Design Considerations for Renewing Podium Waterproofing

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Abstract

Landscaping systems over suspended podium slabs are becoming more common as housing density intensifies and communities endeavor to increase their green spaces. These landscaped podiums often feature difficult-to-access spaces covered with heavy and complex landscaping elements. During this presentation, the speakers will discuss design decisions for landscaped and waterproofing assemblies installed over main building structures and the cost and complexities of future waterproofing renewal. The authors will use specific examples to clearly illustrate the need to coordinate efforts between different disciplines to best meet municipality development requirements.

Speakers

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THE LANDSCAPED PODIUM

As part of a building's exterior element, landscaped podiums or waterproofed plaza decks provide an aesthetically pleasing common space for the enjoyment of their users. In addition to providing much-needed green spaces on concrete structures, podiums that incorporate large softscape areas aid in the building's water management strategy by retaining and slowly releasing stormwater during a heavy rain event.

These landscaped podiums are becoming more common as housing density intensifies in urban and suburban communities and the desire of these communities to grow or maintain these green spaces increases. Podiums often incorporate natural elements such as grass, shrubs, and mature trees, as well as designed elements such as play­grounds, water features, and suspended parking surfaces or drive aisles. They are also becoming more and more elaborate—often including difficult-to-access spaces covered with heavy and complex landscaping elements.

The replacement of the waterproofing systems for podiums is a burden too often passed on to the building owners. With this in mind, their design should include deliberate considerations for a durable waterproofing system. Their design should also include appropriate ground and surface water management strategies, proper tie­ins with building structure and envelope systems, adequate selection of landscaping and overburden, and access provisions for maintenance and future replacement.

WATERPROOFING SYSTEM DURABILITY

Podiums come in many forms; they can have softscape (soil and vegetation) or hardscape (sidewalk, drive aisles, etc.) or a combination of both finished surfaces. These same assemblies can incorporate insulation in their assemblies if the space below is conditioned (occupied or living space). Some podiums, such as those incorporating a water feature or invasive vegetation, are more complex in design. Almost exclusively, all podiums have a concrete base structure that can support the various elements discussed above. Thus, all podium systems have one thing in common: a waterproofing membrane that is not easy to access, service, maintain, or replace once it is fully installed. Therefore, it is prudent to design podiums that have a long service life.

A durable waterproofing system should incorporate a robust waterproofing membrane. Waterproofing membranes, such as hot rubberized asphalt, have proven records in performing very well in waterproofed podium assemblies.1 Hot rubberized asphalt membrane is monolithic in its installation and is applied to a thickness of about 5 mm to 6 mm (215 mil), complete with a reinforcing mesh per the system manufacturer’s instructions3,4 (Figure 1). It is applied in its hot semiliquid state and can easily be worked around the various elements of the waterproofed concrete podium such as reinforcing dowels, curbs, and membrane upturns. It is compatible with various building envelope membrane types and is most often the membrane of choice in many podium waterproofing projects.

Two­ply styrene butadiene styrene­ (SBS) based membranes are also very durable membrane types that are often used in landscaped podiums. In SBS­based membrane application, both layers of the membrane are typically torch­applied onto the concrete structure for a fully adhered and robust membrane application. The two layers provide redundancy and thickness in excess of 7 to 8 mm (300 mil). They are installed with staggered laps so that failures at the seams in the second ply (cap sheet) do not impact the seams in the first ply (base sheet). Both two­ply SBS and hot rubberized asphalt membrane systems are fully adhered. This allows for localization of deficiencies to a limited area on the waterproofed podium, allowing for ease of identification and targeted repair of a deficient area.

Asphalt­modified, cold­applied, polyurethane­based membrane systems are also being specified and installed in many podium waterproofing projects (or at least have been). Similar to hot rubberized asphalts,
this membrane type is fully adhered and can easily be applied to the various elements of the waterproofed podium but is generally applied in thinner layers (with or without reinforcing mesh) and has a history of poor performance. Thus put, the long-term durability of this membrane type has been in question. Issues such as potential blistering of the membrane (Figure 2) and its potential compatibility to adjoining envelope membranes (such as SBS-based self-adhered membranes) should be considered. At the moment, the various manufacturers of these membrane systems are trying to address the shortcomings in modified polyurethane membranes when used in podium waterproofing systems. 

