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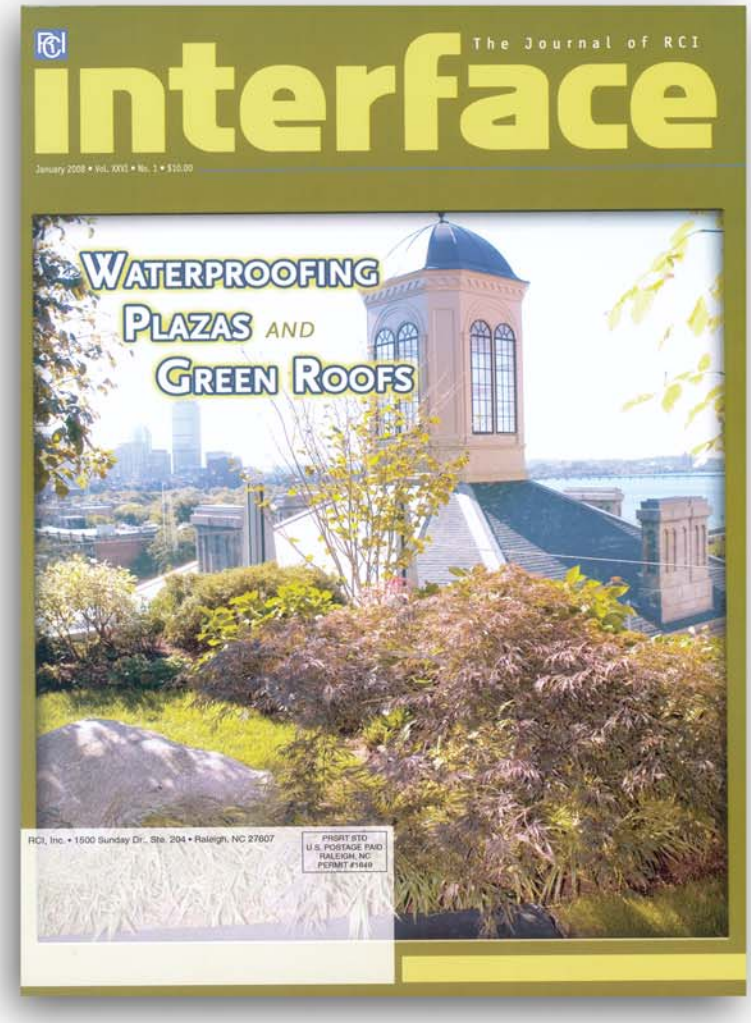


Plaza Waterproofing and Green Roofing Utilizing Liquid-Applied Reinforced Polymeric Membranes

By Paul Allenstein, PE

At first glance, plaza waterproofing and green roofing might not appear to have much in common. After all, most plazas are at grade level or, at most, a few stories above the ground, while green roofs (garden roofs, landscaped roofs, etc.) are way up on top of the building. Though these applications may appear opposite in concept, they end up achieving the same purpose.

Plaza waterproofing and green roofing both represent the need and desire to achieve multiple functions from the same space. Plazas create and allow the use of occupied space under an open public area. Green roofs create and allow the use of an open public area above an occupied space.

Relative elevations aside, plaza waterproofing and green roofing share many of the same challenges toward achieving a watertight condition, which is the fundamental requirement of both applications:

- The membrane will be inaccessible following application of overburden.
- The membrane will be subjected to moist and dark conditions, with the likelihood of standing water in some areas.
- The flashings will be subjected to long-term UV exposure.
- The membrane will be subjected to foot traffic and use as a staging area during overburden placement.
- The waterproofing/roofing membrane will be expected to accommodate elevation changes, dividing walls, planting wells, fountains and other water features, and various overburden materials.

The use of liquid-applied reinforced polymeric membrane systems allows designers and specifiers to satisfy these criteria.

Selecting the Membrane

Liquid-applied reinforced polymeric membrane is a 50-year-old technology that has only recently begun to enjoy more widespread recognition.

Briefly, liquid-applied reinforced polymeric membrane systems utilize a polymer-based resin (polyester, polyurethane, polymethylmethacrylate) to saturate a polyester or fiberglass reinforcing fabric. The advantages of this type of system are as follows:

- The reinforcing fabric is cut to fit tightly at perimeter conditions and around penetrations so that when the fabric is saturated with the resin, the flashings conform and bond directly to the walls, curbs, and penetrations. This eliminates the use of pitch pockets, preformed boots, termination bars, and other accessory products.
- Based upon laboratory testing, liquid-applied polymeric resins generally have an inherent resistance to deterioration from UV rays root penetration, and algae growth. This allows the use of the same resin and reinforcement at flashings as well as on the field membrane, providing a monolithic and continuous barrier to water penetration. This eliminates the need for the use of dissimilar flashing materials such as rubber sheets and metal accessories that can disbond from the primary waterproofing/roofing membrane. In addition, it eliminates the need for the use of a root barrier and UV barrier, typically required with asphalt-based membranes and representing an added expense to the installed system.

