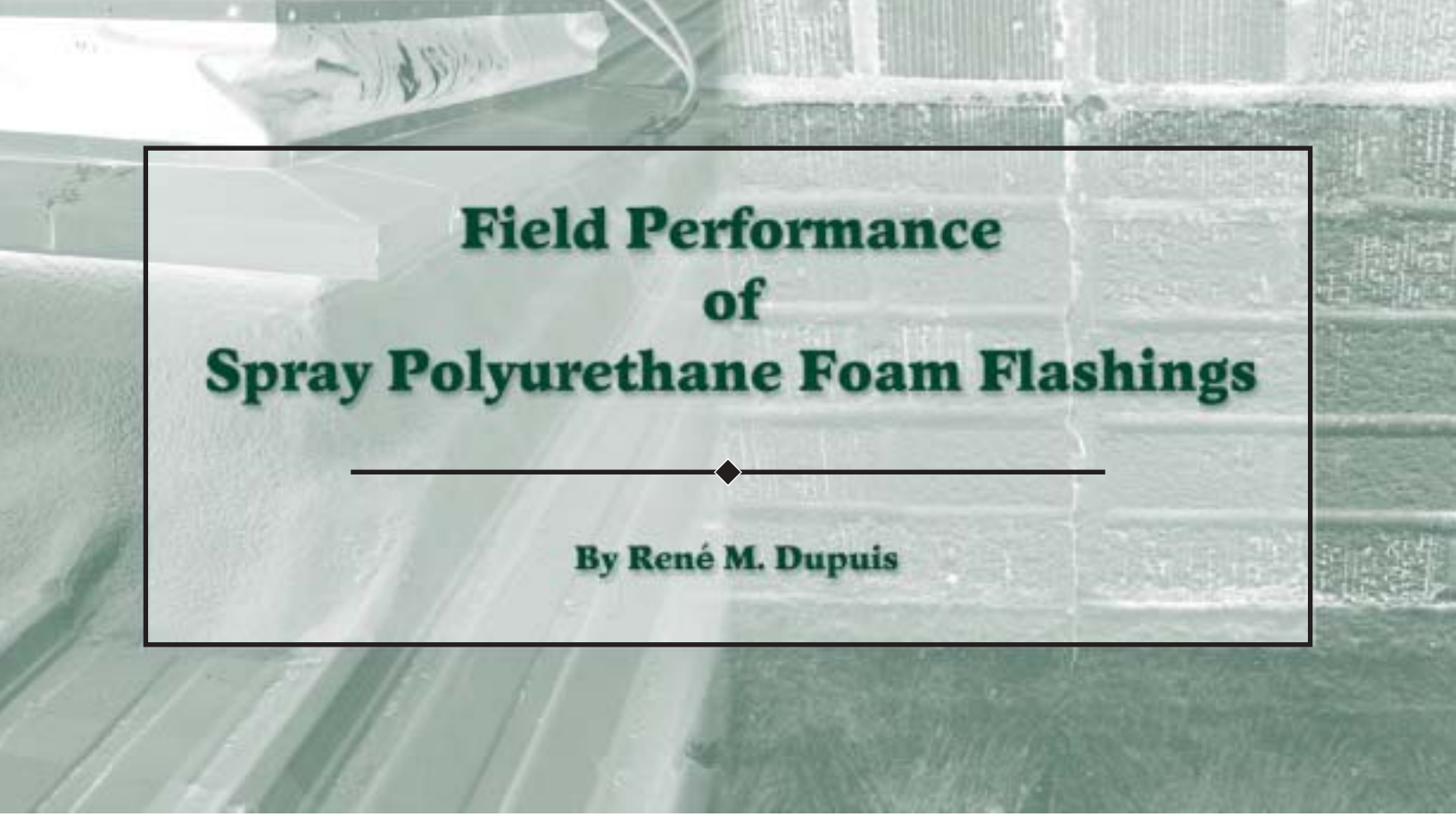


Field Performance of Spray Polyurethane Foam Flashings

By René M. Dupuis

In September of 2003, The National Roofing Foundation completed its second field study of Spray Polyurethane Foam (SPF) roofing systems. The study, which began in 2001, examined 188 SPF roofs of various sizes and shapes. The roofs ranged in age from new to 31 years, with an average age of 11.75 years.

