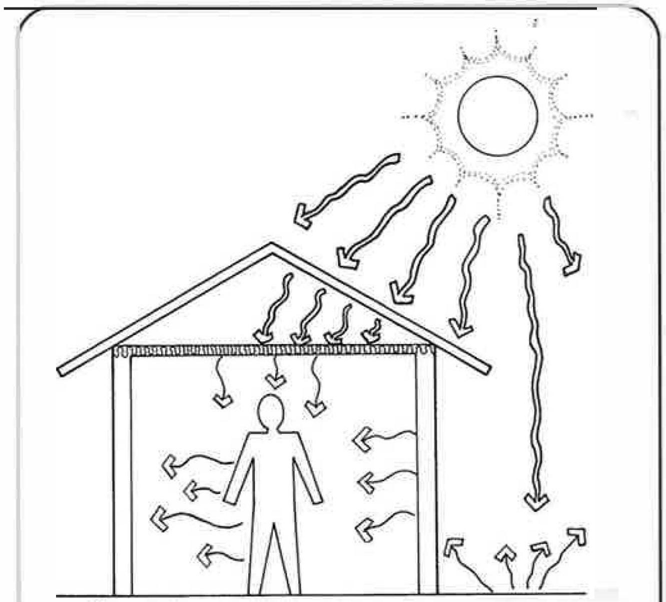
2.4 Reducing Solar Gains

Heat from the sun shining through windows and on building surfaces (called solar gains) is the major source of unwanted heat (*see figure* 2-5). The most effective way to reduce solar heat gain is to stop the sun's rays before they enter the building by reflecting the rays or blocking them with shading devices. Reflectivity is the ability of shiny materials or light-colored materials to reflect solar heat away from the home. Shading means putting a solid object between the sun and parts of the building, to absorb or reflect the solar heat. Shade trees, vines on trellises, sun screens, and awnings provide



***2-5 Radiant Heat Flow** - Heat rays fly through space until they strike a solid object. People absorb radiant heat from their surroundings, and radiate heat back to their surroundings.*

effective shading to windows by reflecting solar heat or absorbing the heat outside the home. Shades, draperies, and blinds can be effective shade-givers too, but they must be closed, blocking daylight and the view through the window.

2.4.1 Roof and Wall Reflectivity

Roof color affects cooling costs. Reflective, light-colored roofs save 10 to 20 percent on cooling costs compared to darker roofs.

Dull, dark-colored surfaces absorb more than 90 percent of the solar energy that falls on them, while bright white surfaces absorb only about 20 percent. The Florida Solar Energy Center measured a significant difference in cooling requirements between reflective and non-reflective roofs and walls. Mississippi Power Company and the Rohm and Haas Company found that white roofs saved 16.8 percent of summer cooling costs over darker roofs.

Percent of Solar Heat Absorbed by Common Wall Surfaces

Paint	
White	15-25%
Flesh/Cream	40-45%
Light Gray	45-50%
Medium Gray-Blue	65-70%
Tan/Brown	70-75%
Medium Brown	75-80%
Brick	
Light-Colored	35-50%
Light Red	50-60%
Burnt Red	65-70%

Table 2-B

(Based on information from the Florida Solar Energy Center)

Percent of Solar Heat Absorbed by Common Roof Surfaces

Asphalt Shingle Roofs	
Dark	85-95%
Medium	80-85%
Light	70-75%
Pebble/Gravel Built-Up Roofs	
Dark	80-90%
Medium	60-80%
Light	45-60%
Tile Roofs	
Dark	80-90%
Medium	70-80%
Light	35-50%
Wood Shingle Roof	
Old Cedar Shake	75-85%
New Cedar Shake	65-75%
Rubber Roofs and Roof Coatings	
White Rubber Roofing	25-30%
White Latex Coating	15-30%
Asphalt/Aluminum	35-55%

Table 2-C

(Based on information from the Florida Solar Energy Center and others)

Common asphalt and fiberglass shingle colors, even white, absorb 70 to 95 percent of the solar heat that strikes the shingles. However, one standard roof coating is very reflective and absorbs less than 30 percent of the solar heat. This bright white latex rubber coating can be applied over many common roofing materials such as asphalt shingles, fiberglass shingles, tar paper, metal, and some other roofing materials. For most surfaces a primer is required under this latex coating. The latex coating sheds dust when sprayed with a garden hose during cool weather.

Another reflective coating is the

asphalt-based roof coating containing glass fibers and aluminium particles. The quality of this silver-colored asphalt coating varies according to the amount of aluminum particles in the mix. This roof coating is compatible with most asphalt and metal roofing materials. Stir the material thoroughly during installation because the aluminum particles and fibers sink to the bottom of the can. The percentage of solar heat absorbed by the asphalt and aluminum coating increases as it ages and as dust collects on its tacky surface. See Table **2-C** for the percentage of solar heat absorbed by various roofing materials.

Wall color, although not as important as roof color, is an important energy-saving measure, especially for south, east, and west walls. Keep wall color as light and bright as possible, both for energy use and for longevity of the siding material. Table **2-B** shows that white paint absorbs very little solar heat. The percent of absorbed heat increases quickly with the addition of pigment. To minimize cooling costs, use a paint color as close to white as you can tolerate.

