NRCA’s 2012 SPF Manual and Technical Updates

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Today...

- **NRCA Roofing Manual: Metal Panel and SPF Roof Systems—2012**
- A few technical topics
- Emerging technologies and issues (PV)
- Where is energy efficiency headed...?
The NRCA Roofing Manual

- SPF (and metal) updated in 2012
- Reformatted
- Still includes reroofing details
- New system configurations
The NRCA Roofing Manual: Metal Panel and SPF Roof Systems—2012

- Reformatted for 2012
  - Roof Decks
  - Other SPF Substrates
  - SPF
  - Protective Surfacings
  - Roof Accessories
  - Roof System Configurations
  - Roof Re-covering
  - Construction Details
1.6 Wood Panel Decks

There are two general types of wood panel decks: plywood and oriented strand panel. Plywood panels are comprised of wood layers, or veneers, glued and laid at right angles to each other under heat and pressure. Plywood panels are composed of wood strands that are bonded together with a resin. These strands are a number of cross-ply strand number according to the type of panel. The term "glued" panel refers to panels that are composed of panels made of glued wood strands. The term "right angles" to one another are referred to as panels. The term "required for a specific roof" refers to design loads anticipated between supporting members.

1.7 Wood Planks and Wood Boards

Wood planks and wood board roof decks are composed of solid-sawn dimensional lumber. They normally are supported by wood beams, glue-laminated timber (glulams), and/or solid lumber joists or purlins.

The terms "plank" and "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 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. Board widths are typically between 4 inches and 12 inches wide and laid with their width dimensions in the horizontal 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.

The proper thickness and species of wood plank and wood board deck required for the specific roof assembly should be determined by the design loads, including wind.
CHAPTER 3
SPRAY POLYURETHANE FOAM

The NRCA Roofing Manual: Metal Panel and SPF Roof Systems—2012

SPF roof systems are constructed by mixing and spraying a two-component liquid that forms the base of an adhered roof system. Isocyanate, referred to as component A, reacts with methylene diisocyanate to create a cell structure that forms a fast-setting, tough, adhered roof system. Most SPF roof systems are designed to be spray-applied directly to the substrate. The final surface texture of SPF can vary because of the state of environmental conditions, equipment adjustments, spraying technique, and characteristics of the foam's chemical and thermal properties. Most SPF roof systems operate at temperatures below 10°F (−12°C). The R-value for SPF varies based upon the types of classifications. ASTM D7425 provides for minimum R-values of 5.6 per inch thickness for Type I and 4.1 to 5.6 per inch thickness for Type II. ASTM C1029 provides for minimum R-values of 6.2 per inch thickness.

NRCA recommends SPF intended for use as a roof system have a minimum R-value of 5.6 per inch thickness. Roof-mounted Photovoltaic (PV) Applications: SPF roof systems sometimes are used as bases for roof-mounted PV installations. SPF roof systems acting as platforms for rooftop PV systems should incorporate design features and materials that enhance SPF’s resistance to ultraviolet (UV) radiation, high surface temperature, and mechanical damage beyond the level of roof systems that do not function as bases for systems. NRCA recommends designers to specify reflective roof systems that provide enhanced protection against high service temperatures. More information about roof-mounted PV installations can be found in NRCA’s Guidelines for Roof-mounted PV Installations.

The NRCA Roofing Manual: Metal Panel and SPF Roof Systems—2012
SPF Roof Systems (Chapter 3—Spray Polyurethane Foam)
CHAPTER 4
PROTECTIVE SURFACINGS

The NRCA Roofing Manual: Metal Panel and SPF Roof Systems—2012

Protective surfacings for SPF roof systems consist of coatings and membrane surfacings. Coatings typically consist of liquid-applied membranes; membrane surfacings typically consist of single-ply membranes.

