Insulation: The Thermal Barrier

Insulation, a primary attic component, is key to a home's overall energy efficiency and comfort. It controls heat transfer through exterior assemblies in cold weather, and minimizes heat gain in warm weather. It plays a vital role protecting the home and roof from ice damming and weather-born problems. To be effective and cost-efficient, insulation must be integrated with other attic systems and installed at today's recommended levels. (See Table 4.0)

Architects and builders must remember that proper installation of insulation takes time. Batts fit easily into standard designs, but should also be cut to fit and fill odd-shaped areas. That labor-intensity should be factored into overall project costs to allow sufficient budget and time for effective and adequate installation.

Insulation recommendations are stated in R-values — the resistance to heat flow of a material. The higher the R-value, the greater the insulating power.

To calculate the total R-value and to achieve higher R-values, the R-values of individual products can be added together. For example, to achieve a recommended insulation level of R-49, add an R-11 batt to an existing R-38. Also, each component in the attic wall, ceiling or floor can contribute to the overall thermal resistance you design. And remember, from a performance point, there's no such thing as too much insulation — provided it's properly installed. A bad installation could cause problems by blocking eave vents, for example. The only effects of properly installed, very high insulation levels would be greater energy savings.

Breaking the thermal barrier

Penetrations in the attic's thermal barrier — vents, skylights, roof windows, pull-down stairs, air conditioning units, even closets and ceiling lights — lower energy efficiency, creating heat loss and potential moisture problems. All frame areas for such thermal penetrations can be filled with fiber glass insulation to further retard heat loss. For example, frame and facing areas of pull-down stairs should be insulated with fiber glass batts, cut to fit, or insulated covers to further maintain thermal integrity.

Skylights and roof windows also should be specified and installed to complement the attic system working with, not against, insulation and ventilation. Constructed of an insulated material and/or a double-glazed material to reduce condensation and conserve energy, skylights and roof windows are often a more affordable construction option than roof dormers. Flashings and curbs should provide maximum weather tightness. To maintain adequate air flow and guard against condensation, use ventilating skylights. In inaccessible roof areas of finished attics, ventilating skylights feature a weather-proof flap in the frame that can be left open year-round.

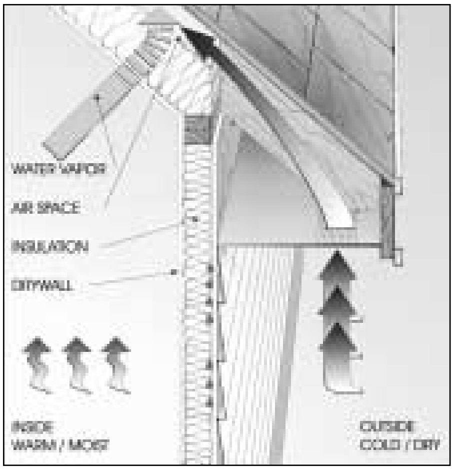

Figure 4.1a

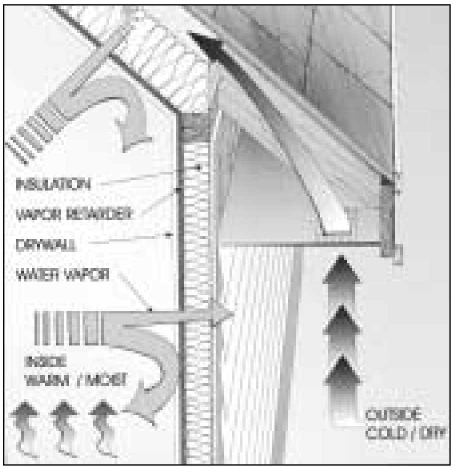

Figure 4.1b
Choice of insulation has a direct impact on other system components such as vapor retarders, which slow the movement of indoor moisture.

Another thermal problem for the attic: standard recessed lighting, which can allow air flow and create openings for heat loss and moisture transfer. One study indicated that as much as nine gallons of moisture can leak into an attic every month from just one typical recessed ceiling light fixture. Also, if surrounded too closely by insulation, standard recessed lighting can overheat. Therefore, Insulated Ceiling (IC) type recessed lights should be used in and around insulated ceilings. Typically made with a sealed construction that restricts air flow, IC lighting eliminates the need to tape or caulk fixture openings. They can also help stop moisture from entering the attic space and causing mildew or structural problems. IC lights are suitable for direct contact with insulation because they automatically switch off if overheated.

WARNING: Should standard non-IC fixtures be in place, keep insulation at least 3 inches away from the fixtures and do not place insulation above the fixture.

Types of Insulation Materials

Fiber glass insulation is made from a molten mixture of sand, borax and recycled glass. The mixture is formed into fibers in a centrifugal process. Fiber glass insulation is by far the most popular type due to its combination of thermal efficiency, acoustical control, light weight, fire safety and overall durability. If it gets wet, its R-value is restored when it dries. And it does not contribute to mold growth. Fiber glass and other types of insulation are available in batts, rolls or blown-in form.