When the owners of Massachusetts General Hospital envisioned constructing a new landscaped green roof above their cancer wing in 2005, they had two chief concerns: safety and long-term durability. They chose a cold-liquid-applied waterproofing and roofing membrane by Kemper System, Inc. The landscaped roof design included four different gardens with extensive shrubbery, trees and grass designed to provide cancer patients with a haven for relaxation and meditation to aid in the healing process.

- Liquid-applied polymeric membrane systems are generally durable and resistant to scuffing, puncturing, and tearing. They do not soften significantly in hot weather and retain reasonable flexibility in cold weather. A simple aggregated surface utilizing kiln-dried sand broadcast into the wet resin will significantly improve resistance to damage related to foot traffic and staging operations. Of course, it is always a good idea to provide additional temporary protection in areas of heavy use.

Typical challenges of most applications where planters are involved are the numerous steel reinforcing bars that project upwards through the deck. Most systems don't have the ability to wrap those penetrations and treat each rebar as an individual flashing. The waterproofing and roofing membrane's ability to detail each individual rebar greatly reduces the possibility that water will seep through the planter walls and down to the existing plaza. This plaza is at 75 Henry Street, Brooklyn, NY.

- When properly installed, a polymeric membrane system provides a tightly bonded, custom-fitted membrane and flashing system that can seamlessly transition from through-wall flashing to base flashing to plaza deck membrane to parapet wall flashing to fountain lining to green roofing membrane to planter lining; all without mechanical transitions, system breaks, material changes, or other discontinuities.

For these reasons, a liquid-applied polymeric reinforced membrane system is often the system of choice for plaza deck waterproofing and green roofing applications.

Selecting the System

A design consideration related to the selection of membrane type is the design of a basic membrane system. This involves the following considerations:

- It is usually preferable to have the waterproofing/roofing membrane fully adhered, whether it is adhered directly to the structural deck substrate or to an underlying foam insulation/cement coverboard assembly. By nature, liquid-applied polymeric reinforced membrane systems are always fully adhered.

- There may be some system cost savings associated with the use of grid-adhered, mechanically attached, and loose-applied membranes, because adhesives can be expensive and less labor is required if adhesives and mechanical fasteners can be eliminated entirely. However, should there be a water penetration event, with mechanically attached and loose-applied systems, there is the certainty of uncontrolled lateral movement of water beneath the membrane. Grid-adhered systems are dependent on the integrity of their grid to provide some degree of water control. The cost savings compared to a fully adhered system is probably not sufficient to justify the increased risk and future expense associated with untraceable, buried leaks.

- It is usually preferable to have the waterproofing/roofing membrane placed directly over the structural deck, which is generally possible with concrete and wood decks. Again, this minimizes the potential for lateral movement of water beneath the membrane. If insulation is required in the system, extruded polystyrene insulation can be placed above the membrane in a manner similar in concept to a typical protected membrane assembly. Wherever possible, fully adhered membranes should be installed in plaza deck waterproofing and green roofing applications.

  If insulation must be installed beneath the waterproofing/roofing membrane (as is the case with steel decks), the use of a water- and rot-resistant foam insulation such as polyisocyanurate or extruded polystyrene is recommended. In addition, the installation of a water and rot-resistant, high-compressive-strength, cement-based cover board is recommended as well. In a 1/2-inch thickness, cement-based coverboards act almost like concrete decks, minimizing the potential for penetration through the membrane and into the heart of the insulated assembly, thereby limiting the potential for lateral movement of water beneath the membrane.

Selecting the Overburden Assembly

Plaza decks and green roofs both lend themselves to creative selection of overburden materials to create an environment that satisfies the overall design intent. This can range from an area for quiet, private reflection to something as completely different as an area for transient, public gatherings.

What follows is a short listing of commonly used overburden materials and some general comments on each.

