ROOF RESTORATION

By Tim Leonard

Metal roof restoration.

Intro

For roofing professionals, one of the primary goals of any project is watertight performance. Most often, this is also the number one measure of success by a customer. Other factors that may be measured by the customer include: cost, durability, warranty, savings over time, aesthetics, and perceived quality. Of course, all of these measurables can be tied together, and each roof system may focus more on one of these measures than another, but when all is said and done, the roof being watertight is still the cornerstone of performance.

The environment (UV + moisture + heat) will degrade a roofing system over time, eventually causing the roof to leak. Often the roof can be repaired with original system components. This is a pointed method that focuses on a problem area while the rest of the roof continues to age. There is definite value in repair by extending the serviceability of the roof system, thereby decreasing the cost of the initial investment over time. Eventually the cost of repair, however, exceeds the savings produced on the initial investment. At this point the roof system may be described as "failing," and options other than repair are explored.

Steps of a Roof Restoration Project

1. Feasibility - is the existing roof in a restorable condition?
2. Address weaknesses of existing system.
3. Evaluate rooftop environment and special considerations.
4. Choose a restoration system based on the features and benefits required.

A proven option that has been growing in popularity over the past 10 years is restoration of the existing roof system. Restoration, as defined by Webster, is to bring something back to its original state. Applying this definition to roofing, we may say restoration is the process of returning a roofing system to its original state of watertight performance. The benefits of a restoration project may include maximum utilization of original materials, energy savings, reduced building interior exposure, environmental savings (landfill), and project savings (time, labor, materials).

The Process

The first component in restoration is feasibility. A roof that is beyond its service life cannot be restored. To determine feasibility, each roof system must be evaluated individually. Some roof conditions, depending upon their degree, may make a restoration project impossible.

The second component in restoration is also the main focus of a restoration system. This component is to reinforce any weaknesses or improve any shortcomings of the original system. Typically, this means addressing items such as seams, fasteners, and corrosion, each depending on the system. Many weaknesses can be addressed by simple improvements that have developed in recent technology including adhesives, tapes, primers, and coatings that are far superior to those used 20 or even ten years ago. Spray polyurethane foam has also proven itself as a viable restoration option.

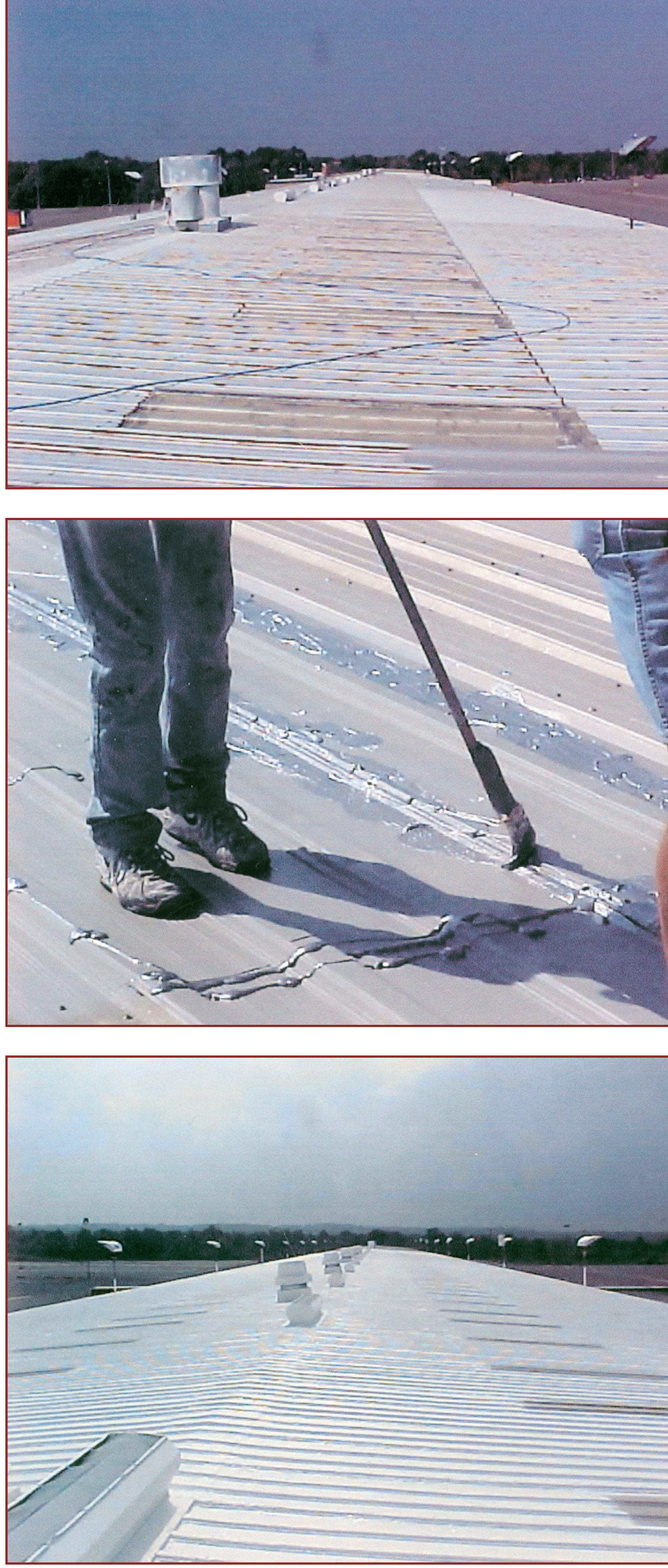
The third component of a typical restoration system is the application of a sacrificial barrier, typically in the form of a high performance coating. This barrier protects the roof system from UV and moisture, thereby slowing the aging process. Additional benefits of a sacrificial barrier can include chemical resistance, improved fire resistance, cool roof characteristics (reflective and emissive properties), improved fungus and algae resistance, and waterproofing. These barriers may be composed of one of several coatings chemistries, but those most commonly used in the industry are acrylic, polyurethane, asphalt, and silicone.

