IMPACT OF DESIGN CONSIDERATIONS ON THE RENEWAL OF LANDSCAPED PODIUMS

by

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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 storm water during a heavy rain event.

These landscaped podiums are becoming more common as housing density intensifies in urban and sub-urban communities and the desire of these communities to grow or maintain these green spaces increases. These podiums 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. These podiums 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 waterproofed podium system. Their design should also include appropriate ground and surface water management strategies, proper tie-ins 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 record 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 5mm to 6mm (215 mil) complete with a reinforcing mesh per the system manufacturer's instructions [3, 4] (Photo 1). It is applied in its hot semi-liquid 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.

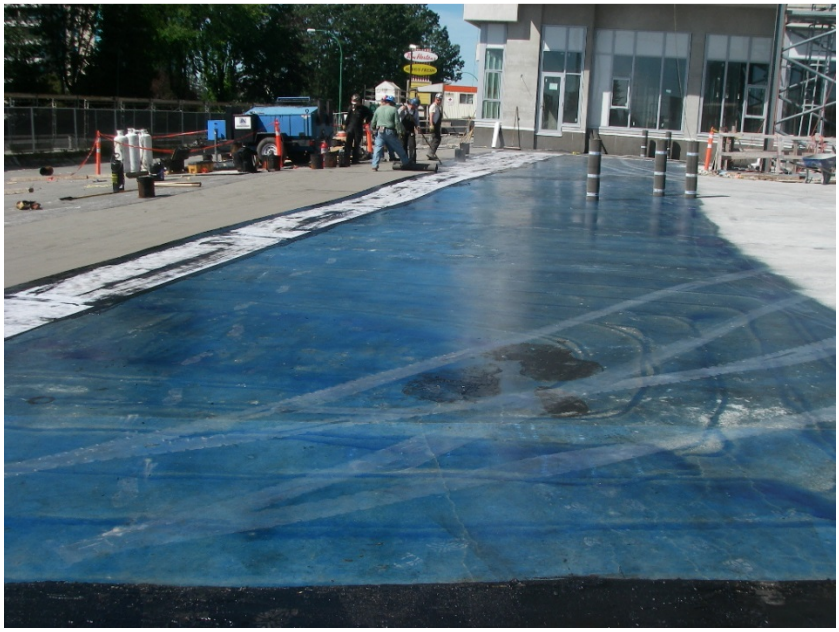


Photo 1: Hot rubber membrane application on a concrete podium

Two-ply SBS (styrene butadiene styrene) based membranes are also very durable membrane types that are often used in landscaped podiums. In SBS based membrane application, both layers of the membrane are typically torch applied on to the concrete structure for a fully adhered and robust membrane application. The two layers provide redundancy and thickness in access of 7mm to 8mm (300mil). They are installed with staggered laps so that failures at the seams at the second ply (cap

sheet) do not impact the seams in the first ply (base sheet). Both two-ply 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.

Asphalt modified, cold applied polyurethane based 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[4]. Issues such as potential blistering of the membrane (Photo 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 shortcoming in modified polyurethane membranes when used in podium waterproofing systems.

Photo 2: Water blisters in an asphalt modified, cold applied polyurethane based podium membrane

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

characteristics of a hot rubberized asphalt systems. Single-ply membranes generally offer thicknesses of 1.5mm to 2mm (60 mil to 80 mil), which is much thinner than SBS or hot rubberized asphalt membranes. They have welded or adhered seam; 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 QC and QA measures. In addition, as part of the system design, it is recommended the designer specifies waterproofing system warranties (third-party's or manufacturer's) 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.

PODIUM DECK WATER MANAGEMENT STRATEGIES

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 (Photo 3). Dying trees and shrubs on a podium are tell-tale signs of heavy saturation of the overburden. Other signs of poor drainage are extensive active leaks to the spaces directly under the podium deck.

Photo 3: Poorly drained waterproofed 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 note a requirement between one to two percent slopes to address drainage issues of podium decks [5, 6]. 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 (Photo 4). During construction, contractors should verify the slope of the podium decks as part of the project's quality control program to ensure positive drainage to the deck drains prior to assembly installation.

Photo 4: Active leak through a podium attributed to poor or impeded podium drainage

In addition, deck drains should be located strategically to address drainage on the podium deck. Concrete planter boxes and partitioned areas can have separate drains. Alternatively, they can have strategically located openings to allow drainage to the closest drain. Drains should be easily identifiable and accessible for regular maintenance by the owners of the building and should not be buried under soil or hard landscape elements.

