REROOFING

When roof maintenance and roof repair can no longer prevent recurrent leakage or extend a roof system's useful service life, consideration needs to be given to reroofing—that is, roof re-covering or roof removal and replacement. Reroofing should also be considered in other situations, including the following:

- Repair expenditures become excessive
- Leakage becomes intolerable
- Maintenance no longer is able to address leakage
- Damage is occurring to structural components
- Damage is occurring to building contents
- Building use or occupancy type changes
- Building owner wishes to increase building thermal resistance
- Building owner wishes to increase roof reflectance
- Installation of a rooftop photovoltaic system
- Installation of a vegetative roof system
- Aesthetic reasons

This chapter provides best practice guidelines for reroofing with new membrane roof systems. Depending on project scope, reroofing may consist of re-covering or removing and replacing an existing roof system.

Section 9.1—Definitions addresses essential terms and concepts used in this chapter.

Section 9.2—Evaluation of Existing Roof Systems provides guidelines for evaluating existing roof systems for the purpose of deciding whether roof re-covering or roof replacement is most appropriate. When contemplating reroofing, the first decision that needs to be made is whether the existing roof system can be re-covered or whether removal and replacement is necessary. This determination needs to be made on a case-by-case basis and is best made after a thorough evaluation of the existing roof system.

Section 9.3—Building Code Requirements for Reroofing provides an overview of model building code requirements applicable to roof re-covering and roof replacement. Most building codes provide specific requirements for reroofing existing buildings.

Section 9.4—Roof Decks for Reroofing discusses design considerations that are unique to reroofing over each existing roof deck type.

Section 9.5—Preparation of Existing Roof Surfaces provides general recommendations for the preparation of existing roof systems to receive new membrane roof systems.

Section 9.6—Re-cover Guidelines for Membrane Roof Systems provides general recommendations for applying membrane roof systems over common types of roof systems.

Section 9.7—Design Guidelines for Roof Replacement with New Membrane Roof Systems addresses the design considerations for replacing common types of roof systems with new membrane roof systems.

9.1—Definitions

In this chapter, the following terms, as defined below, are used extensively.

- **Reroofing:** The process of re-covering or tearing off and replacing an existing roof covering
- **Re-covering:** The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering
- **Replacement:** The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering; also known as tear-off and replacement
- **Roof assembly:** An assembly of interacting roof components, including the roof deck, air or vapor retarder (if present), insulation and membrane or primary roof covering designed to weatherproof a structure.
- **Roof system:** A system of interacting roof components generally consisting of a membrane or primary roof covering and roof insulation (not including the roof deck) designed to weatherproof and sometimes improve the building's thermal resistance.

In general, a roof assembly consists of the structural deck or structural substrate and roof system. A roof system includes every component above the roof deck or structural substrate. The determination whether re-covering or replacement is appropriate follows a thorough evaluation of the existing roof assembly.

In a roof re-covering scenario, the roofing contractor is concerned with the evaluation of the existing roof system to determine whether it will provide an adequate substrate for the installation of a re-cover roof system. If it is determined the existing roof system is not an adequate substrate for re-covering, a roof replacement should be carried out.

In a roof replacement scenario, the roofing contractor is concerned with the evaluation of the existing roof deck surface or structural substrate surface to establish it will accommodate the application of a new replacement roof system. If questionable conditions are observed, the roofing contractor should inform the appropriate and responsible parties, such as the general contractor, architect or project manager. Any questionable conditions should be corrected prior to the application of the new replacement roof system.

It should be understood that a roofing contractor can only inspect the surface of a roof deck and cannot assume responsibility for the deck's slope, structural integrity, method of attachment, erection of any conduit or equipment below the roof deck, or any other conditions beyond his control.

Also, roof systems can generally be divided into two categories: low-slope and steep-slope. The incline, or slope, of the roof system is the primary factor in determining into which of these categories a particular roof system falls.

- **Low-slope roof systems:** A category of roof systems that generally includes weatherproof membrane types of roof systems installed on slopes of 3:12 or less
- **Steep-slope roof systems:** A category of roof systems that generally includes water-shedding types of roof coverings installed on slopes greater than 3:12

Membrane roof systems typically are designed for use in low-slope applications. This chapter primarily addresses membrane roof systems in low-slope reroofing scenarios. In some instances, membrane roof systems are used in steep-slope applications. It is important to realize certain

design modifications may be necessary when membrane roof systems are used in steep-slope applications.

9.2—Evaluation of Existing Roof Systems

This section discusses evaluating an existing roof system for the purpose of determining whether the existing roof system can be re-covered or whether removal and replacement is necessary.

NRCA recommends such evaluations of existing roof systems for reroofing be made on a project-specific basis and conducted by a roofing professional who is experienced in roof system designs, materials and application techniques.

Evaluating an existing roof system can determine its condition and possibly the causes for its condition. Determining the causes for any deteriorated conditions allows for the correction of the deficiencies as part of a reroofing project.

An evaluation of an existing roof system being considered for reroofing should follow a prescribed routine that enables a roofing professional conducting the evaluation to examine each visible component of the roof system to identify areas needing attention.

A logical starting point for a roof evaluation is to review any documentation the building owner may have that is applicable to the roof system. Information relevant to a roof system may include but not be limited to the following:

- Roof system design specifications and drawings
- Flashing details
- Types of deck
- Information provided by the manufacturer(s) of the system components
- Warranty information
- Product samples
- Maintenance and repair history
- Reports of ongoing problems

Any documentation found should be verified against the actual installed conditions as practical.

Next, visual inspection of the actual conditions should be undertaken. Such an inspection typically consists of four primary parts.

- If possible, an inspection of the interior of the building, including the underside of the roof deck, in the areas underneath the roof area being considered for reroofing
- An inspection of the perimeter of the building
- An inspection of the existing roof system
- An inspection of other potential leak sources

The sequence in which these three areas of inspection are conducted is not critical; however, it is important the roofing professional conducting the evaluation is allowed enough access and time to conduct a thorough evaluation.

The following considerations apply to the evaluation of low-slope roof systems when deciding whether to re-cover or replace the existing roof system.

Interior Inspection: An evaluation of an existing roof system for the purpose of determining whether to re-cover or replace it should include a visual inspection of the interior of the building in the area underneath the roof area being considered. The inspection also should note the building interior environment, occupancy and use.

Leakage Into the Interior: Whenever possible, it is often useful to walk through the interior of the building directly beneath the roof area being considered to visually observe any evidence of past or active water leakage that may be associated with the existing roof system. As part of or in addition to the interior walkthrough, it is helpful to interview the building maintenance personnel and/or occupants concerning a history of moisture issues, including the frequency and volume of water entering the interior. The locations of any stained or water-damaged roof deck, structural framing members, ceiling finish materials, walls, building fixtures and floors can be noted for the purpose of correlating these areas to specific rooftop locations and conditions.

In some instances, the locations of water staining or leakage into a building's interior will not directly coincide with the locations of water penetration through the roof system. Water sometimes has a tendency to travel laterally within the roof system along the roof deck and along structural framing members or along duct work or electrical

conduit before it drips into a building's interior. For example, with metal roof decks, water may reach the level of the roof deck at one location and travel along the flutes of the roof deck until it reaches a lap, joint or penetration in the metal roof deck, where it can drip into the interior. Also, water will have more of a tendency to travel laterally within loosely laid or mechanically attached roof systems than it does in fully adhered roof systems.

Rooftop mechanical equipment may be the source of leakage. Rooftop mechanical equipment should be visually inspected to determine the watertightness of enclosures and condensate pans, and condensate pans' drainage lines should be inspected for blockage and leakage.

Roof Deck's Underside: Whenever possible, the underside of the roof deck should be visually inspected to determine its type, condition, slope and attachment.

Roof Deck Type: The type and condition of the roof deck should be observed and noted. Roof deck materials and design considerations are discussed in Chapter 2—Roof Decks. Additional detailed information applicable to roof decks commonly encountered in existing buildings is provided in Section 9.4—Roof Decks for Reroofing.

Roof Deck Deterioration: Stains, rust and degradation on a roof deck's underside are good indications that there is or has been some type of problem or leak. These areas should be noted and closely inspected. Roof decks deteriorate from the top side with few exceptions, such as battery storage areas, corrosive interiors or high-humidity environments. Because roof decks usually deteriorate from the top down, the presence of a deck problem on a deck's underside—or lack of visible clues—may not indicate the potential severity of the deterioration. Areas of deterioration may need repair or replacement before or during new roof system installation.

Roof Deck Slope: For low-slope roof assemblies, the deck slope is sometimes difficult to determine through visual observations. Specific types of "open structures" incorporating metal deck, joists or light frame construction are often built with enough slope to be visually detectable. This information may be found in construction documents.

With deck and joist systems, especially those with brick or concrete masonry unit (CMU) perimeter walls, it may be possible to determine whether the deck is sloped. Observations of where the joists intersect the wall can give an indication of sloped structure. For buildings without fixed ceilings, interior observations or measurements can be made. Observations of the structural framing arrangement can also help determine whether the roof deck is sloped.

Attachment of the Existing Roof System: When making observations of the underside of the deck, a roofing professional should make note of fasteners penetrating the deck. For metal decks, if fasteners are visible in the field of the roof area, the insulation is mechanically attached. Insulation fasteners should not be confused with metal deck side-lap screws or fasteners attaching the metal deck to the structure. Fastening pattern may be used to assess the density of attachment and wind-uplift resistance of the existing roof system. If mechanical fasteners are not visible, the roof system may be loose-laid and ballasted or the insulation may be adhered with asphalt or other adhesive. Lightweight insulating concrete or structural concrete may also be on top of the metal deck. Core cuts may be necessary to determine the attachment method.

Over concrete decks, it is likely that either adhered systems or loose-laid systems were installed. The attachment method of the roof system is unlikely to be determined from the underside of a concrete roof deck.

Over nailable decks, such as wood decks, lightweight insulating concrete decks, gypsum decks and cementitious wood fiber decks, it is likely that a mechanically attached base sheet and/or separation layer were installed. Some roof systems may be adhered, spot mopped, or fastened with toggle bolts or auger-type fasteners to nailable decks.

The attachment of the existing roof assembly may not meet the current building code requirements or current insurance company recommendations. Re-cover systems may not be allowed under certain conditions. Modifications to the existing attachment method may be necessary to fulfill applicable requirements.

Below-deck Insulation: If below-deck insulation is present, its location, type, thickness and condition should be noted if practical. In some roof assemblies, below-deck insulation may only be accessible through the roof deck.

