

Shedding some light on skylights

What you need to know before enhancing a roof system with skylights

by James R. Kirby, AIA

S skylights often are a desired enhancement for low- and steep-slope roof systems. As such, skylights often are installed as part of remodeling or upgrading an existing interior space, especially for residential construction. Skylights allow sunlight into a building's interior and can be designed to increase ventilation or release smoke.

Although there are several skylight types with different features, skylights share many commonalities regarding design and installation. And there are issues that should be understood about what skylight installation does to a roof system, such as flashing concerns, especially for reroofing projects; insulation concerns; and potential vapor retarder and condensation concerns.

Types of skylights

A typical skylight consists of a translucent or clear lens and extruded metal frame. Lenses are made from acrylic or polycarbonate (for impact resistance) and available in single configurations or double configurations (for added insulation). Skylight lenses and frames can be manufactured with an integral curb or installed on top of a site-built curb. Site-built curbs provide greater flexibility for installation height. However, skylights with integral curbs are available in various heights, such as 4 inches, 9 inches and 12 inches (100 mm, 225 mm and 310 mm).

Some skylight frames are made of galvanized steel, but most are made from extruded aluminum. Premanufactured skylights for low-slope roof systems with integral curbs are insulated or noninsulated; insulated curbs typically are double-walled with insulation between the walls. Skylight frames can include condensation gutters and weep holes. Some include thermal barriers—nonmetallic pieces that separate a frame and curb.

Skylights also are manufactured to provide ventilation

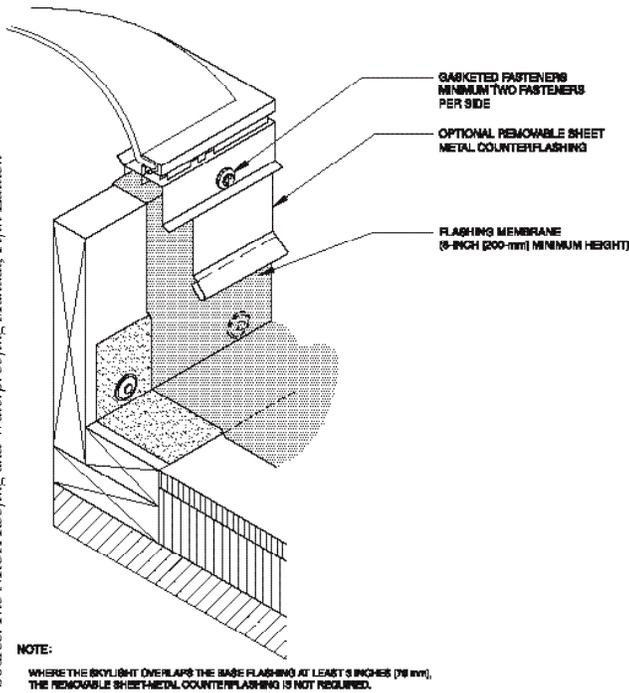
and can be hinged and triggered to allow smoke to be released (these are known as explosion hatches). Skylights also can have drop-out lenses that melt and fall into a building during a fire, which allows for the release of smoke.

In addition, skylight manufacturers provide lenses that resist high-impact loads. Also available are metal bars and screens that cover skylights' lenses to provide fall protection. These bars and screens may be positioned beneath a lens and attached to a curb. Of course, a designer must know the specific requirements concerning fall protection. For example, a skylight's impact resistance must be greater than the potential impact force whether the force is a person, equipment or material. For additional information, see "Skylight safety," page 29.

Skylights are manufactured specifically for installation on continuous roof decks, joists or purlins. Skylights installed directly on joists may be problematic when reroofing because installation must be done before a roof deck is installed. Therefore, temporarily removing and reinstalling a skylight and curb is not possible without removing some portion of a roof deck.

Low-slope issues

For new construction of a low-slope roof system, the securement and flashing of skylights are critical for a successful installation. NRCA recommends that well-secured, decay-resistant, preservative pressure-treated wood blocking be used to support and provide securement for prefabricated skylights. Site-built curbs for skylights also should be treated this way. NRCA also recommends using curbs that provide for proper application of a roof membrane, offer adequate vertical extension, permit the proper termination of base flashings and provide space for installation of sheet-metal counterflashings.



A typical site-built curb used for skylight installation.

