Insurance Institute for Business & Home Safety®

Roofing the Right Way

Use this guidance to improve the long-term performance of your roof.

COMMERCIAL ROOFS

Best Practices Guide

The roof is a commercial building's first line of defense from natural hazards such as wind, rain, hail, ice, and snow. The roof is also the most vulnerable part of every building. Weather events seem to be getting more extreme every year, and if your roof is compromised during a severe weather event, it could sustain costly damage requiring repairs or even replacement. This guide provides best practices for commercial buildings to resist damage to roofs from thunderstorms, hail events, winds at the edges of tornadoes, hurricanes, other high-wind events, wildfire, and severe winter weather.

Both low-sloped and steep-sloped roofs are addressed, and recommendations are provided for roof covers, roof-mounted equipment, photovoltaic systems, skylights, roof designs, sealing roof decks to prevent water intrusion, and other roof-related topics designed to help reduce potential damage. Approved products provide a known performance, so IBHS recommends the use of products that have been tested and approved by a certified testing facility, when available.

Also included in this guide is information about selecting a qualified licensed or bonded roofing contractor. Proper installation directly impacts a roof's long-term performance, so it is important to choose the right contractor. Take the time to check the contractor's references and their insurance coverage for general liability insurance or professional liability insurance and talk to the contractor about your expectations.

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HAIL

ROOF COVERS

Impact-Resistance Standards Background

UL 2218 is a test standard developed by Underwriters Laboratories for assessing the impact resistance of flexible roofing products. Testing involves dropping steel balls of varying sizes from heights designed to simulate the energy of falling hailstones. Class 4 indicates the product was still functional after being struck twice in the same spot by 2-in. steel balls. Note: This standard is appropriate for flexible roofing products like asphalt shingles, and metal panels or metal shingles. Class 4 rated products should be used.

It should be noted that while impact-resistant metal roofs have good impact resistance and are likely to survive hailstones without functional damage, metal roofs can be vulnerable to aesthetic damage since hail can cause permanent indentations in the roofing panels. Use of metal roofing products with granular coatings may reduce the visibility of small indentations.

FM 4473 is a test standard administered by FM Approvals and is a test that is similar to UL 2218, but instead of using steel balls, frozen ice balls are used. The FM 4473 test standard is used on rigid roof covering materials (like concrete tile, clay tile, or slate) and involves firing the ice balls from a sling or air cannon at the roof-covering product. A Class 3 rating indicates the product was still functional after being struck twice in the same spot by a 1 ¾-in. ice ball; a Class 4 rating requires the product to still be functional following 2 impacts in the same spot with 2-in. ice balls. Clay and concrete roof tiles should meet either a Class 3 or Class 4 impact rating. Class 4 rated products are preferred.

The IBHS Impact Resistance Test Protocol for Asphalt Shingles was developed by IBHS in 2019. Like the FM 4473 test, it utilizes frozen ice balls, but in this case, they match the characteristics of real hailstones gathered from the field. The ice balls are propelled at speeds necessary to simulate the energy of falling hailstones, but the energies are updated from the values used by the FM 4473 test to reflect new science. The IBHS method relies on a damage assessment tool using photographs and artificial intelligence to quantify various damage states—such as dents, tears, and granule loss—and provides a performance evaluation rating ranging from Poor to Excellent. When using UL 2218 or FM 4473 impact-resistant asphalt shingles, it is recommended to choose a product that is also rated Good or Excellent on the IBHS rating list.

FM 4470 is an all-encompassing approval standard for low-slope roof assemblies (roof cover, insulation, and deck) and includes multiple test and performance requirements including hail damage resistance, exterior/interior combustibility, wind uplift, and other requirements. This minimum hail damage resistance is Moderate Hail (MH) resistance. IBHS recommends a hail damage resistance of Severe Hail (SH) for hail-prone areas.

Hail-resistant roof covers located in hail-prone areas should meet one of the following standards:

Roof covers for flat and low-sloped roofs (≤ 14° or ≤ 3/12 pitch):

- FM Approvals Standard 4470 with a Class 1-SH
- UL 2218 Class 4

Roof covers for steep-sloped roofs (> 14° or > 3/12 pitch):

- UL 2218 Class 4 (for asphalt shingles, Good or Excellent performance from the IBHS ratings is preferred)
- FM Approvals Standard 4473 Class 3 or Class 4 (Class 4 is preferred; for asphalt shingles, Good or Excellent performance from the IBHS ratings is preferred)

ROOF-MOUNTED EQUIPMENT

Hail guards should be provided for air conditioner condenser fins, air intakes such as fans, and any other vulnerable component that, if struck by hail, can impair the operation of the unit.

PHOTOVOLTAIC SYSTEMS

For photovoltaic (PV) system hail protection, the following is recommended:

- Rigid PV modules that are FM Approved for hail or meet FM Approvals Standard 4478 that include a Class 4 rating.
- Flexible PV modules that are FM Approved for hail or meet FM Approvals Standard 4476 that include a Severe Hail rating.
- Rigid modules that meet UL 1703 Flat-Plate Photovoltaic Modules and Panels.

SKYLIGHTS

For protection against hail, skylights should meet at least one of the following rating requirements:

- ASTM E1886 cyclic pressure test requirements and be ASTM E1996 missile impact rated “B”, “C”, “D”, or “E”.
- FM Approved per ANSI/FM 4431 with Severe Hail rating.
- Current Miami-Dade County Approved (MDCA) Notice of Acceptance including impact resistance.

WIND

HURRICANE-PRONE AREAS VS. HIGH-WIND-PRONE REGIONS

Hurricane-prone regions are areas vulnerable to hurricanes as defined in American Society of Civil Engineers) “Minimum Design Loads for Buildings and Other Structures” (ASCE 7).