Below-deck insulation can hold leakage moisture and obscure visual inspection of the bottom side of the roof deck. If below-deck insulation is present, consideration should be given to removing portions of the below-deck insulation to allow for a more thorough visual inspection of the roof deck.

For roof assemblies that incorporate a vapor retarder, the amount of thermal resistance value of construction below the vapor retarder can be critical to the effectiveness of the vapor retarder. To effectively prevent the formation of condensation inside a roof assembly, the vapor retarder design must provide for the design dew point temperature to occur within the insulation placed above the vapor retarder.

If asbestos-containing insulation or fireproofing material is present on the underside of a roof deck, the building owner is responsible under Occupational Safety and Health Administration rules for determining the presence, location and quantity of any asbestos-containing material (ACM) or presumed asbestos-containing material and notifying others of its presence before work is begun. The building owner has the obligation to abate, remove or encapsulate any ACM on or in the building. Although a building owner is ultimately responsible for such material, a roofing contractor may have liability if he or she, knowingly or unknowingly, exposes his or her workers or others to ACM as a result of roofing-related activities. Contract documents may not necessarily contain provisions that hold the roofing contractor harmless for such inadvertent or unknowing exposure and should be carefully reviewed.

For a complete discussion of issues relating to ACM in roof assemblies, see NRCA's publication *A Practical Guide for Handling Asbestos-containing Roofing Material.*

Hidden Conditions: Conduit for electrical service, alarms, computer wiring, cable television wiring or water lines are sometimes concealed within or just below roof assemblies. These items may be buried in insulation, concrete roof decks or lightweight insulating concrete roof decks. Conduit or plumbing pipes may also be located above or below a metal or wood roof deck. See Figure 9-1. These items are susceptible to damage during roof replacement or re-cover.

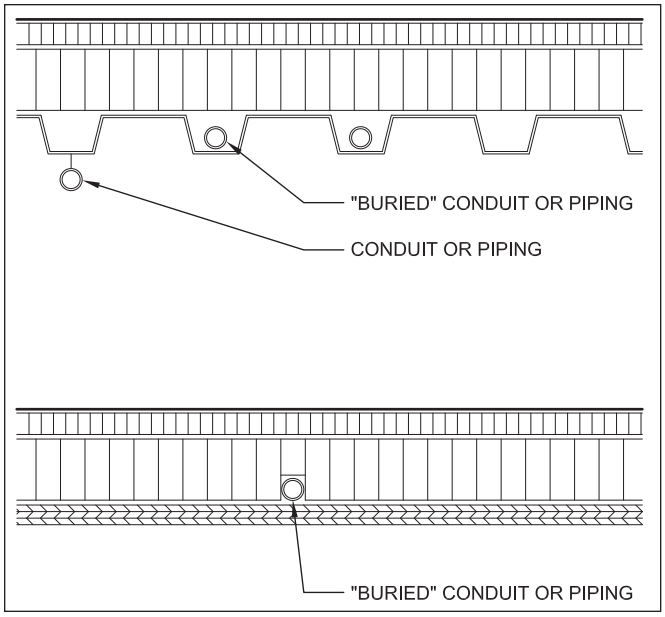

Figure 9-1: Illustration of buried and hidden conduit

The electrical code provides some guidance regarding electrical cables, raceways and boxes placed in or under roof decks. NFPA 70: National Electrical Code® (NEC) serves as the electrical code for most jurisdictions in the U.S.

In NEC's 2014 edition, Chapter 3—Wiring Methods and Materials provides requirements for placement and methods for wiring. Section 300.4—Protection Against Physical Damage includes the following passage specific to wiring installed in or under roof decks:

> **"(E) Cables, Raceways, or Boxes Installed in or Under Roof Decking.** A cable, raceway, or box, installed in exposed or concealed locations under metal-corrugated sheet roof decking, shall be installed and supported so there is not less than 38 mm (1 ½ in.) measured from the lowest surface of the roof decking to the top of the cable, raceway, or box. A cable raceway, or box shall not be installed in concealed locations in metal-corrugated, sheet decking-type roof.
>
> Informational Note: Roof decking material is often repaired or replaced after the initial raceway or cabling and roofing installation and may be penetrated by the screws or other mechanical devices designed to provide 'hold down' strength of the waterproofing membrane or roof insulating material.

Exception: Rigid metal conduit and intermediate metal conduit shall not be required to comply with 300.4(E).”

Generally, wiring placed in metallic conduit is considered “protected” by the electrical profession and appropriate for use in most concealed spaces and areas subject to physical abuse. However, roofing industry experience has shown fasteners used for mechanically attaching rigid board insulation or membranes can readily penetrate metallic conduit embedded within or directly underneath roof assemblies. By way of comparison, the wall thickness of ½-inch-thick metallic conduit is comparable to the metal thickness of a 20-gauge steel roof deck. Self-cutting or self-drilling roof fasteners can readily penetrate metals of these thicknesses. Also, cutting and roof system removal operations can damage and penetrate metallic conduit.

Another section of the NEC, Section 690.31—Methods Permitted, addresses wiring methods for solar photovoltaic systems. It provides the following requirement for direct-current photovoltaic source and output circuits inside a building:

> **“(1) Embedded in Building Surfaces.** Where circuits are embedded in built-up, laminate, or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked using a marking protocol that is approved as being suitable for continuous exposure to sunlight and weather.”

This statement indicates NEC acknowledges the potential for accidentally cutting metallic conduit embedded within a roof system and requires the conduit location be permanently marked; however, it does not adequately restrict metallic conduit placement or prevent such accidental cutting during reroofing.

NRCA does not recommend metallic conduit or wiring be embedded within roof assemblies or placed directly below roof decks. If metallic conduit or wiring needs to be placed near the roof assembly, NRCA recommends it be positioned and supported at least 1½ inches from the bottom side of the roof deck or substrate to which the roof system is applied. Also, hangers or other supports used to attach and support metallic conduit and wiring should be attached to framing or roof deck supports, not the roof deck or roof substrate.

Building’s Perimeter Observations: Whenever possible, the perimeter of the building’s roof area should be observed for any conditions that may affect the performance or weathertightness of the roof system. Deterioration and moisture infiltration of a building’s façade is sometimes a source of moisture infiltration that may appear as roof leakage from the building’s interior.

Visually inspecting the building’s perimeter to determine the condition of the roof edge and any exterior conductor heads, gutters and downspouts can be done at this time. Conditions affecting flashing installation, such as heights of doors and windows and siding condition and height above the roof surface, should be noted, as well.

Also, while conducting the inspection of the building’s perimeter, it is a good opportunity to identify usable areas for ground-level setup and staging of the reroofing work.

Roof System Inspection: Close-up visual inspection of the rooftop of an existing roof system is essential for properly evaluating whether roof re-covering or replacement is necessary. Inspection of the roof system should include evaluation of installed materials, as well as design, and should take account of:

- Perimeter edge-metal flashings
- Base flashings
- Penetrations
- Roof surface condition
- Drainage and slope
- Roof system composition
- Moisture within the existing roof assembly
- Rooftop mechanical equipment

Perimeter Edge-metal Flashings: Perimeter edge-metal flashings are used to terminate, waterproof and provide wind-uplift resistance at the perimeter of roof systems. The proper design, materials, installation and maintenance of perimeter edge-metal flashings will prevent water damage to the building’s structure, components and interior.

During the roof system inspection, perimeter edge-metal flashings should be inspected for missing or displaced pieces; corrosion; open laps, joints and covers; sealants; and loose or missing fasteners.

Also, the height and positioning of the perimeter edge-metal flashings needs to be considered. Because the additional thickness of a re-cover system or possible additional thickness of a replacement roof system will change the distance from the roof surface to edge-metal flashing, whether the flashing will be positioned properly for the new roof systems needs to be evaluated.

Base Flashings: Base flashings are vertical terminations of a roof system at walls and curbs. Because of the many conditions that require base flashings, a variety of problems can occur at these locations. These locations must be flashed properly for the roof system to be weathertight.

For projects involving roof system re-covering, a decision needs to be made whether to recover the existing base flashings or remove the existing base flashings and install new ones. This decision is typically made based on the condition of the existing base flashings and compatibility with the new roof system type.

For projects involving removal of the existing roof system and installation of a new roof system, NRCA recommends the existing base flashings be removed and new base flashings be installed.

Penetrations: Penetrations are pipes, drains and other items that penetrate the field of the roof system. These must be flashed properly and be in good condition to ensure a weathertight roof system.

For projects involving roof system re-covering, a decision needs to be made either to leave the existing penetration flashings in place or remove the existing penetration flashings. This decision is typically made based on the condition of the existing base flashings and compatibility with the new roof system.

For projects involving removal of the existing roof system and installation of a new roof system, NRCA recommends the penetration flashings be removed and new penetration flashings be installed that are compatible with the new roof system.

Roof Surface Condition: The surface condition of a low-slope roof system can provide information such as indications regarding previous maintenance and repair and potential remaining service life. Evaluations based on surface condition alone can sometimes be misleading. For example, a recently coated or surfaced roof membrane can appear to be in good condition but may only have a minimal remaining service life.

Following are potential problems that may be encountered within the field of low-slope membrane roof systems:

- Blisters and/or large areas of nonadhered membrane
- Open laps, excessive wrinkles and/or fishmouths
- Splits and/or ridges
- Empty pitch pockets
- Fastener backout or pop-up against or through the membrane
- Worn spots, deteriorated areas or holes in the membrane
- Differences in the firmness of the insulation or substrate
- Displacement of aggregate, exposing the membrane
- Lack of or deteriorated surface coating
- Dirt accumulation in ponding areas indicating inadequate slope for drainage
- Degradation caused by ponding or biological growth
- Damage caused by contaminants
- Damage caused by falling objects/debris
- Damage caused by equipment supports
- Areas around rooftop accessories and equipment that have been damaged
- Punctures
- Damage caused by foot traffic
- Hail damage
- Wind damage

- Membrane slippage
- Membrane shrinkage

Drainage and Slope: Areas with inadequate drainage should be identified and repairs and/or design changes should be considered when reroofing. Following are potential problems associated with ponding water because of the lack of slope for drainage:

- Deterioration of the roof surface and membrane
- Debris accumulation, vegetation, fungal growth and resulting membrane damage
- Deck deflections, sometimes resulting in structural problems and other complications
- Ice formation and resulting membrane degradation or damage
- Water entry into the building if the roof membrane is punctured or fails in a ponding area
- Worse than expected reflective performance of roof surfaces as a result of dirt and debris accumulation

Roof System Composition: Core cuts should be made to determine the roof system composition. In most instances, the deck type can be determined by visual observation after the sample is removed. Insulation thickness and condition, number of layers, type and attachment method can be determined.