Selecting the right type of drainage medium is important as part of the podium deck water management strategy. If a drain mat is to be used, the designer should specify a drainage mat meeting the appropriate compressive strength for the various types of loads the waterproofing system is going to experience. Alternatively, clean and rounded drain rock, also known as *river rock*, with a median size of ¾" can be used as drainage medium. If drain rock is to be used, the designer should clearly specify the type and size of the rocks needed for drainage, complete with the necessary filter fabric required. Drain rock with sharp edges should be avoided as they can potentially penetrate the membrane and lead to premature failure of the assembly.

It is also important to have a water management strategy for the waterproofed podium that does not entirely depend on the building's below-grade perimeter drainage (or weep tile). Sloping the deck structure such that it drains over the edge and onto the foundation wall can put undue stress on the below-grade foundation wall waterproofing assembly and potentially lead to leaks through the wall structure. It is preferable that irrigation and rain water landing on the podium be picked up via a dedicated podium drainage system that ties to the jurisdiction's storm water system.

Once built, podium decks that lack good water management strategies are expensive to fix since they require access to the podium structure or the drainage plane to address the deficiency. Therefore repairs to a poorly drained podium deck is often done together with full podium waterproofing system renewals as the work requires the removal of the overburden to address the deficiency. Therefore it is prudent on the part of the designer to incorporate a good water management strategy as discussed above complete with the 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 the architect should coordinate with all the responsible disciplines for their proper incorporation. This design approach should include a review on the impact of these elements on the overall durability, on-going 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.

1. Softscape and Paved Elements

Most podiums incorporate both softscape elements (trees, shrubs and grasses) as well as 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 sheets (HDPEs) which comes at different thicknesses dependent on the plants used (Photo 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 their 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 would involve holding back the soil from those details for which waterproofing is difficult to achieve (e.g. drains, upstands, parapets and penetrations) [7].

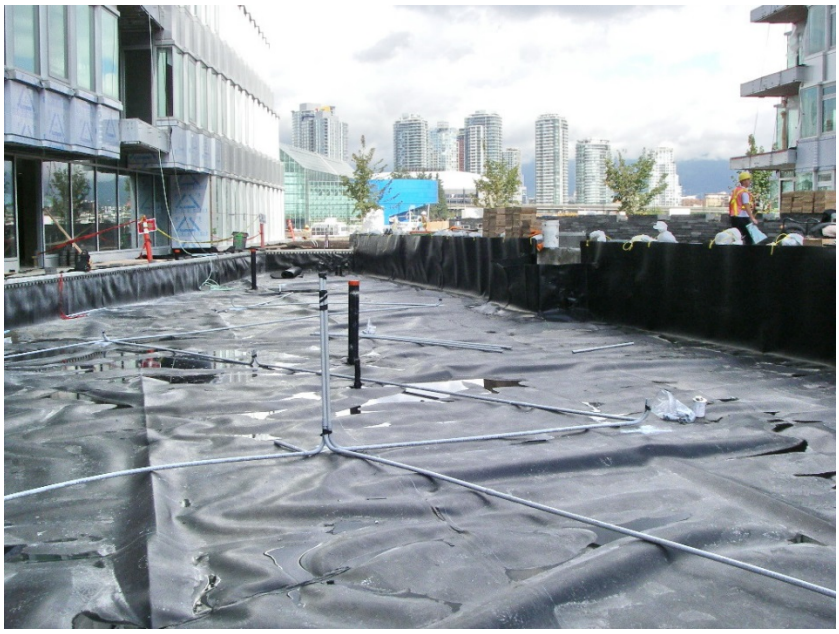


Photo 5: HDPE root barrier installed over the waterproofing membrane to protect it against invasive bamboo roots

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 provided to the owners 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.

2. 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 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 lamp posts, 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 height and are located below the height of the adjacent finished surface or paved area to protect the membrane application over them (Photo 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.

Photo 6: A fully waterproofed planter wall pre-curbs complete with drainage gaps and an internal drain

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" 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 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.

3. Architectural Elements: Water Features

Water features are architectural elements that to ensure proper installation require extensive detailing and the involvement of various disciplines. A well thought-out water feature design will have a secondary membrane and its own separate structure. This secondary membrane is required to reduce the moisture load being experienced by 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 water tight 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 feature (not only to the detail but the installation of the feature).

