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An industry workhorse

EPDM membranes help provide roof systems with long-lasting durability during extreme weather

BY LOUISA HART

WEB EXCLUSIVES

For more than 40 years, EPDM membranes have been one of the roofing industry's workhorses. Long appreciated for durability, longevity, ease of installation and repair, many EPDM membrane roof systems installed during the 1980s still are performing well. But EPDM now is being appreciated in a new context.

Although you might dispute the cause, there is no doubt extreme weather events are increasing worldwide. Houston has experienced three 500-year floods during the past three years. In early January, the National Centers for Environmental Information (NCEI) reported 2017 set a new record for destructive storms. Sixteen "weather and climate disaster events" each caused more than $1 billion in damage in the U.S. These included droughts, one "freeze event," flooding and tropical cyclones as well as Hurricanes Harvey, Irma and Maria. Together, these storms inflicted more than $306 billion in losses. Beyond the material loss, these disasters accounted for the deaths of at least 362 people.

Although all roof systems may be vulnerable to extreme weather, building owners, architects, specifiers and contractors can lessen that vulnerability with their roof system choice.

Why EPDM?

A roof system is essential to maintaining a building's integrity against most of these extreme, natural attacks and is designed to protect a building's occupants, contents and any equipment mounted on the roof itself. According to the Insurance Institute for Building and Home Safety, an independent scientific research organization supported solely by property insurers and reinsurers: "The roof is a commercial building's first line of defense from natural hazards such as wind, rain, fire, hail, ice, snow and extreme heat. It is also the most vulnerable part of your building."

Expansion and contraction, ponding, moisture, thermal shock and temperature extremes are all factors that promote a roof membrane's premature degradation. The great elongation and low-temperature flexibility of EPDM membranes can accommodate building movement in various climatic conditions without stressing the material. Its moisture-absorption resistance allows the material to be installed in assemblies with lower slopes than other single-plies and tolerates ponding and deflection. As a result of its ability to withstand extreme temperatures, EPDM membranes can successfully be used in assemblies with greater thermal resistance (thicker insulations with higher R-values).

EPDM roof membranes have shown superior strength against hail. In an independent laboratory study conducted in 2007 by Jim D. Koontz and Associates Inc., Sarasota, Fla., using new and heat-aged samples of EPDM, of the 81 targets installed over different surfaces, 76 did not fail when impacted with hail ice balls up to 3 inches in diameter.

Although the insulation underneath a roof membrane plays an important role in a roof system's impact resistance, a more recent field study conducted by RICOWI (Roofing Industry Committee on Weather Issues) Inc. reinforced the findings EPDM membranes offer superior resistance against hail. The RICOWI study looked at damage caused by a history-making hailstorm in North Texas in April 2016. About 2.5 million square feet of low-slope roof systems were inspected in the wake of the storm, and at least 1 million square feet of roofing was scheduled for replacement. Twenty-seven single-ply roof systems were reviewed, and seven were severely damaged. Three inspections were made on EPDM membranes impacted with hail sizes between 1 and 3 inches in diameter, and no punctures or fractures were documented.

The right design

As with any roofing material, proper EPDM membrane application is as important to the satisfactory performance of a roof system as the roofing materials. Proper installation and following manufacturers' provided specifications will maximize performance.

The first and most basic decision to be made before application begins is to determine how the membrane will be secured to the layers that support it. The three options for installing EPDM roof membrane are adhered, ballasted or mechanically fastened.

In an adhered roof system, the roofing membrane is glued to the surface beneath it using specially formulated adhesives. Adhered systems are suitable for contoured roofs, roofs with an irregular shape and any roof with limited load-bearing capacity because these roof systems are lightweight and flexible. In addition, adhered roof systems also have a high wind-uplift performance rating, making them a good choice for tall buildings and/or high-wind areas.

Ballasted roof systems rely on the weight of aggregate—usually stones or pavers or a combination of both—to anchor the EPDM membrane in place and resist uplift. When applied in a thick enough layer, the stones can hold the membrane in place even during high winds. Installing a ballasted roof system is extremely simple and relatively quick. These systems have the additional advantage of being able to be installed during almost any kind of weather and offer energy savings similar to reflective roofing.

Mechanically fastened roof systems secure the EPDM membrane to the insulation and roof deck below with fasteners, usually screws, concrete nails or augers, varying with the deck material. This is the fastest and least expensive installation method. Mechanically attached roof systems are the most common choice, accounting for about four out of five EPDM roof membrane system installations.

The right installation

Regardless of the type of roof system installation, there are application basics that must be observed to ensure optimum roof membrane performance. For a new roof system installation or to replace an existing roof, the following roof deck preparations are essential to simplify installation and prevent future conditions that could lead to roof leaks:

- Before membrane application, carefully sweep all roof surfaces (or use a blower) to remove all debris and dirt, creating a completely smooth surface.
- Remove any loose nails and sharp ridges or burrs on concrete if no insulation is used. Repair holes or cracks, less than 1/4-inch wide, in concrete with nonshrink grout.
- Properly seat and make sure all fasteners, if required, are flush, leaving an acceptable surface to receive adhesive in a fully adhered system.
- Make sure all surfaces where products will be applied, such as tapes, adhesives, caulk, primer or cleaners, are dry. If any areas

have been cleaned with soap of any type, rinse thoroughly. Dried soap film will act as a release agent and inhibit proper adhesion.