Skylights should be installed with curbs tall enough to allow for an 8-inch (200-mm) vertical flashing height. Termination of base flashings typically requires mechanically fastening a membrane's top edge. Therefore, a wood nailer is required with premanufactured skylight curbs. Site-built wood curbs inherently provide a location for attachment of a membrane flashing's top edge.

The figure shows a typical site-built curb used for installation of a skylight lens and frame. The curb height allows for proper flashing installation. The skylight frame, as shown, does not adequately overlap the base flashing by 3 inches (75 mm). Therefore, additional, separate counterflashing is needed. This installation applies to all types of low-slope membrane and spray polyurethane foam-based roof systems. Generally, low-slope metal panel roof systems use prefabricated curbs for skylights that fit specifically to the metal panel's shape.

When reroofing or remodeling a low-slope roof system includes installing new skylights, NRCA suggests providing a roof curb high enough to maintain an 8-inch (200-mm) base flashing height. For some reroofing

projects, skylights may need to be raised or temporarily removed to allow for flashing removal and installation. If removed, a skylight should be reinstalled after reroofing work is completed. However, for most reroofing projects, installation of new base flashing does not require removing a skylight lens and frame. For re-cover projects, flashing heights will be reduced if insulation is part of the re-cover roof system, which may necessitate raising a skylight.

If a curb was site-built from wood framing, extensions to the wood curb can be installed to achieve the proper base flashing height. If a skylight's curb is premanufactured, the curb can be removed temporarily to install wood sleepers under the curb's horizontal flanges to achieve proper base flashing height. If a curb was constructed from concrete in a continuous pour with a concrete deck, wood frame extensions can be added to the top of the curb as necessary.

It should be apparent that skylights cause a loss of overall thermal resistance of a roof system. ASHRAE Standard 90.1-2001, "Energy Standard for Buildings Except Low-Rise Residential Buildings," discusses, by inference, the total allowable amount of interruptions, such as skylights, of "continuous insulation."

Section 5.3.1.1, "Roof Insulation," of Standard 90.1-2001 states: "For roofs with insulation entirely above the deck, the rated R-value of insulation is for continuous insulation. Interruptions presented by framing and pads for mechanical equipment with the combined total area no greater than 1 percent of the [roof] assembly area shall be permitted." This means no greater than 1 percent of the total roof area can be

without insulation without reducing the R-value of the installed insulation.

For instance, for a 10,000-square-foot (929-m²) roof system, no more than 100 square feet (9 m²) of the roof system can be without insulation. This means no more than six 4- by 4-foot (1- by 1-m) or three 4- by 8-foot (1- by 2-m) skylights can be installed, assuming there are no other penetrations or mechanical units on the roof. ASHRAE 90.1-2001 also states skylight curbs are to be insulated with the same insulation amount as the roof system or to an R-5 value, whichever is less. Because most premanufactured skylight curbs are insulated with about 1 inch (25 mm) of fiberglass insulation, which has an R-value of about 4, additional insulation is needed to comply with ASHRAE 90.1-2001.

Skylights are not only voids in roof insulation, they are voids in a vapor retarder. Therefore, if a vapor retarder is used, it should be properly tied into the skylight. If a skylight has a premanufactured metal frame and the vapor retarder is below the insulation, the vapor retarder can be adhered to the metal frame. This provides a continuous vapor retarder from the roof system up the skylight's sides.

If a skylight is wooden, a vapor retarder needs to be brought up a curb's face before any insulation installation. If an inadequate amount of insulation is used along a skylight's side walls, a vapor retarder likely will be cold enough to allow condensation to occur on the vapor retarder or the premanufactured metal curb. Condensation also can occur on a skylight's interior face and may be misinterpreted as a leak. This scenario obviously should be avoided when possible.

Steep-slope issues

For new construction of steep-slope roof systems, the ways in which skylights and flashings are installed are important. It generally is acceptable for a general contractor or carpenter to secure a skylight frame/curb on a roof deck. However, NRCA

recommends that a professional roofing contractor install the flashing system and roof covering.

Properly flashing a skylight requires an understanding of sheet-metal installation and roof covering types. NRCA recommends skylights be flashed in the same manner as chimneys with separate apron, step, cricket or backer flashings and counterflashings. Apron flashing is placed around a skylight's downslope face on top of a roof covering. Step flashing is installed up a skylight's sides and generally woven between individual roof covering units, specifically asphalt shingles, slate, and wood shakes and shingles. Channel flashing generally is used in place of step flashing for high-profile clay and concrete tiles.