The following is a summary of some of the roof types that can be restored. Included is a general overview of the techniques and product types that can be utilized in restoration. As in any compilation, this is meant to be an informational comparison, but other restoration techniques exist that are not addressed by this paper. Original and restoration system manufacturers should always be consulted regarding specific applications and compatibility.

Metal Roof Restoration

Metal has proven itself a very functional and generally excellent roofing material. Metal roofs, however, do age over time and may begin to fail through excessive corrosion, fastener back out, and degraded flashings. Selection of a proven restoration system is key and most will have the following characteristics.

1. **Adhesion:** In every restoration system, coating adhesion is critical. A strong bond to the metal is essential for rustproofing and to maintain adhesion over seams and fasteners as the building moves.
2. **Elongation and Tensile Strength:** Metal panels expand and contract with temperature. The restoration system



Metal roof restoration: before (top); sealing seams and fasteners (middle); and after (bottom).

EPDM restoration with seams taped and coated.

components must be able to stretch and twist with the metal while resisting failure. These properties are especially important over the seams and fasteners where stresses can be concentrated. Several methods of sealing seams and fasteners are used in the industry, including: high strength flashing grade coatings, coatings reinforced with fabric, and tapes. Each method has advantages and disadvantages.

3. **Weathering:** The finish coat should protect against UV and moisture over time while maintaining its physical properties.
4. **Cold Temperature Flexibility:** Depending on climate, the system properties may be required to perform at sub-zero temperatures.

All of these characteristics can also be incorporated into a spray polyurethane foam and coating system. The foam system has the advantage of adding insulation value to the restoration system.

Single-Ply Restoration

Single-ply membranes have an excellent performance history. However, many different types and chemistries of membranes can make restoration difficult. The various formulations age differently, but some of the more common membrane weaknesses fall into these categories: failing seams, chalking, plasticizer migration, and shrinkage.

Because each membrane type is different, each restoration system will be specific to the membrane chemistry. Some general membrane categories and associated techniques follow:

EPDM

- This membrane ages very well. The weakness of an EPDM roof normally lies in the seams. Most seams that are between 10 and 20 years old initially used adhesive. Over time, these seams failed due to the combination of moisture and heat. To address this weakness, some restoration systems use a fabric embedded in coating and others use fabric-faced tapes to reinforce existing seams. Restoring

the seams using modern tapes and primers can result in a seam that is better than the original. Failing flashings can be addressed using tapes or polyurethane spray foam. Any large patching can be done with new EPDM and tapes as required.