4.1 Protective Surfacing Requirements

Protective surfacing material selection is important to the long-term performance of an SPF roof system. A protective coating must serve multiple functions in protecting the underlying SPF and should be selected from coatings that have been specifically designed for SPF and have a proven history of performance when used over SPF. Protective surfacings not intended for SPF could fail prematurely and lead to problems or roof system failures.

Protective surfacings are part of SPF roof systems to provide weatherproofing, ultraviolet (UV) protection, mechanical damage protection and fire resistance.

Weatherproofing: Protective coatings provide the long-term weatherproofing characteristics of SPF roof systems.

UV Protection: When exposed to sunlight, the surface of SPF is subject to gradual degradation by UV light. The degree of degradation depends on the time and intensity of exposure and SPF formulation. SPF surfacings gradually change color, depending on specific formulation, from cream to tan to burnt orange. An exposed surface that continues to degrade becomes flaky, which, in turn, makes the exposed surface further susceptible to deterioration by moisture and wind erosion. Degraded SPF surfaces are not suitable for the application of protective surfacings or additional SPF without proper surface preparation.

Mechanical Damage Protection: Protective surfacings may increase the resistance of SPF to mechanical damage and abuse. Increased SPF density, thicker coating applications and/or granules applied in conjunction with the coating provide increased protection for most SPF roof systems. Additional protection may be an important consideration for impact-prone (e.g., hail) areas, high-wind areas, and severe climates.

Fire Resistance: A protective surfacing is necessary to assist in achieving a fire-resistance rating for an SPF roof assembly.
This chapter discusses pre-manufactured roof accessories. Some pre-manufactured roof accessories are provided or installed by other trades that are integrated into a roof system and can be critical to the weathertight integrity of a completed roof system. Examples of pre-manufactured accessories that may be encountered on an SPF roof system include:

- Equipment curbs
- Expansion joint covers
- Prefabricated flashings
- Skylights and roof/vent hatches

### 5.1 Equipment Curbs

Pre-manufactured equipment curbs are available as insulated or noninsulated units and are constructed of galvanized steel or aluminum. Curbs should be in place before a roof system is installed. In addition, curbs should never be set on or fastened through roof insulation. All curbs should be firmly anchored to a properly supported roof deck at a minimum 3:12 pitch. Well-sealed, flexible pipe air admittance valves that provide sealing for the roof membrane at roof curbs. To avoid damage from water, mounting surfaces for roof curbs and accessories should be free from particles, debris, and ice. The roof deck in the vicinity of roof-mounted curbs should have a roof pitch of 1:12 or greater to prevent the entry of water. Condensate drainage pipes should be properly insulated and be located in plenums, crawl spaces, or other areas that maintain a temperature greater than 50°F. Drainage connections should be made at a point at least 24 inches above grade, and the roof shall be designed to shed water. Drainage systems should be effectively designed to prevent water from entering the building and discharge water from the roof in a self-draining manner.

![Diagram of cricket at mechanical unit](image)

**Figure 5-1: Cricket at mechanical unit**

Mechanical units should not restrict the flow of runoff water. Mechanical units also should not be located in valleys or drainage areas.
SPF Roof System Over Nailable Deck

**Roof Slope Limitations**
Refer to Chapter 1—Roof System Design for roof slope.

Minimum slope: Refer to Figure 8-23.

**Roof Deck**
Refer to Chapter 1—Roof System Design for roof decks.

- Cementitious surfaced roof decks
- Lightweight insulating roof decks
- Wood panels
- Wood planks
- Other combustible assemblies

**Air and Vapor Retarder**
Refer to The NRCA Guide to Condensation Control for information on air and vapor retarders.

**Base Sheet**
(select one or more...)

- APP polymer-modified bitumen (ASTM D6695; Type II)
- SBS polymer-modified bitumen (ASTM D6163 or D6695; Type II)
- Asphalt-coated roofing felts (ASTM D4897; Type II)
- Polymer-modified bitumen base sheet

