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RADIANT BARRIERS

Radiant barriers are an energy conservation concept being heavily promoted in the United States. Used in more northerly locations, they improve a home's comfort during the summer and reduce cooling loads. However, they must be installed correctly or else they may contribute to structural damage.

WHAT IS A RADIANT BARRIER?

A radiant barrier is a layer of highly reflective foil placed in an airspace to block radiant heat transfer between a heat-radiating surface (such as the hot roof) and a heat-absorbing surface (such as conventional attic insulation).

Without a radiant barrier, the roof radiates solar-generated heat to the insulation below it. The insulation absorbs the heat and gradually transfers it to the material it touches - principally, the ceiling. This heat transfer makes your ceiling a low temperature radiant heater that heats the indoor space. Where air conditioners are used, this heat adds to the load the air conditioner has to deal with.

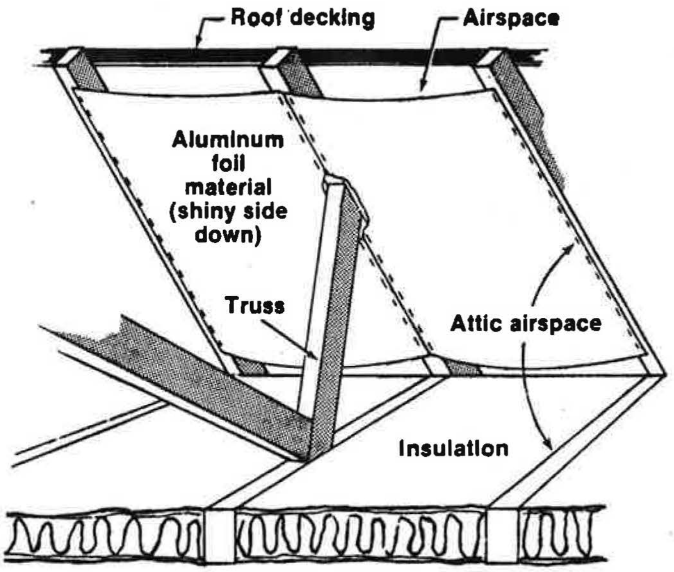
Foil radiant barriers can block 95% of the heat radiated by the roof so it can't reach the insulation.

Radiant heat flows are only one of three means by which heat flows. Conduction and convection are also significant heat flow mechanisms, so the ideal insulation scheme will address all three.

HOW DO RADIANT BARRIERS "BLOCK" HEAT TRANSFER?

Aluminum foil, the operative material in attic radiant barriers, has two physical properties of interest. First, it reflects thermal radiation very well. Second, it emits (gives off) very little heat. In other words, aluminum foil is a good heat reflector and a bad heat radiator.

Aluminum foil across an attic airspace reflects heat radiated by the roof. Even if the radiant barrier material has only one aluminum foil side and that side faces down, it will still stop downward heat transfer because the foil will not reradiate the roof's heat to the insulation below it.



An installed radiant barrier.

WHAT KIND OF RADIANT BARRIER MATERIALS ARE AVAILABLE?

1. Single-sided foil backing on another material such as kraft paper or polypropylene.

2. Double - sided foil with a reinforcement backing (sandwiched between foil layers).

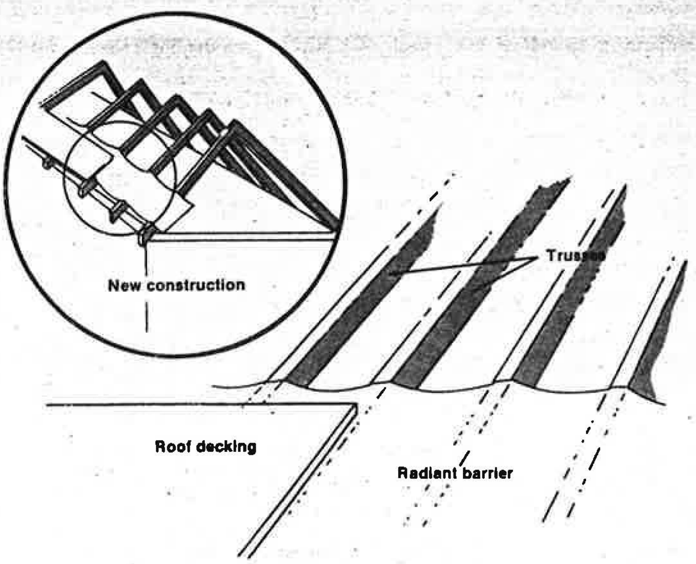
3. Foil-faced insulation. The insulating material may be polyisocyanurate, polyethylene "air-bubble" packing or other materials that impede heat conduction.

4. Multilayered foil systems, which when fully extended and installed so that the foil layers do not touch. These products also form insulating airspaces.

WHICH IS BEST?

The best, most effective material to use is the cheapest material that will do the job. Unlike regular insulation, when used in combination with conventional insulation the radiant barrier does not have to be applied with complete coverage to do its job. Special, high tech products generally are more expensive but not much more effective. Standard builder's foil (or even household foil) will do a good job.

A single-sided radiant barrier will at first work equally well with the foil



Radiant barrier installation in new construction.

facing up or down. However, over time dust will accumulate on the surface of foil facing up. The dust will reduce the radiant barrier effect by allowing the foil to absorb rather than reflect heat. But a radiant barrier with the foil side facing down will not collect dust on the foil and will continue to reduce heat transfer from the hot roof to the insulation over the life of the installation. So in attics, single-sided radiant barrier material should be installed with the foil side facing down.