2.4.2 Radiant Barriers

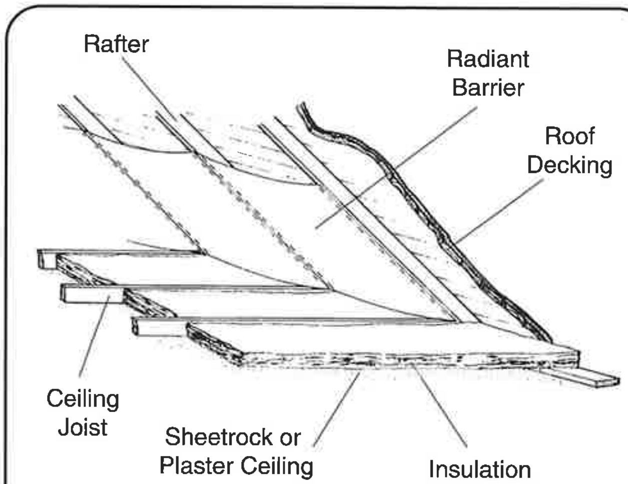
A radiant barrier blocks radiant heat transfer between the roof and the ceiling of a home. The radiant barrier is a sheet of aluminum foil with air spaces on one or both sides.

A radiant barrier cuts air conditioning costs by blocking most of the heat flow that radiates from the roof downward into the attic insulation. In the spring and fall, radiant barriers may allow you to cool with ventilation and air circulation instead of with air conditioning. Radiant barriers can make porches and garages more comfortable, too.

An aluminum foil radiant barrier can block up to 95 percent of the heat radiated down from the roof, and save 2 to 10 percent of total cooling costs. **Insulation is a better investment than radiant barriers wherever the climate demands both heating and cooling.** Homes with dark-colored roofs will benefit most from radiant barriers.

Radiant barriers should be installed on the bottom of the rafters or the top cord of the roof truss as shown in figure **2-6**. Don't install the radiant barrier horizontally directly over the ceiling insulation because the shiny surface facing the roof will collect dust, reducing its effectiveness. If the radiant barrier is installed horizontally, it could also cause moisture problems.

Install a radiant barrier on a cool,



***2-6 Radiant Barriers** - Radiant barriers reduce cooling costs in hot, sunny climates. Attach the radiant barrier to the bottom of the rafters as shown here, or to the side of the rafters.*

cloudy day. Use plywood walk boards or wood planks over the ceiling joists for support. Installation is quicker and easier when working with a partner. **Caution:** *If you must walk around the attic without walk boards, be sure to walk on the ceiling joists and do not step between them, or you may fall through the ceiling.*

Staple the foil to the bottom of the rafter (*as shown in figure* **2-6**) or to the side of the rafter. Don't worry about small tears or about getting the material airtight. Staples should be spaced closely, 2 or 3 inches apart, to prevent air circulation in the attic from eventually loosening or detaching the radiant barrier. A thin bead of construction adhesive applied by a caulking gun to the rafters makes the installation permanent.

Install radiant barriers on the interior side of gable walls and attics above attached garages, to maximize the benefit of radiant barriers. When building new homes, contractors often staple the radiant barrier to the underside of the roof decking, or drape the radiant barrier over the trusses from the top, before nailing the decking onto the roof trusses.

Researchers at Oak Ridge National Laboratory found radiant barriers to be a good investment in hot, sunny locations like Miami, Phoenix, Orlando, and Las Vegas, if installed in an attic with R-11 insulation at a cost of between 20¢ and 35¢ per square foot. However, if the attic has R-19 insulation or greater, radiant barriers are not a very good investment.

2.4.3 The Importance of Insulation

Attic insulation saves money on mechanical cooling and keeps homes comfortable. Insulation reduces the conduction of heat from the hot attic through the ceiling and into the home (*see figure* **2-5**).

The resistance of various thicknesses and types of insulation to heat flow is measured by the R-value (*see Table* **2-D**). The greater the R-value, the more slowly heat conducts through the insulation.

Insulate a new home to a minimum of R-19. The extra value of R-30 insulation is certainly worth the cost. Be sure to consider heating costs, too, in determining insulation levels. You should be able to install R-19 in your attic for between 40¢ and 55¢ per square foot.

Adding R-19 to an existing insulation level of R-11 makes good economic sense in all but the hottest climates. Adding another R-19 to an existing insulation level of R-19 makes sense for the northern half of the U.S.

Roof color is also important when determining the need for more attic insulation. Attics under darker-colored roofs need more insulation because they are hotter.

R-Values of Common Attic Insulation Materials Per Inch of Thickness

Fiberglass Batts	2.9-3.1
Fiberglass Blowing Wool	2.9-3.2
Mineral (Rock) Blowing Wool	2.5-3.0
Cellulose Blowing Insulation	3.2-3.5
Vermiculite	2.1
Polystyrene Beads	2.3

Table 2-D