- For ASCE 7-05: hurricane-prone regions are locations along the Gulf of Mexico and Atlantic coasts where the design wind speed is greater than 90 mph, plus Hawaii, Puerto Rico, the Virgin Islands, Guam, and American Samoa.
- For ASCE 7-10 and ASCE 7-16: hurricane-prone regions are locations along the Gulf of Mexico and Atlantic coasts where the wind speed for Risk Category II buildings is greater than 115 mph, plus Hawaii, Puerto Rico, the Virgin Islands, Guam, and American Samoa.

High-wind-prone regions are areas NOT located in a hurricane-prone region.

WIND DESIGN PARAMETERS

Flat and low-sloped roof cover systems such as built-up roof, modified bitumen, single-ply, and structural metal panel roof systems should be designed using an additional safety factor based on the appropriate wind pressures of ASCE 7 for the field, perimeter, and corners.

WIND DESIGN ADDITIONAL FACTOR OF SAFETY

The minimum required factor of safety should be 2.0 for ASCE 7-05 and ASCE 7-10, and 1.67 for ASCE 7-16 based on allowable stress design (ASD) loads, unless a higher factor of safety is required for a particular assembly, system, element, fastener, or connection. The ultimate strength of the building assembly, element, fastener, or connection should meet or exceed the load on that assembly, element, fastener, or connection using one of the following calculated wind loads:

1. ASCE 7-05 ASD Method: Calculated ASD wind load x 2 (minimum required factor of safety)
2. ASCE 7-05 Load and Resistance Factor Design (LRFD) Method: Calculated LRFD wind load/1.6 x 2 (minimum required factor of safety)
3. ASCE 7-10 ASD Method: Calculated ASD wind load x 2 (minimum required factor of safety)
4. ASCE 7-10 LRFD Method: Calculated LRFD wind load x 0.6 x 2 (minimum required factor of safety)
5. ASCE 7-16 ASD Method: Calculated ASD wind load x 1.67 (minimum required factor of safety)
6. ASCE 7-16 LRFD Method: Calculated LRFD wind load

LOW-SLOPE CONTINUOUS ROOF COVERS

IBHS recommends the use of products that have been tested and approved by a certified testing facility. Approved products provide a known performance. Low-sloped roof covers should have one or more of the following product approvals with the adjustments in design/allowable pressures outlined in the wind design additional factor of safety section above.

- Florida Product Approval (FPA) approved
- FM Approved
- ICC-Evaluation Services (ICC-ES) approved
- Miami-Dade Approved
- Texas Department of Insurance (TDI) approved
- UL Rated

ADDITIONAL SINGLE-PLY MEMBRANE RECOMMENDATIONS

Peel-Stop: Single-ply roof covers should include a perimeter peel-stop with a termination bar or similar, located 1–2 ft from the roof edge. Mechanically attached systems with fasteners 1–2 ft from the roof edge would not require an additional peel-stop.

Mechanically Attached – SPM On Steel Decks: Mechanically attached membranes should have their sheets and fasteners installed perpendicular to the steel deck ribs.

Ballasted, Roof Pavers, and Pedestal Systems:

In hurricane-prone regions, stone ballast, roof pavers for ballast applications, plaza decks or terrace pavers should not be used. This includes loosely laid, interlocked, mechanically connected, and all pedestal systems.

In high-wind-prone regions, stone ballast, roof pavers for ballast applications, plaza decks or terrace pavers should meet the minimum uplift requirements as defined in the wind design additional factor of safety section above and should be installed in accordance with FM Data Sheet 1-29 and ANSI/SPRI RP-4.

STRUCTURAL AND ARCHITECTURAL METAL ROOF PANEL SYSTEMS

Structural metal panel roof systems on spaced supports and nonstructural architectural metal roof panels on solid wood sheathing should meet one of the following approvals with the adjustments in design/allowable pressures outlined in the wind design additional factor of safety section above.

- Florida Product Approval (FPA)
- FM Approved
- ICC-Evaluation Services (ICC-ES)
- Miami-Dade Approved
- Texas Department of Insurance (TDI)
- UL Rated

VEGETATIVE ROOF SYSTEMS

Vegetative roof systems should NOT be installed in hurricane-prone regions. This includes intensive, simple intensive (semi-intensive), and extensive green roof systems.

In high-wind-prone regions, only extensive and simple intensive (semi-intensive) vegetative roof systems with an active FM RoofNav number or Miami-Dade NOA should be used. Extensive vegetative roofs have growth less than 6 in. in depth and simple intensive (semi-intensive) vegetative roofs have growth from 6 to 8 in. in depth.

BUILT-UP ROOFING SYSTEMS

Built-up roofing systems with pea-size, loosely laid gravel should not be used in hurricane-prone regions. Built-up roofing systems with pea-size gravel that is fully embedded in asphalt can be used.

STRUCTURAL DECK

Structural roof deck should be capable of resisting the loads and load combinations specified in ASCE 7 as outlined in the wind design parameters section above. Structural roof deck attachments should be designed for field, perimeter, and corner component and cladding wind pressures requirements of ASCE 7 for the building location with the adjustments in design/allowable pressures outlined in the wind design additional factor of safety section above.

ROOF EDGE FLASHING, COPING, AND COUNTERFLASHING

Edge flashing, coping, and counterflashing should comply with ANSI/SPRI/FM4435/ES-1 for the site-specific ASCE 7 design pressures.

SKYLIGHTS

Skylights and their attachments should be designed and detailed for the ASCE 7 wind speed and provide an uplift resistance with a minimum factor of safety as described in the wind design resistance section above. Installation should meet the air and water infiltration requirements of ASTM E330 and ASTM E331. The curb installation should meet the required uplift minimum resistance with a minimum factor of safety as described in the wind design resistance section above.

For hurricane-prone regions, the skylights should meet AAMA 520-12 and should meet one of the following:

- ASTM E1886 cyclic pressure test requirements and ASTM E1996 large missile impact rated “C” or “D”.
- FM Approved per ANSI FM 4431 and FM 4350 with large missile impact rating.
- Miami-Dade County Approved (TAS 201 and TAS203) with large missile impact rating.