- EPDM roofs must be powerwashed and often primed before the finish coating is applied. Because thermosets may exhibit chalking, a primer can provide a good physical bonding surface for the coating. Again, adhesion is very important, and primer/coating combinations should be tested on the membrane prior to full application. Prepare the membrane for the adhesion test using methods similar to what is anticipated during the restoration project.

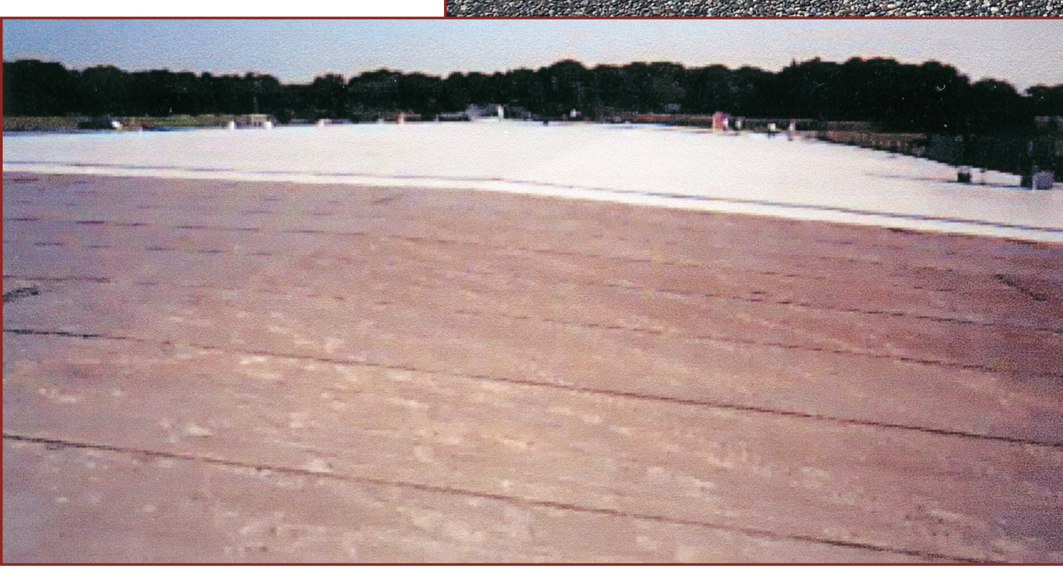
Hypalon

- Hypalon roofs should be inspected for excessive chalking, exposed scrim, and seam failure. Any exposed scrim should be intact, have good integrity, and be carefully evaluated for wicking moisture. If the membrane is restorable, a process similar to that used for EPDM can be employed.
- Again, as a thermoset membrane, Hypalons will require priming, and an adhesion check is always recommended. Seam reinforcement may be done with tapes or fabric in coating per the manufacturer's specification. If any large sections need to be patched or repaired, new Hypalon can be used by chemically welding to the underside of the existing membrane. Welding the aged membrane can be difficult, and the system manufacturer should be consulted.

Thermoplastics

- A variety of thermoplastics have been introduced over the last 20 years. These membranes should be inspected for exposed scrim, seam failure, and embrittlement of the sheet. Seam repairs can be addressed using a method similar to EPDM seam repair. Other patching and repairs can be done using new membrane and welding to the underside of the existing sheet. If welding is not possible, consult the system manufacturer. Priming after powerwashing is not required in most cases. However, adhesion checks should be used to verify coating performance with and without a primer.

Spray polyurethane foam application over BUR with gravel.



PVC restoration: cleaned and coated membrane in background and uncleaned membrane in foreground.

Asphalt restoration with acrylic coatings and foam flashings.

Asphalt Restoration

Asphalt-based roofing systems have probably the longest service performance history of any roof system. Because these systems age gradually, restoration can often extend the service life of these roofs by 10 to 20 years. Some of the signs of aging in asphalt roofs are alligatoring, splitting, and cracking due to embrittlement.

