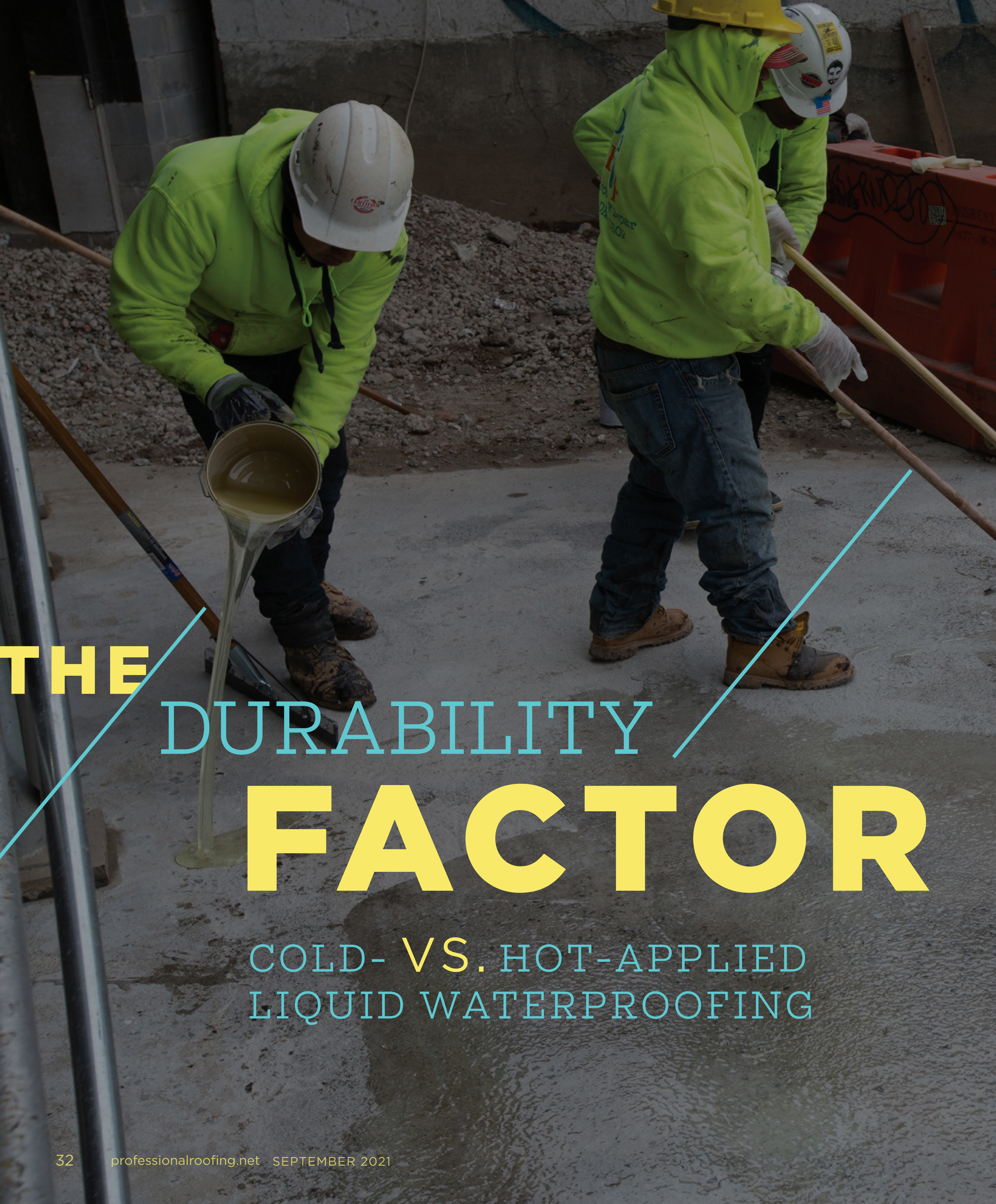

THE DURABILITY FACTOR

COLD- VS. HOT-APPLIED LIQUID WATERPROOFING

Photo courtesy of GCP Applied Technologies, Cambridge, Mass.

BY BRIAN CHANG

There are many obvious reasons why durability is important for commercial construction. Most public areas need to withstand foot traffic, vehicles and equipment transport. In all cases, specifiers need to ensure there is a reliable, highly durable membrane sealing the surfaces to provide long-term waterproof protection.

When sealing green roof systems, plaza decks and other areas, commercial builders, designers and architects can choose from numerous types of waterproofing products. They typically prefer liquid-applied materials when conformation to a given site layout or installation speed is critical. There are two types of liquid waterproofing materials—cold-applied and hot-applied—and each has its own set of features and benefits.

Hot-applied systems have proved to work for many years. However, each project's specifications are unique. When an alternate option is needed to address specific issues such as safety, fire risk or worker health environment, a liquid-applied system may be preferred.

Durability factors

There are six major criteria that should be considered when assessing the durability performance of a component product and overall system:

1. Tensile (tension) strength (ASTM D412, "Standard Test Methods for Vulcanized Rubber and

Thermoplastic Elastomers—Tension"): Tensile strength measures the stress required to stretch the material to the point where it breaks. It can be used to evaluate the maximum amount of tensile force a material can be subject to before failure.