GUTTER SYSTEMS

Gutter systems consisting of gutters, gutter straps, gutter brackets, joints, fasteners, and roof flanges should be designed in accordance with ANSI/SPRI GD-1 (2010) or ANSI/SPRI GT-1 (2016) with the additional factor of safety described in the wind design resistance section above.

Notes:

- ANSI-SPRI GD-1 document includes a minimum factor of safety of 1.67 (see section 2.0 of ANSI-SPRI GD-1). A minimum 2.0 factor of safety is recommended as described in the wind design resistance section above.
- ANSI-SPRI GT-1 document does not include a minimum factor of safety. A minimum 2.0 factor of safety is recommended as described in the wind design resistance section above.

ROOF-MOUNTED STRUCTURES & EQUIPMENT

Roof-mounted structures and equipment and their attachments should be designed in accordance with ASCE 7-10 Section 29.5.1 “Rooftop Structures and Equipment for Buildings with h ≤ 60 ft” or ASCE 7-16 Section 29.4 “Rooftop Structures and Equipment for Buildings.” They should be designed with a minimum factor of safety 2.0 for ASCE 7 ASD loads (1.67 for ASCE 7-16 based ASD design loads) as described in the wind design resistance section above.

PHOTOVOLTAIC (PV) SYSTEMS

Roof-mounted ballasted photovoltaic (PV) systems are not recommended in hurricane-prone areas. However, if ballasted systems are selected, they should be designed using an additional safety factor as described above for structurally attached systems. PV systems and their attachments should be designed using wind loads in accordance with ASCE 7-16, SEAOC PV2, or a model-scale wind tunnel study that meets the requirements of ASCE 49-12. A minimum factor of safety as described above is recommended. The roof deck should be designed to support the increased PV array loads with appropriate load combinations, including live loads, wind, rain, and snow (including drifts).

Or PV should meet one of the following tested and approved systems:

- Rigid PV modules that are FM Approved or meet FM Approval Standard 4478 (wind uplift, combustibility from above the deck).
- Flexible PV modules that are FM Approved or meet FM Approval Standard 4476.
- PV system with an ICC AC 428 Evaluation Report.

While this document focuses on wind loads and hail risks for PV systems, IBHS strongly recommends that all additional building risks be addressed including: the increased combustibility from above the deck, which may lead to re-classification of the exterior fire rating of the roof cover system; snow, hail, seismic, electrical, and fire hazards; and firefighting hazards. Periodic inspection, maintenance, and repair should include the prevention of roof cover puncturing, debris accumulation, and proper water-shedding of the roof cover to allow drainage, which will prevent overloading of the roof. The use of a cover board is recommended in new roof cover systems to increase puncture resistance. Best Practices: When installing PV panels on a low-sloped roof, ensure the row spacing between the panels is wide enough for maintenance crews to service damaged panels. If the panels are installed too close together, perimeter panels may need to be removed to access interior ones.

STEEP-SLOPED WOOD DECK ROOF DESIGN FOR GREATER WIND RESISTANCE

RE-NAILING A WOOD ROOF DECK

IBHS research has found that the use of staples and minimum size nails allowed in older building codes, regardless of the spacing, are inadequate to keep a roof from lifting up in high winds. This is particularly true along trusses and rafters in the middle of the roof sheathing panels, where it has been common practice to space fasteners 12 in. apart.

When an old roof cover and underlayment is torn off, it's easy to inspect the existing fasteners and to install additional nails to strengthen the roof deck attachment. IBHS recommends installing ring-shank nails, if additional nails are required to strengthen the roof deck attachment.

Generally, if nails fastening the roof deck to the roof framing below are smaller than 8d common nails or if staples were used, 8d ring-shank nails should be added at 4 in. o.c. (for roof heights less than 30 ft tall and a roof square footage less than 5,000 sq ft). For roofs with heights greater than 30 ft and a roof square footage of greater than 5,000 sq ft, engineering analysis should be conducted.

If local code requires more fasteners, use the more stringent design.

SEALING THE ROOF DECK AGAINST WATER INTRUSION

The roof deck should be "sealed" to prevent water intrusion. Typical felt underlayment is not sufficient. The following options provide more specific information on underlayment systems that "seal the roof deck."

FOR SHINGLE OR METAL ROOF COVERS

Sealed Roof Deck: Option 1

Tape roof seams between roof sheathing. There are two material options for taping the seams on the roof deck.

Material Option 1: Apply an ASTM 1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4 in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Material Option 2: Apply an AAMA (American Architectural Manufacturers Association) 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape at least 3¾ in. wide directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck should be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer's recommendations for installation and primer requirements (if applicable).

Next, apply an ASTM D226 Type II (#30) or ASTM D4869 Type IV (#30) underlayment over the self-adhering tape. As an alternative, apply a reinforced synthetic roof underlayment which has an ICC approval as an alternate to ASTM D226 Type II felt paper. The synthetic underlayment should have a minimum tear strength of 15 lbf in accordance with ASTM D4533 and a minimum tensile strength of 20 lbf/in. in accordance with ASTM D5035. These underlayments should be attached using annular-ring or deformed-shank roofing fasteners with minimum 1-in.-diameter caps (button cap nails) at 6 in. o.c. spacing along all laps and at 12 in. o.c. vertically and horizontally in the field, or a more stringent fastener schedule if required by the manufacturer for high wind and prolonged exposure installations. Horizontal laps should be a minimum of 4 in. and end laps should be a minimum of 6 in.

Caution: Be sure to check product labelling carefully. Not all products labelled ASTM D4869 are Type IV. Look for ASTM D4869 felt that is labeled Type IV. The use of ASTM D4869 Type I, Type II, or Type III is not recommended.

Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the underlayment at the eaves. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness ⅛ in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See Section 3.1.3.4 for further drip edge installation requirements.
- Lap underlayment with minimum 6-in. leg "turned up" at wall intersections; lap wall weather barrier over turned-up roof underlayment.

