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Design Principles for Plazas

Russell M. Sanders, AIA

Whether used for outdoor dining, as an extension of the building interior, or simply as a landscaped pedestrian setting, plazas offer building owners and occupants many benefits. But they also offer their fair share of repair nightmares. Most plaza deterioration problems stem from:

- poor detailing and failure to adequately plan for water flow and removal
- incorrect installation
- inappropriate materials

When things go wrong with a plaza's waterproofing system, fixing the problem usually means removing tons of landscaping, plantings, pavers, and other overburden just to find the source of the leak, an expensive enterprise even before addressing the actual cost of repair. For that reason, choosing and properly detailing the right waterproofing and drainage system and surface finish is paramount, whether in new construction or when rehabilitating a deteriorated plaza. Equally important is a thorough and rigorous maintenance program to protect new or rehabilitated areas.

Patterned concrete is often used as solid paving.

As Director of Technical Services, Russell M. Sanders, AIA oversees the firm's architectural and engineering functions of the practice, and is responsible for the technical integrity of its projects. He is extensively involved in the design and documentation for plaza and deck rehabilitation projects.

The Basics of Plaza Design

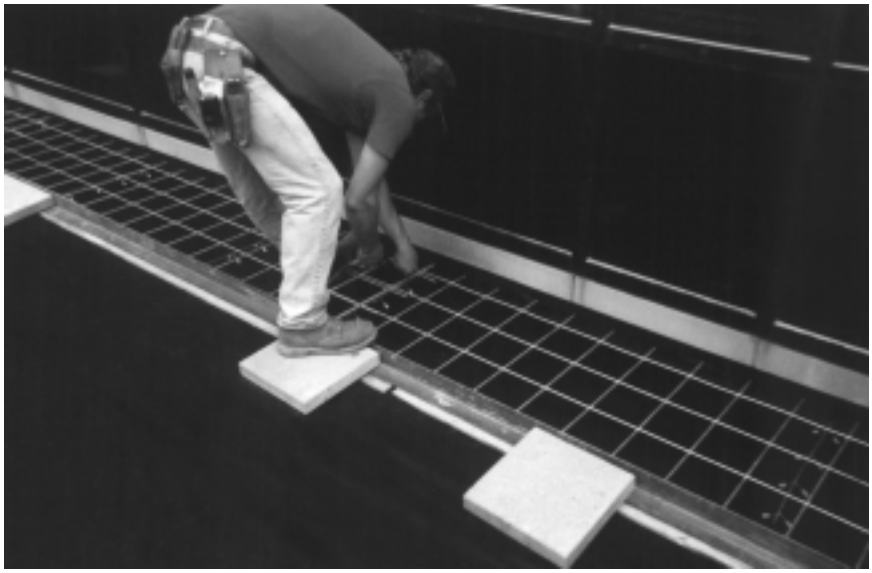
At its simplest, a plaza over occupied space consists of four layers: the deck on which it rests, the waterproofing membrane, the sub-surface drainage system, and the overburden. The overburden includes the finished walking surface, landscaping, plantings, outdoor seating, and other amenities.

Effective management of water flow should be the overriding concern in plaza design. Water infiltration problems — the primary symptom of plaza deterioration — typically comes from a failure to properly direct rainwater, melted snow, or moisture from other sources to drains. Water must flow quickly and easily to a well-designed system of drains at both the surface and the membrane levels to limit any opportunity for water to reach the building interior. Drains must be designed to accommodate the anticipated water flow, and should be easy to maintain and keep free of impediments to drainage. It is critical that the membrane have a positive slope to the drains. The membrane itself must be impervious to moisture and durable enough to last the life of the plaza. Without this, leaks are inevitable over time.

Types of Plazas and Recommended Design

The type of plaza design selected must be based on its ultimate use. The following looks at three general plaza uses and the waterproofing-finish system most appropriate to each.

1. When plazas are planned for use as an *extension of the building interior,* the design goal is to achieve a dead-level finish surface that will make the plaza usable for dining, seating, or other such uses. In this situation, the waterproofing membrane is designed with a positive slope to the drainage system, while the finish surface is installed to achieve a level surface. This can best be achieved using a paver-on-pedestal system.