- Remove all perimeter and penetration flashings.
- If using mechanical fasteners, perform pull-out tests of the fasteners to confirm they provide sufficient pull-out strength for adequate wind-uplift resistance.
- Ensure the roof slope is at least 2 percent to allow for adequate roof drainage.
- If concrete substrate is used, it needs to be structurally sound and dry to the touch.

Applying the membrane

Application of an EPDM membrane should be planned carefully so it can be completed in one phase during as short a period as possible. One of the greatest roof construction hazards is installing a roof system in phases where a partially completed roof system is left exposed to weather for a period of time, even overnight, and the remainder of the roof system is installed at a later time. This can lead to entrapped moisture, which can cause premature roof system failure. Good roofing practice dictates no more roofing area be started than can be completed the same day. This means the finished membrane must be installed and seamed the same day.

Moisture is the enemy of any roof system, so it's important to ensure the EPDM membrane, as well as any other roofing materials used, are dry while installation is underway. If moisture is trapped within a roof system, it can severely damage a membrane, insulation and deck as well as erode the quality of the adhesive bonds.

Keep an eye on the weather, and do not start the project until at least three dry days are forecast. Likewise, some sealants have specific cold-weather application procedures, so be sure to observe them.

When installing two layers of insulation boards or cover boards, ensure the joints of both layers do not coincide. Mechanically attach in a pattern advised by the manufacturer and in accordance with national wind-uplift standards.

Once the substrate's surface is prepared, unroll the membrane without stretching it as close to its final position on the roof as possible. Allow it to "relax" for at least 30 minutes, or a longer period of time in cold weather, before applying the adhesive in a fully adhered system.

Position the membrane with an overlap appropriate for the width of the seam type that will be used. Fold the membrane back along its entire length so the underside of half the EPDM sheet is exposed.

Sealants should be kept in the manufacturer's container until ready for use. To facilitate dispersing of solids in the sealant, turn the container upside down and wait for a minimum of five minutes before returning it to the right-side up position. Carefully open the container and mix until the adhesive is a uniform color and all solids are dispersed.

For an adhered system, saturate the roller by dipping it in the container. Carefully roll the adhesive onto the substrate and membrane (for smooth-backed membranes), avoiding wrinkles.

Adhesive should be tacky at the point of assembly; approximate time of readiness will vary depending on the environmental conditions. Once the adhesive begins to change color (from white to clear) and feels tacky, carefully roll the membrane to the substrate. Avoid capturing air or creating wrinkles during this process. If the adhesive is completely dry or too wet, adhesion will be compromised. Apply pressure using a roller with a minimum weight of 75 pounds to ensure good contact between the membrane and substrate. Do not apply the adhesive in the seam area. Note adhesive coverage, open-

and dry-time rates can dramatically vary depending on the particular substrate and environmental conditions. It is essential to follow the manufacturer's product data sheets.

Two methods of splicing the seams of adjoining EPDM sheets include liquid adhesive or splice tape.

When using liquid adhesive, adjoining sheets are cleaned with the manufacturer's recommended splice cleaner before applying the splicing adhesive. A sealant is used along the edge of the splice and is applied after allowing solvent in the adhesive to flash off (minimum two hours). Some manufacturers also have used an additional sealant within the overlapping area applied immediately before putting the splice together. The sealant is intended as a secondary protection to guard against moisture penetration in the event of workmanship error at intersections with factory seams.

Splicing was developed to speed up the seaming process while maintaining consistent application across an entire seam. This process uses an adhesive tape with a splice primer. The adjoining membranes are primed, and once the primer has dried the tape is applied. No additional sealant is used along the edge of the splice. This method has become more favorable as a result of application consistency.

One of the most vulnerable points on a roof is where a low-slope roof area terminates with an exterior wall. Most low-slope roof systems are designed so the membrane terminates under the edge flashing system.

Securing the edge flashing is critical to keeping the roof membrane intact during high winds. Loose flashing will allow wind and rain to get underneath the roof membrane where the wind will add to uplift pressure on the roof system. High winds can peel back loose fascia and tear away the entire edge flashing system. The roof membrane

system also can peel away from the edge if the flashing fails. This is a common failure point that can result in partial or total loss of a roof membrane system.

In addition, water entry as a result of loose flashing can create moisture problems within a roof membrane system and inside a building.

Flashing performs best when the lower portion of the fascia is attached directly to the building using screws spaced 12 inches to 24 inches on center. Poorly secured edge flashing can come loose in winds as low as 40 to 50 mph.

EPDM roof membrane manufacturers offer specially constructed fascia that provides roof systems with maximum protection against wind-uplift damage. Fast, effortless installation eliminates the stripping in typical of many other roof edge designs.