Precast Concrete Pavers on Pedestals – This is the most common plaza-deck wearing course. Pavers are typically 24" x 24" x 2" thick. The use of a drainage mat, asphalt-protection board, or nonwoven polyester mat is often specified as protection between the pedestals and the waterproofing membrane. Sometimes pieces of extruded polystyrene insulation are substituted for pedestals as a cost-saving measure. This is not a good idea because the pieces of extruded polystyrene insulation tend to move around under the pavers and do not allow for accurate shimming and adjustment of paver heights.

Precast Concrete Pavers, Natural Stone Tiles, or Brick Paving Stones in a Sand Setting Bed – The use of a drainage mat is critical in order to have the sand-setting bed drain properly. Edge securement around the perimeter, at drain outlets, etc. is required to ensure that the paving units do not shift over time. The selection of the correct sand for the setting bed is important. Some specifiers prefer to mix a small quantity of asphalt into the sand. The use of bilevel plaza drains is required with this type of overburden, providing drainage at both the membrane level as well as at the overburden level.

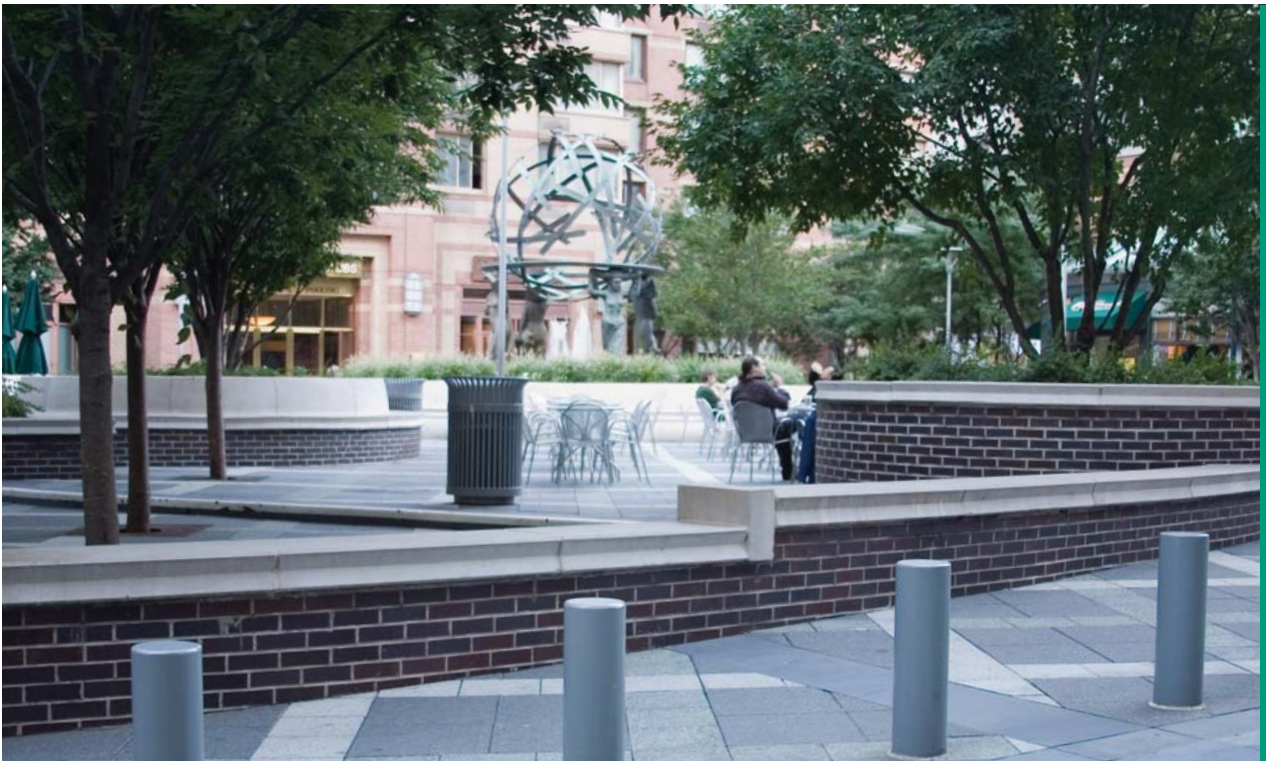
Quarry Tile or Natural Stone Tile in a Cementitious Setting Bed – The use of a drainage mat beneath the setting bed is preferred by many specifiers as a means of ensuring proper drainage of the setting bed, reducing the potential for freeze-thaw damage, and possibly limiting efflorescence in the grout joints. Typically, a 2" thick cementitious setting base bed is installed first, with the quarry or stone tile situated into a thin-set cementitious tile adhesive. The selection of a polymer-modified setting bed, tile adhesive, and grout intended for exterior application is important to achieve satisfactory performance. Interior-grade materials should not be used. The use of bilevel plaza drains is required with this type of overburden, providing drainage at both the membrane level as well as at the overburden level.