Singly-ply sheet membranes such as polyvinyl chloride (PVC), ethylene propylene diene monomer (EPDM), and thermoplastic polyolefin (TPO) may be practical in conventional roofing system installations. However, these membrane types come short in addressing the complexities that are associated with a podium and its various elements. Single-ply membrane systems lack the redundancy present in two-ply SBS membrane systems and the seamless nature that is the characteristic of a hot rubberized asphalt system. Single-ply membranes generally offer thicknesses of 1.5 to 2 mm (60 to 80 mil), which is much thinner than SBS or hot rubberized asphalt membranes. They have welded or adhered seams; adhered seams are generally more vulnerable, eventually leading to leaks. In addition, they are not easy to detail around the complex elements of the podium and can present compatibility issues with asphaltic membrane.

Designing for a long-lasting waterproofed podium system also requires the careful consideration of the complete podium waterproofing assembly being installed above the membrane. Designers should select assembly components that are compatible with the waterproofing membrane of choice. This includes the selection of the appropriate drainage medium and root barrier where required. Waterproofing system durability is also a function of its proper installation. Improper installation of an otherwise robust waterproofing system can potentially lead to its premature failure. It should be noted that it is the responsibility of the contractor (or that of the waterproofer) to install the waterproofing system following approved instructions from the system’s manufacturer and the project specifications. Thus, it is essential to have specifications that outline parameters for the proper installation of the waterproofing system and the quality control and assurance measures. In addition, as part of the system design, it is recommended the designer specify third-party or manufacturer’s waterproofing system warranties in the waterproofing section. These warranties often come with field reviews by the warranty provider to ensure adherence to the terms of the warranty and installation procedures. A durable, well-designed, and properly installed waterproofed podium system can last up to 40 years.

Conversely, a poorly designed or installed waterproofing assembly can lead to a shorter-than-average service life for the system. This type of deficiency is often systemic and requires full replacement of the waterproofing assembly at an early stage in the building service life. Many owners of such deficient podiums elect to address the leaks by performing partial repairs due to the expensive nature of addressing this type of deficiency. This means that over the life of the building, the cost associated with the waterproofing increases as it needs to be addressed more frequently. Therefore, designing and installing a robust waterproofing membrane system is critical in preventing expensive maintenance and replacement costs. 

**POD IUM D ECK W A T E R M ANAGEMENT S TRATEGIES**

Designers should also consider deck water management strategies when designing a robust podium waterproofing system. In a well-drained podium deck, much of the water—whether from rain or the irrigation system—is easily redirected to the deck drains and removed from the podium deck structure. The membrane in a well-drained podium is therefore not exposed to a buildup of water (Figure 3). Dying trees and shrubs on a podium are telltale signs of heavy saturation of the overburden. Other signs of poor drainage are extensive active leaks to the spaces directly under the podium deck.

A primary requirement for a well-drained podium deck is ample slope of the concrete structure towards the deck drains. Most industry standards require 1 to 2% slopes to address drainage issues of podium decks. Decks with higher slopes can remove water faster from the deck surface, thus diminishing the risk of leaks through defects in the waterproofing, as a head of water is avoided. A head of water would put more pressure on the podium membrane and more likely lead to leaks into the building structure (Figure 4). During construction, contractors should verify the slope of the podium decks as part

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**Figure 3 – Poorly drained waterproofed podium deck.**

**Figure 4 – Active leak through a podium, attributed to poor or impeded podium drainage.**
water management strategy as discussed above, complete with quality control parameters.

**ELEMENTS OF THE PODIUM**

The visible parts of podiums often come with architectural, structural, electrical, mechanical, and building envelope elements that require carefully thought-out tie-in and incorporation strategies. The prime consultant or architect should coordinate with all the responsible disciplines for their proper incorporation. This design approach should include a review of the impact of these elements on the overall durability, ongoing maintenance, and renewal costs of the podium. The following is an in-depth discussion on the proper design and installation of some of these elements.