Figure 1. Installing a sealed roof deck system; taping the seams of roof sheathing.

Sealed Roof Deck: Option 2

Cover the entire roof deck with a full layer of self-adhering polymer-modified bitumen membrane meeting ASTM D1970 requirements. This approach provides a waterproof membrane over the entire roof and can greatly diminish the potential for leaks. In some instances, the ability of the self-adhered membranes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where membrane adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels to ensure the proper attachment of the self-adhering membrane to the sheathing. Also, roofers are finding that shingles are bonding to many of these self-adhered membranes and this could lead to damage of the sheathing when it comes time to replace the shingles. Consequently, the membrane should be covered with a bond break such as a #15 ASTM D226, Type I underlayment. This underlayment on shingle roofs only needs to be fastened well enough to keep it on the roof surface and provide safety to the roofers until the shingles are applied.

Notes: For asphalt shingle installations, hold bond break material back 8 in. from roof edges to allow mastic and starter strip or self-adhered starter strip to be applied directly to drip edge. Additionally, manufacturers emphasize the need for adequate attic ventilation when this type of membrane is applied over the entire roof. Check with the local building department for restrictions.

Installation Notes:

- Best practice for drip edge installation at eaves: Install drip edge on top of the underlayment. Make sure the top surface of the drip edge is cleaned, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roof installations, seal the drip edge, underlayment, and starter strip at the eave by either using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness ⅛ in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge. See the drip edge section below for further drip edge installation requirements.
- Lap underlayment with minimum 6-in. leg "turned up" at wall intersections; lap wall weather barrier over turned-up roof underlayment.

Sealed Roof Deck: Option 3

Install two (2) layers of ASTM D226 Type II (#30) or ASTM D4869 Type IV (#30) underlayment in a shingle-fashion, lapped 19 in. on horizontal seams (36-in. roll), and 6 in. on vertical seams.

Caution: Be sure to check product labelling carefully. Not all products labelled ASTM D4869 are Type IV. Look for ASTM D4869 felt that is labeled Type IV. The use of ASTM D4869 Type I, Type II or Type III is not recommended.

The starter course of felt is to be installed as described below and shown in Figure 2. Cut 17 in. off one side of the roll and install the remaining 19-in.-wide strip of underlayment along the eave, safely tacked in place. Carefully install a 36-in.-wide roll of ASTM D226 Type II (#30) or ASTM D4869 Type IV (#30) underlayment over the 19-in.-wide course of ASTM D226 Type II (#30) or ASTM D4869 Type IV (#30) underlayment along the eave. Follow the same procedure for each course, overlapping the sheets 19 in. (leaving a 17-in. exposure). Fasten the bottom edge of the roll (eave edge or horizontal lap) with a row of annular-ring or deformed-shank nails with 1-in.-diameter caps at 6 in. o.c. Since the bottom edge (horizontal lap) of the next underlayment layer will be fastened approximately 19 in. above the horizontal lap below, install a row of annular-ring or deformed-shank nails with 1-in.-diameter caps with 12-in. o.c. horizontal spacing about 10 in. above the bottom lap. When the installation is completed, the resulting fastening of the two (2) layers of felt should consist of the same fasteners at approximately 6 in. o.c. along all laps and at not more than 12 in. o.c. in the field of the sheet between the side laps. Add fasteners along any exposed vertical laps so that the maximum spacing between fasteners is 6 in. o.c. Use annular-ring or deformed-shank nails with 1-in.-diameter thin metal disks (“tincaps”).

Installation Notes:

- Best practice for drip edge installation: Install the drip edge on top of the double layer of underlayment at the eaves. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the starter strip manufacturer, primed with ASTM D41 primer. For shingle roofs, seal the drip edge, underlayment, and starter strip at the eave by using a self-adhering starter strip or applying an 8-in.-wide layer of compatible flashing cement, maximum thickness ⅛ in., over the drip edge and adjacent underlayment. For metal roof covers, apply a compatible manufacturer-approved sealant between the drip edge and adjacent underlayment to prevent water from accumulating under the drip edge.
- Lap underlayment with minimum 6-in. leg “turned up” at wall intersections; lap wall weather barrier over turned-up roof underlayment.