In addition to the point where the membrane terminates at exterior walls, any roof surface penetrations, such as pipes, vents, skylights, HVAC equipment and drains, create potential opportunities for water to seep into a roof system and damage a building's interior. Creating a strong, effective waterproof seal on these roof penetrations is essential to maintaining a roof system's integrity. These weak points should be covered with flashings and other commercially available devices such as pipe boots, witches' hats, molded rubber boots, elevated curbs or pitch pans and caulked as needed to create a tight seal and protect the area from moisture intrusion.

Maintenance and repairs

One of the most important aspects of maintaining a roof system is to perform inspections at least annually. Frequent inspections and scheduled maintenance can save time and money involved with emergency repairs.

Walk the roof and look for anything that may be problematic, such as a tear, puncture or hole in the membrane. Check coping caps to make sure they are not loose or missing. Any ″soft spots″ on the roof could be an indication of a leak. Check for separated seams on the deck sheets or around flashings. Obviously, after a storm, clear debris from the roof as quickly as possible and check for any rips or punctures in the membrane. And if any service companies have accessed the roof, ensure they have not left items, even small items such as screws or metal shavings, that could damage the membrane.

Ballasted roof systems present special inspection and repair challenges. However, given the nature of these systems and the protection the ballast itself provides a roof, inspection of the perimeter and penetrations most likely will reveal the source of any problems.

One of the unique attributes of EPDM membranes is their ability to be easily repaired or restored. Because EPDM maintains its integrity and flexibility, repair and modifications such as washing the membrane, preparing the roof membrane surface, adhesive applications and installing new material can be done with relative speed and ease. In the wake of a major disaster that has knocked out power and perhaps damaged a roof, emergency repairs can be made without access to power tools.

EPDM membrane seams can be repaired with adhesive or tape, following the same general methods as the initial membrane installation.

First, open laps should be pulled back to a sound part of the seam or splice and any debris removed. If water infiltration is suspected, open the membrane and inspect the insulation and deck for damage. Remove wet or damaged insulation and repair or replace the deck as required. Install new, dry insulation consistent with the existing

insulation's thickness. After cleaning the open-lap area, the open lap or splice should be glued together with seam adhesive before installing a patch.

Before patching the membrane, it is essential to clean the surface and remove any field-applied coatings. The clean area should extend at least 6 inches beyond the perimeter of the patch. The patch itself should be large enough to extend at least 4 inches beyond the defect.

Apply the appropriate manufacturer-recommended primer to both surfaces to be mated, and allow time to dry according to manufacturer's instructions. Follow this by applying adhesive and allowing enough time for it to dry thoroughly. When the adhesive is dry, apply the patch and roll it to ensure solid contact between the two adhesive films. If this repair has been made on a ballasted roof, redistribute the ballast over the patched area.

If repairs are being made with tape, follow the instructions for patching the membrane, using tape primer to cover the actual length and width of the piece to be repaired. While the primer is drying, cut a piece of tape cover strip (or flashing) the appropriate size, allowing at least a 3-inch overlap of the area to be repaired.

Peel back the release paper on the back of the tape cover strip and install the cover strip centered over the area to be repaired with the adhesive side turned toward the primed surface. Smooth this patch into place as it is applied, taking care to avoid wrinkles.

Maximizing EPDM performance

Many former EPDM membrane issues, such as stretching, have been solved by new technologies and no longer are concerns. Although the installation cost of an EPDM roof membrane system may initially be more than other available roofing products, the demonstrated long-term service life and durability of EPDM membrane lowers the overall cost of ownership.

However, as with all roof membranes, there are circumstances surrounding the installation and repair of EPDM that demand specific attention. For instance, during cold weather, adhesives can take longer to flash-off, and ballasted and mechanically fastened systems generally are more user-friendly from an installation standpoint during winter months.

EPDM membranes should be protected from oils, greases and certain chemicals as these will tend to swell and soften the membrane. EPDM is available only in black or white, but if other colors are required, an EPDM membrane can be color-coated after installation with a coating system designed to work with EPDM.

Extra design measures such as the addition of an air and vapor barrier system typically are required to avoid condensation issues when using a white EPDM membrane in central and northern climates. For this reason, black EPDM is strongly recommended in these climates to avoid condensation accumulation within the roofing assembly.

Additionally and most important, EPDM membranes require a properly designed and installed roof deck; system components will not compensate for a poorly designed or poorly installed roof system.

A 21st century product

When EPDM was introduced, it was a product designed—with appropriate installation—to protect a structure from day-in, day-out weather events, as well as infrequent weather extremes. According to the National Oceanic and Atmospheric Administration, in 2017, there were 16 weather events that caused about $306 billion in damage. With sustainability and resilience now major concerns for the construction community, EPDM is a product that meets the demanding standards of contemporary construction. In the decades since it was introduced, EPDM has stood the test of time in the field

and has been tested by scientists in the lab and has proven itself to be a 21st century product that is helping to overcome 21st century challenges.

Louisa Hart is director of communications for the EPDM Roofing Association.

For articles related to this topic, see "The original sustainable roof," November 2013 issue and "A success story," June 2010 issue.

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