Blown-in fiber glass insulation is generally installed with automatic or pneumatic equipment in a horizontal open blow. Attic penetrations and the amount of framing impact the net coverage of blown-in insulation.

Batts are pre-formed and designed to fit easily into various framing sizes, meeting code and energy requirements without changing construction technique or timing. And faced batts provide the added advantage of a built-in vapor retarder.

Both batts and blown-in insulation will provide claimed R-values when correctly installed. Both have advantages. With batts, you know that the proper R-value is installed because it's determined by the manufacturer, not the installer. Blown-in insulation fills nooks, crannies and odd-size cavities more easily. You will generally get a more uniform thermal blanket with a blown-in insulation.

Another good option is to use a combination of batts and blown-in insulation. For example, install faced R-11 from underneath and then later add blown-in insulation to achieve the desired R-value.

Cellulose insulation is made from scrap newspaper, which is shredded and chemically treated to resist burning. When blown-in, cellulose tends to settle as much as 20 percent so an additional amount must be initially installed. If it gets wet through leakage or condensation, it presents significant problems, such as permanent reduction of R-value and breeding of dangerous molds and fungi. Even though cellulose is treated with fire retardants, it will burn if incorrectly installed and thus exposed to a prolonged heat source such as recessed lights or fireplace flues.

Foam insulations are produced from various chemicals, usually in board form. Rock or slag wools consist of fibers formed from either rock or slag (residue from the manufacture of steel).

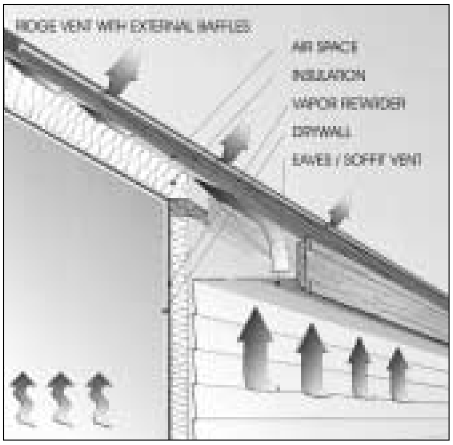

Figure 4.2
Here, vapor retarders are used to slow the movement of moisture from indoor air to exterior surfaces where it can condense and cause structural damage. For all their effectiveness, vapor retarders cannot fight moisture build-up alone and must be specified in conjunction with proper insulation levels and venting.

Insulation Affects Venting and Vapor Retarders

Insulation has a significant impact on the need for the two Vs — Ventilation and Vapor Retarders.

During the heating season, water vapor in the home moves from the warm interior to the cooler exterior. If passage into attics and exterior walls isn't slowed by a vapor retarder, condensation can occur on cold surfaces, and can eventually lead to mold, mildew growth and wood rot. It can also affect insulation, causing it to become damp and temporarily, or permanently, reducing its thermal performance, depending on the type of insulation used.

Vapor Retarders are materials that are applied to one side of insulation and work to slow the flow of the home's generated water vapor from its interior rooms to the attic and wall cavities. Most common is insulation with kraft facing. If unfaced insulation is used, a separate vapor retarder, such as 4 or 6 mil. polyethylene, is recommended.

Vapor retarders are not a standard recommendation for all attics in all climates. In fact, in some temperate, dry climates such as parts of California and Arizona, they typically aren't required at all. If the attic has excellent ventilation, vapor retarders can be limited to situations of extreme cold and/or high humidity.

For most of the U.S., however, vapor retarders such as the kraft facings of CertainTeed's insulation products can help prevent moisture problems. In the North, and in most other areas of the country, vapor retarders should be installed on the warm-in-winter side of the insulation — toward the living space.

Builders and remodelers in Southern regions have a trickier time specifying vapor retarders. In warm, humid regions, such as the Coastal South, high humidity and air conditioning cause a continuous moisture flow from the exterior toward the interior. **Here, a vapor retarder should be installed on the exterior side of the wall**, but it should not be a "tight" retarder such as polyethylene, which is commonly used when air-tight applications are desired or when unfaced building insulation is installed. Using a discontinuous retarder, such as that on fiber glass insulation, will accommodate winter weather when the flow of water vapor reverses to move from the inside out.

In some areas of the South, it may be difficult to decide where vapor retarders should be placed. If that's the case, it's best to follow local practice and to stick with discontinuous vapor retarders.

Not only does your choice of insulation impact use of vapor retarders, it can also impact ventilation.

Here's how:

- If your design provides a minimum of ½" of clearance between batt insulation and roof decking, you won't need to install vent baffles.
- Blown-in insulation generally will require baffles at the eaves to enable soffit vents to be fully effective.
- In cathedral ceilings with both ridge and soffit vents, baffles are recommended to assure adequate venting space if insulation thickness is not at least ½" or less than the framing height.