**Base Sheet Securment**
- Large-head roofing nails
- Self-locking fasteners
- Threaded fasteners

**SPF**
Refer to Chapter 3—SPF Systems for more information regarding SPF application.

- Primer (select one, if necessary...)
  - Acid wash
  - Acrylic
  - Chlorinated rubber
  - Epoxy
  - Neoprene
  - Polyurethane

**SPF (Specify Overall Thickness)**

**BASE SHEET (MECH. ATTACHED)**

**NAILABLE DECK**

**2" LAP (MIN.)**

**TOP COAT**

**BASE COAT**

CHAPTER 7
ROOF RE-COVERING

This chapter provides information intended to help designers in preparing drawings and specifications for re-covering existing roof systems. The chapter also presents general guidelines for re-covering existing roofs covered with SPF roof systems.

7.1 Roof Re-covering Using an SPF Polyurethane Foam Roof System

When roof system maintenance and repair have not prevented recurrent leakage or extended a roof system's service life, consideration needs to be given to either roof re-covering or roof removal and replacement. Re-covering should also be considered in other situations, including the following:

- Repair expenditures become excessive.
- Leakage becomes intolerable.
- Damage is occurring to structural components.
- Damage is occurring to building contents.

When contemplating re-covering, the first decision that

SPF Application Over Existing Built-up Roof Systems:

- An SPF roof system may be applied directly to an existing built-up roof system when the surface has been prepared. Loose gravel, dirt and debris should be removed using powered wet-vacuum equipment, a power sweeper, a roof blower or other suitable means. Coated, smooth-surface roof systems should be prepared by power washing or by a suitable means to ensure SPF adhesion. Priming of previously coated areas

7.2 Roof Re-cover Design Considerations

The following is a list of general recommendations for re-covering an existing roof system with a new SPF roof system.

Chapter 8: Considerations

The NRCA recommends the following):

1. SPF roof systems may be used with metal flashing to provide edge protection.

Figure 8-2: Perimeter edge-metal flashing installation

Often, SPF roof systems are used with edge-metal flashing to provide a protective layer. If the foam thickness is less than 1 inch, NRCA recommends using edge-metal flashing with elastomeric sealant. It is important to ensure that the flashing is properly installed and sealed to prevent moisture infiltration and potential damage to the roof system.
The NRCA Roofing Manual Series
Technical Issues and Comments

• White membrane over one layer insulation
  – Vapor retarder/air retarder (barrier?)

• Concrete dryness
  – NRCA proposing new dryness test
  – See Mark Graham, AED Technical Services article from January 2012 Professional Roofing
Concrete Deck Dryness

Concrete deck dryness

Alternative approaches are needed to determine when concrete decks are dry

by Mark S. Graham

In September 2011, at the International Roofing Symposium 2011: Emerging Technologies and Roof System Performance held in Washington, D.C., Rene Dupuis, president of Structural Research Inc., Middleton, Wis., and I presented a paper about research we have been conducting regarding the dryness of newly poured structural concrete roof decks and alternative approaches for evaluating concrete decks' readiness for roofing materials.

Our research may help you if you are involved in new construction roofing projects with concrete roof decks or an existing roofing project with a concrete roof deck where moisture accumulation within the roof system is problematic.

Historical methods

Most roofing professionals have relied on historical methods of determining the relative dryness of concrete roof decks to be adequate.

The historical methods of determining the relative dryness of concrete roof decks no longer are adequate

The historical methods of determining the relative dryness of concrete roof decks do not exist. However, Kanare reports relative humidity values from 65 to 85 percent typically are considered acceptable in the flooring industry depending on the floor covering being used. Also, though normal-weight structural concrete used for floor slabs may reach acceptable levels in fewer than 90 days, lightweight structural concrete may take about six months to reach equivalent levels.

An alternative approach

An alternative approach

During our research, Dupuis and I looked to the flooring industry and found some alternative methods of evaluation.

Concrete Floors and Moisture, Second Edition, written by Howard Kanare, senior principal scientist at CTL Group, Skokie, Ill., discusses several ways to evaluate the necessary dryness of concrete floor slabs before floor covering application. Dupuis and I found one method to be of particular interest and practical for use in evaluating concrete roof deck dryness.

