DETAILS

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Working on the Cutting Edge

SPRI Updates and Improves Roof Edge Standards

The effect of high winds on roofs is a complex phenomenon, and inadequate wind uplift design is a common factor in roofing failures. Damage from wind events has historically been dramatic, and wind-induced roof failure is one of the major contributors to insurance claims.

Roofing professionals have long recognized the importance of proper low-slope roof edge and gutter designs, particularly in high-wind conditions. For this reason, SPRI, the association representing sheet membrane and component suppliers to the commercial roofing industry, has spent more than a decade enhancing testing and design standards for these roofing details.

SPRI introduced the first version of its landmark standard, ANSI/SPRI/ES-1 "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems" in 1998. Since then, the association has continually revised, re-designated and re-approved the document as an ANSI (American National Standards Institute) standard.

Testing of edge securement per ANSI/SPRI ES-1 is required per the International Building Code (IBC), which has been adopted by every state in the country.

PHOTO: JOHNS MANVILLE

As part of the ES-1 testing protocol, RE-3 tests upward and outward simultaneous pull of a horizontal and vertical flanges of a parapet coping cap.

This gravel stop is being tested according to the ANSI/SPRI ES-1 standard using the RE-2 test for fascia systems.

This gutter is being tested using the test method specified in ANSI/SPRI GD-1, "Design Standard for Gutter Systems Used with Low-Slope Roofs."

This standard provides the basic requirements for wind-load resistance design and testing for roof-edge securement, perimeter edge systems, and nailers. It also provides minimum edge system material thicknesses that lead to satisfactory flatness, and designs to minimize corrosion.

Construction professionals have been successfully using the standard, along with the specifications and requirements of roofing membrane and edge system manufacturers to strengthen their wind designs.

Until recently, the biggest news on the wind design front was the approval of ANSI/SPRI/FM 4435/ES-1, "Wind Design Standard for Edge Systems Used with Low-slope Roofing Systems." Let's call it "4435/ES-1" for short. SPRI knew recent post-hurricane investigations by the Roofing Industry Committee on Weather Issues (RICOWI) and investigations of losses by FM Global consistently showed that, in many cases, damage to a low-slope roof system during high-wind events begins when the edge of the assembly becomes disengaged from the building. Once this occurs, the components of the roof system (membrane, insulation, etc.) are exposed.

Damage then propagates across the entire roof system by peeling of the roof membrane, insulation, or a combination of the two.

Recognizing that edge metal is a leading cause of roof failures, SPRI has redoubled its efforts to create a series of new and revised documents for ANSI approval. As has always been the case, ANSI endorsement is a critical step toward the ultimate goal of getting these design criteria included in the IBC.

A SYSTEMS APPROACH TO ENHANCING ROOF EDGE DESIGN

Roofing professionals understand that successful roof design requires the proper integration of a wide variety of roofing materials and components. For years, leading roofing manufacturers have taken a "systems" approach to their product lines. Recently, SPRI has zeroed in on the roof edge. Low-slope, metal perimeter edge details include fascia, coping and gutters, are critical systems that can strongly impact the long-term performance of single-ply roofs.

SPRI first addressed roof gutters in 2010 with the development of ANSI/SPRI GD-1. The testing component of this document was recently separated out to create a test standard and a design standard. The test standard, GT-1, "Test Standard for Gutter Systems," which was approved as an American National Standard on May 25, 2016.

Similarly, SPRI has revised 4435/ES-1 to only be a test standard.

Making both edge standards (4435/ES-1 and GT-1) into standalone testing documents makes it easier for designers, contractors and building code officials to reference the testing requirements needed for metal roof edge systems.

IBC requires that perimeter edge metal fascia and coping (excluding gutters), be tested per the three test methods, referred to as RE-1, RE-2 and RE-3 in the ES-1 standard. The design elements of ES-1 were never referenced in code, which caused some confusion as to how ES-1 was to be applied. The latest version of 4435/ES-1 (2017) only includes the tests referenced in code to eliminate that confusion.

Test methods in 4435/ES-1 2017 have the same names (RE-1, RE-2, and RE-3), and use the same test method as 4435/ES-1 2011. Because there are no changes to the test methods, any edge system tested to the 2011 version would not need to be retested using the 2017 version.

FM Global's input was instrumental in the changes in 2011 when ANSI/SPRI ES-1 incorporated components of FM 4435 to become 4435/ES-1. However, there are no additional FM related changes in the latest 4435/ES-1 standard.

Per ANSI requirements, 4435/ES-1 2011 needed to be re-balloted, which is required by ANSI every five years. SPRI took this opportunity to have it approved as a test standard only to eliminate the confusion referenced above. FM Global was consulted and indicated it wanted to keep "FM" in the

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title. (FM was on the canvas list for the test standard and actually uses it as its own test standard.)

With 4435/ES-1 becoming a test standard for coping and fascia only, and GT-1 being a test standard for gutters, SPRI determined that a separate edge design standard was needed. Meet ED-1, a design standard for metal perimeter edge systems.

The design portions of the ES-1 edge and the GD-1 gutter standards have been combined and are now referenced by SPRI as ED-1. It has been developed and is currently being canvassed as an ANSI standard that will provide guidance for designing all perimeter edge metal including fascia, coping, and gutters.

ED-1 will be canvassed per the ANSI process later this year. However, SPRI is not planning to submit ED-1 for code approval.

