings, no moisture condensation problems have been reported with radiant barriers installed over attic insulation in cold climates. It may be that the perforations provide sufficient permeability to prevent moisture buildup underneath the radiant barrier.

A few important questions remain:

- Are problems occurring that just haven't been reported?

The widespread use of radiant barriers in cold climates is still new. Although millions of square feet have been installed since Eagle Shield entered the market, most of those installations have only been through one or two winters. If moisture problems have occurred, they would not likely be reported to the research community this quickly.

Table 1 — Radiant barrier permeance to water vapor.
(All values are manufacturers' reported results according to ASTM E-96 tests.)
Source: EDU Special Report on Radiant Barriers.

PRODUCT	PERMEANCE (perms)
Lamtec FSKF	30
Spectra-Shield	30
Denny Flame Guard FG 2635	30
Denny Flame Guard FG 1635	30
Diamond Crown	30
Lamotite 9238 PF	26.2
Eagle Shield (A)	26.2
RaBar	20
ESI - Miofoil	13
Lamotite 9285 PF	9.3
Comfort Shield	9
Lamotite 8010 PF	7.6
Alumax Breather Foil B-500	5.8
Lamotite 8922 PF	5.6
Supreme Crown	>5
Silver Crown	>5

- Have we just been lucky so far?

It may be that only a certain percentage of houses would ever experience moisture problems — most likely those with high air leakage rates into the attic. Maybe very few of those have received radiant barrier installations.

- Might the permeance of perforated radiant barriers change over time?

It has been suggested that dust accumulation could clog the perforations in radiant barriers and thus reduce the permeance after a few years. However, there is no evidence supporting this.

For more information

The report on the Oak Ridge tests (ORNL/CON-255 - "Moisture Measurements in Single-Family Houses With Attics Containing Radiant Barriers) is available from Oak Ridge National Laboratory, Oak Ridge, TN 37831.