Wood Decking on Pedestals or Sleepers – Wood decking is often installed in residential applications. The use of a drainage mat is usually specified as a protection layer between wood sleepers and the waterproofing membrane because it facilitates drainage beneath the sleepers. Wood decking is sometimes constructed in sections to allow removal and reinstallation to provide access to the water-proofing membrane. Of interest is the recent introduction of wood deck tiles intended to be supported on pedestals commonly used to support concrete pavers. The selection of wood type is important; the current trend towards environmentally sensitive use of natural resources favors the use of naturally rot-resistant wood such as teak and ipâ that are part of a controlled harvesting program. Wood decking will require maintenance.

Sedum-Based Extensive Green Roofing – Many traditional green roof systems use hardy, low-lying sedum plants set in 2"–3" of a special growing medium. The sedum plants may not be particularly attractive compared to flower beds, shrubs, and turf, but the sedum plants require little maintenance and provide all of the environmentally important attributes of green roofing such as drainage retention, improved localized air quality, and protection of the waterproofing membrane.

A drainage and water-retention mat is usually installed between the growing medium and the waterproofing membrane. The special growing medium consists of mineral aggregates with a small amount of organic material. The idea is that the organic material fosters initial plant growth and establishment, while the mineral aggregate fosters development of a root mat that knits the planting layer together. The installation of concrete pavers in the corner and perimeter areas of the roof may be necessary to resist wind scour.

Intensive Green Roofing and Planting Beds – Most people expect green roofs to be garden-like, with flowers, perennials, shrubs, grasses, etc. The growing medium becomes thicker and more organic as larger plants are incorporated into the green landscape. This type of green



An 80,000-sq-ft open plaza area in New York City with difficult vertical flashing details required a seamless membrane, with many parts being covered with soil. The track record and ability of the waterproofing and roofing membrane to protect high-end businesses located below the plaza area were key factors in the product's selection.

roofing requires regular landscaping maintenance, supplemental irrigation systems, and periodic fertilizing, but it also allows for great design flexibility.

This type of green roofing is often combined with hardscape materials such as concrete pavers and with water features such as ponds and fountains. The most straightforward method of addressing the waterproofing requirements of such a varied design is often to install the waterproofing membrane throughout the roof area, followed by a drainage and water retention mat, and then the landscaping materials over this common base assembly.

Providing Positive Slope to Drain

Both plaza deck and green roof applications involve the use of overburden materials that can eliminate the appearance of ponding water. If a waterproofing/roofing system is used that is resistant to biodeterioration and is fully adhered directly to the structural substrate, the need for positive slope to drain may not be apparent. However, positive slope to drain is an important consideration that should not be ignored for the following reasons:

- Ponding water represents significant dead weight that must be taken into account when evaluating the structural adequacy of a deck to support all of the overburden materials, saturated soils, vehicular and pedestrian traffic, etc. The weight issue is always a structural concern.

- Ponding water represents a fertile breeding ground for mosquitoes. Positive slope to drain can limit the amount of standing water trapped beneath pedestal-supported concrete pavers. This is becoming more and more of an issue now that mosquito-borne diseases are experiencing a resurgence.

- When it comes to plants, providing the correct amount of water is critical to long life. Too much water will cause root rot to develop, while too little water will dry the roots out. Poorly draining soil can lead to underwatering just as readily as overwatering. Either way, the plants die. Therefore, achieving properly draining soil is the key to balancing moisture within the growing medium. Providing positive slope to drain allows excess water to make its way out of the assembly.

Approach Green Roofing with Caution

Plaza deck waterproofing is a relatively well-understood application when compared to green roofing. A green roof is a living environment, and in order for a green roof to be considered a success, it must be sustainable for 20 years or longer. It only seems like an easy proposition to roll out a drainage mat, spread some dirt, and install some plants, a walkway, and a koi pond. But that is only the beginning.

A green roof is much easier to maintain if it is properly designed. Achieving the correct balance among drainage, irrigation, growing medium composition, water retention, and plant types is an endeavor that requires careful consideration. The correct balance is going to be different, based upon geographic location as well. That is why the design services of a qualified landscape designer may be a smart investment in order to ensure the success of a green roof project.

This large penthouse terrace was designed as an outdoor environment to complement a multi-million dollar apartment high atop the New York City skyline, with multiple levels requiring exceptional waterproofing, especially around the flashings.

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