12

Insulation

Energy Code Requirements

Insulation R-values

The R-values of insulation in any part of the thermal envelope are defined by your compliance analysis. Whether it is a prescriptive table, a RES*check* printout or any other approach, the minimum R-value for each component is specified and documented with the building permit application (ECCCNYS Section 104). If, during construction, you want to substitute a lower than specified R-value for a particular component (wall, ceiling, etc.), you must redo to the compliance analysis to see if that will pass the code, and re-submit the paperwork with the new specifications. You may have to substitute higher R-values somewhere else in the building to compensate, or choose a different prescriptive package.

Proper installation

All R-values are based on proper installation. For fiberglass batts, this means:

- **Full loft**—Insulation should be fluffed to its full thickness, not compressed, and not rounded or scalloped at the edges.
- **Fill the cavity**—Insulation should be in snug contact with all wall studs, plates, sheathing and drywall. In ceilings and floors, it should be in contact with the drywall or subfloor, and extend all the way to joists on both sides without gaps (see Figure 12.2).
- **Cut around obstacles**—Insulation should be split around wires and small pipes; cut out around electrical boxes, larger pipes and other obstacles; and split over cross bridging in floors. Never stuff insulation in to get it to fit (see Figure 12.1).

Refer to industry standards such as *Fiber Glass Building Insulation: Recommendations for Installation in Residential and other Light-Frame Construction* (North American Insulation Manufacturers Association), or

Standard Practice for Installing Cellulose Building Insulation and *Standard Practice for the Installation of Sprayed Cellulosic Wall Cavity Insulation* (Cellulose Insulation Manufacturers Association). These resources are listed in Appendix B.

Documentation of R-values (ECCCNYS 102.4 and 102.5)

Many common insulation products have R-value markings right on them. Faced and unfaced fiberglass batts, and rigid foam insulation must be installed so the markings are visible to the building inspector. If you are using blown- or sprayed-in insulation such as cellulose, spray foam, or blown fiberglass, the installer should provide a certificate showing installed thickness, settled thickness, the square feet of coverage, the number of bags (or amount of material) used, and the net installed R-value. For blown-in attic insulation, "tell-tale" inch markers are also acceptable, provided they show installed thickness and settled thickness (one marker minimum per 300 square feet of attic.)

Credit for "raised truss" construction (ECCCNYS 602.1.2)

Insulation in flat or cathedral ceilings is assumed to be compressed over the exterior walls, as is typical (Figure 12.4). If you can install the insulation in such a way as to get the *full R-value* of insulation, all the way to the outside of the exterior wall, then you can take credit for "raised truss" in the RES*check* software ceiling input box. In the prescriptive method a raised truss or its equivalent allows you to substitute R-30 insulation when R-38 is specified, or R-38 for R-49. For the other methods, it gives you some credit toward your point score. This does not mean you have to use a raised heel truss to get this credit; examples of alternative methods are shown in Figures 12.5-12.7, 12.9. Depending on the roof geometry and the care of installation, you may not even need to modify the framing. For example, a high-pitched roof truss with a large overhang may not need any special treatment to achieve the full R-value at the eaves.

Access Openings

Attic hatches, scuttles, pulldown stairs, etc. must be insulated

to the same R-value as the surrounding area, or the actual R-value must be accounted for in your calculations (see Appendix A).

Steel Framing

Steel is an excellent conductor of heat. Consequently, the effective performance of insulation in steel framed building assemblies is reduced dramatically. Cold interior surfaces near the steel studs bring an increased potential for condensation and mold growth. Code accounts for the thermal "bridging" that results from the use of steel framing by making insu-

lation requirements more stringent. The easiest way to meet these requirements is to add a layer of continuous, rigid insulation that covers all the framing and acts as a thermal "break" (see ECCCNYS Tables 502.2.4.16 (1 and 2) for insulated steel and wood wall equivalencies).

Additions (ECCCNYS 502.5)

Energy code compliance for additions may be demonstrated in a number of different ways. Theoretically, they can be analyzed as part of a whole building analysis or independently from the rest of the house. You can also choose any of the available compliance pathways (systems analysis, component performance, etc.). Regardless of the approach, it may be difficult to achieve compliance based on the fact that additions typically have lots of window area. In response to this, a simplified prescriptive table specific to additions has been developed. In most cases, the use of this prescriptive table will be the simplest option (see page 9).