Multiple core cuts at select locations should assist in determining whether tapered insulation was used in the existing roof system and, if so, the thickness. If ceiling construction in the building prohibits determination of deck type, core cuts will allow determination of the deck type. Core cuts should be made at all roof areas at different elevations and levels and where differing roof system compositions are apparent.

Moisture Within the Existing Roof Assembly: When evaluating moisture content of roof assemblies, nondestructive moisture evaluation techniques should be considered. Nondestructive moisture evaluation techniques include infrared thermography, neutron (nuclear) thermalization and electrical capacitance.

In such investigations, core cut analysis results should be used for calibration and verification of indirect moisture measurements obtained with nondestructive moisture evaluation techniques.

The quality and applicability of conclusions from core cut analysis is limited by the selection of core cut locations and their number. A core cut is representative of a limited area, and evaluation of large roof areas requires removing a greater number of core cuts than evaluation of a small roof area.

Confirmed areas of moisture must be removed prior to new roof application and replaced using compatible materials.

Rooftop Mechanical Equipment: Because rooftop mechanical equipment may be the source of leakage, rooftop mechanical equipment inspection is an important aspect of evaluating an existing roof system in preparation for reroofing.

Rooftop mechanical equipment condition should be investigated by a mechanical contractor to identify mechanical equipment leakage root causes that cannot be addressed by reroofing. In these situations, a mechanical contractor should address leakage root causes not related to roof system installation.

A mechanical contractor should visually inspect rooftop mechanical equipment to determine the watertightness of enclosures and condensate pans, and condensate pans' drainage lines should be inspected for blockage and leakage. Also, condition of rooftop mechanical supports should be inspected.

A mechanical or electrical contractor should visually inspect the condition of rooftop electrical conduit.

Other Leak Sources: The source of leakage into a building is not exclusive to the roof membrane and its associated flashings. There are many building components that may be sources of leakage, including:

- Parapets or adjacent walls above flashings
- Door or wall openings
- Skylights
- Expansion joints
- Rooftop equipment
- Roof system accessories

- Equipment within a plenum space or attic space
- Condensation
- Plumbing or sprinkler piping
- Blocked gutters and downspouts
- Clogged condensate discharge lines

It is important to recognize the potential for water infiltration at the building components listed previously when reroofing. If these components are the source of a leak, a new roof system will not solve the problem. Also, if not repaired, these types of leaks may cause considerable damage to an existing or new roof system.

9.3—Building Code Requirements for Reroofing

Building codes provide specific requirements applicable to reroofing and limitations to when roof systems can be re-covered.

As part of the evaluation of existing roof systems, the designer of a reroofing system should verify the specific building code that applies to the building and design a reroofing system that complies with the applicable building code.

When considering the building code, it is important to consider what specific building code is applicable and what edition of that particular code is applicable.

The following information is provided based on the *The International Building Code, 2015 Edition* (IBC 2015) and *International Residential Code for One- and Two-family Dwellings, 2015 Edition* (IRC 2015).

International Building Code: For most code jurisdictions in the U.S., the International Building Code is applicable. Section [A] 101.2—Scope of IBC 2015 indicates it is applicable in the following situations.

> **"[A] 101.2 Scope.** The provisions of this code shall apply to the construction, *alteration*, relocation, enlargement, replacement, *repair*, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures.
>
> **Exception:** Detached one- and two-family *dwellings* and multiple single-family *dwellings* (townhouses) not more than three *stories above grade plane* in height with a separate *means of egress,* and their accessory structures not more than three *stories above grade plane* in height, shall comply with the *International Residential Code*."

The bracketed letter "A" designates ICC's Administrative Code Development Committee responsible for this section's provisions.

The International Building Code's requirements applicable to reroofing apply to reroofing most buildings. For detached one- and two-family dwellings and most townhouses, the International Residential Code applies.

IBC 2015 defines reroofing in Section 202—Definitions as:

> **"[EB] REROOFING.** The process of recovering or replacing an existing roof covering. See "Roof recover" and "Roof replacement."

The bracketed initials "EB" designate the International Energy Conservation Code Development Committee responsible for the definition.

Roof re-cover and roof replacement are defined in the same section as:

> **"[EB] ROOF RECOVER.** The process of installing an additional r*oof covering* over a prepared existing *roof covering* without removing the existing *roof covering*."
>
> **"[EB] ROOF REPLACEMENT.** The process of removing the existing *roof covering*, repairing any damaged substrate and installing a new *roof covering*."

The reroofing provisions of IBC 2015 are located in Section 1511—Reroofing. The following are excerpts from Section 1511, as well as explanatory commentary regarding each item.

> **"1511.1 General.** Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of Chapter 15.

Exception:

1. *Roof replacement* or *roof recover* of existing low-slope roof coverings shall not be required to meet the minimum design slope requirements of one-quarter unit vertical in 12 units horizontal (2-percent slope) in Section 1507 for roofs that provide positive roof drainage.
2. Recovering or replacing an existing roof covering shall not be required to meet the requirement for secondary (emergency overflow) drains or scuppers in Section 1503.4 for roofs that provide for positive roof drainage. For the purposes of this exception, existing secondary drainage or scupper systems required in accordance with this code shall not be removed unless they are replaced by secondary drains or scuppers designed and installed in accordance with Section 1503.4."

This section of the code states that when a roof is recovered or replaced, it must comply with the same code provisions for materials and methods as roof systems for new construction situations with only two exceptions for low-slope roof systems.

Exception No. 1 indicates that roof replacement or roof re-covering is not required to meet the code's ¼:12 minimum roof slope requirement provided the roof has positive drainage. The code provides the following definition for the term "positive roof drainage":

> **"[BS] POSITIVE ROOF DRAINAGE.** The drainage condition in which consideration has been made for all loading deflections of the *roof deck*, and additional slope has been provided to ensure drainage of the roof within 48 hours of precipitation."

The bracketed initials "BS" designate IBC's Structural Code Development Committee responsible for the definition.

Exception No. 2 clarifies the applicability of the code's requirements for secondary (emergency overflow) drainage to reroofing. The first part indicates reroofing does not trigger the code's requirements for emergency overflow drainage if the new roof system provides positive roof drainage. For instance, when reroofing an existing roof system with internal primary roof drains and no emergency overflow drainage, a roofing contractor is not required to install secondary drains or scuppers if the new roof system provides positive drainage. The second part indicates this provision is not intended to trigger the removal of existing code-compliant emergency overflow drainage during reroofing.

Furthermore, this section does not mandate that the entire roof system be replaced but simply that the portion of the roof area being replaced comply with the current code's requirements.

> **"1511.2 Structural and construction loads.** Structural roof components shall be capable of supporting the roof-covering systems and the material and equipment loads that will be encountered during the installation of the system."

The structural integrity of the roof assembly must be maintained during reroofing operations, including loading on the roof attributable to workers and material being present during this special period of time. The roof structure must be able to support all layers of roof-covering materials.

> **"1511.3 Roof replacement.** *Roof replacement* shall include the removal of all existing layers of roof coverings down to the roof deck.
>
> **Exception:** Where the existing roof assembly includes an ice barrier membrane that is adhered to the roof deck, the existing ice barrier membrane shall be permitted to remain in place and covered with an additional layer of ice barrier membrane in accordance with Section 1507."

In a reroofing scenario where the code requires a roof replacement, all layers of the previously installed roof systems must be removed from the roof deck before the installation of a new replacement roof system with one exception—an existing water and ice-dam protection membrane adhered directly to the roof deck. This type of application cannot be removed without damaging the roof deck in the process. The existing membrane is permitted to remain in place and covered with an additional layer of water and ice-dam protection membrane.

"1511.3.1 Roof recover. The installation of a new roof covering over an existing roof covering shall be permitted where any of the following conditions occur:

1. Where the new roof covering is installed in accordance with the roof covering manufacturer's approved instructions.
2. Complete and separate roofing systems, such as standing-seam metal roof panel systems, that are designed to transmit the roof loads directly to the building's structural system and that do not rely on existing roofs and roof coverings for support, shall not require the removal of existing roof coverings.
3. Metal panel, metal shingle and concrete and clay tile roof coverings shall be permitted to be installed over existing wood shake roofs when applied in accordance with Section 1511.4.
4. The application of a new protective coating over an existing spray polyurethane foam roofing system shall be permitted without tear off of existing roof coverings."

Except as provided in Section 1511.3.1.1, the code permits re-cover installations over existing roof systems under the specific sets of conditions provided in Section 1511.3.1.

A re-cover application of a roof covering may be installed if the manufacturer's installation instructions do not prohibit such an application. The installation is required to follow the installation instructions, and the building official has to find the instructions acceptable.

A roof system designed to transmit all roof loads directly to the building's structural system is permitted to be installed without removing existing roof coverings.

Re-cover installations of metal panel, metal shingle and concrete and clay tile roof systems are permitted over wood shake and wood shingle roof systems only if the resulting concealed combustible spaces are covered with a thermal barrier material (see 1511.4).

A common practice of applying a new protective coating over an existing spray polyurethane foam roof system is permitted.

"1511.3.1.1 Exceptions. A *roof recover* shall not be permitted where any of the following conditions occur:

1. Where the existing roof or roof covering is water soaked or has deteriorated to the point that the existing roof or roof covering is not adequate as a base for additional roofing.
2. Where the existing roof covering is slate, clay, cement or asbestos-cement tile.
3. Where the existing roof has two or more applications of any type of roof covering."

Section 1511.3.1.1 lists scenarios under which the code does not permit roof re-cover installations. When these conditions are encountered, a roof replacement is required.

When the existing roof system or roof covering is water-soaked, it must be allowed to dry completely so as not to trap moisture beneath the new roof system. The existing roof system is required to be removed if it cannot adequately dry out or its physical properties have been permanently altered.

Clay and concrete tile, wood shakes, slate and asbestos-cement shingles historically have not proved adequate substrates for new roof systems. Clay and concrete tile, wood shakes, slate and asbestos-cement shingles must be removed and must not be re-covered.

When the existing roof has two or more layers of any type of roof system, all layers must be removed to enable verification that the existing roof deck is not water-damaged and still capable of providing an adequate substrate for attachment of the new roof system. Single-layer or "peel-off" removal is not permitted.

