BBS MEMO

Ohio Board of Building Standards May 16, 2013 6606 Tussing Road, P.O. Box 4009, Reynoldsburg, Ohio 43068-9009

Roof Replacement – Energy Conservation Requirements

Roof Systems

There are numerous shapes/types of roofs (i.e. flat roofs, shed roofs, butterfly roofs, gable roofs, hip roofs, gambrel roofs, mansard roofs, saw-tooth roofs, thin-shell roofs, arched, domed). Similarly, there are numerous materials that are used in roof construction (i.e. concrete, tile, slate, stone, asphalt, metal, wood, gypsum, plastic, foam, composites). Most of these roofs, but not all, are actually constructed as roof assemblies comprised of different roof systems. Roof systems can be generally classified into three groups: roof coverings (roofing), roof decks, and structural supporting members. Roof coverings are the first line of defense, protecting the building interior from the outside weather. Examples of roof covering systems are: asphalt shingles, clay and concrete tile, metal shingles, mineral-surfaced roll roofing, slate shingles, wood shingles, wood shakes, built-up roofs, metal roof panels, pre-formed roof panels, modified bitumen, thermoset single-ply, thermoplastic single-ply, sprayed polyurethane foam, and liquid-applied coatings. "Green" roof coverings such as roof gardens and landscaped roofs are becoming increasingly more popular. The roof covering, or roofing, is usually applied to the roof deck. Examples of roof decks are: sheathing, roof planks, roof panels, and roof slabs. Sometimes, as in roof panels, the roof covering and the roof deck are one and the same. The roof loads, such as those imposed by wind, snow, ice, accumulated rain, roof gardens, roof assembly, and roof equipment are transmitted through the roof deck to the structural supporting members. Examples of structural supporting members are: trusses, rafters, joists, purlins, sub-purlins, girders, rigid frames, and the ribs of arches or domes. Sometimes, as in shell roofs, the roof deck and the structural supporting members are one and the same.

Roof Alterations

As with all building components, the building roof is required to be maintained and will eventually need to be repaired or replaced. The time will eventually come when the roof can no longer be repaired or when it becomes more cost effective to replace the roof. Generally, a roof replacement would be considered an alteration to an existing building. As such, in accordance with OBC Section 3404.1 and RCO Section 113.4, the alterations are required to comply with the current code for new construction *to the extent of the alteration*. In other words, portions of the structure not altered and not affected by the alteration are not required to comply with the code requirements for a new structure. The Ohio Building Code (OBC) and the Residential Code of Ohio (RCO) both address the subject of roof covering replacement, or reroofing. The OBC addresses this issue in OBC Section 1510 and the RCO addresses this issue in RCO Section 907. General roof construction is addressed in the OBC Chapter 15 and in the RCO Chapter 8. In accordance with Sections 105 and 102.10 of both the OBC and the RCO, the owner *is* required to obtain an approval from the building official prior to replacement of a roof system, including reroofing.

Energy Conservation

Current building energy codes require that a building thermal envelope be created that encloses the conditioned spaces within the building. Generally, the building thermal envelope is a boundary created by insulated walls, floors, ceilings or roofs. The purpose of the thermal envelope is to keep conditioned air within the building. Because warm air rises within a building, much heat loss can occur across a poorly insulated ceiling or roof thermal boundary. As a result, the ceiling insulation or the roof assembly insulation can be a critical component of the building thermal envelope.

In typical residential light-weight wood frame construction, the roof is usually a gable or hip type sloping roof with trusses or rafters/ceiling joists forming the structural supporting members. The roof deck is usually constructed of wood panel sheathing. The roof covering is typically asphalt shingle systems. Thermal insulation is typically provided just above the finished ceiling within the attic or concealed space formed by the trusses or joist space above the ceiling. Often times, the insulation is located well below the roof deck. In commercial construction, the roof types and designs vary significantly. As a result, the location of the roof insulation varies too. Sometimes, above-deck thermal insulation is provided between the roof deck and the roof covering. Other times, this required roof insulation is located just below the roof deck. In other situations, much like residential construction, the insulation is located just above the ceiling, well below the roof deck.

Energy Conservation Alterations

The 2009 IECC Section 101.4.3 and the 2007 ASHRAE 90.1 Section 5.1.3, both model energy code standards adopted by the Board of Building Standards, offer code language that attempts to help the user specifically understand how to handle energy conservation issues when making alterations to existing buildings. While generally consistent with the OBC and RCO alteration philosophy described above, the energy standards treat each building energy system as a whole, not as individual components. In other words, if making an alteration to a building energy system (building thermal envelope, mechanical system, service water heating system, lighting system, or power system), the altered building system has to meet the current code, unless an exception applies. However, the other energy systems, those not altered and not affected by the alteration are not required to comply. For example, replacing the furnace does not require or trigger any upgrades to the building thermal envelope.

