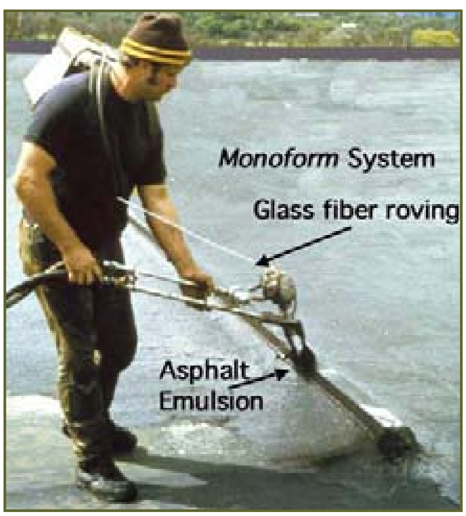
Is the "No-Ply" Roof in Our Future?

BY DICK FRICKLAS

Some years ago, RCI member, architect, and roof consultant Toby Nadel made a lighthearted presentation on the evolution of membrane roof systems to the ASTM D-08 Committee on Roofing and Waterproofing. He pointed out that into the 1950s, bituminous, low-sloped roofs often used a total of five plies – two laid dry and nailed, followed by three mopped. With the development of coated base sheets, the industry eliminated one ply, just lapping a single layer of coated base sheet 2-4 inches, followed by three mopped. This remained the standard through the 1960s, until inflation, oil shortages, and labor costs drove us to find less expensive alternatives. One was to drop one of the ply sheets, so we were down to a 3-ply roof membrane. The next step was to eliminate the remaining ply felts, just using two coated felts: the so-called "bond-ply" or "dual-eighty" systems. The labor was again reduced, since only two sheets were used, and the moppings were also halved. At approximately the same time, the first single-ply rubber and plastic membranes were appearing.



This system consists of asphalt emulsion simultaneously sprayed with chopped glass fibers for reinforcement. Over a suitable substrate, such as a patched bituminous roof, this might be construed as a "no-ply" system. However, the original Flintkote Monoform used an asphaltic base sheet to provide continuity, then a reinforced coating. A white, reflective coating layer completed the "no-ply" system.

A new generation of elastomeric, acrylic coatings provide reflection and UV protection to single-ply, bituminous, MB, SPF, and metal roof systems. In some re-cover applications, just acrylic coating and reinforcing fabric constitute the "no-ply" roof system.

Mr. Nadel theorized that with such a trend, it would only be a matter of time before the "no-ply" roof system appeared. With this system, labor would be reduced to zero, as would material usage. Fire, wind, and hail resistance would be excellent, as there was no fuel to burn, nothing to fatigue or puncture. The "no-ply" roof could be torched without damage or applied as a self-adhesive system, since it could not delaminate or blister. It would not shrink, so edge restraint was unnecessary and term-bars could also be eliminated.

Pretty silly discussion so far? Perhaps we could depart from the realm of satire with a rephrasing of the premise: at what point does a roof coating (or any other substance) become a roofing (or waterproofing) system?

When a continuous waterproof membrane is in place – whether BUR, MB, elastomeric, or plastic – then the role of a typical roof coating is unambiguous. It is there to protect or decorate the membrane, but in itself is not functioning as the waterproofing membrane. However, suppose a hot-melt, rubberized mastic is applied directly to a substrate. Is this now a membrane? If so, what additional properties has this mastic or coating imparted so that we can consider it a complete roof system? What if we use a thinner layer of mastic? At what thickness does it revert back to just a coating? There are successful "no-ply" waterproofing systems that use materials such a hot-melt systems or cold-applied, polymer-modified asphalt, but reinforcement is used "wherever the substrate has a gap or high-stress point." Another example could be a gravel-foam system, in which polyurethane foam is spray-applied to form both membrane and flashings. The gravel acts only to screen UV and improve fire ratings, so the foam must be serving as the membrane. Continuity of the substrate, as with the mastic water-

The traditional BUR uses three to five plies of reinforcing, with each ply laid in hot asphalt.

proofing, is all that is required.

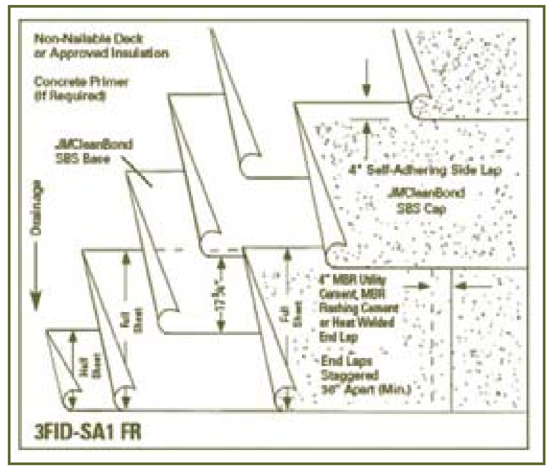
Those who have attended roofing trade shows for a decade or more will recall seeing many such liquid waterproofing or coating systems. They have been offered using silicone, polyurethane elastomer (single or plural component; moisture or catalyzed-cure systems), acrylic, liquid Neoprene, Hypalon®, as well as other also-ran options. All these liquid systems require a continuous substrate, so at least taping is needed at joints and other discontinuities, and in many cases both primer and multiple coats are needed. Most also utilize reinforcement embedded either in mastic or more of the same coating material. Does the taping or reinforcement make a coating into a roof system? If so, at what minimum thickness, tensile, puncture, or hydrostatic force does the "no-ply" coating then become a roof system?