This study was a follow up to the original study completed in 1998, which examined performance characteristics of in-place SPF roofs. While the first study dealt with physical properties of the aged roofs, the second survey was chartered to determine the viability of the SPF material as a flashing material over a wide range of substrates.

Unlike other roofing systems, the mechanic applying SPF materials literally goes up the wall, curb, or roof-mounted penetrations. Flashing sheets and fasteners are not required. The *NRCA Manual of Roofing and Waterproofing Construction Details* calls for the use of metal counterflashings. The study examined what is actually happening in the field with SPF flashing details that do not incorporate metal flashings. *Table 1* details the information for both the 1998 and 2003 study of SPF roofs.

	Phase I (1998)	Phase II (2003)
Number of roofs in study	140	188
Oldest age of roof(s)	27 Years	31 Years
Number of recoated roofs	39	40
Percentage of recoated roofs in study	28%	21%
Average age of roof at recoat	11.3 Years	15.0 Years
Number of roofs of unknown age at recoat	11	3
Average age of all roofs	11.0 Years	11.75 Years

Table 1: Comparative Data on SPF Roof Studies

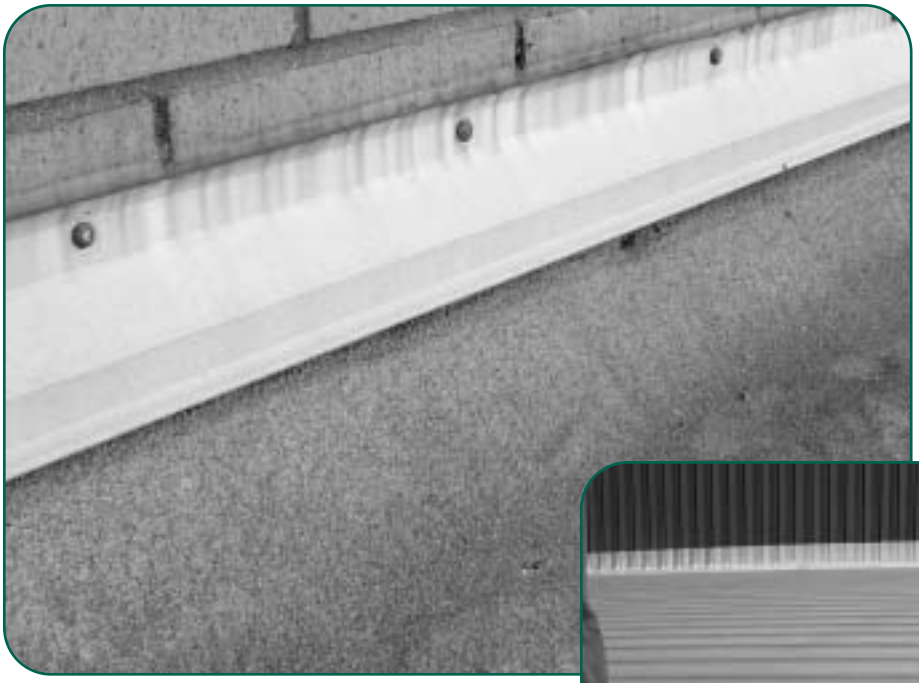
While flashing details are the most likely cause of roof leaks in virtually all roofing systems, they are often overlooked during the membrane selection process by the roof owner and the consultant or architect. Most conventional systems utilize metal, bituminous, or polymeric membrane to solve a variety of flashing details. Sometimes these materials are manufactured in the factory, and sometimes the roofing contractor relies on experience to field manufacture the proper solution to the problems.