**Softscape and Paved Elements**

Most podiums incorporate both softscape elements (trees, shrubs, and grasses) and paved elements (paved walkway, concrete-topped or asphalted driveways). The incorporation of these elements is often coordinated with the landscape architect. Softscape elements are often irrigated. In addition, these elements require a root barrier installed directly over the waterproofing membrane. This component comes in many different shapes and forms. The most common root barrier is high-density polyethylene (HDPE) sheet, which comes in different thicknesses, dependent on the plants used (Figure 5). For plants with very invasive roots (such as bamboo), steel containers can be used to contain the root system and avoid damage to the waterproofing system. The root barrier should be fully continuous in the landscaped area, lapped or welded at joints. It should be installed following the manufacturer’s instructions. It is installed below the drainage layer, and where insulation is part of the assembly, below the insulation as well. Design and contract documents should also incorporate information for the provision and proper installation of this element. Coordination is required with the landscape architect to ensure that this requirement is reflected in the design drawings. Coordination is also required for the proper placement of this component of the waterproofing assembly with the contractor. Ultimately, a good design approach for the landscaping needs to be followed; this involves holding back the soil from those details for which waterproofing is difficult to achieve (e.g., drains, upstands, parapets, and penetrations).

Once installed and passed to the subsequent owners, landscaped elements will require some maintenance. As part of the contract documents, the designer should include the provision of the building maintenance documents. These maintenance documents should include protocols for the proper maintenance of the landscaped podium. The nature and type of softscape can change during the life of the podium. Therefore, maintenance documents should include a section on the proper use of softscape elements, including plant selection by the building’s subsequent owners.

Paved elements, such as paved walkways and concrete topping, are often used on podiums. Selection of the appropriate drainage element is important in these assemblies, taking the type of live load expected as a factor. Driving lanes over podium surfaces will require a drainage medium with higher compressive strength than areas with walking traffic. It is highly recommended that easily removable pavers be used in lieu of concrete or asphalt topping unless that latter finished surface
is absolutely required. Pavers are easier to remove and reinstall to address localized issues. During future podium renewals, the cost associated with removal of the overburden—and possibly the new surface if the pavers are reused—can be reduced significantly. Concrete topping, on the other hand, is jackhammered and is never reused. This process significantly adds to the overall cost of the renewal projects and has a negative impact on the environment—in part, due to the high volume of waste produced.

### Structural Elements: Planter Walls and Stairs

The design and incorporation of structural elements should be coordinated with the structural engineer. Concrete elements such as planter walls and stairs are often connected back to the main structure by steel reinforcing bars that penetrate the waterproofing membrane. Therefore, the proper detailing of these structural penetrations through the waterproofing system is paramount. The most common design strategy in properly detailing these elements is to raise these reinforcing bar penetrations above the drainage plane. This is often done by forming small curbs at the base of the concrete structural element that will be fully encapsulated with the waterproofing membrane.

Similarly, for anchoring secondary structures or elements such as screens, railings, or lampposts, pedestals (complete with membrane and metal cap flashing) can be used. The concrete curbs (also known as pre-curbs) or concrete pedestals are most often between 4 to 6 in. high and are located below the height of the adjacent finished surface or paved area to protect the membrane application over them (Figure 6). Pre-curbs are also good locations to locate electrical wire and gas line penetrations. Provision of pre-curbs also allows ample access for proper tie-in of the waterproofing membrane during construction and in future membrane replacement programs. It is a cost-effective strategy that may avoid extensive demolition during planned future renewals.

Structural elements such as planters can potentially block drainage paths on the podium surface. It is recommended that gaps be strategically located in between the pre-curbs to allow drainage to the nearest drain. These drainage gaps (or knock-outs) can be 8 to 10 in. wide. All reinforcing attaching the structural element to the podium deck should be located in the pre-curbs and not in the drainage gaps. The architectural and structural drawings should be coordinated and show the locations of these drainage paths in relation to the planter wall reinforcing.

Surfaces of planter walls that are in contact with landscaping elements should be waterproofed for additional protection of the structure from premature deterioration. Membrane application on the exterior face of the planter is not required; in fact, it should not be installed so as to avoid “tubbing” the wall. In addition, the root barrier and drainage medium should be extended up the inside face of the planter wall and above the height of the overburden. This will allow for proper termination of the root barrier and the adequate drainage provision against the planter wall, respectively.

### Architectural Elements: Water Features

Water features are architectural elements that require extensive detailing and the involvement of various disciplines in order to ensure proper installation. A well-thought-out water feature design will have a secondary membrane and its own separate structure (Figure 7). This secondary membrane is required to reduce the moisture load on the primary waterproofing membrane and to keep the water in the pool. The secondary structure should have a separate drain that is fully detailed such that it does not allow for bypass of moisture from the water feature to the primary membrane. Other mechanical and electrical penetrations servicing the water feature will require a watertight detail since they are in continuous exposure to moisture. The primary waterproofing membrane should be continuous under the water feature structure, complete with its drainage medium. It is important to note that once the water feature is installed over top of the primary waterproofing, the latter will no longer be accessible; this is why it is important to give due consideration to installing such features (not only to the detail but also to the installation of the feature).