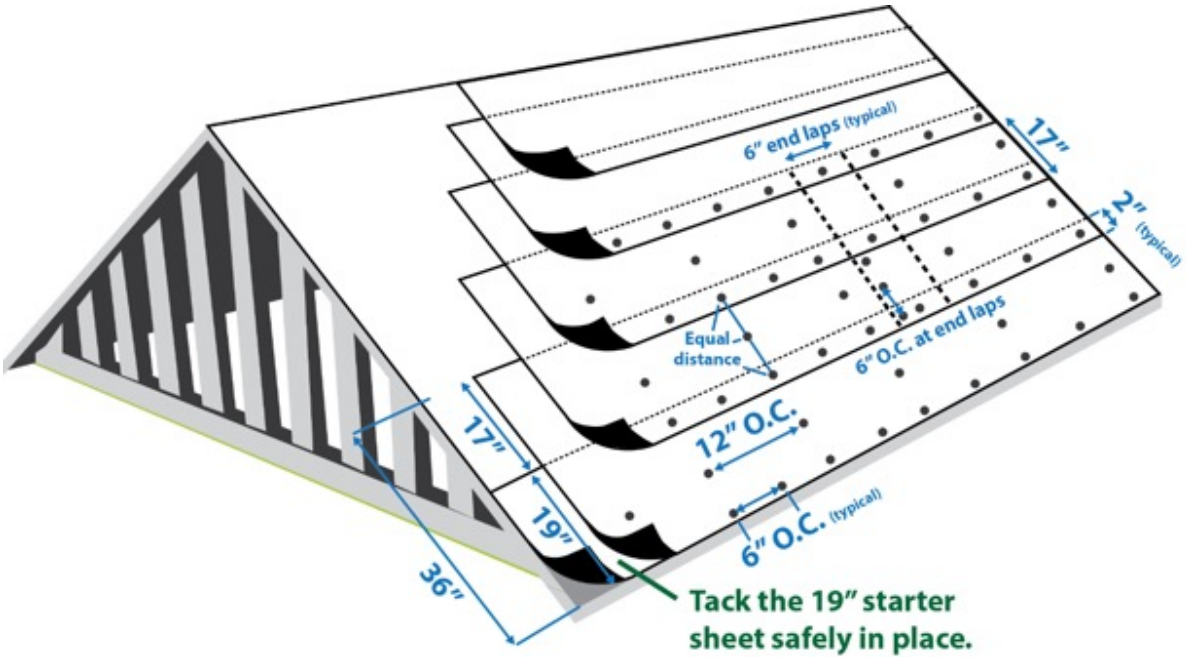

Figure 2. Installation of 19 in. starter course general notes.

FOR CONCRETE AND CLAY TILE ROOF COVERS

The following options qualify as sealed roof decks under clay and concrete roof tiles. In option 1, the self-adhering tape provides a barrier against water intrusion in case the roofing felt begins to lift.

Sealed Roof Deck: Option 1

Tape seams between roof sheathing that forms the roof deck. There are two material options for taping the seams on the roof deck.

> **Material Option 1:** Apply an ASTM D1970 compliant self-adhering polymer-modified bitumen flashing tape, at least 4 in. wide, directly to the roof deck to seal the horizontal and vertical joints in the roof deck.
>
> **Material Option 2:** Apply an AAMA 711-13, Level 3 (for exposure up to 80°C/176°F) compliant self-adhering flexible flashing tape at least 3¾ in. wide directly to the roof deck to seal the horizontal and vertical joints in the roof deck.

Any flashing tape used to achieve a sealed roof deck should be fully adhered without voids (e.g., wrinkles) in order to be accepted. In some instances, the ability of self-adhered flashing tapes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where flashing tape adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels where the tape will be applied to ensure the proper attachment of the self-adhering tape to the sheathing. Do not nail or staple the tape to the roof sheathing. Refer to the manufacturer's recommendations for installation and primer requirements (if applicable).

Next, apply a #30 ASTM D226 Type II underlayment/anchor sheet over the self-adhering tape. Attach the underlayment/anchor sheet using annular-ring or deformed-shank roofing fasteners with minimum 1-in.-diameter metal caps at 6 in. o.c. spacing along all laps and at (2) rows in between side laps at a maximum of 12 in. o.c. or a more stringent fastener schedule if required by the manufacturer for high-wind use as an anchor sheet. Horizontal laps should be a minimum of 4 in. and end laps should be a minimum of 6 in.

Finally, apply an approved self-adhering polymer-modified bitumen roof tile cap sheet complying with ASTM D1970 that meets the site design wind speeds over this underlayment - OR- hot-mop an approved tile underlayment over the underlayment/anchor sheet using hot asphalt.

Installation Notes:

- Best practice for drip edge installation at eaves: Install the drip edge on top of the ASTM D226 Type II underlayment but under the self-adhering ASTM D1970 cap sheet. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the membrane manufacturer, primed with ASTM D41 primer so that the self-adhering cap sheet adheres to the top of the drip edge. See the drip edge section below for further drip edge installation recommendations.
- Lap underlayment with minimum 6-in. leg "turned up" at wall intersections; lap wall weather barrier over turned-up roof underlayment.

Sealed Roof Deck: Option 2

Cover the entire roof deck with an approved self-adhering polymer-modified bitumen underlayment complying with ASTM D1970 installed in accordance with both the underlayment manufacturer's and roof covering manufacturer's installation instructions for the deck material, roof ventilation configuration, and climate exposure for the roof covering to be installed. In some instances, the ability of the self-adhered membranes to adhere to oriented strand board (OSB) sheathing may be compromised by the level of surface texture or wax used in fabricating the OSB panels. In applications where membrane adhesion to OSB is marginal, apply a manufacturer-specified compatible primer to the OSB panels to ensure the proper attachment of the self-adhering membrane to the sheathing.

Note: Some local building departments prohibit the use of this system. Check with the local building department for restrictions. Manufacturers emphasize the need for adequate attic ventilation when this type of membrane is applied over the entire roof. This is particularly important north of the North Carolina/South Carolina border.

Installation Notes:

- · Best practice for drip edge installation at eaves: Install the self-adhered underlayment over the drip edge. Before installing the drip edge, prime the roof deck with a compatible primer or install a separator sheet that extends 2 in. past the deck flange of the drip edge. Make sure the top surface of the drip edge is clean, free of oil, and, if required by the membrane manufacturer, primed with ASTM D41 primer so that the self-adhering membrane adheres to the top of the drip edge. See drip edge section below for recommendations.
- Lap underlayment with minimum 6-in. leg "turned up" at wall intersections; lap wall weather barrier over turned-up roof underlayment.

DRIP EDGE (EDGE FLASHING)

Provide a minimum 26-gauge galvanized metal drip edge along all eaves and gable rake edges. Overlap drip edge at joints a minimum of 3 in. Eave drip edges should extend ½ in. below the bottom of the sheathing and extend back on the roof a minimum of 2 in. Drip edges should be mechanically fastened to the roof deck at maximum of 4 in o.c. Mechanical fasteners should be applied in an alternating (staggered) pattern along the length of the drip edge with adjacent fasteners placed near opposite edges of the leg/flange of drip edge on the roof. Drip edge should be installed **OVER** the underlayment along gable rake edges and at eaves it should follow the best practices guidance outlined above for the sealed roof deck option and roof cover selected.

FLASHING (ALL NON-EDGE FLASHING APPLICATION)

Steep-sloped flashings are used to weatherproof or seal roof system edges at perimeters, penetrations, walls, expansion joints, valleys, drains, and other places where the roof covering is interrupted or terminated. Flashings should be installed in a manner that will prevent moisture from entering the wall or roof, or through moisture-permeable materials at intersections or other penetrations through the roof plane.