All SPF details are essentially field manufactured. This allows for an easier seamless transition around roof-mounted equipment, parapets, and roof penetrations. The spray application allows for thicker applications to slope away from potential leak problems, such as walls or penetrations. After the application of foam, the protective coating usually extends 4 to 6 inches up projections and vertical walls.

A note of caution on thicker applications of SPF: industry standards call for maximum lifts of 1-1/2 inches. When foam is applied in thicker lifts, the exothermic reaction can cause thermal degradation, creating poor cell structure and foam with low compressive strength. Caution must still be used when applying greater thickness in multiple lifts as the heat must be given time to escape.

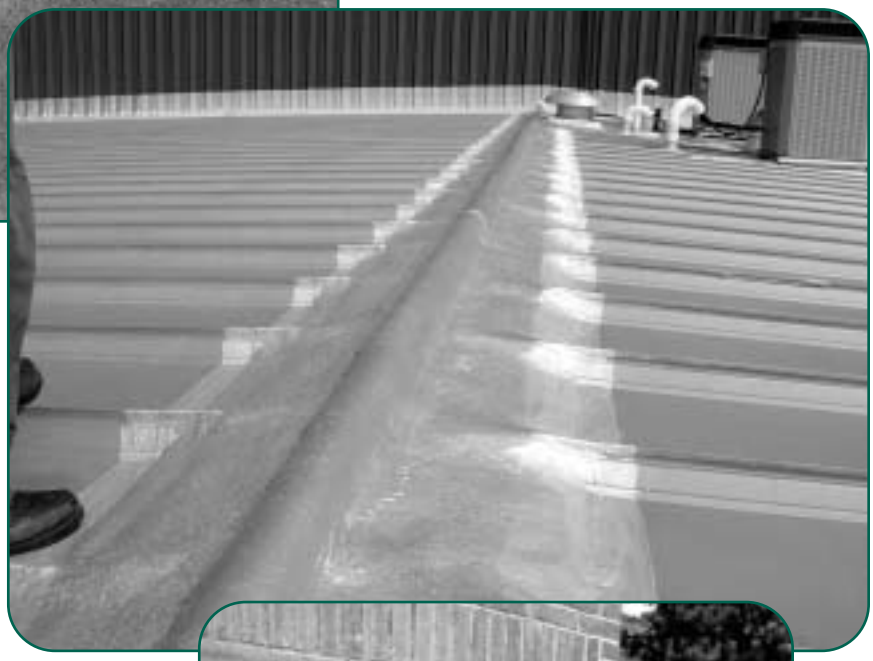
Spray foam has the unique ability to adhere to virtually all exterior building materials. However, certain non-ferrous metal flashings should be primed prior to application of SPF.

During the field study, we learned that spray polyurethane



Left: Figure 1 - Standard metal counterflashing.

Below: Figure 2 - Metal roof expansion joint.



foam, when correctly applied to surfaces and then coated, does not require metal counterflashings. The survey examined roofs in California, Texas, Wisconsin, Kentucky, Illinois, New Jersey, New York, and Connecticut. SPF flashings, including roof-to-wall, roof-to-roof transition, penetrations, termination points, and equipment supports were found to work well in each of these climates. The National Roofing Foundation released the report, "Performance of Spray Polyurethane Flashings" earlier this year.

Following are pictures and descriptions of various roofing details examined during the study. Special thanks to the NRCA for allowing their reprint.

Standard Metal Counterflashing

Figure 1 shows a typical wall with SPF and coating applied up the wall and covered by the metal counterflashing. Galvanized sheet metal was formed and surface mounted with a drip edge. The use of metal as a counterflashing is consistent with detail SPF-4, which can be found in the 5th Edition of the N*RCA Roofing and Waterproofing Manual.*

Metal Roof Expansion Joint

Figure 2 shows how SPF flashing can be used with a flexible bellows to handle differential and cumulative movement in a large metal roof. Note that the elastomeric bellows has been anchored in SPF and coated. This deck runs along a second-story wall that uses SPF as a transition between roof and wall.

