INDUSTRY TAKES A CLOSE LOOK AT ROOF FASTENER PERFORMANCE

Secure roof attachment relies on corrosion-free fasteners that perform as specified

By SPRI

One of the primary concerns of roof consultants and designers is maintaining the integrity of the roof during high-wind events. Field research by both FM Global and the Roofing Industry Committee on Weather Issues (RICOWI) shows that the integrity of the roof and perimeter flashings is a critical first line of defense against roof failure.

Because corrosion of fasteners can severely reduce the strength of roof securement, SPRI, representatives of SPRI, the RCI Foundation, and the National Roofing Contractors Association (NRCA) jointly funded an evaluation of metal fasteners in contact with preservative-treated wood. The results of the study were reported at the RCI annual convention in Orlando, FL, in March 2009.

Besides its interest in fastener performance in general, SPRI was also concerned about the effects of fastener corrosion on roofing systems. In addition, the association's ANSI/SPRI ES-1 standard addresses the separate issue of roof-edge securement. SPRI represents sheet membrane and component suppliers to the commercial roofing industry and developed ES-1, *Wind Design Standard for Edge Systems Used With Low-Slope Roofing Systems*, in 1998.

SPRI knew that post-hurricane investigations by RICOWI 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.

For this reason, SPRI investigated the role that fastener corrosion could play in roof failures, and whether or not metal fastener corrosion in treated lumber is an issue. The study went on to assess the relative corrosion levels of various fasteners in different lumber treatments, including CCA, ACQ, and CA-B lumber (see *Figures 1* and *2*).

The wood industry began using these new preservative chemicals due to environmental and regulatory concerns. But soon there were concerns that some of these new chemicals may cause corrosion of certain types of metal fasteners, which had been observed in some instances. Fortunately, these concerns tended to be a knee-jerk

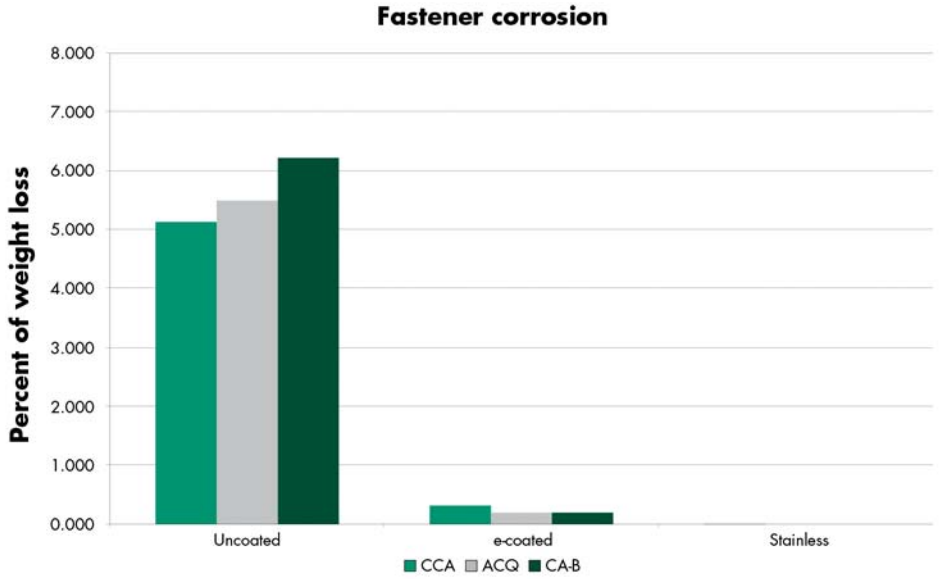

Figure 1 – SPRI found that uncoated fasteners exposed to ACQ/CA-B treatments exhibited greater corrosion than those exposed to the CCA treatment.