1. After addressing any field repairs and powerwashing, reinforcement can be made using fabric embedded in base coat material. Flashings can be repaired using the same method or with spray polyurethane foam. Note: coating used over the foam may differ from the top coat used over the remainder of the restoration system.

Summary of Coatings Performance Characteristics

Coating Type	Performance Characteristic				
	Elongation	Tensile Strength	US Perm	Abrasion	Weathering
Acrylic	170-300%	200 - 350 psi	2.5 - 8.0	Fair	Fair
Butyl	150-250%	200 - 800 psi	0.01 - 0.03	Fair	Fair
Hypalon	150-350%	500 - 800 psi	0.10 - 0.30	Fair	Fair
Neoprene	400-500%	1000 - 2000 psi	0.10 - 0.15	Fair	Fair
Silicone	100-150%	200 - 500 psi	2.5 - 15.0	Poor	Excellent
Aromatic Polyurethane	150-600%	250 - 3500 psi	0.5 - 2.0	Excellent	Fair - Poor
Aliphatic Polyurethane	150-350%	1000 - 3500 psi	0.5 - 1.5	Excellent	Excellent
Asphalt, Modified	50-150%	40 - 200 psi	0.1 - 0.15	Fair	Fair

2. A base coat of acrylic, polyurethane, or asphalt can be applied to the entire roof per the manufacturer's recommendations. Fabric is embedded either between layers of basecoat or on top of the basecoat, depending on the system. Chopped glass may be used with the basecoats mentioned above in place of fabric. Finally, a compatible topcoat is applied over the basecoat.

Gravel-surfaced, built-up-roofs may be restored using the technique above (after removing loose gravel), or by using spray polyurethane foam and coating.

Considerations and Summary

It is important to apply a restoration system designed for the substrate. Manufacturers should be consulted regarding compatibility, feasibility, and performance of restoration materials and systems in the specific rooftop environment. For example, an asphalt restoration system used in San Diego, California, may be different from a system used in Fargo, North Dakota, but have the same manufacturer. Likewise, rooftop conditions may require different coatings to meet chemical or ponding resistance requirements. Also, when comparing costs of restoration systems, compare system costs per square foot. Picking a baseline comparison (i.e., 10-year warranted installation) can often be helpful. Comparing costs per gallon or costs per mil thickness of coating can be deceiving due to different coating formulations.

In conclusion, technological advances in tapes, adhesives, fabrics, primers, and high performance coatings can be incorporated into restoration systems that will preserve the functionality of the roof over extended periods of time. The other benefits that can be achieved include improved appearance, improved reflectivity and emissivity, and enhanced fire resistance. The best results of a restoration project match the project needs to the features, benefits, and limitations of each system. Remember, the best candidates for restoration may be watertight today but beyond restoration in mere months. ■

About the Author

Tim Leonard holds a degree in Aerospace Engineering and five patents in aerospace and automotive airbag applications. He is on the SPRI Board of Directors and a member of the SPFA technical committee. Mr. Leonard received his Certified Energy Manager (CEM) designation from the Association of Energy Engineers and is the VP of Operations and Technology of Elastomeric Roofing Systems, Inc., Loretto, MN.

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Penn State Center for Green Roof Research

The Penn State Center for Green Roof Research, University Park, PA, is studying the ability of green roofs to minimize heat flux through roofs, manage stormwater runoff, and filter nutrients. There are six buildings, three with green roofs and three with conventional roofs. The green roofs are a modified layer system utilizing an Enkadrain drainage layer overlain with 4″ of an expanded clay-based growing medium, and covered with PEPP (Porous Expanded Poly Propylene). The PEPP sheet has 1″ diameter holes on 3″ centers into which researchers inserted rooted cuttings of *Sedum spurium.* A weather station that collects data on rainfall, solar radiation, temperature, and wind speed and direction serves to collect ambient environmental data for all buildings.

Each building is fitted with thermistors in the walls, roof, and floor to collect data every 30 minutes that is recorded continuously. These data will be utilized to evaluate, modify, and enhance existing German technologies and new green roof system technologies for use in North America.

— www.hortweb.cas.psu.edu/research/greenroofcenter