Roof to Short Wall Transition

Figure 3 illustrates how SPF can make roof transitions to a wall along with a short transition to the adjoining lower roof. A light-gage metal wall panel and cap previously formed this transition. This detail was installed in 1977.

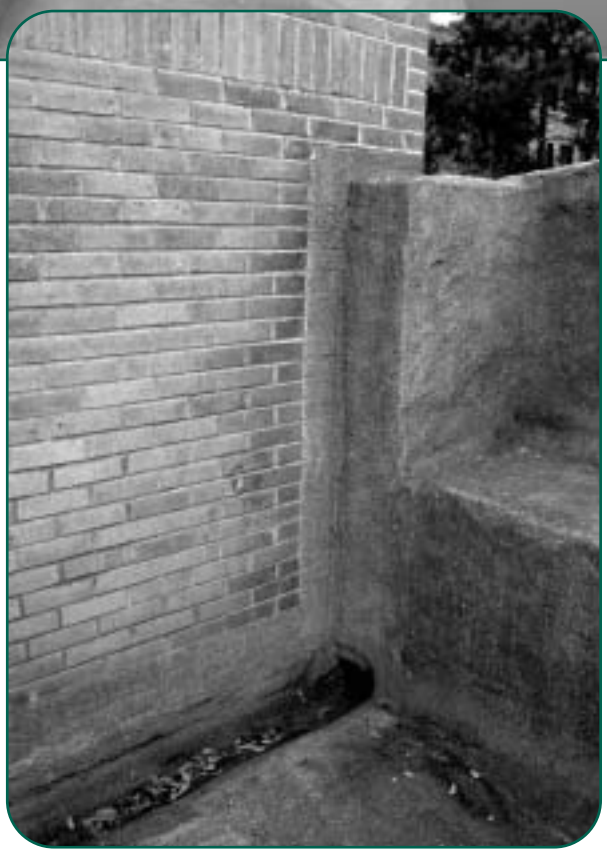


Figure 3 - Roof to short wall transition.

Above: Figure 4 - SPF roof to high roof transition.

Right: Figure 5 - Interior gutter system.

SPF Roof to High Roof Transition

A roof-to-roof transition is shown in *Figure 4* that details how SPF was used to solve a difficult tie-in for two different roof systems. The existing metal flashing was covered with spray foam and coated. The SPF transition detail also covers a short wall that has metal panels and window units. The SPF tie-in was installed in 1991.

Interior Gutter System

A large existing warehouse complex was re-roofed with SPF in 1991. The existing metal roof and interior gutter system were overlaid with 1.5 inches of spray polyurethane foam and coating. All of the existing metal flashing system was secured and covered with spray foam. No new metal flashing or counterflashings were added. The interior gutters were also covered with SPF as shown in *Figure 5*.

SPF Roof and Wall Transition

A complete roof and wall transition with SPF is shown in *Figure 6*. No metal flashing has been used on this 1997 installation. All of the pre-existing metal flashing is now encased in SPF. No new metal was used.

SPF Wall Flashing

The large lower main roof of this distribution center is broken up by a three-story brick wall. As seen in *Figure 7*, the expansion joint in the brick wall is active. The SPF re-roof covers all pre-existing metal flashing. The SPF flashing now reaches above the original metal counter flashing. There are no cracks or spalling of the SPF. The coating is functioning as a counterflashing over the SPF at the top of the pre-existing metal.

SPF Low Wall Flashing Application

In some instances, walls may be completely covered by the SPF system with no adverse performance. *Figure 8* shows a low masonry parapet wall and metal cap system with SPF and coating in a 1998 installation. Wall construction – especially how moisture is handled from the outside brick veneer – must be thoroughly understood before covering with SPF.

Equipment Support Curbs

Both low and high equipment support curbs were observed as shown in *Figures 9* and *10*. The high curb appears to have been extended up with a slightly smaller curb from the original base *(Figure 9)* and flashed with SPF and coating. Low curbs *(Figure 10)* were observed to have been treated the same way with no functional difference, using SPF and coating. No metal counterflashing was used, nor does it appear to be needed.