"1511.4 Roof recovering: When the application of a new roof covering over wood shingle or shake roofs creates a combustible concealed space, the entire existing surface shall be covered with gypsum board, mineral fiber, glass fiber or other *approved* materials securely fastened in place."

This section addresses a specific roof re-cover scenario and not re-cover applications in general. Where re-covering over existing wood shakes or wood shingles creates a combustible concealed space, the code requires the entire surface of the existing roof system be covered with a layer of gypsum board, mineral fiber or fiberglass insulation or other materials that are approved by the authority having

jurisdiction. The code does not specify a required minimum thickness for this layer. This layer must be securely fastened in place to allow the completed roof system to resist design wind loads.

> **"1511.5 Reinstallation of materials:** Existing slate, clay or cement tile shall be permitted for reinstallation, except that damaged, cracked or broken slate or tile shall not be reinstalled. Existing vent flashing, metal edgings, drain outlets, collars and metal counterflashings shall not be reinstalled where rusted, damaged or deteriorated. Aggregate surfacing materials shall not be reinstalled."

Some existing roof system materials are permitted to be recycled for use as part of newly installed roof systems. Historically, slate and tile materials have been removed without substantially damaging the material. Before reuse is allowed, material such as slate and clay and concrete tile should be examined thoroughly for cracks and deterioration. Reuse of existing metal flashing materials only is permitted when the materials' remaining service life is at least equivalent to the service life of the new roof system.

> **"1511.6 Flashings:** Flashings shall be reconstructed in accordance with *approved* manufacturer's installation instructions. Metal flashings to which bituminous materials are to be adhered shall be primed prior to installation."

Flashings to be reused or reconstructed as part of reroofing installations must be in accordance with the new roof system manufacturer's installation instructions.

Metal flashings that are to be reused for bituminous materials must be primed in accordance with the new roof system manufacturer's installation instructions.

International Residential Code: IRC 2015 Section R908—Reroofing provides the code's requirements for re-covering and replacing existing roof systems. This section provides similar requirements as IBC 2015, Section 1511—Reroofing.

9.4—Roof Decks for Reroofing

As part of a roof assembly, a roof deck needs to provide structural support, dimensional stability, contribute to fire resistance and be the substrate for the roof system. The roof deck also needs to accommodate building movement.

For steep-slope roof systems, the roof deck provides the necessary slope for the roof system. For low-slope roof systems, slope for drainage is provided by sloping the roof deck or using tapered fill or insulation or a combination of both.

The roofing contractor should make sure a deck's surface condition is suitable for application of roofing materials. Before applying a new roof system, the deck should be inspected to determine that it is smooth, straight and free of irregularities, such as significant humps or depressions. If the deck is composed of panels or planks, the roofing contractor should check to see that adjacent deck sections are aligned vertically on the same plane.

In reroofing, unsatisfactory or questionable deck conditions are usually not discovered until roofing work has begun and removal of the existing roof system components is taking place. For this reason, roof deck deterioration and any necessary repairs are often considered to be unforeseen conditions.

If unsatisfactory or questionable roof deck conditions are observed, the roofing contractor should promptly inform the building owner or other appropriate and responsible parties, such as the general contractor, architect or project manager, and make arrangements for any necessary repairs or replacement of deck materials.

NRCA recommends unforeseen roof deck repairs or replacement be addressed on a time-and-materials or unit-cost basis.

Damaged roof deck components need to be repaired to provide a suitable surface for roof system application. If repair is not possible, deck sections should be replaced before applying the new roof system.

The subsections that follow address reroofing considerations applicable to specific types of roof decks, including the following:

- Cementitious wood fiber panels
- Structural concrete (cast-in-place, post-tensioned and precast/prestressed)
- Lightweight insulating concrete
- Poured gypsum
- Precast gypsum panels
- Steel

- Thermal-setting insulating fill
- Wood panels (plywood, oriented strand board)
- Wood planks and wood boards

For additional information applicable to roof decks, refer to Chapter 2—Roof Decks.

Cementitious Wood Fiber Panels: Cementitious wood fiber panels used as roof deck components are composed of treated wood fibers that are bonded together with cement and/or other binders, compressed and molded into panels. Panels are available with tongue-and-groove edges for application directly over joists and with rabbeted edges for use with bulb tees or over subpurlins.

Roof Replacement Considerations: Fasteners in cementitious wood fiber decks can be removed. Locking tube-type fasteners used for base sheets can be removed and new fasteners installed as part of the replacement roof system. Because cementitious wood fiber deck panels are made with water-soluble binders, roof leaks may weaken the panels, causing them to deflect or fail. If deflection of the panels is significant, proper installation of new base sheet fasteners may be difficult or impossible to achieve.

When existing toggle bolts and auger-type fasteners are removed, NRCA recommends installation of a new structural roof deck because the structural capacity of the cementitious wood fiber roof deck can be reduced by the voids left by the removed fasteners. When the existing roof system is removed, any necessary replacement and repair of panels should be performed before installing the new roof system.

It is important to check the attachment of the panel to the substructure. Checking the panel attachment is the responsibility of the designer and may need to be inspected by a structural engineer. Additional fasteners may be required for attaching the panel to the substructure because of updated wind-uplift-resistance requirements.

Weather and Temperature: Installation or repair of a roof deck should be scheduled and coordinated with weather and temperature conditions that allow for proper installation of a roof system. Designers should give special attention to the storage, erection and handling of cementitious wood fiber panels.

Cementitious wood fiber panels should be protected from moisture during storage and installation. All cementitious wood fiber panels laid in a day should be made watertight at the completion of that day's work, preferably by the installation of the roof system or, if necessary, by covering the deck panels with a temporary waterproof film such as polyethylene.

Unprotected panels that are damaged or deteriorated from weather exposure should be replaced before a roof system is installed.

Damaged Deck Surface: Care should be taken in handling and erecting cementitious wood fiber panels to prevent damaging edges and exposing surfaces to mechanical damage and staining caused by exposure. Damaged deck panels should be repaired to ensure structural integrity and a suitable surface for roof system installation. If repair is not possible, deck sections should be replaced before installing a roof system.

The National Roof Deck Contractors Association (NRDCA) guideline, NRDCA 600 may be useful as a guide for cementitious wood fiber panel deck replacement.

Vertical Alignment: Adjacent cementitious wood fiber deck panels should align vertically to provide a uniform substrate for the roof system. Elevation differences in excess of ⅛ of an inch between panels are considered unacceptable. Uneven joints of ⅛ of an inch or more should be grouted with the grout feathered to a slope of ⅛ of an inch per foot.

Roof Openings: When an opening or a hole is cut to accommodate penetrations through cementitious wood fiber roof decks, depending on the size of the opening, supplemental framing usually is necessary to support the opening. Designers should follow the guidelines set forth by the cementitious wood fiber panel manufacturer or appropriate product institute's publications.

All openings for penetrations through a deck and mechanical equipment that is designed to be set on raised curbs should be attached to the deck before roof system installation begins.

Structural Concrete: There are two general types of structural concrete used in roof decks: normal-weight structural concrete and lightweight structural concrete. Both have structural-load supporting capacities.

Normal-weight Structural Concrete: Normal-weight structural concrete is produced by mixing normal-weight aggregate, usually stone or crushed gravel; sand; Portland cement; water; and, in some design mixes, various chemical additives. Steel reinforcing bars and/or steel wire mesh are used to reinforce the concrete. The density of reinforced, normal-weight structural concrete generally is about 150 pounds per cubic foot (pcf).

Most normal-weight aggregates used in normal-weight structural concrete absorb less than 2 percent of water by dry mass, largely as surface moisture. Moisture absorbed on aggregate surface is available for concrete hydration.

Lightweight Structural Concrete: Lightweight aggregates are used in structural lightweight concrete mixes instead of stone and crushed gravel, which are used in normal structural concretes. Lightweight aggregates are manufactured from natural raw materials, such as shale, clay and slate, or are mined from deposits of porous volcanic materials, such as pumice, scoria or tuff, depending on availability.

The most commonly used lightweight aggregate is expanded shale. Shale is crushed and heated to a high temperature until it becomes plastic-like. Then, small amounts of water that are naturally present in the shale turn to steam and expand, popping the particles like popcorn. Blast-furnace slag can be used and is expanded by treating it with water while the slag is in a molten state.

This expansion process produces lightweight aggregates that are highly porous. These materials require a pre-wetting step before they can be added to lightweight structural concrete mixes. The pre-wetting step is necessary to ensure the lightweight aggregate does not absorb the mix water necessary for concrete to fully hydrate. Pre-wetting typically involves submerging lightweight aggregate in water until it is saturated. Depending on the aggregate pore system, after 24 hours of pre-wetting, the amount of water absorbed by lightweight aggregates ranges from 5 to 25 percent of the aggregate dry mass. As a result, lightweight structural concrete inherently contains much more water than normal-weight structural concrete. The water internally absorbed in the lightweight aggregate is not immediately available for concrete hydration and is not counted as mix water.

The pre-wetting water stored in lightweight aggregate increases lightweight structural concrete water content to levels significantly higher than in normal-weight structural concrete. As a result, lightweight structural concrete deck drying times may be unacceptably long.

Structural lightweight concrete roof decks made with these types of aggregate and Portland cement have densities ranging from 95 to 120 pounds per square foot, about 80 percent of the density of normal-weight structural concrete.

Although lighter in weight, lightweight structural concrete retains most of the characteristics of normal-weight structural concrete.

Once poured, lightweight structural concrete typically cannot be easily distinguished from normal-weight structural concrete. Visual identification is possible using magnification, typically a microscope used by a trained technician.

Roof Replacement Considerations: Once the existing roof system is removed, concrete spalls and deterioration should be repaired and the deck swept and primed, if required by the replacement roof system manufacturer, before installing the roof system. If the existing roof material cannot readily be removed from the deck, the material must be well-adhered and compatible with the new roof system. The existing material must not prohibit the new roof system from being properly attached and installed smoothly and flat. To repair small areas of concrete deterioration where there are no visible reinforcing bars, a concrete repair method should be used that does not affect the new roof system when installed according to instructions and allowed appropriate cure time.

Where concrete deck surfaces are irregular and not adequately level to accept rigid insulation board, it may be necessary to install thinner layers or multiple layers of insulation to acquire a smooth surface for the rest of the roof system.

For prestressed or post-tensioned concrete decks, drilling into the deck can be detrimental to the load-bearing capacity of the deck because of the possibility of severing a tension cable. NRCA does not recommend attaching the roof insulation or membrane to prestressed or post-tensioned concrete decks with mechanical fasteners.

