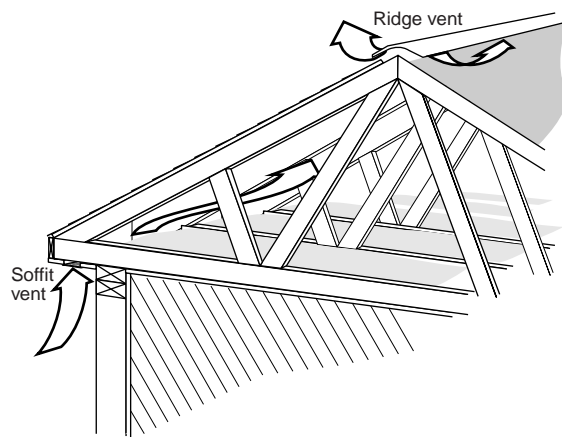


Ceiling and Attic Insulation and Ventilation

Insulating ceilings is one of the most cost effective energy efficiency measures. When planning and managing attic insulation projects, make sure:

- ❑ All air leaks through the top floor ceiling are completely sealed
- ❑ Insulation levels meet or exceed local building codes
- ❑ Insulation coverage is continuous
- ❑ Space is provided for both insulation and air flow from soffit vents at the eave
- ❑ Attic areas intended for storage have sufficient space underneath for full insulation value
- ❑ Attic access doors are insulated and sealed
- ❑ Knee wall areas have adequate insulation and an air sealing barrier

Attics over flat ceilings are often the easiest part of the exterior building envelope to insulate. They are usually accessible and have ample room for insulation. However, many homes use cathedral ceilings or have attic kneewalls that present unique insulation requirements. It is important to insulate all types of ceilings properly.



Attic Ventilation

Most building codes require roof vents to expel moisture in winter which could deteriorate insulation or other building materials. In summer, ventilation may reduce roof and ceiling temperatures, thus saving on cooling costs and lengthening the roof's life.

However, research studies are investigating whether attic ventilation is beneficial for all climates. For years, researchers have believed the cooling benefits of ventilating a well-insulated attic are negligible. Some experts also question whether ventilation is effective at moisture removal. Until the research results are available and accepted, builders should follow local code requirements, which usually dictate attic ventilation.

The vent opening combination of continuous ridge vents along the peak of the roof and continuous soffit vents at the eave provides the most effective ventilation. Common rules of thumb are 1 sq ft of net vent opening for every 150 sq ft of insulated ceiling or 1:300 if the insulation has a vapor barrier. The vent area should be divided equally between the ridge and soffits.

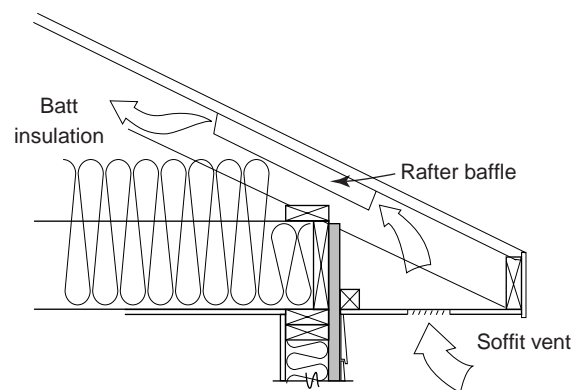
Cap vents, turbines, and gable vents can supplement a roof design that has insufficient ridge vent area. Power roof ventilators are not recommended as they consume more energy than they save and create negative pressures that may pull room air into the attic.

Increasing the roof height at the eave

One problem area in many roof designs occurs at the eave, where there is often insufficient space for full insulation without blocking air flow from the soffit vents. If the insulation is compressed, its R-value is diminished. If using a truss roof, consider *raised heel* or *cantilevered trusses* that form elevated overhangs. These should provide clearance for both ventilation and full-height insulation.

In stick-built roofs, where rafters and ceiling joists are cut and installed on the construction site, an additional top plate that lays across the top of the ceiling joists at the eave will prevent compression of the attic insulation and allow for ventilation.

The raised top plate design also minimizes *windwashing* of the attic insulation – where air entering the soffit vents flows through the attic insulation. When installing a raised top plate, place a band joist at the open joist cavities of the roof framing. The band joist helps prevent windwashing, which can reduce attic insulation R-values on extremely cold days and can add moisture to the insulation.