Cricket or backer flashing is installed on the upslope side (or back) of a skylight. Cricket flashing is angled to redirect water run-off from behind a skylight when adequate flashing height exists. When skylights are more than 24 inches (610 mm) wide, NRCA suggests contractors use cricket flashing on the upslope side if curb height permits. Backer flashing is flat and does not redirect run-off.

Counterflashing—typically integral with a skylight's frame—is installed over apron, step and cricket flashings' top edges. Because it is difficult to install separate counterflashings, it is important to select skylights with adequate vertical projections integral with frames that can act as counterflashing.

Flashing heights for skylights on steep-slope roof systems are less than those for skylights on low-slope roof systems. This is a functional and aesthetic issue. Because steep-slope roof systems rapidly shed water, flashing height does not need to be 8 inches (200 mm) high. Four inches (100 mm) is rational. NRCA's steep-slope construction details show step or channel flashing at walls installed about 4 inches (100 mm) high. The flashing then is covered about 2 inches by the wall cladding (or metal counterflashing). A correlation to skylight flashing heights easily is made here; if a skylight has a

4-inch (100-mm) vertical side wall and self-flashing lens/frame design, there is no need to raise the skylight to allow for an 8-inch (200-mm) flashing height.

Many manufacturers market their skylight units to be self-flashing, which means a premanufactured skylight curb and curb flanges are intended to serve as roof flashing. Although self-flashing skylight units may provide weather-proof installations, they typically include continuous flashing at the curbs' sides instead of individual step flashing. Step flashings can accommodate larger amounts of run-off and minimize lateral movement of water into the roof covering. NRCA recommends step or channel flashing be used for flashing skylights' sides and integrated appropriately with the roof covering type.

In addition, a self-flashing skylight often does not offer adequate curb flange width at its upper side to serve as adequate backer flashing. Therefore, NRCA recommends the use of an additional, appropriately sized backer flashing. A flange's dimension should extend upslope far enough to provide headlap with the roof covering type.

Condensation may occur on the interior side of skylights, especially residential skylights in bathrooms and kitchens. In any location where there is excess moisture vapor, such as from taking a bath or shower, there is a possibility of condensation occurring. When the temperature of a skylight's lens, frame or curb is below the dew-point temperature for the relative humidity level within the space, condensation will occur. Because it is difficult, if not impossible, to increase the temperature of a skylight, the most effective way to minimize condensation is to adequately ventilate a space.

Skylights, especially those with internal gutters, should be installed with enough slope to move water to the weep holes but without so much slope that the internal gutter will overflow. Internal gutters catch condensation accumulation that is inevitable with most single-lens, noninsulated skylights.

There is a recent design trend

related to skylights for residential use. The most recent configuration uses a flexible tube to direct light into a building's interior. There reportedly is less framing that needs to be disturbed or reconfigured during installation and less interior work at the ceiling line. In addition, these types of skylights are flashed into a steep-slope roof covering similar to a static vent. This means a skylight's horizontal flange is installed with proper laps and headlap in the same plane as the roof covering.

Issues

For low- and steep-slope roof systems, skylight installation occurring after a roof system is installed should include flashing installed by a professional roofing contractor. A professional roofing contractor should be aware of proper flashing techniques. In circumstances where a roof system warranty still applies, a professional roofing contractor who can perform work as an approved or certified contractor should be used. This likely will be the roofing contractor who installed the original roof system or covering.

Any installation of a skylight following roof system installation requires several retrofit operations to be performed. Removal of existing roof system materials larger than the outline of the skylight is needed; this allows for work space and tying in of the roofing materials and new flashing. Mounting a skylight and curb to an existing roof deck also is required; additional framing supports may be required depending on a skylight's curb size and weight.

In addition to framing installation, the alteration of interior surfaces, such as drywall and paint, is necessary to provide a path for the entry of light or exhaust of smoke (for those buildings with ceilings). This also requires work to be done at the ceiling level.

Externally, the reinstallation of a roof system and flashings needs to be completed. For low-slope roof systems, it is critical roof system reinstallation is at least at the same level as, if not above, the existing roof membrane. Therefore,

Skylight safety

by Bill Steinmetz

According to the Occupational Safety and Health Administration (OSHA), skylights are considered roof holes unless they can support twice the intended load of workers and equipment. For example, if your heaviest worker weighs 250 pounds (113 kg) with his tools, a skylight he is working near must support a 500-pound (225-kg) load. Unless a credentialed engineer makes a weight determination for you, it is best to be cautious and provide fall protection for all crew members working in the vicinity of a skylight.