Curing and Drying: The pre-wetting water stored in lightweight aggregate increases lightweight structural concrete water content to levels significantly higher than in normal-weight structural concrete. As a result, lightweight structural concrete deck drying times may be unacceptably long.

Moisture infiltration problems with roof systems installed over lightweight insulating structural concrete have been reported to NRCA. The problems were related to the continuing release of water from the decks for years after placement.

For reroofing situations where the existing roof deck is known to be lightweight structural concrete or where there is evidence of concrete deck-related moisture problems, NRCA recommends two alternative roof system designs be considered.

An above-deck venting design, such as a venting base sheet, using a loosely laid ballasted roof system with perimeter venting may allow release of the concrete deck's moisture without adversely affecting roof system components.

Sealing the concrete's moisture into the deck by using a high-bond strength vapor retarder adhered directly to the deck followed by an adhered roof system is another option. A high-quality, 12- to 15-mil-thick two-part epoxy has successfully been used as a vapor retarder in the flooring industry.

Damaged Deck Surface: Areas of spalling or broken concrete roof deck should be repaired to ensure structural integrity and a suitable surface for roof system application. If repair is not possible, concrete deck sections should be replaced before applying a new roof system.

Lightweight Insulating Concrete: There are two general types of lightweight insulating concrete roof decks, sometimes referred to as LWIC: those made with lightweight insulating aggregates composed of perlite or vermiculite and those using pre-generated foam or another air-entraining agent to form lightweight cellular concretes.

Lightweight insulating concrete—both lightweight-aggregate insulating concrete and lightweight-cellular insulating concrete—is used as a fill material, usually to add slope to drain or as a topping over another substrate, such as a corrugated metal form deck or form boards.

Lightweight-aggregate insulating concrete and lightweight cellular concrete roof decks are considered "nailable" substrates and, as such, they typically require the use of a base or separator sheet that is mechanically attached to the lightweight insulating deck. This base or separator sheet provides a substrate to adhere additional roofing components.

Roof Replacement Considerations: When replacing a roof system, reusing existing lightweight insulating concrete or lightweight cellular concrete is acceptable as long as the lightweight insulating concrete or lightweight cellular concrete is not deteriorated.

During removal, many base-sheet fasteners may remain embedded in a deck; fasteners remaining in a deck can be pulled out or hammered flush with the deck. It is acceptable that many of the existing fasteners can remain in a deck when a new roof system is installed. Removing existing fasteners can cause damage to lightweight insulating concrete. Some damage may not require repair. Other damage can be repaired by filling holes, or irregularities can be covered by adding a layer of insulation over a mechanically attached base sheet; a minimum ½-inch-thick layer of insulation can be adhered over the base sheet over the deck to begin the reroofing process.

Securing a replacement roof system over an aged lightweight insulating concrete deck with new lightweight insulating concrete fasteners can be considered if the replacement roof system-specific pullout resistance can be achieved. If pullout tests reveal less than the minimum required system-specific pullout resistance, the lightweight insulating concrete should be removed and replaced with new lightweight insulating concrete or another type of new deck.

If the structure can support the additional weight, installation of a ballasted membrane replacement roof system may be a solution in this situation. Therefore, removing the existing lightweight insulating concrete may not be necessary. When a ballasted roof system installation over an existing lightweight insulating concrete deck is being considered, a structural engineer should verify the structure can accommodate the associated additional load.

If the lightweight insulating concrete is over a concrete deck, the load-bearing capacity of the concrete deck is not compromised by removing the lightweight insulating

concrete. If the lightweight insulating concrete is applied over lightweight steel form-deck panels, corrugated metal deck or bulb tees with form board, the load-bearing capacity of the remaining roof deck components is reduced, possibly significantly, after removing the lightweight insulating concrete.

For lightweight insulating concrete over bulb tees or form deck, removing fasteners and subsequently spalling the top surface of the concrete can reduce the load capacity of the overall roof deck, as well.

Damaged Deck Surface: Wet or otherwise damaged lightweight insulating concrete deck should be repaired to ensure structural integrity and a suitable surface for roof system application. If repair is not possible, deck sections should be replaced before applying a new roof system.

The National Roof Deck Contractors Association (NRDCA) guidelines, NRDCA 100, "Guideline for Field Application of Aggregate Insulating Concrete Roof Deck Systems," and NRDCA 175, "Guidelines for Field Application of Cellular Insulating Concrete Roof Deck Systems," provide guidelines for the installation of lightweight-aggregate insulating concrete and lightweight cellular concrete roof decks, respectively. These documents may be useful in providing information regarding repairs to lightweight insulating concrete roof decks.

Gypsum: Two types of gypsum decks may be encountered in reroofing:

- Poured gypsum decks
- Precast gypsum panel decks

Poured Gypsum: A poured gypsum roof deck consists of gypsum that is mixed with wood fibers or mineral aggregate. The density of cured gypsum varies from 30 pounds to 55 pounds per cubic foot depending on the design mix and type of aggregate used. The mixture forms a slurry that is poured over vapor-permeable form boards that are supported by subpurlins and associated framing members. The subpurlins are used to support the form boards and anchor a deck to the remainder of a building's structural frame. The gypsum mixture may be reinforced with steel wire mesh. The reinforcing mesh may be a welded or woven galvanized wire.

Form boards remain in place after installation of gypsum and can provide a finished interior surface. The vapor-permeable form boards allow additional drying of the gypsum to the building's interior. Various types of form boards are available to provide enhanced interior light reflection, added fire resistance, insulation and acoustic control.

Poured gypsum roof decks are considered nailable and, as such, typically require the use of a base sheet or separator sheet nailed to the deck. The base sheet or separator sheet is used as a substrate to adhere additional roofing components.

Design requirements of a gypsum manufacturer and NRDCA can be consulted. Refer to NRDCA 500, "Gypsum Roof Deck Replacement Procedures" for information about specification of gypsum roof decks.

Three general requirements are:

- The gypsum fill should be reinforced with wire mesh located at the proper depth within the fill.
- Design mixes for gypsum roof decks should provide for compressive strengths of about 500 pounds per square inch.
- A finished gypsum deck should be a minimum thickness of 2 inches, not including the form board, and should extend a minimum of ¼ of an inch above the top of bulb tees or other supporting structural members.

Precast Gypsum Panels: Precast gypsum panel roof decks are constructed of metal-bound gypsum internally reinforced with a steel wire mesh or panels composed of two factory-laminated paper-faced gypsum sheets. Metal-edged precast gypsum panels feature tongue-and-groove edge sections. Panels of factory-laminated gypsum sheets have offset sheet edges, reportedly to facilitate grouting to subpurlins. Both types of gypsum panels are materials manufactured off-site at a production facility. Precast gypsum panel roof decks are no longer used, but many remain in service. Gypsum panels generally are supported by structural steel beams or load-bearing walls.

Precast gypsum panel roof decks are considered nailable substrates and, as such, typically require the use of a base sheet or separator sheet nailed to the deck panels, which is used as a substrate to adhere additional roofing components. Auger- or screw-type fasteners are generally not used with precast gypsum panels.

Precast gypsum panel roof decks should be installed according to panel manufacturers' specifications. Designers

are urged to consult a manufacturer's recommendations about the installation of precast gypsum panels. The designer's specifications should give special attention to storing, erecting and handling precast gypsum roof deck panels. It is recommended the specifications require the joints between adjacent panels greater than ¼ of an inch be grouted or filled with compatible material recommended by the panel manufacturer. Voids around bulb tees should also be grouted with material recommended by the deck manufacturer. NRDCA guidelines can also be consulted for information about the specification of gypsum panel roof decks.

Roof Replacement Considerations: A concern when reroofing over poured gypsum roof decks and precast gypsum panel roof decks is it may not be practical to use the fasteners intended for new gypsum decks.

Because poured gypsum decks were mixed on-site, variation in the mix design may allow for the use of one or more of the mechanical fasteners intended for new gypsum decks.

When reroofing over existing precast gypsum panel roof decks, roofing contractor experience indicates it is often impractical to use mechanical fasteners intended for new gypsum decks.

For poured gypsum decks and precast gypsum panel decks, the determination whether a reroofing application using mechanically attached base sheets is practical should be made on a case-by-case basis.

During removal, many base-sheet fasteners may remain embedded in a deck; fasteners remaining in a deck can be pulled out or hammered flush with the deck. It is acceptable that many of the existing fasteners can remain in a deck when a new roof system is installed. Removing fasteners, such as metal cone shank or split/separating shank with integral caps, used to attach a base sheet can cause damage to the substrate, which may require repair. Minor damage may not require repair; instead, a layer of insulation can be adhered over a mechanically attached base sheet. If the existing roof system was attached with roofing nails or cut nails, damage to the gypsum deck should be relatively minor.

If the existing roof system was sprinkle- or strip-mopped to the deck, the removal process may only cause minor damage to the deck. If the existing roof was solid-mopped, the removal process may cause major damage to the deck. If major damage occurs, consideration should be given to replacing the roof deck or using a re-cover system.

If the structure can support the additional weight, installation of a ballasted membrane replacement roof system may be a solution in this situation. Therefore, removing the existing gypsum deck may not be necessary. When a ballasted roof system installation over an existing gypsum deck is being considered, a structural engineer should verify the structure can accommodate the associated additional load.

Deck Damage: Water-damaged or otherwise damaged gypsum roof deck should be repaired to ensure structural integrity and a suitable surface for roof system application. If repair is not possible, deck sections should be replaced before applying a new roof system.

For poured gypsum deck repairs, any form material that will not support the newly installed, uncured gypsum deck will need to be replaced prior to re-pouring a gypsum roof deck.

NRDCA 500 may be useful in developing appropriate repair procedures.

Fasteners for Existing Gypsum Decks: In some instances, gypsum decks may allow the installation of base sheet fasteners. For reroofing applications over gypsum decks where this is the case and the existing gypsum deck surface is in good condition, it is recommended a base sheet be mechanically fastened to act as the substrate for a new replacement roof system. The base sheet fasteners should be nails of the two-piece tube locking or one-piece serrated split-shank types (see Figure 9-2 on page 290); base sheet plates should be used. Toggle bolts, screws and auger-type fasteners should not be used to attach base sheets to gypsum decks.