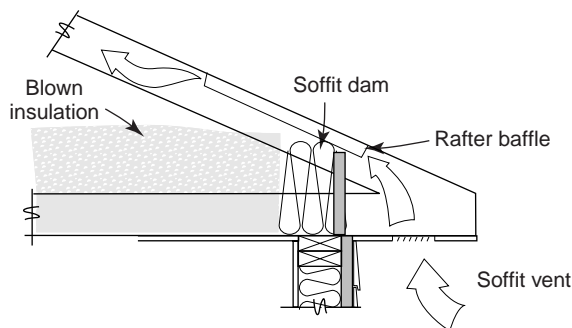
A raised top plate increases the area for insulation and ventilation at the eaves.

Attic insulation techniques

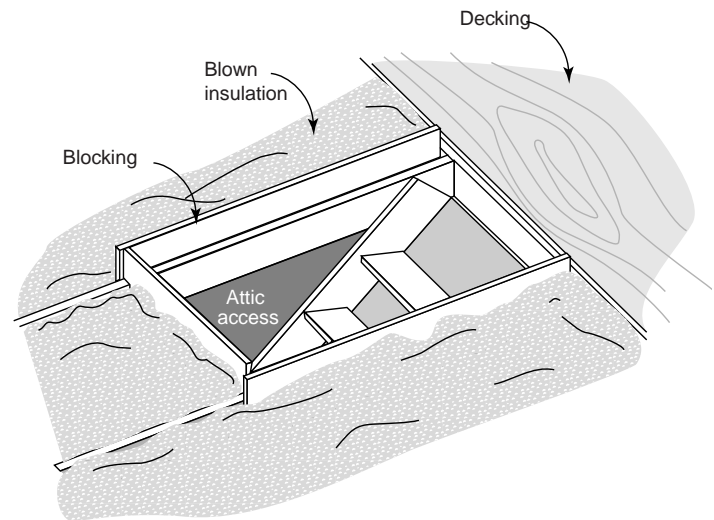
Loose-fill or batt insulation is typically installed in an attic. For batts with attached vapor retarders, put the backing next to the ceiling finish. Although installation costs may vary, blowing loose-fill attic insulation — fiberglass, rock wool or cellulose — is usually less expensive than installing batts and provides better coverage.

Steps for installing loose-fill insulation:

1. Seal all attic to home air leaks, especially chases, bypasses, and furr-downs. Most insulation, such as fiberglass and rock wool, does not stop air flow (refer to Airsealing Energy Bulletin).
2. Follow clearance requirements for heat-producing equipment found in an attic, such as flues or exhaust fans. Other blocking requirements may be mandated by local building codes. Use metal flashing, plastic or cardboard baffles, or pieces of batt or rigid insulation for blocking.
3. Prior to hanging ceiling drywall, install rafter baffles, to preserve ventilation from soffit vents at eave of roof. To ensure full coverage and reduce spillage use insulation dams at the soffit, porch, garage and attic access.
4. Insulate over the attic access by attaching a piece of batt insulation or installing an insulated cover box.
5. Obtain complete coverage of the blown insulation at consistent depths. Follow the manufacturer's specifications for accurate insulation quantity (# of bags per sq ft) and avoid fluffing the insulation.
6. As required by the 1995 Model Energy Code (MEC), make sure the installer:
 - Provides attic rulers to show proper blown depth (facing the attic entrance, one for every 300 sq ft).
 - Provides an accurate attic "Report Card" showing that sufficient density was installed.



This raised-heel truss shows loose-fill insulation that is blocked or dammed at the eave with a piece of fiberglass batt or rigid insulation. A baffle creates a channel for air flow.



Block or dam to keep full height blown insulation and to prevent spillage.

Steps for installing batt insulation

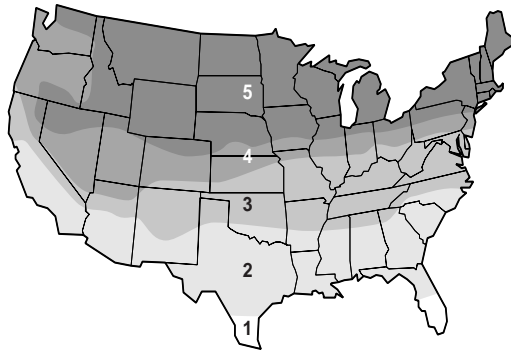
1. Seal all attic to home air leaks, especially chases, bypasses, and furr-downs. Remember, most insulation such as fiberglass and rock wool, does not stop air flow (refer to Airsealing Energy Bulletin).
2. Block around heat-producing devices.
3. Insulate the attic hatch or attic stair as described in Step 4 for loose-fill insulation.
4. Determine the attic insulation area; based on the spacing of the joists, order sufficient insulation for the attic. Refer to the MEC for the R-value for your area. It is important to cover the top of ceiling joists or bottom cord of truss with insulation.
5. Obtain complete coverage of full-thickness, non-compressed insulation. When installing the batts, make certain they completely fill the joist cavities. Shake batts to ensure proper loft. If the joist spacing is uneven, patch gaps in the insulation with scrap pieces. Do not compress the insulation with wiring, plumbing or ductwork (cut slits in the insulation if necessary).