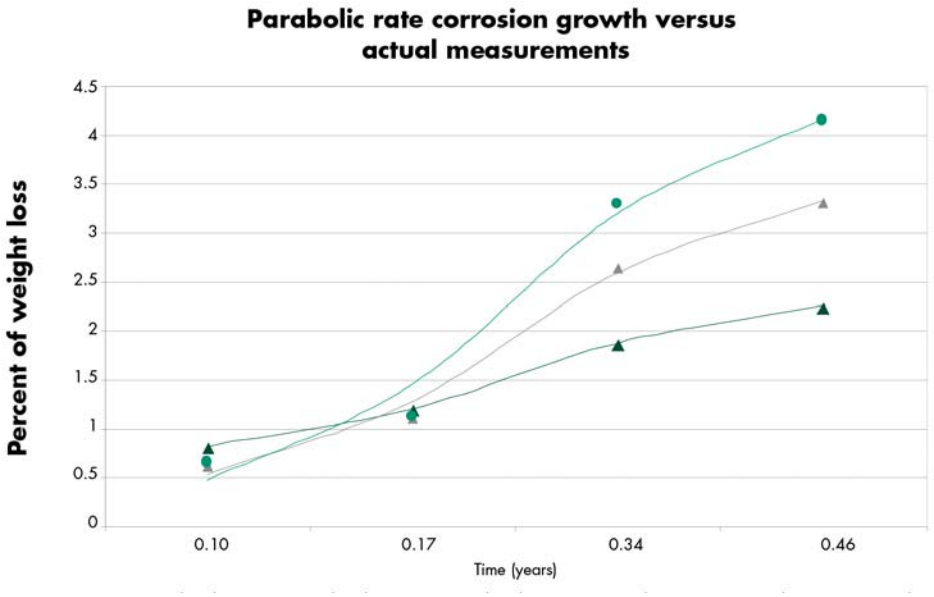

Figure 2 – Coated fasteners exposed to ACQ/CA-B exhibited less corrosion than those exposed to the CCA treatment initially.

reaction to the new wood treatments.

SPRI's report provided the following information:

1. Background on the potential issues of corrosion of metal fasteners in treated wood.
2. Data developed in various laboratories that identify critical variables that initiate corrosion of metal fasteners in contact with wood using various types of preservatives, along with theories as to why this reaction is occurring.
3. Field data from the wood nailer location of low-slope roofing systems located in various regions of the country to determine if the critical parameters necessary to initiate corrosion are present.
4. Recommendations as to the proper combination of fasteners and wood nailers that should be used to prevent corrosion.

LABORATORY STUDIES

SPRI's studies were limited to low-slope roofing applications, and laboratory tests were conducted by SPRI member Duro-Last Roofing of Saginaw, MI, to identify critical temperature and humidity conditions required to initiate corrosion. TRUFAST of Bryan, OH, also conducted various studies that Duro-Last considered as part of its research.

Fastener corrosion can occur when two or more different types of metals come into contact in the presence of an electrolyte, resulting in the formation of a galvanic couple. The electrolyte provides a means for ion migration whereby metallic ions can move from the anode to the cathode. Duro-Last conducted gravimetric studies to assess the corrosion product weight growth as a function of time of exposure to different test environments.

The first phase was an accelerated test exploring corrosion of stainless steel and e-coated carbon steel fasteners, determining their response in a controlled environment in various lumber treatments. The environment simulated was extremely harsh and likely unrealistic. However, the test was designed to maximize sensitivity to corrosion rates. The second phase was to assess rates of corrosion at various temperatures and relative humidity (RH) levels.

For a detailed look at the laboratory test protocols and conclusions, SPRI recommends roof consultants access the full results of the study at www.spri.org. The highlights of the laboratory test results include the following:

- Stainless steel fasteners exhibited no corrosion in any of the lumber treatments and were eliminated from further studies.
- Corrosion was only observed on samples exposed to 90% RH.
- Temperature appears to be the key driver in the extent of corrosion, though a sustained presence of moisture within the wood is also required for corrosion to occur. It appears that the absorbed moisture becomes the medium (electrolyte) for electron transfer.

Photo 1 – SPRI investigated the role that fastener corrosion could play in roof failures and whether or not metal fastener corrosion in treated lumber is an issue. (Photo courtesy of GAF, Wayne, NJ.)

- At typical ambient conditions, the responses observed for the treated lumbers are comparable to those observed with CCA-type wood treatments.
- For conditions common for a roof, the typical ambient temperature and normal levels of moisture saturation required to generate corrosion are not problematic.

"Duro-Last has stated that, in the last four years, it has seen no indication that rooftop conditions are sufficient to cause accelerated fastener corrosion in ACQ- or CA-B-treated lumber," says SPRI technical director Mike Ennis, who coauthored the study. "In fact, for the temperature and moisture conditions observed in the field study, no corrosion issues would be expected."

FIELD STUDIES

Field tests were also conducted to determine if corrosive conditions generally exist in low-slope, commercial roofing applications. The objectives of the field study were as follows:

- Determine how long wood nailers stay wet if saturated with water prior to installation.
- Gather field data in various climates and measure wood nailer moisture content.
- Use the data to develop a model to predict drying times in various climate zones.
- Compare collected data to the critical temperature/humidity levels identified in the laboratory test procedures that are required to initiate severe corrosion of metal.

It should also be noted that in SPRI's testing, the wood nailers were located in the center of the test roof over a deck. Nailers are usually located at the roof edge.

Rather than using common nails for attachment of edge metal, Bob LeClare, vice president of sales for W.P. Hickman Company, recommends specifying hot-dipped galvanized or stainless steel ringshank nails. "These nails should be the same fastener—or have the same pull-out resistance—as the fastener used when the edge metal was ES-1 tested," says LeClare, who is also chairman of SPRI's promotion committee.