ASTM F2170, "Standard Test Method for Determining Relative Humidity in Concrete" relative humidity values for concrete roof decks do not exist. However, Kanare reports relative humidity values from 65 to 85 percent typically are considered acceptable in the flooring industry depending on the floor covering being used. Also, though normal-weight structural concrete used for floor slabs may reach acceptable levels in fewer than 90 days, lightweight structural concrete may take about six months to reach equivalent levels.

Additional information

A possible alternative approach for determining when a newly placed concrete deck is suitable to be covered has been identified. However, before the roofing industry can...
Technical Issues and Comments

• TPO activity at ASTM (heat vs UV)
  – Increasing “aging” requirements

• 2011 NRCA recommendations
  – 60 mil minimum TPO
  – Polyisocyanurate R-value
    • 5.0 in heating climates
    • 5.6 in cooling climates

• PV temperatures, “Parallel Rack” PV panel fire concerns
Emerging technologies and issues

- NRCA is affecting building codes to ensure consistent requirements for vegetative, PV and new technologies
- Roof-mounted PV system code compliance
  - Fire, wind, impact, labeling...
  - NEC/NFPA 70
  - IFC 2012
- PV temperatures, “Parallel Rack” PV panel fire concerns
Flammability Testing of Standard Roofing Products in the Presence of Stand-off Mounted PV Modules

Overview
This fact sheet summarizes a Solar America Board for Codes and Standards (Solar ABCs) Interim Report that was developed in partnership with Underwriters Laboratories Inc. (UL) to investigate whether and how the presence of roof mounted PV arrays may affect the fire class rating of common roof covering materials. In particular, these tests were initiated in response to questions from stakeholders about the language in the UL Guide Card that stated that PV modules may or may not reduce the fire class rating of roof coverings when modules of a lower rating are installed above a roof covering with a higher rating. All tests were conducted by UL in Northbrook, IL, with assistance from representatives of Solar ABCs.

Key Findings
To assess flammability, “spread of flame” and “burning brand” tests were used. These are UL/ASTM standard tests that are conducted on all roofing systems (during UL 790 certification) as well as on all PV modules (during UL 1703 certification). However, flammability tests are typically performed on either a roof covering or a PV module in isolation. The current tests applied fire and burning material to the roof covering while non-mounted PV was present. Therefore, unlike UL 1703, which evaluates the properties of a PV module in isolation, the current tests were conducted to examine combined effects of modules and roof coverings in a system when exposed to fire and flames. Tests were designed to use the methods of UL 790 to evaluate different combinations of modules, stand-off heights, and roofing materials.

Burning Brand Tests
In all cases, when the burning brand was placed on top of either Class A or Class C modules, the standard test geometry (UL 1703) the roof system was found to remain compliant with Class A requirements. However, when the brand was placed on the Class A rated roof covering beneath Class C rated PV modules (the test geometry not defined in either UL 1703 or UL 790) the roof covering remained in compliance with Class A requirements in some cases and in some cases it did not. Multiple tests placing the brand on Class A rated roof coverings beneath Class C rated PV modules resulted in the roof covering failing to meet the Class A requirements in all cases.

Spread of Flame Tests
During the spread of flame tests it was observed that any panel even a non-combustible panel mounted at a stand-off height of 6 feet retained the flame. For Class A modules, the flame spread was limited to a small area beneath the panel. The flame spread would be extinguished by the roof coverings. For Class C modules, the flame spread would be limited to the area beneath the panel and not extend to the roof covering. The increased temperature and heat flux present at the roof surface when the flames were applied between the panel and roof would be a result of a “channeling effect” through which the panel holds hot gases and flame closer to the roof surface not allowing them to dissipate as they do when not confined. Due to this effect, in all cases, the presence of either Class C or Class A modules mounted above Class A roof materials resulted in the roofing assemblies failing to meet the Class A spread of flame test requirements (i.e. flame spread greater than 6 feet was observed). When comparing spread of flame test results for Class A versus Class C modules, both types were found to fail the tests with the same frequency. It should be noted that spread of flame in failures due to the “channeling effect” would not occur for building integrated PV arrays or arrays that mount directly onto the roof surface with no gaps.