The non-edge flashing installation should meet the requirements found in the 2018 IBC and the product manufacturer's installation instructions.

STEEP-SLOPE ROOF COVERINGS

Choosing and Installing High-Wind-Rated Shingles

The ASTM shingle testing standards and classification system, not the advertised warranty period and warranty wind speed for the shingles, will determine which shingles are best suited for the wind speeds in your area.

For optimal protection from high wind, choose shingles that have an ASTM D7158 Class H or ASTM D3161 Class F wind rating.

For improved hail protection, select a product that has a UL 2218 or FM 4473 Class 4 impact rating. Note: If you live in a wildfire-prone area, make sure the shingles also include a UL or ASTM Class A fire rating. Asphalt shingles, along with tile and metal roof coverings, are widely available with a Class A fire rating.

Shingles should be installed in accordance with the manufacturer's instructions for high-wind installation, using the number of nails in the locations required by the manufacturer for high-wind fastening. In areas where the local building code requires more fasteners than are required by the manufacturer, fasteners should comply with the local building code.

Installation of Starter Strips at Eaves: Manufacturer-approved starter strips at eaves should be installed on an approved sealed roof deck with the drip edge conforming to the recommendations of the sealed roof deck section. The starter strip should be either:

1. Set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement should be ⅛ in. Fasten starter strips parallel to the eaves along a line above the eave line according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed under the cutouts in the first course. Starter strips and shingles should not extend more than ¼ in. beyond the drip edge.
2. Shingle manufacturer-approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at eave—installed so that starter strip adheres to and covers the drip edge top surface.

Installation of Shingles at Gable Rakes (Drip Edge Installed Over Underlayment): Shingles installed at gable rake edges should be installed according to one of the following three options:

1. Shingles at rakes should be set in a minimum 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing should be ⅛ in. Fasten shingles at rakes according to the manufacturer's specifications.
2. Manufacturer-approved starter strips at rakes should be set in an 8-in.-wide strip of compatible flashing cement. Maximum thickness of flashing cement should be ⅛ in. Fasten starter strips parallel to the rakes according to the manufacturer's specifications. Position fasteners to ensure they will not be exposed. Starter strips and shingles should not extend more than ¼ in. beyond the drip edge.
3. Shingle manufacturer-approved ASTM D1970 fully adhered (peel-and-stick) starter strip with asphaltic adhesive strip at rake—installed so that starter strip adheres to and covers the drip edge top surface. Starter strips and shingles should not extend more than ¼ in. beyond the drip edge.

Attachment of Shingles at Intersections and Valleys: Shingles installed at all intersections and both sides of open valleys should be set in a minimum 8-in.-wide strip of flashing cement. Maximum thickness of flashing cement should be ⅛ in. Cut side of closed valleys should be set in a minimum 2-in.-wide, ⅛-in.-thick strip of flashing cement. Woven valleys to be according to the manufacturer's specifications.

Clay and Concrete Roof Tiles Wind Resistance

Clay and concrete roof tile systems and their attachment should meet the requirements of the site design wind speed and exposure category. Clay and concrete roof tiles should be installed in accordance with the manufacturer's product approval for the site design wind speed, roof height, and Exposure Category. FRSA/TRI installation guidelines, "Florida High Wind Concrete and Clay Tile Installation Manual Fifth Edition, Revised, FRSA/TRI April 2012 (04-12)" provide additional guidance for installation incorporating ASCE 7-10 wind loads for mechanically attached tile. Roof tiles may be installed with roof tile adhesives that are recognized and installed in accordance with an ICC-ES Evaluation Report, a Florida Product Approval, a Miami-Dade County Notice of Acceptance (NOA), or a Texas Department of Insurance (TDI) Evaluation Report. Mortar set tile or mortar set hip and ridge tiles should not be permitted. Hip and ridge boards or metal should be attached to the roof framing to resist the uplift pressure for the site design wind speed and exposure or in accordance with the tile manufacturer's product approval. Hip and ridge tiles should be secured to the hip and ridge boards or metal with mechanical fasteners and/or an approved roof tile adhesive.

ASCE 7-16 wind loads are not addressed in the FRSA/TRI Installation (Fifth Edition Revised) guidelines. In jurisdictions that require ASCE 7-16 wind loads, follow the tile manufacturer installation guidance and product approvals for the design wind pressures, and, if the roof tile is installed with adhesives, the adhesive manufacturer's product approval for those wind pressures.

The clay and concrete tiles should be installed over minimum 15/32-in.-thick plywood and one of the acceptable sealed roof deck underlayment options outlined above.

Note: FRSA/TRI Installation guidelines, "Florida High Wind Concrete and Clay Roof Tile Installation Manual Fifth Edition Revised, FRSA/TRI April 2012" are available for purchase from the Tile Roofing Institute or the Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.

Architectural metal panels wind resistance requirement

Metal panel roofing systems and their attachments should be installed in accordance with the manufacturer's installation instructions and should provide uplift resistance equal to or greater than the design uplift pressure for the roof based on the site design wind speed and exposure. For high-wind consideration, a minimum 110 mph Vasd/140 mph Vult is appropriate. The metal panels should be installed over continuous decking and one of the acceptable sealed roof deck underlayment options.

It is highly recommended to select a structural metal panel roof system on spaced supports and nonstructural architectural metal roof panels on solid wood sheathing with one of the following approvals:

- Florida Product Approval (FPA)
- FM Approved
- ICC-Evaluation Services (ICC-ES)
- Miami-Dade Approved
- Texas Department of Insurance (TDI)
- UL Rated

WILDFIRE

GUIDELINES FOR COMMERCIAL ROOFING IN WILDFIRE-PRONE AREAS

Wildfires in western states receive a lot of media attention, but the fact is wildfire risks exist in almost every state in areas the fire service calls the Wildland Urban Interface (WUI), which is where people and vegetation are located in close proximity. Commercial buildings often are located in suburban areas, with designated conservation/preservation areas in and around the complexes. This type of land use planning can create increased exposure to wildfire, especially in typically dry and drought-stricken areas. While direct exposure to wildfire flames and radiant heat can be the source of ignition, burning embers associated with wildfires can travel significant distances and land on roofs or be blown into vents, resulting in substantial property damage.