It is time to convert this prescriptive "art" to roofing science. Some 50 years ago, the Building Research Advisory Board (BRAB) enumerated the properties of a roofing system. These eventually evolved into Performance Criteria for Membrane Roofing Systems.

It would not be much of a leap to define when a coating becomes a membrane system using some version of these criteria, perhaps following the suggestions in NIST Report 4638, *A Performance Approach to the Development of Criteria for Low-sloped Roof Membranes*. Yet, what we see in the literature are claims as to elongation of unsupported film, which is hardly the way coatings are actually used. Is 300% elongation a good number? Are our roofs really expanding or contracting 300%? If the 300% is an indication of ability to bridge joints and cracks, why is the reinforcing necessary? Several thousand percent would be needed to accommodate movement that originates as a hairline crack and opens to a sixteenth of an inch. Perhaps elongation needs to be redefined in terms of spanability or crack-bridging, and that, in turn, would depend upon stress concentration and porosity of the substrate. As a suggestion, if crack-bridging is important, the basis for the necessary test procedure on which a performance criterion might be developed is available, since ASTM D-08 has issued Test Method D5849 for evaluating resistance of MB membranes to cyclic joint movement.

How about tensile strength? What loads are induced in the no-ply roof by expansion and contraction and other mechanisms? Building Science #55 defined performance attributes for bituminous systems, but the recommended minimum tensile strength of 200 pounds per linear inch at 0˚F was based upon comparison with similar, adequately performing, multiple-ply bituminous roofs. Unfortunately, in all likelihood, this would have very little meaning for a non-bituminous or liquid-applied roof system. The performance of alternative membranes might best be examined through mathematical modeling coupled with comparison to actual membrane systems.

Impact resistance? Yes, this would be meaningful. We could use the existing FM and UL criterion of a minimum of 30 joules, equivalent to the energy of a 2-inch hailstone. But the nature of the substrate under any roof makes all the difference in the world. Over a hard substrate such as concrete or gypsum board, the impact resistance might be quite high. On softer substrates such as isoboard or wood fiber, results are lower. Reinforcement in the "no-ply" membrane could also have an influence. A suggestion on impact resistance is that the French FIT approach[1] to performance might offer a model for examining



Many ModBit systems use just a base layer and cap. Hybrid systems may use a 2- or 3-ply BUR system with a ModBit cap.

While called a single-ply system, all thermoplastic systems use internal reinforcement with polymer layers on both sides of the fabric.

Traditional single-ply systems focus on the integrity of the seam. The seam area may require splice wash to remove talc, a primer, and butyl tape sandwiched between two layers of membrane.

Over any suitable, continuous substrate, sprayed-in-place polyurethane is applied, generally using more than a single pass (lift). The freshly applied foam needs UV protection — commonly a base and top coat of polymeric coating.

impact resistance of various membranes, depending upon their conditions of use.

To begin our quest for performance criteria for our "no-ply" roofs, we need only to review the excellent papers of the past several decades. These would include:

- Mathey and Cullen, "Preliminary Performance Criteria for Bituminous Membrane Roofing," *Building Science* #55, 1974.
- "Elastomeric, Thermoplastic, and Modified Bitumin Roofing," Technical Report of CIB W.83 and RILEM 75-SLR Joint Committee, 1986.
- "Performance Testing of Roofing Membrane Materials," Recommendations of RILEM 75-SLR/CIB W.83, November 1988.
- Rossiter and Seiler, "Interim Criteria for Polmer-Modified Bituminous Roofing Membrane Materials," NIST BSS 167, 1989.
- Rossiter et. al., "A Performance Approach to the Development of Criteria for Low-sloped Roof Membranes," NIST IR 4638, 1991.

The roofing industry has a great deal of science behind it, and it would seem that we ought to now be able to better define when any material becomes a membrane in terms of performance attributes. Only then will we know whether we have a true roofing/waterproofing system or just a "no-ply" coating.

Roofing granules may be embedded in an additional layer of top coat to improve resistance to impact and bird pecking.

References

[1] Alain Chaize and Bruno Fabvier, "FIT Classification for Roofing Systems," 1991 International Symposium on Roofing Technology.

In this re-cover application, after patching the old bituminous membrane, just a single layer of polyester mat is laid in hot bitumen. Surfacings are optional but include glaze coats, cold adhesive with embedded roofing granules, and asphalt-aluminum roof coatings.

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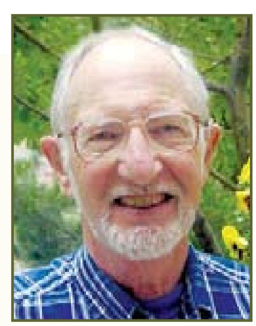

Dick Fricklas is an honorary member of RCI and was director of the Roofing Industry Educational Institute. He is co-author of *The Manual of Low-slope Roof Systems*, a contributing editor for RSI and web columnist for Buildings.com/newletters/roofing. He has earned the J.A. Piper Award from the NRCA, the James Q. McCawley Award from the MRCA, the Walter C. Voss Award from ASTM, and Lifetime Achievement Awards from both the Educational Foundation of the IRWC and from the Colorado Roofing Contractors Association. He resides in Centennial, Colorado, with his wife Anita.