When selecting an appropriate mechanical fastener, pullout resistance and fastener density must be determined. Easy installation of mechanical fasteners may indicate inadequate strength of the cured gypsum. Because a fastener can be installed into the gypsum deck does not imply the required pullout resistance of the fastener will be achieved. Pullout tests should be conducted to determine if the specified fasteners and fastening density achieve the

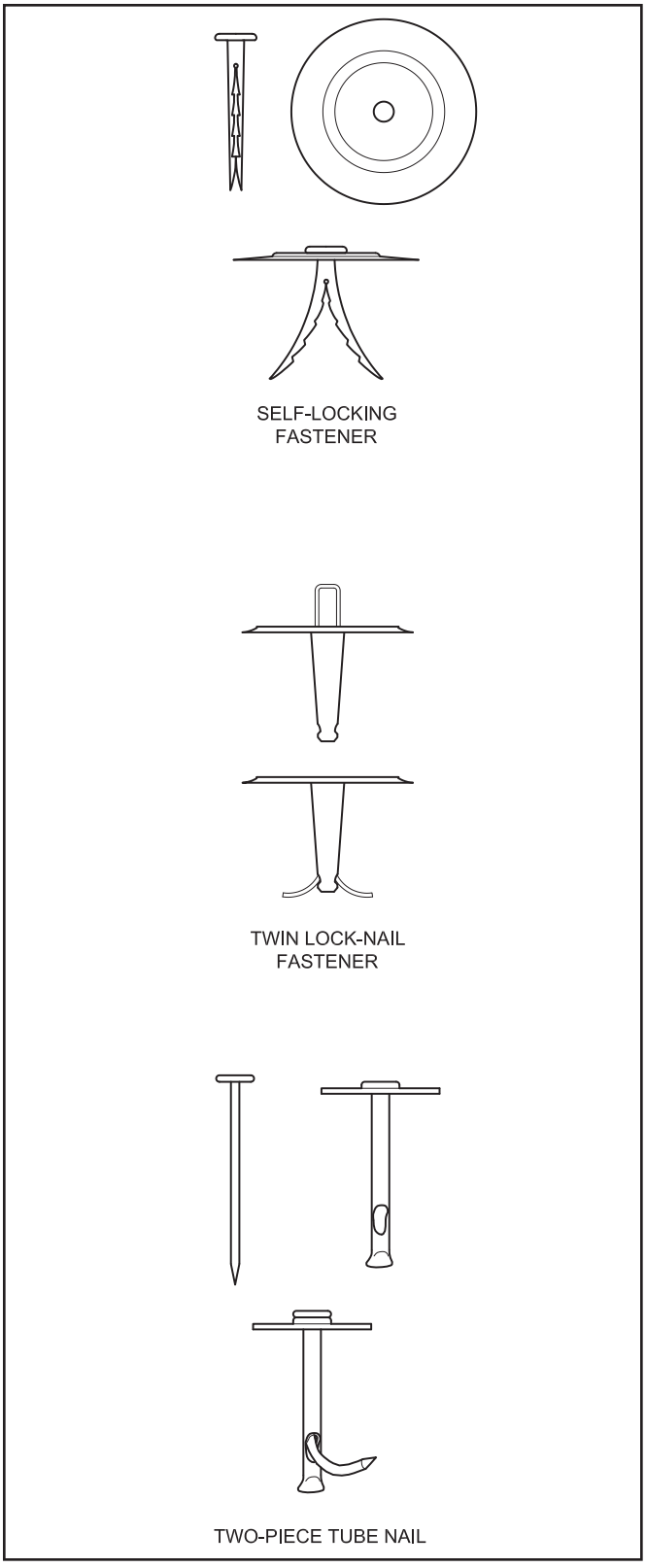

Figure 9-2: Fasteners for reroofing over gypsum roof decks

minimum required replacement roof system-specific uplift resistance.

Pre-drilling anchor holes or hammering a fastener into non-pre-drilled gypsum can spall the bottom of the panel or poured deck. Cured gypsum decks may be hard enough to prohibit the installation of anchors typically considered acceptable for new gypsum decks. Preformed deck units are typically very hard and may require the use of hardened fasteners or adhesives to apply a base sheet. For gypsum panels, hardened nails are suggested.

On cured gypsum roof decks or gypsum panels that do not accept fastener installation and the gypsum remains in good condition, it may be acceptable to treat the cured gypsum as a concrete deck. Directly applying insulation boards to primed gypsum decks with hot asphalt or adhesives may be an acceptable attachment method. A test area may be necessary to determine the best method for preparing the cured poured-in-place gypsum deck and installing the membrane.

Roof Openings: When a hole is cut to accommodate penetrations through a poured gypsum deck, supplemental framing usually is necessary to support the opening. Designers should follow the guidelines set forth by poured gypsum deck manufacturers or appropriate product institutes' publications.

All openings for penetrations through a roof deck should be in place and any mechanical equipment curbs should be attached to the deck before installation of the new roof system begins.

Steel: Steel roof decks are constructed of cold-rolled steel sheets or panels with ribs formed in each panel to provide strength and rigidity. The panels are available in several gauges, rib depths and flute spacings.

Roof Replacement Considerations: For steel roof decks, holes in the top flange have less effect on the structural capacity of the metal deck than holes in the bottom or sides of the flutes. If the attachment-bearing surface is damaged to the extent that proper installation of new fasteners does not provide adequate pullout resistance, overlaying or replacement with new metal roof deck should be considered. NRCA is concerned with the structural capacity and potential fastener-holding power of steel roof decks lighter than 22 gauge (0.028 inches thick).

The deck should be inspected for corrosion and any type of deterioration. Areas of steel deck that have surface corrosion but are not pitted should be properly prepared and field-coated with a rust-inhibiting paint.

Installing new steel deck without removing the existing metal deck is called nesting. Nesting can be accomplished by using the same type and grade of steel or a steel roof deck with narrower flutes so the new deck fits into the existing deck.

Guidelines for nesting of new steel deck:

- A new steel deck should be selected based on appropriate span capabilities. The existing steel deck should not be required to support the new nested steel deck.
- When galvanized steel roof decks are used, coatings should be G-90.
- Loose rust from the top side of the existing deck should be removed, and those areas should be coated with a rust-inhibiting paint.
- At a minimum, steel roof deck panels should span from joist to joist. The length of span (joist to joist) and number of spans (one, two or more) will determine the required gauge of the steel roof deck. Steel roof deck panels are designed based on the length of span, number of spans a single length of steel deck will span and deck thickness.
- Replacement steel roof deck panels are to be fastened to the existing joists, not the existing deck, by mechanically fastening according to the SDI or FM guidelines (see Section 2.4—Steel). Replacement steel roof deck panels should span a minimum of two spans (i.e., three supports) depending on the span length and gauge of the steel roof deck panel.

Consideration should be given to the possibility of continued deterioration of the existing deck after a replacement steel deck has been nested over the existing deck. Continued deterioration of the existing deck may result in failure even though failure of the existing deck may not affect the performance of the replacement deck and roof system. See Figure 9-3.

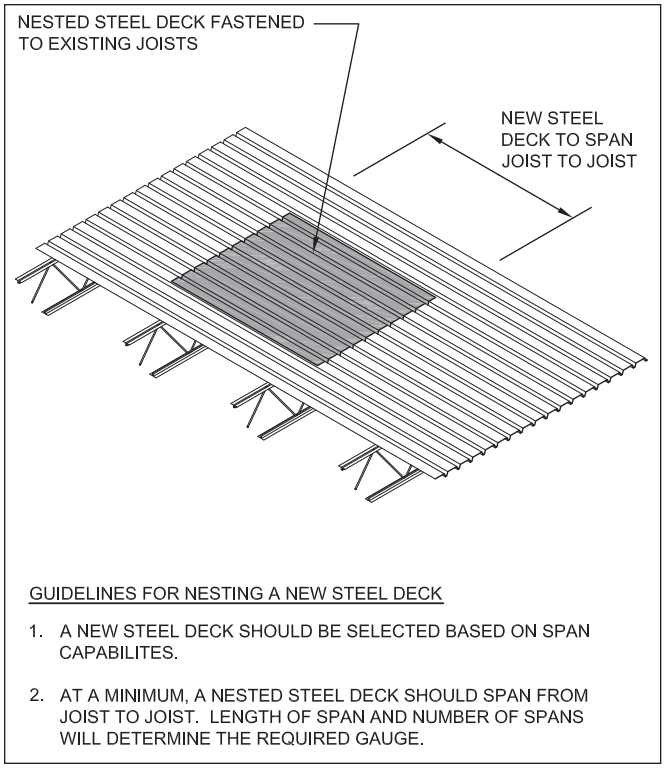

Figure 9-3: Guidelines for nesting a new steel deck

When replacing a roof system over a steel roof deck where the original assembly had been adhered with asphalt, complete removal of all asphalt is not typically required.

Deck Damage: A damaged or severely corroded steel roof deck should be repaired to ensure structural integrity and a suitable surface for roof system application. If repair is not possible, steel deck panels should be replaced before applying a new roof system.

Spray-applied Fire-resistive Materials: Spray-applied fire-resistive materials (SFRM) applied to the underside of a steel deck may get displaced or dislodged as a result of reroofing operations or when mechanically attaching rigid board insulation or a roof membrane. This situation is unavoidable and beyond the control of a roofing contractor. In addition, the repair or replacement and clean-up of SFRM is outside the scope of roofing-related work.

Thermal-setting Insulating Fill: Thermal-setting insulating fill—commonly known as All-Weather Crete—is a nonstructural material produced by mixing perlite aggregate with hot asphalt binder. It can provide insulation, fill irregularities of an underlying structural substrate and provide slope for drainage. The hot, loose fill must be placed on a primed surface and screeded to a thickness

that will allow for proper compaction to a specified thickness and density.

Thermal-setting insulating fill usually is roller-compacted to about two-thirds of its applied thickness. Hand-tamping may be required at perimeters, curbs and other roof-to-vertical intersections. Proper compaction results in a density between 18 pounds per cubic foot and 22 pounds per cubic foot.

Thermal-setting insulating fill is considered a nonnailable substrate and, as such, typically requires the use of a base sheet or separator sheet adhered to the fill, which is used as a substrate to adhere additional roofing components.

Thermal-setting insulating fill has special characteristics and requirements. The manufacturer's specifications and instructions should be consulted for information pertinent to a material's specific design requirements.

Roof Replacement Considerations: In a roof replacement situation, reusing thermal-setting insulating fill is generally not practical because a new roof system cannot be mechanically attached to it, and adequate adhesion typically cannot be achieved to provide for adequate uplift resistance of the new roof system.

In situations where the roof deck has adequate load capacity, installation of a loosely laid and ballasted roof system can be considered.