ENERGY STAR

Proper application of insulation materials is critical to the success of any ENERGY STAR Labeled New Home. Here are some guidelines in addition to the code requirements:

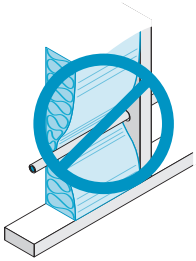
- **Insulation shall be installed to manufacturer's specifications**, with no gaps, voids or compressions, including around electrical boxes, around pipes and in corners.
- **Rating the installation of insulation**—The building may not receive the highest quality rating if proper insulation installation is not verified by a pre-drywall inspection or other approved methodology.
- **No side stapling**—Although side stapling of faced fiberglass batts is mentioned in industry standards, it is not recommended in ENERGY STAR Labeled New Homes because it compresses the installation (see Figure 12.3). Face stapling is often disliked by drywall installers. To lessen the potential impact, be sure to set staples firmly into the studs, avoid pulling fiberglass fibers over the face of the studs, and mark the stud locations on the floor.
- **High density fiberglass batts** such as R-13, R-15, and R-21 get a higher R-value in the same cavity. They also tend to be stiffer, and fluff up so it is easier to get a good fit without compression. Although not an ENERGY STAR requirement, it is a good idea to use high density batts if you are using fiberglass, and you can get credit for the added R-value in the code analysis as well.
- **Air barriers and eave baffles to prevent wind washing**—No matter how well you install insulation, cold air washing through it will not only severely compromise its effectiveness, but also increase con-

densation potential by cooling the vapor retarder. Eave baffles made of cardboard or foam board are essential (see Figures 12.5, 12.6 and 12.8); if the baffle extends above the top of the insulation, no vent chute or "propavent" is required. Also vulnerable are exposed insulated walls, such as attic knee walls (Figures 7.15, 7.16 and 7.18). Cover the exposed fiberglass on the attic side with a vapor permeable air barrier such as housewrap, polystyrene foam, drywall, or similar material. Floor insulation over piers, cantilevers and the like should also be sealed to prevent outside air from circulating into the insulation (Figures 7.11 and 7.12). Flat or sloped attic insulation need not be covered, but baffles should be provided near eaves (see Figures 7.16, 7.17, and 12.5 through 12.8).

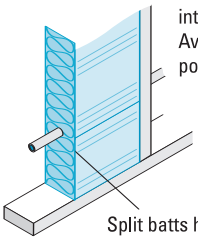
- **Cavity fill types that improve air tightness**—Some insulation materials can help. See page 90.
- **Avoid strapped ceilings**—1x3 furring strips running perpendicular to the joists provide a cavity for free air circulation, which often compromises the insulation performance, especially near eaves and in cathedral ceilings. Once nailed in place, they also make it very difficult to install insulation properly. This is another area where money can be saved while thermal performance is improved.
- **Higher R-values in sloped ceilings** can be achieved with smaller framing by adding sister joists with plywood gussets. See Figure 12.9.

FIGURE 12.1

Insulating around plumbing, wiring, and other obstacles



Do not compress insulation



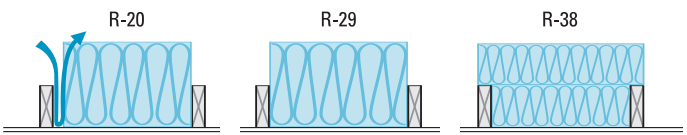
Keep plumbing toward the interior to avoid freezing. Avoid exterior walls where possible.

Split batts horizontally to slide around plumbing, wiring, and other obstacles; or split horizontally to embed wire or pipe in batt

FIGURE 12.2

Effective R-value of insulation

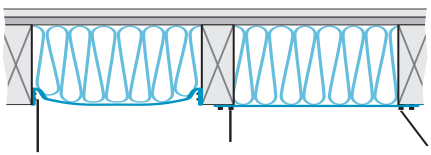
This schematic shows the effect of insulation installation quality and technique on effective (or installed) R-values. Note that the same depth of insulation (12", nominally R-38) is used in all three cases.



⚠ CAUTION: Most of initial R-value is lost as void area increases. For example, increasing the void area above from 3% to just 6% would result in an effective R-value of only 15!