COMMERCIAL ROOF COVER—EXTERNAL FIRE RATINGS

To address the level of roof cover protection provided against wildfire risks, fires from nearby buildings, and other external fire risks, roof covers are specifically rated as Class A, Class B, Class C, or unrated, based on testing to ASTM E108, UL 790 or FM 4470 standards. A roof cover system rated Class A (Figure 3) provides the best protection from wildfire or ember ignition, while an unrated roof is the most vulnerable.

For low-slope roofs, Class A–rated roof covers are very common and include testing and rating of the entire roof system assembly, which includes all materials present such as the roof cover, cover board, insulation, vapor or air barriers, and the type of deck. Examples of roof systems considered to be Class A regardless of the deck type include built-up roofing and ballasted single-ply membranes.

Common Class A roof coverings for steep-sloped roofs include asphalt fiberglass composition shingles, clay tiles, or steel. As with low-sloped roofs, some steep-sloped roof cover materials have a “by assembly” Class A fire rating, meaning additional materials should be used between the roof covering and the roof sheathing in order to attain the fire rating. Examples of steep-sloped roof coverings with a “by assembly” fire rating include aluminum, some fire-retardant wood shake products, and recycled plastic and rubber products.

Unrated roofs include non-fire-retardant-treated wood shakes or shingles. If a building has a wood shake roof and there is no available documentation that specifies the fire rating, the owner should assume it is unrated, although this can be verified by a professional roof inspection.

When repairing or replacing a commercial roof in a wildfire-prone area, be sure to use Class A fire rated roof coverings. Also, be sure to check whether the rating is “by assembly,” which means you will need additional materials between the roof covering and roof sheathing to attain the Class A fire rating.

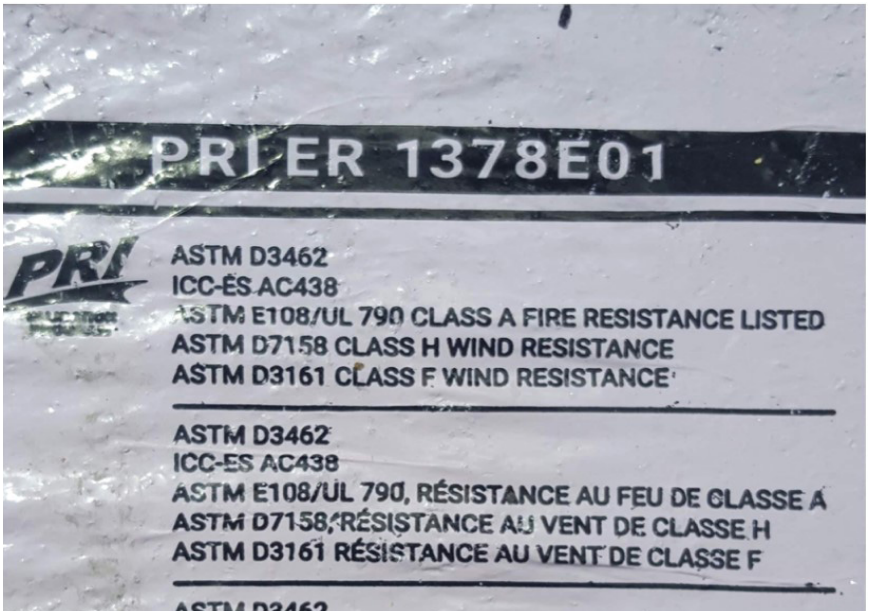

Figure 3. Class A Fire Resistance Label

SEVERE WINTER WEATHER

WEIGHT OF SNOW

- To include a factor of safety, the ground snow loads (pg) used to design the building should be 1.2 times the ground snow loads (pg) shown in ASCE 7 (or the locally adopted ground snow loads in case study areas).
- Flat roof snow loads should be calculated in accordance with ASCE 7-16 section 7.3 using the additional ground snow load safety factor of 1.2.
- Steep-slope roof snow loads should be calculated in accordance with ASCE 7-16 section 7.4 using the additional ground snow load safety factor of 1.2.
- During design or re-roofing, structural framing members should be designed or verified per a structural engineer using the most stringent loading combinations specified in ASCE 7.
- Existing roofs should be evaluated for increased snow loads caused by additions or alterations. If a higher roof is constructed within 20 ft, a structural engineer should verify the roof's capacity with the additional snow load produced per section 7.2 of ASCE 7-16.
- For existing buildings, hire a structural engineer to verify snow load threshold of the roofing system. After a winter weather event, conduct an assessment (visual and/or measurements) of the snow and ice equivalent as described in Figure 3. Compare the estimated loads to the loads determined by the structural engineer.
- After a winter weather event, conduct a visual assessment of the roof deck and framing members from below, looking for any signs of excessive deflections (sagging), moisture, deterioration, rotting or rusting, or any other damage. Consider hiring a licensed structural engineer to conduct an assessment, or if a self-assessment identifies any concerns.
- Under safe operating conditions, remove excessive snow. If self-removal is not a safe option, hire a professional.

SNOW DRIFTS AND SLIDING SNOW

- Snow drift loads should be calculated per ASCE 7 using the prescribed additional ground snow load factor of 1.2.
- Additional snow drift loads should be accounted for on both low- and steep-sloped roofs at all changes of elevations; this includes but is not limited to mechanical units, photovoltaics, elevator caps, communication equipment, and chimneys.
- For existing roofs, hire a structural engineer to calculate the weight of snow drifts and verify that the drift-prone regions are adequately supported by the structural framing.
- Per ASCE 7-16 section 7.10, rain loads on snow drifts should be considered.
- After a significant winter weather event, conduct an assessment (visual and/or measurements) of the snow drift and determine its weight as described in the diagram below. Compare the estimated loads to the snow drift loads determined by the structural engineer.