There are two areas of concern when providing fall protection. One is protecting employees who are working or walking near skylights that are not being constructed. The other is protecting workers while they are working on a skylight.

The best way to provide fall protection around a skylight not being worked on is by using a guardrail. This consists of a top rail 39 inches to 45 inches (991 mm to 1143 mm) above the roof with a midrail that can withstand a 200-pound (90-kg) load without deflecting. There are many guardrail systems available that are easy to install and meet OSHA requirements.

In some jurisdictions, OSHA also allows a warning line to be used to direct workers away from roof areas containing skylights. This can be a practical alternative to using a guardrail when a building has a large group of skylights not in a roofing work area. However, as the work area progresses closer to skylights, you will need to protect workers with a guardrail or another means of fall protection, such as a screen or personal fall-arrest (PFA) system. Check with your local OSHA office before using a warning line to protect workers.

If a potential fall to the inside of a building through a skylight is more than 6 feet (2 m), all workers must be protected with PFA systems, safety nets or covers. A PFA system consists of a harness with a locking D-ring placed in the center of a worker's back, lanyard limiting the fall to 6 feet (2 m) or less, and anchorage point capable of withstanding a 5,000-pound (2250-kg) load. For many contractors, it is difficult to comply with the 5,000-pound (2250-kg) load requirement because it is difficult to find anchorage points

on a roof that can support such a load. However, the anchorage must be this strong—a 200-pound (90-kg) man falling 6 feet (2 m) generates a tremendous amount of force.

If the area under a skylight is open and unoccupied, it may be possible to build a mobile scaffold platform that would limit the fall to the interior to less than 6 feet (2 m). The platform could be moved under each skylight as skylights are removed, reflashed and replaced. Safety nets designed to catch people can be used but are difficult to set up and generally not used in the roofing industry. Consult OSHA regulations for mobile scaffold platform requirements, or call your local OSHA office for more information.

Instruct workers to never stand or put a foot on a skylight. They also should never sit on skylights or put tools or materials on or next to skylights. If a roof has groups of skylights that are protected with a guardrail or warning line, workers should not store materials or equipment or walk inside the guardrail or warning line according to OSHA regulations.

Several manufacturers are developing screens designed to provide fall protection for skylights. These serve the same purpose as a cover. They can be installed inside or over the outside of a skylight, as well as permanently or temporarily during roof system installation. Screens are designed to meet OSHA requirements and available in a variety of sizes.

All OSHA offices—both federal and state—have a Consultation Division that provides free advice about how to comply with OSHA standards. The divisions will not issue citations or fines if you comply with their directives. Working with a Consultation Division is a good way to develop a positive working relationship with your local OSHA office, help you understand OSHA regulations and demonstrate goodwill in wanting to comply.

There have been many high-profile skylight fatalities during the past several years that easily could have been prevented if fall protection was provided. Be sure all skylights your crews work on or near are protected, and you will help prevent costly falls.

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the horizontal portion of the reinstalled roof system should not be *below* the existing roof system so water may pond around the newly installed skylight. Adequate amounts of filler material, such as insulation, should be installed to prevent potential ponding water. Also, a cricket may need to be installed on a skylight's upslope side so water is directed around the skylight.

When a skylight is installed after a roof system, it generally is understood that a new roof membrane or roof covering materials will be used. However, it is possible to reuse loose-laid or mechanically attached insulation for

low-slope projects and rigid materials, such as slate or wood shingles, for steep-slope projects. Any fully adhered materials likely will be damaged and unusable. For additional information regarding the installation of skylights on steep-slope roof assemblies, see "Going through the roof," May 1998 issue, page 32.

Finally, tell clients, especially homeowners, to be suspiciously cautious of do-it-yourself installation instructions that are provided by a skylight manufacturer. From research I conducted of skylights during the past two months, manufacturers' instructions regarding

flashing generally are inadequate and, in some instances, actually incorrect, especially with regard to flashing a skylight into a low-slope roof system.

Building owners and homeowners choose to incorporate skylights to brighten a space, but most do not understand how a skylight affects a roof system. Roof system designers and contractors need to be familiar with proper skylight and frame design and installation methods to ensure successful installations. 

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