FIGURE 12.3

Face-stapling versus inset stapling kraft-faced batts



Side stapling leaves air channels, and compresses insulation; avoid if possible

Face stapling allows full loft, even at edges

Overlap tabs on stud and set staples flush

FIGURE 12.4

Conventional truss

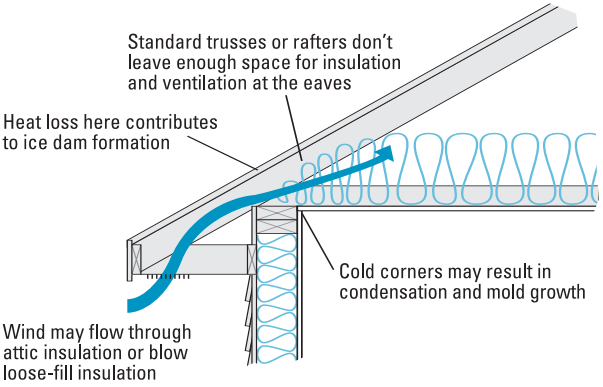
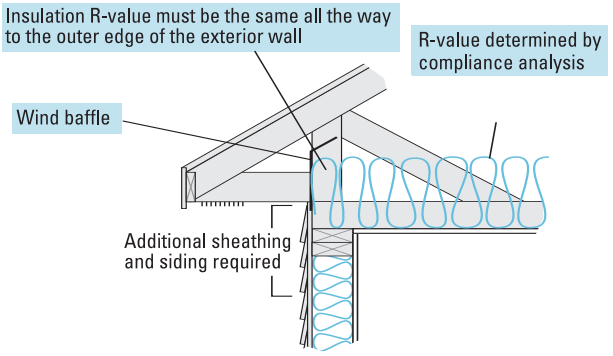


FIGURE 12.5

Raised heel truss

Raised heel trusses can be ordered for any eave height.



Credit is given in the code compliance analysis for better performance. See Figures 12.6 and 12.7 for other options.

CAUTION: Trusses must be sized carefully so that the truss heel lines up with the edge of the wall below.

FIGURE 12.6

Conventional truss or rafter with insulated eaves

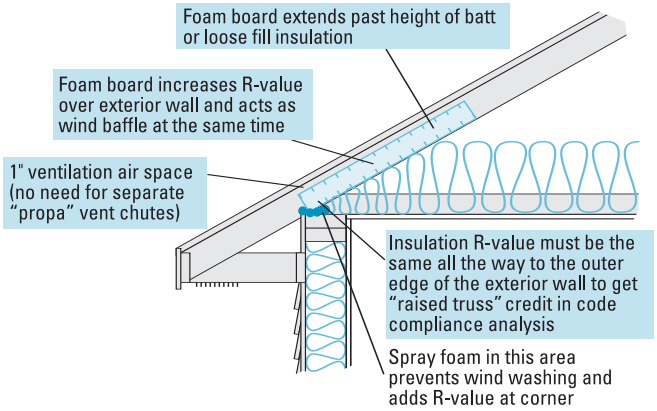


FIGURE 12.7

Conventional rafter with raised plate

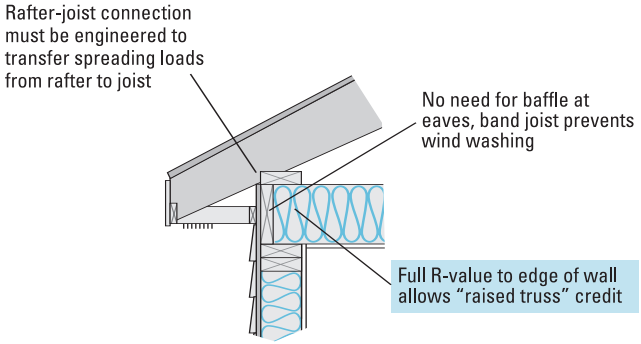


FIGURE 12.8

Vented cathedral ceiling

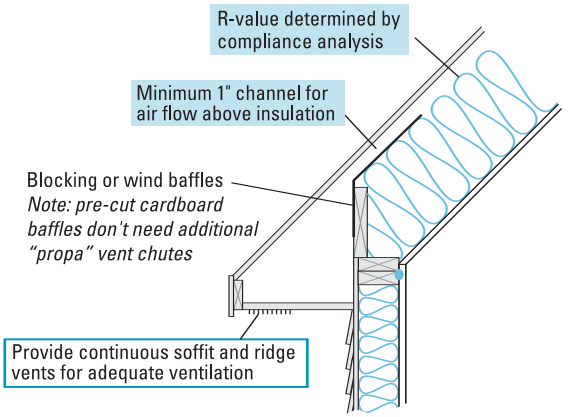


FIGURE 12.9

Cathedral ceiling with built-up rafters