As for corrosion, the field studies demonstrated that wood nailers dried from a saturated condition to 45% to 65% RH within six months of exposure. Because corrosion was only observed on samples exposed to 90% RH, corrosion of e-coated or stainless steel fasteners is not an issue. Supporting this conclusion is the fact that there were no reports of excessive fastener corrosion when installed in treated wood nailers.

"The roofing environment—when properly constructed—does not provide the conditions that cause accelerated corrosion," says Stan Choiniere, coauthor of the SPRI study and technical director of OMG Inc., Agawam, MA. "I have seen no evidence of corrosion since the change in wood treatments, even in less-than-ideal conditions."

However, SPRI recommends that roof consultants take the following precautions:

- Use either nontreated or SBX-treated (boron oxide) wood for nailers. SBX boron compounds are well-known, nontoxic preservatives but are water-soluble.
- Use either e-coated steel or stainless steel fasteners if treated wood is used.
- Use a Factory Mutual-compliant fastener or the equivalent.

"This study was initiated to address concerns that were being expressed throughout the roofing industry regarding potential corrosion of metal fasteners in new wood treatments," says Ennis. "SPRI appreciates the funding for this study that was obtained from the contracting and consulting communities, along with our own manufacturing community. I think this shows the industry-wide concern regarding this issue."

FASTENERS USED WITH FLEXIBLE MEMBRANES

In July 2010, SPRI released a new set of roof fastener recommendations in its "Guidelines for Fasteners Used with Flexible Membrane Roofing Systems."

Photo 2 – Rather than use common nails for attachment of edge metal, specify hot-dipped galvanized or stainless steel ring-shank nails. These nails should be the same fastener—or have the same pull-out resistance—as the fastener used when the edge metal was ES-1 tested. (Photo courtesy of OMG Inc., Agawan, MA.)

This guideline describes typical application methods for fasteners used in flexible membrane systems.

These fasteners may be used with stress plates, membrane attachment devices, batten bars, and other related components. They may also be used in new roofing, replacement roofing, and re-covers on substrate types that have been accepted by roof manufacturers.

The SPRI recommendations stress that the roofing contractor, designer, or roof consultant verify that the mechanical attachment used for flexible membrane systems is designed and installed in accordance with the manufacturer's instructions. In addition, evidence should be submitted that shows the system being installed meets specified code and/or insurance requirements. When required, pull-out tests representative of all deck areas should be made using the ANSI/SPRI FX-1-2006 standard.

The SPRI document also points out key job conditions the contractor and roof consultant need to be aware of when using fasteners with flexible membrane roof systems:

- When staging materials on the roof during application, the contractor and consultant need to ensure that the deck and structure are not temporarily overloaded by the weight of construction materials.
- The fasteners used must be suitable for the deck

type, and the deck must be of the required thickness to ensure reliable installation and performance.

- Any deteriorated deck, substrate, or wet insulation discovered by the contractor or roof consultant must be promptly reported to the architect or building owner so that appropriate repairs can be accomplished.
- The existing roof surface shall be free of visible moisture, such as ponding water, ice, or snow.
- The roof fastener must be suitable for the interior environment of the building—especially in high-moisture or corrosive environments. In these cases, alternative materials or protective measures may be required.

FASTENERS AND INSULATION ADHESIVES

Last summer, SPRI announced that another key standard—this one addressing insulation adhesives—had also been reaffirmed by ANSI.

ANSI/SPRI IA-1 2010, *Standard Field Test Procedure for Determining the Mechanical Uplift Resistance of Insulation Adhesives Over Various Substrates*, was developed to provide a uniform field testing procedure for determining the suitability of using an insulation adhesive for insulation or cover board attachment to a substrate. This standard is intended primarily for situations when an existing roofing system is being replaced or re-covered and the general condition of the substrate is in doubt.

This procedure, however, is also applicable to new construction. The uplift data obtained provides the roof system manufacturer, adhesive manufacturer, design professional, and roof consultant with pull-resistance values that will assist in verifying the suitability of the intended design. The standard was first approved as an American National Standard in 2005. It has been revised and reapproved by ANSI.

In addition, SPRI member and RCI Past President David Hawn led the creation of an advisory statement focusing on the issue of under-membrane and above-deck materials that benefit from attachment. This statement was provided to all SPRI members and posted on the SPRI Web site (www.spri.org).

"It is this type of risk evaluation research in which we at SPRI feel that we can make the best contributions," says SPRI President Dave Bailie. "These studies and standards contribute not only to our members' knowledge of the issues relating to the long-term integrity of the commercial roofing assembly but also to all industry stakeholders with an interest in the research and test results."

SPRI

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