### Mechanical Elements: Irrigation Lines, Plumbing Stacks, Hose Bibs, Drains, and Gas Lines

Mechanical elements such as irrigation lines, hose bubs, and plumbing stacks are also located on podiums. These mechanical elements often penetrate the slab to provide the required service to landscaped areas. If
they cannot be located at building wall or at the pre-curb as previously recommended, the penetration of these mechanical lines through the waterproofing membrane may require the provision of a stack flashing, complete with a proper termination detailing at the base and head. Where these lines require full exposure—such as a plumbing stack—industry standard requires a minimum 8-in. extension of this stack and the associated flashing above finished height of the adjacent finished surface (Figure 8). Maintenance manuals should include guidelines for proper maintenance of the landscaping around the service line to ensure the required elevation is maintained. Where these lines do not require full exposure—such as irrigation penetration—these should come with an irrigation control box complete with an access panel for maintenance purposes (Figure 9). The area around these penetrations should be adequately drained. Irrigation lines can be directed through the drainage gaps in the planter wall to connect with adjacent planters and should not penetrate the sides of the waterproofed pre-curbs. Gas lines also require a stack flashing detailing complete with base and top termination detailing.

As noted previously, drains should be easily accessible for maintenance purposes. Drains in planters can be separated from the surrounding overburden with perforated PVC shroud. This perforated shroud can be a pipe that is 2 to 4 in. wider in diameter than the drain body itself. It should be wrapped with filter fabric and have a clean-out access panel on the top. Architectural drawings created by the designer and shop drawings provided by the contractor should reflect the required detailing for the various mechanical elements discussed above. The necessary mechanical accessories (flashings, access boxes, and drain access panels) should also be specified in contract documents and coordinated with the contractor.

Electrical Elements: Light Posts, Electrical Wiring

Electrical lines that service outlets and lighting on the podium should have direct buried cables (DBC). Flexible electrical conduits (both plastic and metal) should not be used in podium systems, as these are problematic to detail with waterproofing membrane, and they are not durable (Figure 10). If lighting or an electrical outlet is to be provided on planter walls, it is preferred that the conduit housing be located at the pre-curbs (Figure 9). This will raise the conduit penetration through the waterproofing membrane above the drainage plane. If light posts are to be provided on the podium, these should also be installed on concrete pedestals that are membraned and flashed over with a metal cap flashing. Coordination will be required among architectural,
structural, and electrical drawings to ensure that conduit penetrations are located in pre-curbs and pedestals.

**Tie-In With Building Wall Elements**

Membrane tie-in of the waterproofed podium to the building wall elements is critical. At the early design phase and membrane selection stage, the designer should confirm the compatibility of the podium waterproofing and the building envelope membranes. Modified asphalt-based membranes (including hot rubber and SBS-based membranes) are compatible with most wall membranes. In addition, architectural details should reflect proper termination as well as tie-in of the waterproofing membrane at the building envelope. The tie-in details to the building envelope should allow for easy access to the waterproofing termination edge for future podium waterproofing replacement. Otherwise, removal in part or section of the building envelope assembly may be required to access the waterproofing membrane. A robust waterproofing membrane termination edge will often have an easily accessible membrane upturn that allows for podium waterproofing membrane replacement without greatly impacting the envelope assembly to which it is tied.

In addition, it is prudent on the part of the designer to ensure that a drainage strip, free of organic matter, is provided at the envelope perimeter where in contact with landscaped planters (green spaces). Building envelope elements are moisture-sensitive, so taking as much of the drainage away from these elements as possible is important (Figure 11). This can be done by installing a clear separation between the landscaping overburden and the building envelope with drainage strip (preferably with drain rock). Refer to Figure 12.

**Replacement and Repair Costs Associated With Podium Elements**

The costs of repair and/or replacement of a waterproofed podium are dependent on the waterproofed system design and its incorporation to adjacent assemblies, such as the building envelope (or the building wall). As noted previously, accessibility to problem areas is key in reducing the cost of repairs. When waterproofing cannot be accessed from above, negative-side repairs, such as urethane or epoxy injections, are often used to stop the leaks. Unfortunately, that approach only serves to displace the leak to the next crack in the concrete until such time as the leaks become systemic in nature and too expensive to address from the underside. In these situations, the waterproofing often experiences a shorter-than-expected service life. This is why designers should ensure that not only the waterproofing selection but also the design of penetrations and overburden with proper access are addressed during the design phase and implemented during construction.