Mitigation
Though not part of the initial test plan, a few methods were examined for their potential to prevent the channeling effect observed in the...
NRCA and PV
NRCA Guidelines for
Roof-mounted Photovoltaic System Installations

This document provides NRCA’s technical information for attachment and roof system enhancements.
This document provides an overview of non-technical information and should be used as a leave-behind for building owners who are researching roof-mounted PV systems.
Credentials

• CSRP
Certified Solar Roofing Professional
Presented by RISE
www.riseprofessional.org

• NABCEP: Solar Photovoltaic Installer Certification
Rooftop Photovoltaic Systems: Energizing Your Business

presented by

NRCA University

February 21, 2012 .......... Orlando
Where are we headed, energy-wise??

- “Roofs” and “Walls” are what we use to build. It’s mostly still used, but it’s going away. Give it a couple building code cycles.
- We are headed to “Building Envelope” and that includes Roof, Walls and Junctures.
  – Junctures become important because of the need for continuity of the air barrier.

...is following ASHRAE 189.1’s lead to now include air barrier requirements for the entire building.
IECC 2012, Chapter 4

- Commercial and residential air barriers are mandated by adoption of IECC 2012

C402.4 Air leakage (Mandatory). The thermal envelope of buildings shall comply with Sections C402.4.1 through C402.4.8.

R402.4 Air leakage (Mandatory). The building thermal envelope shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2. The sealing methods between dissimilar materials shall allow for differential expansion and contraction.
• C402.4.1 Air barriers
  – Exception: “...not required ... in Climate Zones 1, 2 and 3.”

**Exception:** Air barriers are not required in buildings located in Climate Zones 1, 2 and 3.

• Table R402.4.1.1 Air Barrier and Insulation Installation
  – Continuous ... sealed joints
  – Access opening, drop down stairs ... shall be sealed
IECC 2012, Chapter 4

- Air barrier compliance paths:
  - Material
  - Assembly
  - Building

**C402.4.1.2.2 Assemblies.** Assemblies of materials and components with an average air leakage not to exceed 0.04 cfm/ft² (0.2 L/s · m²) under a pressure differential of 0.3 inches of water gauge (w.g.) (75 Pa) when tested in accordance with ASTM E 2357, ASTM E 1677 or ASTM E 283 shall comply with the requirements in Items 1 and 2 shall be tested and the air leakage rate of the building envelope shall not exceed 0.40 cfm/ft² at a pressure differential of 0.3 inches water gauge (2.0 L/s · m² at 75 Pa) in accordance with ASTM E 779 or an equivalent method approved by the code official.
• SPF: air barrier and insulation
  – Inherently minimizes thermal bridges
  – Used in roofs and walls, of course
• Roof surfacings and reflectivity
  – For building or environment? ...aka, the owner versus Stephen Chu?
• The best way to conserve energy is to not use energy, that is, use less energy. Then, energy production is a way to reduce your energy use?
Additional NRCA “SPF” Documents


• *Quality Control Guidelines for the Application of Sprayed Polyurethane Foam Roofing* (NRCA / SPFA, 2003)

• *A Field and Laboratory Assessment of Sprayed Polyurethane Foam-based Roof Systems* (R. Dupuis, 1998)

• *Performance of Sprayed Polyurethane Foam Flashings on CD-ROM* (R. Dupuis, 2003)
Today...

• *NRCA Roofing Manual: Metal Panel and SPF Roof Systems*—2012
• A few technical topics
• Emerging technologies and issues (PV)
• Where is energy efficiency headed...?
Thank you!

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