The membrane, insulation, and protection fabric are in place for this plaza installation. The welded wire mesh is installed prior to pouring concrete.

The paver-on-pedestal or open-joint system typically uses 2' x 2' square pavers set on 1/2"-thick pedestals and columnar pedestal supports up to 10" high, which are installed directly on the insulation. (Please see Illustration A and B on page 3.) The pedestals are individually set to achieve the level surface over the sloped membrane. A perimeter of cast concrete aligns and stabilizes the installation. Often, a building wall, railing base, stairs, or stone balustrade forms part of the perimeter. This system provides the best drainage of any plaza design, as water can freely flow through the open joints. In some situations, height limitations may preclude the use of this system. Snow removal should be done with snowblowers or shovels, as the open-joint system is not usually designed to accommodate vehicle loads, and snow plows can easily dislodge or damage the pavers. This also limits any fire vehicle access to the building from the plaza. Of course, vehicle access can be accommodated if needed, but at a greater construction cost. These drawbacks are relatively minor, however, and Hoffmann Architects most frequently recommends this system where appropriate, as it provides the best long-term solution for a water-impermeable plaza setting. Installation costs may be higher than other plaza types, due to the hands-on care and skill required to set and level each paver.

2. A solid-set paver or closed-joint system is often used on plazas offering a *landscaped pedestrian setting*, with plantings and seating areas, where heavy foot traffic is expected. The finish surfaces of these plazas are usually allowed to conform to the slope of the roof deck, as the typical 1/8" slope-per-foot needed for positive drainage also provides an acceptable walking surface. (Please see Illustration C on page 3.) This system calls for a modular clay, stone, brick, or concrete paver set on mortar or asphalt, inside bands of cast-in-place concrete that are separated by expansion joints. This design can accommodate heavy loads, including vehicle traffic. Hard-set systems such as these, however, have critical maintenance requirements, particularly in protecting the integrity of the mortar joints. The primary drawback to this system is its inability to tolerate any movement through either expansion and contraction or flexion of the deck surface. For that reason, the solid-set system is best used on a street-level plaza or slab-on-grade. Creating plaza "sections" with control joints can help minimize cracking of the mortar or grouting joints caused by movement.

3. A loose-laid or sand-set system is typically used where the plaza is set on grade. (Please see Illustration D on page 3.) Here, pavers made of tile, brick, stone, or concrete are placed in a sand-setting bed. When installing pavers over a slab-on-grade substrate, no waterproofing is needed, as the water will drain down through the pavers and slab to the soil below. A well-designed surface drainage system is vital, however. The loose-laid system is moderately easy to maintain, but replacement of damaged pavers can be difficult. Potential problems include weeds pushing up through the open joints, heaving from freeze-thaw cycles, which can create tripping

hazards, and vandalism, as pavers can be removed.

Some General Rules

• Where possible, continuously install the waterproofing system below pools and planters to provide a continuity of protection and minimize interruptions and penetrations in the membrane. Waterproof the interiors of pools and planters to protect the underlying concrete.

• Properly detail and install control joints and expansion joints in the concrete to accommodate the substantial amount of thermal movement expected in a horizontal slab and to prevent cracking.

• Energy code requirements may demand plaza insulation, which can also help keep the water at the membrane level on the warm side of the insulation and therefore able to flow in all seasons. A typical board insulation would be extruded polystyrene boards placed directly over the drainage boards. Extruded polystyrene can tolerate exposure to water. Water drains between the boards, and in some cases, along special drainage channels created by notches on the bottom edge of the boards.

• Carefully detail sealant joints to create a 2-to-1 width-to-depth ratio, with a closed cell non-gassing backer rod, and a sealant that will tolerate water exposure and potential damage from foot traffic, particularly high-heeled shoes.