Hardscape and softscape elements are often parts of the waterproofing assembly that require maintenance by the building
owners. As such, the provision of a maintenance plan for these systems should be coordinated among the designer, the contractor, and the landscape architect. The plan should include a clear outline of the maintenance procedure and maintenance frequency, complete with a maintenance logbook. In addition, the designer and the landscape architect should clarify the design of their waterproofing assembly with notes as to what part of the full assembly can be modified without disturbing the functional elements of the full assembly. For example, the type of plants to be installed on podium and those that are to be avoided based on their design (small shrubs vs. trees vs. plants with invasive roots such as bamboo) should be clarified. Consequently, the proper maintenance of a podium following the guidelines as set in the maintenance plan will extend its service life.

Waterproofed assemblies with concrete-topped hardscape surfaces are very expensive to replace. They will require jackham-mering, transportation, and disposal of the concrete, the reinforcing, and all associated waste (Figure 13). The cost implication associated with this work is not only monetary but also environmental. It is also important to note that jackhammering and hauling are noisy and disruptive to the building occupants. Therefore, design consideration of concrete pavers is recommended in lieu of concrete-topped hardscape surfaces. During future membrane replacement programs, the pavers can be removed, stored, and reused in the new system. The reuse of concrete pavers will reduce the overall cost of the waterproofing, in addition to lessening the impact of the project on the environment.

Deficiencies associated with poor waterproofing detailing at structural elements may require detail strategies that can potentially change the aesthetic feature of the element during the membrane replacement. In an extreme case, where a pre-curb is not provided in the original design and extensive leaks into the interior are attributed to the planter walls, the full planter wall may require encapsulating in waterproofing membrane complete with a counter-flashing detail. Where minimal deficiencies are attributed to this element, addressing the cracks in the exposed concrete element by
sealing them with the appropriate sealant; painting the exposed concrete surface with a breathable, water-repellent paint; and installing cap flashing over the top surface of the concrete planter wall may address it. The intent here is to reduce or eliminate the uptake of water by exposed concrete surfaces, as this water can potentially find its way into the building structure.

Leakage into the building interior due to water features is very expensive to address. Based on our experience, many owners are forced to decommission their water features due to the heavy cost associated with maintaining and repairing them. Therefore, it is recommended that designers try to avoid the inclusion of large concrete-formed water feature structures on waterproofed podium surfaces.

Deficiencies associated with mechanical and electrical elements require a targeted repair approach. Once identified, they can be properly addressed with minimal impact to the building aesthetic. However, the cost to identify these leaks and address them can often become expensive. Therefore, it is highly recommended that electrical and mechanical elements such as light posts, electrical lines, plumbing stacks, and irrigation lines penetrating the waterproofed structure are appropriately detailed and constructed.

A good tool for identifying the location of leaks where overburden is extensive is the use of a permanent monitoring system. A leak detection system can be installed underneath the waterproofing to identify when a leak happens. Because these systems employ moisture detection strips installed in a grid pattern to monitor for moisture intrusion, it is possible to pinpoint where the problem originates. A leak detection and location system is a mandatory requirement for compliance to some guaranteed standards for waterproofing systems that incorporate heavy or complicated overburdens in their design. Short of installing a permanent monitoring system, it is a good idea to scan the waterproofing using electrical integrity testing before covering the membrane with the overburden. This will allow identification of hard-to-see breaches in the waterproofing that may become issues in the long term and easier repair while accessible.

CONCLUSION

Waterproofed podiums are becoming common features of many concrete structures. These features are also becoming more complex in their design. Therefore, designers should ensure that their designs include assemblies that are detailed with the overall durability of podium waterproofing systems in mind. In addition, the design around the elements installed on waterproofing systems should incorporate strategies for proper maintenance and future renewal of the waterproofing assembly. Designers should also coordinate specifications and drawings with the various disciplines involved in the podium waterproofing project (envelope, landscape, structural, mechanical, and electrical) to provide durable waterproofed assemblies that have a well-thought-out and coordinated design approach, system installation, and maintenance program. If designed and constructed in the way discussed herein, a landscaped podium will be worry-free and not overly cumbersome to the owners during future renewal considerations.

REFERENCES