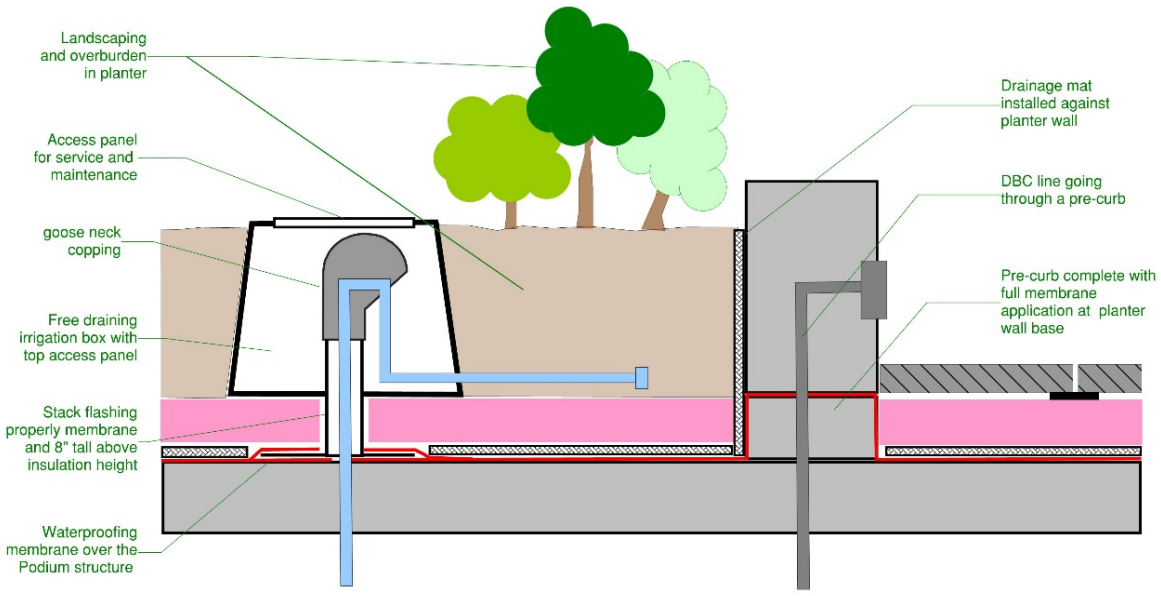
Photo 7: A typical water feature installed in between softscape elements

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

Mechanical elements such as irrigation lines, hose bibs 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 this lines require full exposure, such as a plumbing stack, industry standard requires a minimum 8" extension of this stack and the associated flashing above finished height of the adjacent finished surface (Photo 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 (Detail 1, Below). 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.

Photo 8: Plumbing stack (only the stack flashing cap can be seen) is buried inside a landscaped planter

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" 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.



Detail 1: Proper waterproofing of mechanical and electrical service lines on the waterproofed podium

5. Electrical Elements: Light Posts, Electrical Wiring

Electrical lines that service outlets and lighting on the podium should have direct buried cables (DBCs). 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. 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 (Detail 1, above). 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 between architectural, structural and electrical drawings to ensure that conduit penetrations are located in pre-curbs and pedestals.

Photo 9: Poorly detailed podium light post has led to leaks into the spaces below the podium structure

6. 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 program. 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 that it is tied to.

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 element is important (Photo 10a). 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 Photo 10b.

Photo 10a: Overburden installed against the building wall has led to water ingress and deterioration of a conduit line.

Photo 10b: Perimeter drainage strip installed against the building perimeter allows for good drainage and easy access to the top of the waterproofing

7. Replacement and Repair Costs Associated with Podium Elements

The costs of repair and/or replacement of a waterproofed podium is 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 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 between 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 log book. 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. Thus put, 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 jackhammering, transportation and disposal of the concrete, the reinforcing and all associated waste (Photo 11). 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.

Photo 11: Jackhammering of concrete topping and removal of landscaping can be an expensive endeavor

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 surface which 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, pluming stacks and irrigation lines penetrating the waterproofed structure are appropriately detailed and constructed.

A good tool to 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 pin point where the problem originates. A leak detection and location system is a mandatory requirement for compliance to some guarantee standards for waterproofing system that incorporate heavy or complicated overburdens in their design[8]. 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 repairing them 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, a landscaped podium will be worry free and not overly cumbersome to the owners during future renewal considerations.

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