Energy efficient cathedral ceilings

Cathedral or vaulted ceilings have limited space for insulation and ventilation within the depth of the rafter. Fitting in a 10-inch batt (R-30) and still providing ventilation is impossible with a 2x6 or 2x8 rafter.

The MEC may allow R-19 cathedral ceiling insulation for some house designs, depending on the climatic zone. For most areas, R-25 to R-38 insulation is recommended, if not required. Choose high density R-30 batts, since they are about the same thickness as R-25 batts, and follow the same installation practice.

Ceiling insulation R-values



Recommended R-values for geographical location in the continental United States.

HDD Zone	Ceiling R-value
1 (0-500)	R-19
2 (501-3,000)	R-30
3 (3,001-5,000)	R-38
4 (5,001-6,000)	R-38
5 (6,001-10,000)	R-49

HDD=Heating Degree Days

(Consult local weather bureau for your city's actual heating degree day range)

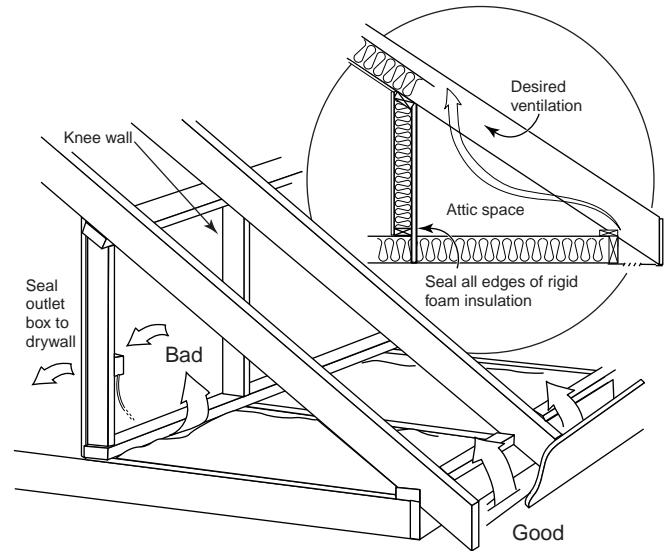
Cathedral ceiling insulation techniques

Cathedral ceilings must provide space between the roof deck and ceiling for adequate insulation and ventilation. Cathedral ceilings built with 2x12 rafters have space for standard R-30 batts and ventilation. A *vent baffle* should be installed between the insulation and roof decking to ensure that the ventilation channel is maintained.

If roof framing provides insufficient space for required insulation, higher insulation values can be obtained, by either framing furring strips (that permit additional insulation to be installed) or by adding rigid foam insulation under the rafters. Both techniques offer a resistance to the thermal bridging effect of the wood rafter. The rigid foam insulation must be covered with a fire-rated material when used on the interior of the building. Half-inch drywall usually complies, but check with local fire codes for confirmation.

Knee walls

Knee walls are vertical walls with attic space directly behind them. Typically, builders insulate the knee wall and the attic floor in the attic space. Unfortunately, the knee



Increase insulation and air sealing in knee walls

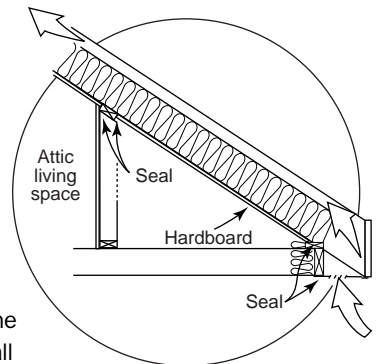
wall often receives only R-13 insulation with no protective cover. Heating and cooling systems and ductwork are often located in the spaces behind the knee wall. Mechanical equipment and ducts suffer leakage and efficiency losses due to the extreme temperature range found in this unconditioned space.

For energy efficient renovation of an existing home, effort should be devoted to adding more insulation and air sealing the knee wall. Knee wall insulation should be adequate (refer to chart); installing and sealing the seams of rigid insulation achieves this plus helps to prevent attic air from infiltrating into the house.