2. Tear resistance or tear strength (ASTM D624, "Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers"): Tear resistance measures tearing action, including the force to initiate tearing of materials or tear propagation. With a waterproofing application, the force to initiate tearing is particularly important.
3. Adhesion to concrete (ASTM D4541, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," and ASTM D7234, "Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers"): Adhesion to concrete is the greatest perpendicular force a surface area can bear before a section of material is pulled off or detached. How well the material adheres to concrete and maintains itself after water immersion is critical with liquid waterproofing.
4. Shore hardness (ASTM D2240, "Standard Test Method for Rubber Property—Durometer Hardness"): Shore hardness is the resistance a material has to indentation. This measures the indentation hardness of substances such as thermoplastic elastomers, vulcanized (thermoset) rubber, elastomeric materials and some plastics.
5. Abrasion resistance (ASTM D4060, "Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser"): Abrasion resistance is the rate of wear as calculated by measuring the loss in weight (in milligrams) per thousand cycles of abrasion. The lower the wear index, the better the abrasion resistance.
6. Low-temperature crack bridging (ASTM C836, "Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course," or ASTM C1305, "Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane"): This is the ability of the material to maintain its integrity while bridging a crack in the substrate at low ambient temperatures when the polymeric materials are least likely to be flexible. Meeting this criterion allows the material to perform exceptionally at crack-bridging, a critical factor with construction-based waterproofing.

A waterproofing system should be evaluated based on results of this set of tests and should not be selected based on a single performance value. Importantly, the highest possible test value does not always translate to installed performance. The system should be evaluated in total to determine the likelihood of achieving the desired installed performance.

Product materials and chemistry

Cold-applied liquid waterproofing systems are made of polymers such as thermoplastic elastomers, or polyurea, and require applying one or two layers (after the primer) to achieve durable performance. Some systems do not require a reinforcement layer or protection course during construction.

Hot-applied liquid waterproofing systems consist of rubberized asphalt and require multiple layers to achieve durability along with, in most cases, a reinforcement layer made of fleece and a protection board, which add complexity to the installation. Because of the additional skill set required to install these systems to achieve optimal reinforcement and protection, there is a greater chance of errors occurring during installation that could affect the product's watertight performance and durability. Providing workers with installation training of hot-applied systems will help eliminate potential errors.

Damage resistance

Most cold-applied liquid waterproofing systems are reactive and made to form a high molecular weight or cross-linking polymer. This results in good resistance to wear and tear, hydrocarbons, grease or solvents often spilled on job sites. The waterproofing material must have crack-bridging capability to maintain its integrity.

Reactive cold-applied liquid waterproofing often is designed with the ability to handle "point loads," which can be caused by a heavy piece of equipment with a narrow leg at the bottom or similar point-load situations. In those instances, the membrane will have a high resistance to dents or penetrations.

Asphalt-based hot-applied liquid waterproofing is composed of large proportions of low and medium molecular-weight components. Consequently, it does not stand up well to equipment grease and solvents that may be dropped on the surface. Also, it can handle only limited loads or cycles of abrasion on its surface before showing wear or penetration.

Overall, cold-applied waterproofing can handle greater loads and a higher number of cycles of abrasion than hot-applied waterproofing.

Low temperature crack-bridging

Crack-bridging is a critical feature of liquid waterproofing materials resulting from the natural dynamic movement of buildings and structures. In climates with seasonal temperature changes, these cracks can shift, open and close. This back and forth movement of cracks as temperatures change creates many fatigue cycles on a waterproofing membrane.

Waterproofing materials need to withstand various temperatures, particularly cold temperatures, so when there is a crack in the substrate (typically concrete), the waterproofing membrane remains in its original condition. There should be no fine-line cracks or breaks in the membrane, and it should remain monolithic, protecting the structure underneath by preventing water intrusion.

Materials can become rigid or brittle when the temperature drops, rendering them unable to maintain their original condition under stress or repetitive movement. When choosing a waterproofing system, the material's temperature-related properties and overall chemistry should be given serious consideration.

The elastomeric qualities inherent in cold-applied liquid waterproofing membranes easily withstand building movements and fatigue cycles, maintaining their integrity over a long period of time. Cold-applied liquid waterproofing can handle temperatures as cold as -15 F.

Hot-applied liquid waterproofing requires continuous maintenance to ensure the membrane is protecting the surface below. Enduring fatigue cycles of building movement or maintaining integrity over time, especially in cold temperatures, is a challenge for hot-applied liquid waterproofing.

A waterproofing product is considered durable when it installs easily and is tough enough to handle construction-site abuse and long-term aging

Application durability

Applying cold liquid greatly reduces the chance of evaporation of moisture and water trapped in concrete as well as expansion of trapped air in the concrete when compared with hot-liquid application. With cold-applied waterproofing, you can build a continuous membrane for waterproofing integrity.

When applying hot rubberized asphalt at hot temperatures, air will try to escape, and moisture will try to evaporate through any defects in the primer, which can cause a good deal of blistering or pinholes.

So which one is more durable?

A waterproofing product is considered durable not only when it meets the six critical performance requirements but also when it demonstrates the ability to handle job-site conditions and maintain long-term performance in the service condition. In other words, it installs easily with minimal defects and is physically tough and chemically inert enough to handle construction-site abuse and long-term aging to maintain its waterproofing integrity.

Depends on the scenario

Commercial construction projects come in all sizes and can include anywhere from a dozen to hundreds of scenarios. For some scenarios, either cold- or hot-applied liquid waterproofing products works well.

For construction-site waterproofing scenarios on green roofs and plaza decks—particularly performance-critical and time-sensitive ones—cold-applied liquid waterproofing can be the better option.

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