Sometimes, depending upon the type of existing roof system and the scope of the proposed roof work, it may be difficult to define "to the extent of the alteration" or difficult to determine how the proposed alteration may affect the existing building in terms of energy usage.

The energy conservation standards contain the following roof system alteration language, the intent of which may be confusing and somewhat difficult to understand:

> **2009 IECC, Section 101.4.3 Additions, alterations, renovations or repairs.** Additions, alterations, renovations or repairs to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code. Additions, alterations, renovations or repairs shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code if the addition alone complies or if the existing building and addition comply with this code as a single building.
> **Exception:** The following need not comply provided the energy use of the building is not increased:
> 3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
> 4. Construction where the existing roof, wall or floor cavity is not exposed.
> 5. Reroofing for roofs where neither the sheathing nor the insulation is exposed. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.

The 2009 IECC Commentary does not provide any insight into the intent of exception #5. However, the 2012 IECC Commentary seems to indicate that Exception #5 is intended to apply where the building thermal envelope/insulation is located at the roof, as opposed to being located at the ceiling. In other words, Exception #5 is not intended to apply to typical light-frame construction where the building thermal envelope/insulation is located at the ceiling, as opposed to being located at the roof. The ASHRAE standard contains similar language as follows:

> **2007 ASHRAE 90.1, Section 5.1.3 Envelope Alterations**. Alterations to the building envelope shall comply with the requirements of Section 5 for insulation, air leakage, and fenestration applicable to those specific portions of the building that are being altered.
> **Exceptions:** The following alterations need not comply with these requirements, provided such alterations will not increase the energy usage of the building:
> c. alterations to roof/ceiling, wall, or floor cavities, which are insulated to full depth with insulation having a minimum nominal value of R-3.0/in.
> e. replacement of a roof membrane where either the roof sheathing or roof insulation is not exposed or, if there is existing roof insulation, below the roof deck.

The ASHRAE 90.1 User's Guide offers similar commentary to that of the IECC Commentary.

In summary, roof alteration requirements can best be described by first understanding where the building thermal envelope is located. **If the thermal envelope is located at the ceiling level and not the roof level, as is typical for most residential applications, then any roofing alterations such as removing and replacing sheathing and/or shingles will not trigger any insulation requirements because the proposed alteration is not affecting the thermal envelope and, thus, does not affect the energy use of the building**.

However, for those situations where the roof is an integral part of the building thermal envelope, roof alterations may trigger additional insulation requirements because any proposed alteration to the building system is required to meet code. In other words, when the thermal envelope is altered, the thermal envelope is required to meet code where practically feasible to do so. A few simple examples may help to understand and illustrate this concept. The examples assume that the prescriptive compliance method is used.

Example #1: Given: An existing commercial building having a flat roof assembly (steel purlin supporting members, light-weight concrete slab and metal deck, R-18 rigid insulation above the roof deck, and thermoset single-ply membrane roof covering) located in Cleveland.
Proposed: Replacement of the entire single-ply membrane roof covering which exposes the existing rigid insulation. The proposed roof work will not increase the energy usage of the building.
Required: The alteration to the thermal envelope would have to meet code. This may require adding additional rigid insulation to the roof so that the resulting thermal envelope assembly meets the current R-20 continuous insulation requirements found in both the IECC and ASHRAE 90.1 prescriptive tables.

Example #2: Given: An existing single- family dwelling having a cathedral ceiling/roof assembly (gypsum board ceiling directly attached to wood frame structural supporting members, plywood sheathing roof deck, and asphalt roof shingles).
Proposed: Removal and replacement of the shingles, underlayment, and any rotted sheathing.
Required: Although a literal reading of the code would require the thermal envelope to meet code because the sheathing is exposed and cavities are exposed, the Board intends for this to be more liberally applied ***for residential buildings***. If there was no existing insulation in the ceiling/roof cavity, a literal reading of Section 101.4.3 of IECC (Exception 5) would require adding insulation either above or below the sheathing to meet current code prescriptive "R" values because the roof is part of the thermal envelope assembly. However, the Board's intent is to limit the requirement to add insulation to only those cavities where the sheathing was removed and replaced. No additional insulation would be required above the sheathing. If there was existing insulation in the ceiling/roof cavity, then Section 101.4.3 of IECC (Exception 3) would allow the existing insulation levels to suffice.

If you have further questions regarding this issue, please call the Board's office at 614-644-2613 or E-mail to dic.bbs@com.state.oh.us.