Deck Damage: Areas of wet or noncompacted thermal-setting insulating fill should be repaired to ensure structural integrity and a suitable surface for roof system application. If repair is not possible, thermal-setting fill material should be removed before applying a new roof system.

Roof Openings: All openings for penetrations through a roof deck should be in place and any mechanical equipment curbs should be attached to the deck before installation of the new roof system begins.

Wood Panels: There are two general types of wood panels used for roof decks: plywood and oriented strand board (OSB).

Plywood panels are composed of thin wood layers, or veneers, peeled from logs. The veneers are laid at right angles to each other and then glued together under heat and pressure. This cross-lamination adds strength and stability to the all-veneer panels. Panels consist of numerous cross-laminated layers that vary in number according to the panel's thickness or design.

OSB panels are composed of layers of compressed, glued wood strands. These strand layers are oriented at right angles to one another before being glued under heat and pressure and formed into panels. OSB panel performance can be affected by the type of wood (i.e., hardwood or softwood) used in its manufacture.

Roof Replacement Considerations: When reroofing over wood panel roof decks, complying with APA—The Engineered Wood Association's (APA's) recommendations for attachment of plywood and OSB sheathing to framing generally provides for compliance with the building code's prescriptive requirements. In some instances, this fastening schedule may be more restrictive than the fastening schedule applicable at the time the building was constructed. In such instances, renailing the plywood and OSB sheathing to comply with the applicable APA fastening recommendation is suggested.

Most roof systems installed over plywood and OSB roof decks include a base sheet or underlayment mechanically fastened to the deck. Removal of a roof covering and the associated fasteners typically does not damage or reduce the structural capacity of wood panel roof decks. During removal, many base sheet or underlayment fasteners may remain embedded in a deck; fasteners remaining in a deck can be pulled out or hammered flush with the deck. It is acceptable that many of the existing fasteners can remain in a deck when a new roof system is installed. With mechanically fastened insulations, screw-type fasteners typically are backed out of the deck before installation of a new roof system.

Deteriorated areas should be cut out and replaced with material to closely match the existing thickness. A deck should be sound and smooth with fasteners flush to the deck before installation of a new roof system. New wood decking should be the same thickness, have similar strength characteristics and span ratings, and span the minimum spans recommended for the material. Deck fasteners that have backed out should have new fasteners installed adjacent to them. Loose or lifted panels and panel corners should have additional fasteners installed to secure an existing deck.

Holes in low-slope wood roof decks up to approximately 10 inches wide can be covered with 24-gauge

(0.025-inch-thick) steel. the steel plate must overlap the wood roof deck a minimum of 4 inches and be secured with fasteners at 4 inches on center.

NRCA does not recommend installation of roof systems over structural wood panel roof decks, such as plywood and OSB, that are less than 15⁄32 of an inch thick.

Deck Damage: Water-damaged or otherwise deteriorated plywood or OSB structural panels should be removed and replaced with new panels of matching type, thickness and size before applying a replacement roof system to ensure structural integrity and a suitable surface for a new roof system application.

Wood Planks and Wood Boards: Wood plank and wood board roof decks are composed of solid-sawn dimensional lumber. They are typically supported by wood beams, often glue-laminated timber (glulams), and/or solid lumber joists, purlins or trusses.

The terms wood "plank" and wood "board" generally are differentiated by thickness and width.

Wood planks are long, relatively thick pieces of lumber. Specifications sometimes vary in thickness from 2 inches up to 5 inches with the width dimension in the plane of the roof deck. Wood planks may be single or double tongue-and-groove, straight-edge, ship-lapped or grooved for splines on longitudinal edges.

Wood boards are pieces of lumber that are less than 2 inches thick with square edges. Boards are typically between 4 inches and 12 inches wide and are laid with their width dimensions in the plane of a roof deck. Boards less than 4 inches wide are sometimes classified as strips. Use of nominal 6-inch-wide wood boards is suggested for roof decks to prevent excessive movement and splitting. Boards that are thinner than nominal 1 inch are not considered strong enough to support roof loads.

Roof Replacement Considerations: Most roof systems installed over wood roof decks include a base sheet or underlayment mechanically fastened to the deck. Removal of a roof covering and the associated fasteners typically does not damage or reduce the structural capacity of wood roof decks. During removal, many base sheet or underlayment fasteners may remain embedded in a deck; fasteners remaining in a deck can be pulled out or hammered flush with the deck. It is acceptable that many of the existing fasteners can remain in a deck when a new roof system is installed. With mechanically fastened insulations, screw-type fasteners typically are backed out of the deck before installation of a new roof system.

Deteriorated areas should be cut out and replaced with material to closely match the existing thickness. The deck should be sound and smooth, with fasteners flush to the deck, prior to installing the new roof system. New wood decking, whether boards or planks, should be the same thickness and have similar strength characteristics and span ratings and should span the minimum spans recommended for the material. Deck fasteners that have backed out should have new fasteners installed adjacent to them and the existing fasteners should be removed. Loose or lifted boards, planks and corners should have additional fasteners installed to secure the existing deck in place.

Holes in tongue-and-groove plank decks up to 10 inches wide can be covered with 24-gauge (0.025-inch-thick) steel plate. The steel plate must overlap the wood roof deck 4 inches minimum and be secured with fasteners at 4 inches on center. Where holes are found in square-edged board decks, the affected boards should be replaced with new wood of matching type, thickness and size.

NRCA does not recommend installation of roof systems over wood board roof decks that are less than ¾ of an inch minimum thickness.

Deck Damage: Deteriorated wood plank or wood boards should be removed and replaced with new wood of matching type, thickness and size before applying a replacement roof system to ensure structural integrity and a suitable surface for application of a new roof system.

9.5—Preparation of Existing Roof Surfaces

The following guidelines are specific to the preparation of existing built-up, polymer-modified bitumen, single-ply and liquid-applied membranes prior to the installation of a re-cover roof system.

- Loose aggregate-surfacing, large buildups of bituminous coatings, and large buckles or blisters should be removed; any deficiency that prevents a proper installation of the re-cover roof system should be repaired.

- Areas of wet and deteriorated insulation should be removed and replaced to match the height of the existing system.
- Loose, damaged or otherwise incompatible existing base flashings should be removed.

If the existing uninsulated roof membrane is to be used as a vapor retarder, the flashings should remain in place and the existing membrane and flashings should be repaired sufficiently to perform as a vapor retarder.

Only insulation boards should be used as separation layers over aggregate-surfaced built-up roof systems. Insulation boards, nonwoven mats, mineral boards or base sheets are used as separation layers for granule-surfaced or smooth-surfaced built-up, polymer-modified bitumen or liquid-applied membranes.

Existing single-ply membranes should be cut to relieve existing stress within the membrane. It is suggested to refer to the manufacturer of the re-cover membrane or system to determine whether the existing membrane is required to be cut or sliced.

NRCA does not recommend mechanically fastening a re-cover system through an existing coal tar built-up roof system because of the possibility of bitumen drippage.

9.6—Re-cover Guidelines for Membrane Roof Systems

The following is a list of general recommendations for re-covering over an existing roof system with a new built-up, polymer-modified bitumen, single-ply or liquid-applied membrane roof system.

- The existing roof system and new re-cover roof system must be compatible or appropriately separated.
- The roof deck should be secured to the structure of the building, support the design live load and dead load required for the building, and provide the necessary pullout resistance for fasteners used with a new mechanically attached re-cover roof system.
- If the new roof system is fully adhered to the existing roof system, the existing roof membrane and insulation, if any, should be secured to the roof deck according to appropriate wind-uplift resistance requirements. The surface of the existing roof system may require preparation and/or may need to be primed with a compatible primer to enhance adhesion before application of the new adhered roof system.
- The existing roof system should be inspected and tested, if necessary, to determine whether excess moisture is present within the roof assembly. Wet insulation must be removed and replaced with compatible materials.
- The existing roof system should be inspected for shrinkage, ridging, splitting and cracking and then repaired appropriately. Portions that may present problems should be secured or removed.

Chapter 5—Roof Membranes in this manual should be referred to for additional information about built-up, polymer-modified bitumen, single-ply or liquid-applied membrane roof systems.

9.7—Design Guidelines for Roof Replacement with New Membrane Roof Systems

This section discusses design considerations applicable to new replacement membrane roof systems.

Design considerations related to the following concepts and construction components apply to new replacement membrane roof system projects:

- Building code compliance
- Fire resistance
- Wind-uplift resistance
- Drainage and slope
- Insulation
- Condensation control
- Existing metal flashings
- Wood blocking

Building Code Compliance: For most code jurisdictions in the U.S., the International Building Code's (IBC's) requirements apply to reroofing most buildings. For detached one- and two-family dwellings and most

townhouses, the International Residential Code's (IRC's) reroofing requirements apply.

The designer of a replacement roof system should verify the specific building code that applies to the building and design a replacement roof system that complies with the applicable building code. Replacement roof systems need to comply with the same building code provisions as roof systems in new construction situations except positive roof drainage is permitted instead of the building code's prescriptive minimum roof slope provision of ¼:12 for low-slope roof systems.

Additional information regarding building code requirements applicable to reroofing is provided in Section 9.3—Building Code Requirements for Reroofing.

Fire Resistance: The International Building Code, Section 1505.1 states the minimum fire classification for a roof assembly is determined according to the type of construction of the building. It references Table 1505.1 (Figure 9-4) for minimum fire classifications.

IBC defines types of construction in Chapter 6—Types of Construction. An in-depth review of the code's criteria for classifying construction types is beyond the scope of this manual. The following brief descriptions provide a general idea of the classifications:

- **Type IA, IB, IIA, IIB:** Major building elements are of noncombustible materials
- **Types IIIA and IIIB:** Exterior walls of noncombustible materials and the interior building elements are of any material permitted by the code
- **Type IV:** Heavy timber construction
- **Types VA and VB:** Structural elements, exterior walls and interior walls are of any materials permitted by the code

Class A, B and C external fire-exposure classifications are assigned to roof assemblies tested using the protocols provided in ASTM E108, "Standard Test Methods for Fire Tests of Roof Coverings," or UL 790 of the same title. ASTM E108 and UL 790 provide the same test protocols and classification criteria. A roof covering always is tested and classified as part of a complete roof assembly. The class designation thus obtained applies to the whole roof assembly and not the roof covering itself.