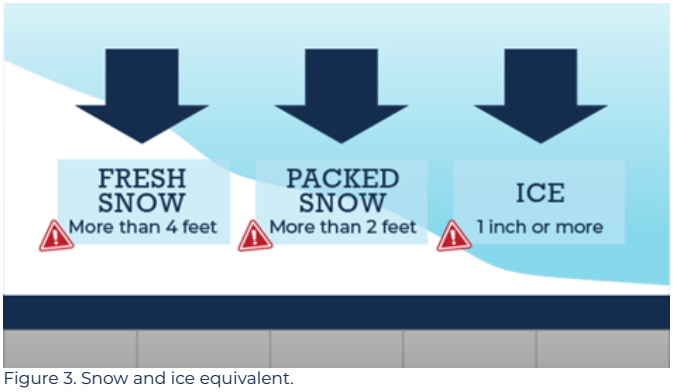

Figure 3. Snow and ice equivalent.

- Install snow guards or snow cleats to reduce snow sliding on steep-sloped roofs. Refer to the manufacturer's guidance for sizing and spacing depending on the commercial building's site-specific conditions.
- Under safe operating conditions, remove excessive snow. If self-removal is not a safe option, hire a professional.

HEAVY RAIN ON SNOW

- Buildings with low-sloped roofs and bays susceptible to water ponding should be adequately evaluated by a licensed engineer for the additional loads and mitigated if necessary.

MELTING SNOW AND REFREEZING

- Remove all debris and other items from roof drainage systems that prevent drainage of water from the roof during the melting process.
- If large temperature swings are in the forecast, consider hiring a contractor to remove excess snow from the roof to minimize the quantity of ice produced during the re-freeze stage.

HOW TO HIRE A COMMERCIAL ROOFING CONTRACTOR

Hiring a commercial contractor can be a daunting task. Recognizing this challenge, IBHS recommends the list below to help business owners make informed decisions about choosing a dependable roof contractor with a track record for ethical business practices and quality work.

BID SOLICITATION AND CONTRACTOR SELECTION

Once you have asked and answered the basic questions about potential contractors, you should solicit several bids before making a selection. Whether this is done through a formal RFP process or more informally, be sure to request the following information from all contractors:

Supporting documents to demonstrate the contractor has a clear understanding of the purpose, services, scope, and objectives of the roof project, including:

- Statement of work, legal terms, and conditions.
- Project schedule to show duration of major activities, critical elements and milestones necessary to complete the work.
- Site utilization diagram showing construction.
- Detailed manufacturer specifications of the roof cover system to be installed, including testing information or nationally recognized approvals that the system may have received, such as from Miami-Dade, Florida Product Approvals, Texas Department of Insurance, UL, FM Approvals, etc.
- Site utilization diagram showing construction activities to be conducted within the property.
- A plan describing strategies for addressing quality control, methodology for coordination of materials delivery, temporary storage, and installation.
- A plan for bad weather that may alter the project schedule, along with an emergency plan for locations subject to severe weather during the installation period. This should include securing or removal of any loose materials on the site.

SAFETY CONCERNS

- Verify that a designated qualified safety representative who is charged with the responsibility of safety management for the project will be on-site throughout the project.
- Ensure there are written safety plans for the work to be conducted, including compliance with all Occupational Safety & Health Administration (OSHA) requirements for roof work and fall protection.
- Often times, roof cover systems may be installed or repaired using torch application. If not properly conducted, this can cause a fire hazard. It is recommended that a written hot work program should be implemented for any cutting, welding, torching, brazing, or any introduction of a flame-involved process in order to protect against the significant risk of fires during installation.

SELECTION PROCESS

While it is tempting to go with the lowest cost bid, all of the above considerations should be included in the decision process. When evaluating the bids, it is important for the business owner to have a clear understanding of the capabilities of the potential contractor, and the contractor needs to fully understand the parameters of the job. The key is to avoid any miscommunication that could lead to a roof system that does not meet expectations.

If possible, try to have major roof work done when the weather is appropriate for this type of activity. Roof work in hurricane-prone regions can be difficult during hurricane season, and in the northern part of the United States, cold or snow can interfere with the installation process. Be aware that some roof cover systems require a certain temperature for proper installation, so the scheduling should account for expected and unexpected weather. Your contractor can provide more information.

For more information on selecting a Professional Roofing Contractor see: http://staticcontent.nrca.net/consumer/low.pdf

UNDERSTANDING WARRANTIES

Standard warranties are available from the roof manufacturer and the installing contractor that typically include coverage for workmanship, defects, etc. Pay close attention to what the warranty does and does not include, particularly what is contained in the "Terms, Conditions, and Limitations" section, which may reference specific wind speeds, types of weather, or "Acts of God." Additionally, it is important to be aware of the "Exclusions" section. Wind warranties may also be available to address damages relating to wind, which are typically excluded from the standard warranty.

CONTRACTOR HIRING CHECKLIST

This checklist is intended to help you make informed decisions about choosing a dependable roofing contractor with a track record for ethical business practices and quality work.

- ☐ Look for a well-established, licensed and bonded roofing professional with a federal tax identification number and a permanent address.
- ☐ Check references that specifically include other commercial buildings in your area.
- ☐ Contact your local Better Business Bureau to check for complaints filed against the company.
- ☐ Ask to see the company's certificates of insurance. Make sure its coverage for liability and workers' compensation insurance is current.
- ☐ Discuss available material warranties from the manufacturer and installation warranties from the contractor.
- ☐ Check to see if the company is a member of a roofing industry organization that provides continuing education and up-to date information about roofing trends and developments.
- ☐ Obtain several bids for services.