SPRI ED-1 will include:

MATERIAL DESIGN

- Nailer attachment
- Proper coverage
- Recommended material thicknesses
- Galvanic compatibility
- Thermal movement
- Testing requirements
- "Appliance" attachment to edge systems

LIMITED WIND DESIGN

- Load to be required by the Authorities Having Jurisdiction (AHJ).
- Tables similar to those included in 4435/ES-1 will be included for reference.

If this sounds a tad complex, imagine the design work required by the dedicated members of SPRI's various subcommittees.

THE TEST METHODS IN DETAIL

The GT-1 standard is the newest, so let's tackle this one first. As noted above, the ANSI/SPRI GT-1 test standard was developed by SPRI and received ANSI Approval in May of 2016. Testing of roof gutters is not currently required by IBC; however, field observations of numerous gutter failures in

moderate to high winds, along with investigations by RICOWI following hurricanes have shown that improperly designed or installed gutters frequently fail in high wind events. GT-1 provides a test method that can be used by manufacturers of gutters, including contractors that brake or roll-form gutters, to determine if the gutter will resist wind design loads. Installing gutters tested to resist anticipated wind forces can give contractors peace of mind, and may provide a competitive advantage when presented to the building owner.

GT-1 tests full size and length samples (maximum 12 feet 0 inches) of gutter with brackets, straps, and fasteners installed per the gutter design. It is critical that the gutter be installed with the same brackets, straps, and fasteners, at the same spacing and locations as per the tested design to assure the gutter will perform in the field as tested. The fabricator should also label the gutter and/or provide documentation that the gutter system has been tested per GT-1 to resist the design loads required.

GT-1 consists primarily of three test methods (G-1, G-2, and G-3). Test method G-1 tests the resistance to wind loads acting outwardly on the face of the gutter, and G-2 tests the resistance to wind loads acting upwardly on the bottom of the gutter. G-3 tests resistance to the loads of ice and water acting downwardly on the bottom of the gutter.

Tests G-1 and G-2 are cycled (load, relax, increase load) tests to failure in both the original GD-1 standard and the new GT-1. The only change being that in GD-1 the loads are increased in increments of 10 lbf/ft2 (pound force per square foot) from 0 to failure, and in GT-1 they are increased in increments of 15 lbs/lf (pounds per linear foot) from 0 to 60 lbs/lf, then in 5 lbs/lf increments from above 60 lbs/lf to failure.

Note also that the units changed from lbf/ft2 (pound force per square foot) to lbs/lf (pounds per linear foot), which was done so that the tests could be run using the test apparatus loads without having to convert to pressures.

The GT-1 standard specifies a laboratory method for static testing external gutters. However, testing of gutters with a circular cross-section is not addressed in the standard, nor does the standard address water removal or the water-carrying capability of the gutter. In addition, downspouts and leaders are not included in the scope of the standard.

SPRI intends to submit ANSI/SPRI GT-1 for adoption in the next IBC code cycle.

As referenced above, IBC requires that perimeter edge metal (fascia and coping), excluding gutters, be tested per three test methods, referred to as RE-1, RE-2 and RE-3 in the ES-1 standard.

RE-1 tests the ability of the edge to

secure a billowing membrane, and is only required for mechanically attached or ballasted membrane roof systems when there is no peel stop (seam plate or fasteners within 12 inches of the roof edge). RE-2 tests the outward pull for the horizontal face of an edge device. RE-3 tests upward and outward simultaneous pull on the horizontal and vertical sides of a parapet coping cap.

CALCULATING ROOF EDGE DESIGN PRESSURES

All versions of ANSI/SPRI ES-1 and ANSI/SPRI GD-1, the 2011 version of ANSI/SPRI 4435/ES-1, and the new ED-1 standard all provide design information for calculating roof edge design pressures. These design calculations are based on ASCE7 (2005 and earlier), and consider the wind speed, building height, building exposure (terrain), and building use.

However, as stated above, IBC requires that the load calculation be per Chapter 16 of code, so the SPRI design standards are intended only as a reference for designers, fabricators, and installers of metal roof edge systems.

ES-1-tested edge metal is currently available from pre-manufactured suppliers, membrane manufacturers and metal fabricators that have tested their products at an approved laboratory.

The roofing contractor can also shop-fabricate edge metal, as long as the final product is tested by an approved testing service. The National Roofing Contractors Association (NRCA) has performed lab testing and maintains a certification listing for specific edge metal flashings using Intertek Testing Services, N.A. Visit www. nrca.net/rp/technical/details/files/its details.pdf for further details.

A list of shop fabricators that have obtained a sub-listing from NRCA to fabricate the tested edge metal products are also available at www. nrca.net/rp/technical/details/files/its details/authfab.aspx.

SPRI CONTINUES TO TAKE LEAD ROLE IN WIND TESTING

As far back as 1998, SPRI broke ground with its ANSI/SPRI/ES-1 document addressing design and testing of low-slope perimeter edge metal. Today, the trade association has a variety of design documents at the roofing professional's disposal, and is working to get ED-1 approved as an Edge Design Standard to be used for low-slope metal perimeter edge components that include fascia, coping and gutters.

All current and previously approved ANSI/SPRI standards can be accessed directly by visiting https://www.spri.org/publications/policy.htm.

For more information about SPRI and its activities, visit www.spri.org or contact the association at info@spri.org. R