TABLE 1505.1[a, b]
MINIMUM ROOF COVERING CLASSIFICATION FOR TYPES OF CONSTRUCTION

IA	IB	IIA	IIB	IIIA	IIIB	IV	VA	VB
B	B	B	C[c]	B	C[c]	B	B	C[c]

a. Unless otherwise required in accordance with the *International Wildland-Urban Interface Code* or due to the location of the building within a fire district in accordance with Appendix D.

b. Nonclassified roof coverings shall be permitted on buildings of Group R-3 and Group U occupancies, where there is a minimum fire-separation distance of 6 feet measured from the leading edge of the roof.

c. Buildings that are not more than two stories above grade plane and having not more than 6,000 square feet of projected roof area and where there is a minimum 10-foot fire-separation distance from the leading edge of the roof to a lot line on all sides of the building, except for street fronts or public ways, shall be permitted to have roofs of No. 1 cedar or redwood shakes and No. 1 shingles.

Figure 9-4: IBC 2015 Table 1505.1

It is significant to note no type of construction requires a minimum Class A fire-resistance classified roof assembly according to the code.

Roof system manufacturers should be consulted for specific fire-resistance information regarding their products. Also, Underwriters Laboratories Inc.'s UL Online Certifications Directory found at www.ul.com/database can be consulted. UL certifications are ordered according to a proprietary scheme of product categories. The UL categories for external fire-exposure classifications of roof assemblies are:

- Prepared Roof-covering Materials (TFWZ)
- Prepared Roof-covering Materials, Formed or Molded Metal, Fiber-Cement, Plastic or Fire-retardant-treated Wood (TFXX)
- Prepared Roofing Accessories (TGDY)
- Roofing Systems (TGFU)
- Wood Structural Panels (TGGN)

Wind-uplift Resistance: Roof systems installed as replacement for existing roof systems need to be able to resist the design wind loads applicable to the building. Because of changes in building code requirements, the

current requirements for wind-uplift resistance applicable to the building may be greater than those of the existing roof system.

Local code officials or the applicable code should be consulted for current roof system uplift resistance requirements.

Roof system manufacturers should be consulted for specific wind-uplift-resistance information regarding their products.

Drainage and Slope: Most roof systems need positive drainage to function properly for long periods of time. Slope can be built into the building's structure and roof deck, or insulation or another material can be added on top of a flat roof deck to create slope. If adequate slope is built into the building's structure, flat stock insulation in conjunction with localized crickets or saddles should provide positive drainage.

Adding materials to create slope may create additional design issues. The increased insulation height can affect the perimeter edge design and may reduce the allowable flashing height where through-wall flashings exist. Where edge metal exists, the increased insulation height will require the installation of additional wood blocking, which will increase the vertical face height of the perimeter edge metal.

Because tapered insulation becomes thicker farther away from the drains, the total thickness at perimeters may not allow for adequate perimeter edge design. By adding additional drains, the distance from the drains to the perimeter can be reduced, as well as the total thickness of the insulation at the perimeters.

Insulation: Because of changes in energy code requirements, the minimum thermal resistance requirements for a replacement roof system may be greater than the requirements for the existing roof system.

Local code officials or the applicable code should be consulted for current roof insulation thermal resistance requirements.

Condensation Control: Where required by code or necessary because of building use or roof assembly performance history, design of a replacement roof system needs to include features for controlling water vapor transport into the roof assembly. Air retarders and vapor retarders may be included as components intended to control water vapor transport into roof assemblies.

The design objective of including components intended to control water vapor transport into roof assemblies is to prevent moisture accumulation so that moisture-sensitive roof assembly components are not damaged and the assembly's thermal resistance is not adversely affected. When designing a replacement roof system, one or more of the following considerations may need to be addressed with regard to its water vapor transport performance:

- When solar reflectance of a replacement roof system is significantly greater than the existing roof system solar reflectance, the designer should not rely on the existing roof system's water vapor transport performance to predict the water vapor transport performance of the new roof system. Because their service temperatures are lower, reflective roof systems effect less downward drying than roof systems that do not include a reflective top surface.
- If the existing roof assembly includes a vapor retarder, the designer should consider including a vapor retarder with the replacement roof system.
- If the existing roof assembly has been damaged as a result of condensation, a designer should consider including a vapor retarder or air retarder with the replacement roof system.
- If the building's use will have changed such that interior temperature and/or relative humidity will be distinctly different than the current conditions, the designer should evaluate the water vapor transport performance of the new roof assembly under new use conditions to decide whether a vapor retarder or air retarder should be included as part of the roof replacement.

Additional information about design and implementation of condensation control measures is provided in the Condensation and Air Leakage Control section of The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing.

Existing Metal Flashings: Reroofing projects typically incorporate new metal flashings, metal counterflashings and copings.

Counterflashings: Surface-mounted counterflashings should be removed. Anchor holes or deterioration in the substrate can be repaired if necessary and the substrate

can be properly prepared prior to reinstallation of the existing counterflashings or installation of new metal counterflashings. Only existing metal with an expected remaining service life at least equal to the expected service life of the new roof system should be reused.

The lower portion of multi-piece counterflashings should also be removed. Depending on the fastening type, care should be taken during removal so damage does not occur to the counterflashing receiver. Only existing metal with an expected remaining service life at least equal to the expected service life of the new roof system should be reused. Otherwise, new metal compatible with the receiver should be installed.

Counterflashings that are embedded into a raggle can be removed, the raggle can be cleaned out and may be repaired if necessary, and a new embedded counterflashing can be installed into the prepared raggle. Some counterflashings are embedded into a wall, such as a masonry wall. This type of flashing often acts as through-wall flashing, as well as counterflashing. This metal, if not deteriorated, may be reused. The existing metal can be cut, leaving approximately a minimum of 1½ inches of metal exposed, and new counterflashing metal can be fastened to the back side of the existing metal.

Where raggles exist, new raggles can be cut into an existing concrete or brick wall to accommodate reinstallation of counterflashing at a different height. Generally, when raggles are used, no through-wall flashing is used. Therefore, raising a raggle should not block weep holes or wall drainage.

Through-wall Flashings: Counterflashing details for membrane roof systems may incorporate a through-wall flashing. Through-wall flashings with removable counterflashings allow removal and reinstallation of the existing counterflashings or installation of new counterflashings. New flashings should tie into the existing through-wall flashing, and the existing through-wall flashing or weep holes should not be covered.

Where existing through-wall flashings are of single-piece design, the existing metal can be cut, leaving approximately a minimum of 1½ inches of metal exposed, and new counterflashing metal can be fastened to the back side of the existing metal.

Special care should be taken when raising roof system heights. Where the existing through-wall flashing height can accommodate the new roof system, it may be reused, if not deteriorated.

If through-wall flashings are deteriorated, damaged or not functional, they should be replaced. Replacing through-wall flashings is a detail-driven process. It involves the removal of the wall cladding and buried flashings, installation of new flashings and reinstallation of the wall cladding with new weep holes or other drainage devices in appropriate locations.

Perimeter Edge-metal Flashings: Because of unknown attachment methods, NRCA suggests existing perimeter edge-metal flashings not be reused.

The removal and reinstallation of existing masonry copings can be done successfully. NRCA suggests incorporating a membrane or metal liner under the masonry coping if reinstalled to provide a secondary water barrier. The joints between individual masonry coping units are not considered to be weatherproof over time.

Where roof gutters and downspouts are used, a roof replacement provides the opportunity to address drainage system deficiencies. If the existing gutters and downspouts perform satisfactorily, they may be reused if their expected remaining service lives are commensurate with the expected service life of the new roof system. Refer to the Architectural Metal Flashing section in The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing for additional information about gutter and downspout materials, design and installation.

Fixed Openings: Doors, windows and other fixed openings can create design issues. If a new replacement roof system is used, the height of the flashing may be reduced. NRCA suggests a minimum 8-inch base flashing height be maintained whenever possible. Special flashing considerations may also be incorporated.

When reroofing changes the termination height at a fixed opening or if the termination height is not adequate, there are a few potential ways to terminate the roof system, including:

- Allowing the existing construction conditions to dictate the flashing heights
- Modifying the size of the opening
- Removing the fixed opening

Roof Curbs and Equipment Supports: NRCA suggests roof curb heights be sufficient to maintain 8-inch minimum base flashing heights for roof-mounted curbs. For some reroofing projects, roof-mounted equipment may need to be raised or temporarily removed to allow for the removal and installation of flashings. If removed, the equipment is reinstalled after completion of the roofing work at the curbs or support stands. Figure 9-5 provides NRCA's guidelines for clearance for equipment support stands.

Width of Equipment	Clearance Above Roof Surface
Up to 24 inches	14 inches
24 inches to 36 inches	18 inches
37 inches to 48 inches	24 inches
48 inches to 60 inches	30 inches
61 inches and wider	36 inches

Figure 9-5: NRCA guidelines for clearance for equipment support stands

For most reroofing projects, installation of new base flashing at skylights, smoke hatches and scuttles does not require the temporary removal of the top of the unit. However, for roof replacement projects, flashing heights will be reduced if insulation is part of the new roof system, which may necessitate raising the skylight, smoke hatch and/or scuttle. For existing self-flashed skylights, smoke hatches or scuttles, separate counterflashings can be added. However, most self-flashed units do not have flashings that meet the recommended minimum height of 8 inches.

Rooftop unit curbs constructed from concrete in a continuous pour with the concrete deck can have wood frame extensions added to the top of the concrete curbs if necessary. Premanufactured curbs may need to be raised.

Pipe Penetrations: Different types of pipe penetrations require different methods of flashing during reroofing projects.

- Plumbing vent stacks and pipes have a limited height but can be extended to accommodate new flashing height.
- Continuous vertical pipes generally have adequate height relative to the height necessary for new flashing; therefore, the storm collar cover can be raised as necessary.
- Pipes that extend vertically through the roof assembly and turn horizontally may require a sheet-metal enclosure installed on a curb or may be flashed with penetration pockets.

Pipe penetrations can move in a different direction from the roof assembly. If there are any signs of tearing or shearing of the pipe flashing, a sleeve-and-collar expansion-type flashing and counterflashing detail may be considered.

Wood Blocking: After removing the existing roof system, the wood blocking at the perimeter will need to be inspected for deterioration, straightness, attachment to the substrate and fastener holding capacity. If equal heights of insulation are removed and replaced, the wood blocking should not require any changes.

Deteriorated or damaged wood will need to be replaced with wood of similar dimensions. Inadequately fastened wood blocking should be reattached. Wood blocking attachment should be designed and installed to meet code requirements for design load resistance.

Well-secured wood blocking should be designed and provided at all roof perimeters and penetrations for fastening membrane flashing and sheet-metal components. Wood nailers should be provided at the tops of all prefabricated curbs for attachment of membrane base flashings.