Left: Figure 6 - SPF roof and wall transition.

Below: Figure 7 - SPF wall flashing.

Equipment Support Columns

SPF roofs were often found to have no need for pitch pans or for separating support columns that are structurally sound and tied to a wall. *Figure 11* shows a heavy steel support stand that is directly flashed with spray foam and coating into the SPF roof/wall detail. The 1992 flashing installation detail appears to be watertight and serving its intended purpose.

SPF Flashing

The NRF studies observed numerous flashing details where pre-existing metal flashing had been installed. As shown in *Figures 12* and *13*, SPF can easily adapt to many rooftop details by being overlaid onto the existing prepared substrate. Existing metal flashings may remain and be totally enclosed or left open as the need dictates.

Just as the Phase I study demonstrated the performance value of SPF roofing systems when properly applied, Phase II has demonstrated that the use of SPF as a flashing system easily accommodates virtually all termination details. The study specifically identified:

- Masonry units.
- Metal wall panels.
- Metal flashing of all types.
- Concrete pre-cast panels.
- Wood sheathing and board products.
- Asphaltic flashing systems.
- Single-ply flashing systems.

SPF may require primers when applied over thermoplastic, single-ply membranes. The use of a wash primer is recommended when spraying over EPDM.

Figure 8 - SPF low wall flashing application.

Figure 9 - Equipment support – high curb.

It is important that all substrates receiving SPF should be properly prepared, cleaned, (and, if necessary), primed. When SPF is used as a recover over old membranes, it is important to thoroughly examine the existing assembly. If edge metal is not replaced, it may need to be reattached. Any wood nailers or other materials that have surpassed their service life should be removed and replaced.

SUMMARY

The use of SPF and appropriate coatings were observed to work quite well as singular flashing systems. The use of metal counterflashing was not seen to be required as part of an SPF roof system.

SPF as a flashing material in concert with an SPF roofing system offers the following advantages:

- No seams or joints to allow for water penetration.
- No differential movement between materials.

Figure 10 - Equipment support – low curb.

- A fully insulating system with no thermal shorts to allow energy transfer.
- Ability to conform to any angle on penetrations, terminations, or vertical walls.

It is easy to envision a future where this material is used with conventional membranes in a "hybrid" system, allowing for the benefits of SPF as flashing material on roofs of other types. This already is occurring on liquid-applied coating systems where penetrations and terminations are foamed, while the field of the roof is coated. ■

Figure 11 - Equipment support with columns.

Above: Figure 12 - SPF flashing on a metal roof.

Figure 13 - SPF flashing, roof-to-wall.

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About the Author

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René M. Dupuis obtained his B.S., M.S., and Ph.D. degrees in civil engineering from the University of Wisconsin at Madison. He has worked for the National Science Foundation, the University of Wisconsin, and was also an assistant professor at the State University of New York at Buffalo. He is a professional engineer and a principal and president of Structural Research, Inc., a consulting engineering firm located in Middleton, Wisconsin. Since 1974, Dr. Dupuis has been involved in materials research with much of this effort devoted to the roofing industry as a consultant. He has written and presented many articles and research reports on roofing materials technology and has conducted numerous investigations for building owners, architects, contractors, and manufacturers. Dupuis is a member of ASTM, CSI, NSPE, and ASCE. He is a member of the CIB/RILEM International Committee on Single Layer Roofing; has served on the Roof Advisory Panel for the DOE/Oak Ridge National Laboratory's Roof Test Center; and as chairman of the Board of Regents for the Roofing Industry Educational Institute (RIEI). He has served as technical advisor to the Midwest Roofing Contractors Association (MRCA) and the National Roofing Contractors Association (NRCA) and as the ASTM Task Group Chairman on Roof Performance. Dr. Dupuis received the James Q. McCauley Award from the MRCA and the Distinguished Service Award from the University of Wisconsin at Madison College of Engineering in 1995.