In new construction, a better approach is to insulate and air seal the rafter space along the sloping ceiling of the knee wall attic space. The rafters should receive

R-19 to R-49 insulation, depending on the MEC. They should be covered with a sealed air barrier, such as drywall or foil-faced hardboard. The barrier must be caulked to the top plate of the wall below the attic space and to the top plate of the knee wall itself. All other cracks and holes

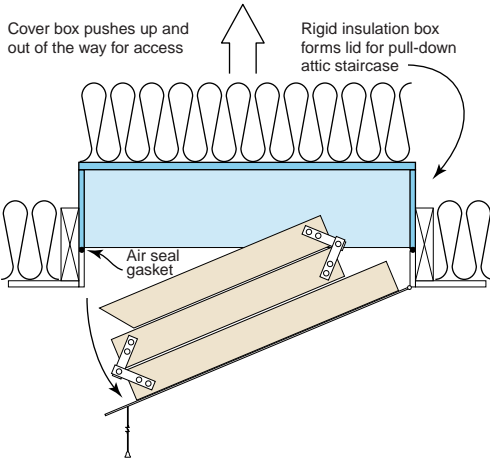
must be sealed as well. The advantage of this technique is that all ductwork is now located inside the conditioned space and benefits from the more even temperatures.



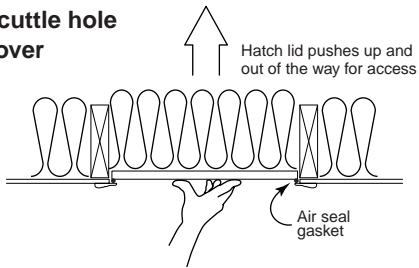
Attic access

Build an insulated attic access cover to provide continuous coverage.

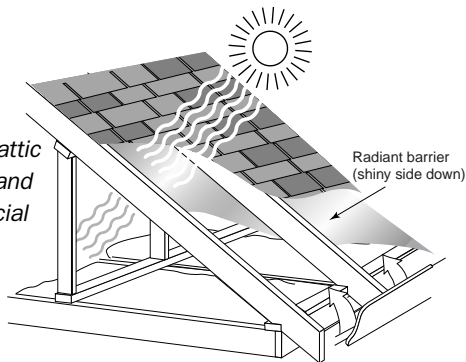
Pull-down attic staircase



Scuttle hole cover



Radiant heat barriers lower attic temperatures and may be beneficial in reducing air conditioning requirements.

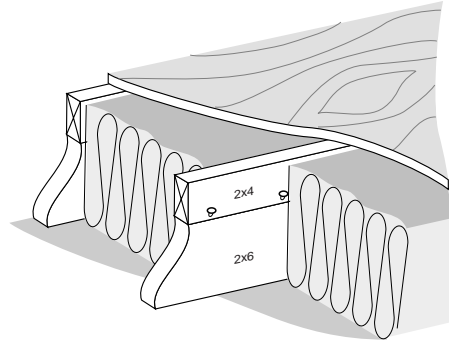


Radiant heat barriers

Radiant heat barriers (RHB) are reflective materials that can reduce summer heat gain by the insulation and building materials in attics and walls. RHB's work two ways: first, they *reflect* thermal radiation well and second, they *emit* (give off) very little heat. RHB's should always face a vented airspace and be installed to prevent dust build-up. They are usually attached to the underside of the rafter or truss top chord or to the underside of the roof decking and may be cost effective in hot climates.

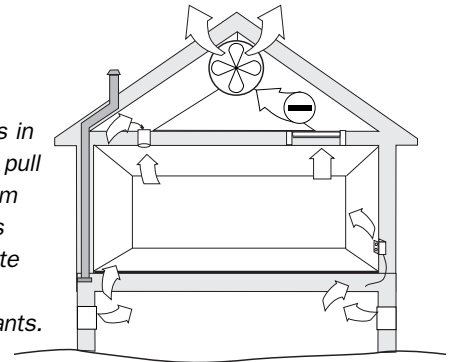
Attic storage areas

Attic storage areas can pose a problem. If the ceiling joists are shallower than the depth of the insulation, raise the finished floor using 2x4's or other spacing lumber. Install the batts before nailing the flooring in place. If mechanical systems are located in the attic, be sure to elevate the equipment to allow for full-height insulation.



Additional wood can be toe-nailed to the ceiling joists to increase the available depth for insulation when adding flooring to an attic.

Powered attic ventilators create negative pressures in the attic. This can pull conditioned air from the living space as well as contaminate the indoor air with crawlspace pollutants.



Powered attic ventilator problems

Electrically powered roof ventilators can consume more electricity to operate than they save on air conditioning costs and *are NOT recommended* for most designs. Power vents can create negative pressures in the home which may have detrimental effects such as:

- Removing conditioned air from the home through ceiling leaks and bypasses
- Pulling pollutants from the crawlspace such as mold, radon, and sewer gases into the home
- Backdrafting fireplaces, water heaters, and fuel-burning appliances