Where double-sided radiant barrier material is used, it must be installed at the rafter level so the bottom side faces the attic air space and will not collect dust.

The most effective way to install a radiant barrier is to staple the foil material to the underside of the top chord of the roof trusses or to the underside of the roof decking. In an attic with a pitched roof and conventional insulation, a radiant barrier is not difficult to install even in a retrofit situation. However, a radiant barrier must never be installed flat on top of insulation, as that will create a vapour barrier on the cold side of insulation.

DOES THE RADIANT BARRIER HAVE TO BE AIRTIGHT?

No, as it is a barrier against radiated (not convected) heat, air motion does not have to be stopped. In fact, ventilation from soffit to peak will improve radiant barrier performance.

Small tears and holes will not lessen the performance of the radiant barrier, so if it is necessary to cut and patch around obstructions such as vent stacks, truss supports and other penetrations, it will still work.

The material must not be rolled out on top of the insulation. As dust will accumulate on the foil surface facing the roof, it will lessen the radiant barrier effect. But more importantly, this kind of installation will create a vapour barrier on the cold side of the insulation and result in moisture being trapped in the ceiling insulation. You have been warned twice!

WILL HEAT IN THE ROOF DAMAGE THE ROOFING?

It's extremely unlikely. The Florida Solar Energy Centre has measured the tempe ratures of roof shingles above attic radiant barriers on hot, sunny summer days. Depending on the colour of the shingles, their peak temperatures are only 1-3°C (2-5°F) higher than the temperature of shingles under the same conditions without a radiant barrier.

Roofing materials are manufactured to withstand the high temperatures to which they are frequently exposed. A 1-3°C (2-5°F) increase in peak temperatures that normally reach 71-87°C (160-190°F) should have no adverse affect.

Be aware, however, that accumulated heat from a sub-roof plenum may cause built-up tar and gravel roofing to shrink. If sufficient shrinkage occurs, the water seal may be broken at flashings or elsewhere.

HOW MUCH CAN RADIANT BARRIERS SAVE?

Economy depends on the characteristics of the house and its occupancy. Savings from an attic radiant barrier depend on the amount of heat the roof and attic contribute to home's cooling load.

Computer studies conducted in the development of the Florida Model Energy Code indicate savings on cooling costs can typically be up to 8 - 12%. A typical attic radiant barrier installed in a Florida home will offer a six to seven year simple payback and a 15% to 19% return on investment.

Attic radiant barriers are an inexpensive but effective way to save energy and money in cooling conditions. While they are not a new concept, radiant barriers have only recently been proved effective for energy conservation.

Unfortunately, the high profit potential has led to exaggerated claims for radiant barriers. It is likely we will hear these claims in Canada soon. Many distributors in the USA are promoting radiant barrier products as the only insulation needed for use in walls as well as ceiling installations. Properly used this may be effective in the hot southern climates.

In northern heating climates this is not as likely to be suitable. Improper installation can actually be counterproductive. Some 20-30 years ago multi-layered foil insulation (for walls) was promoted on the Prairies. It was quickly abandoned as the foil layers provided ideal channels for convection currents, and the walls actually cooled the house rather than contributing to the insulation properties.

In our northerly locations, combining a radiant barrier with an R-2000 home will improve the home's comfort, and even eliminate the need for mechanical air conditioning.

*This article was adapted from **Radiant barriers** an energy note by Ingrid Melody of the Florida Solar Energy Centre.*

CRANBROOK, B.C. RESIDENTIAL RETROFIT - A CASE STUDY

In September 1987, Energy Conscious Design undertook a major retrofit of a single family home in Cranbrook B.C. (4807 DD°C). Part of the project included a three day workshop for contractors to learn effective retrofit techniques by hands-on participation.

The house has 1190 sq.ft. on the main floor, and 1150 in the basement. The total building area was heated before and after the renovation.

The house had 2x4 frame walls with R12 insulation and R20 in the ceiling. The foundation was concrete with R12 on the basement walls. Some windows were aluminum sliders, others sealed wood frame. In winter the house was drafty and dry. The construction offered unlimited air leakage points to challenge our air sealing efforts including poured-in-place floor joists, metal and masonry chimneys, recessed pot lights, cantilever, as well as the usual assortment of electrical penetrations, plumbing, vent stacks and attic hatch.

The objectives of the retrofit were three-fold:

1. To reduce the winter fuel consumption. The home had at one point been heated exclusively by electricity (at current prices, this cost $1200 per year). It was recently being heated mainly by wood with some supplementary electric heating. Wood usage exceeded six cords per year.

2. To improve comfort. The home was deficient in this area due to the high air leakage rates.

3. To improve indoor air quality. While there was no lack of fresh air, there was always a lack of moisture, with winter relative humidity running at 15% to 20% despite attempts to increase it.

Main Floor Walls:

The original siding was removed to expose the wall sheathing. This allowed a thorough inspection which revealed many air leakage paths. The worst were at the floor joist level. There were large gaps where rim joists butted and between rim joist and subfloor or subfloor and bottom plate. Leaks were also evident through the cantilevered floor and through butt joints in the aspenite sheathing. These large gaps also allowed easy entrance for insects.

Air sealing of the walls was accomplished by a complete wrap of Tyvek which bridged from the top of the concrete foundation to the top plate of the main floor wall. All joints were caulked with acoustical sealant or taped with sheathing tape and all service penetrations were gasketted with rubber sheets. This approach was easy to do and proved very effective.

Most of the wall was upgraded by installing a curtain wall on the outside to create a six inch cavity for insulation.