• Carefully detail waterproofing for stairways which are incorporated into the plaza, as these are prime candidates for water infiltration if improperly designed or installed. Waterproofing should be installed on

(continued on page 8)

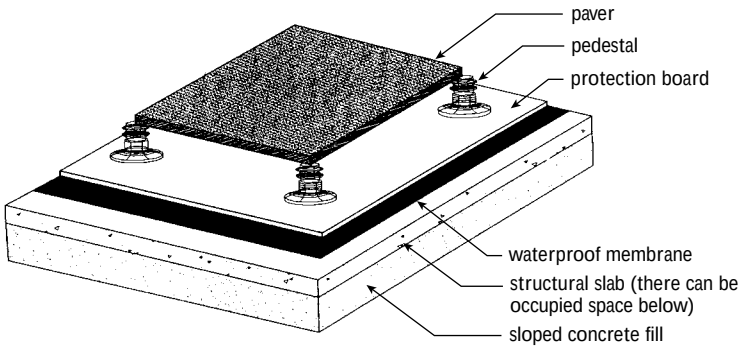


Illustration A: Paver-on-pedestal or open-joint system.

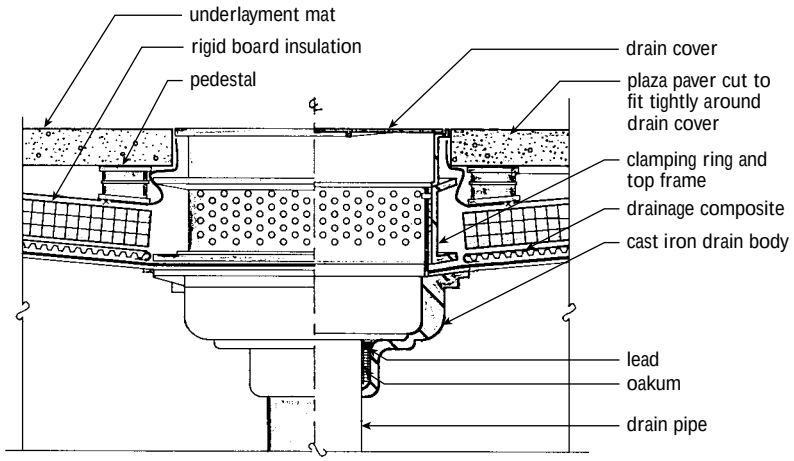


Illustration B: Plaza drain detail for open-joint system.

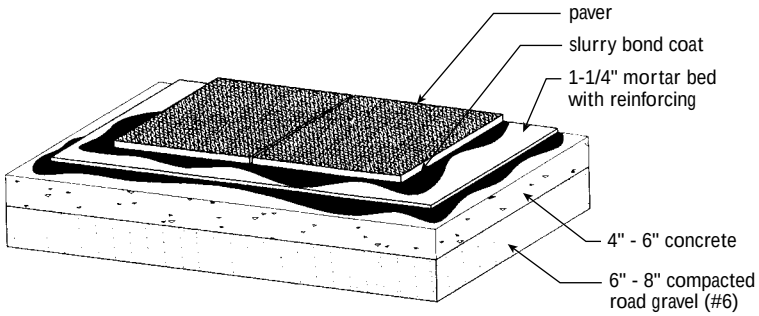


Illustration C: Solid-set paver or closed-joint system.

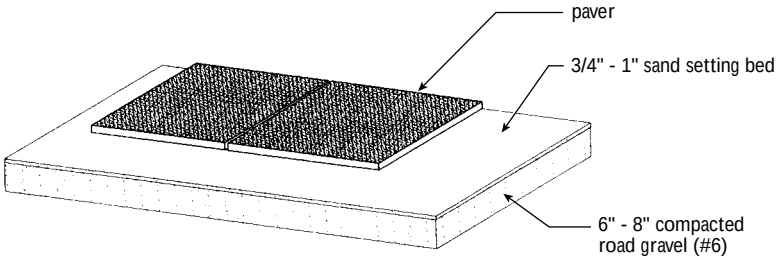


Illustration D: Loose-laid or sand-set system.

A self-adhered rubberized asphalt sheet membrane.

Choosing the Right Waterproofing Membrane

Once the waterproofing has been installed on a plaza and buried beneath tons of overburden, it is seldom seen again. That makes it all the more important to choose the right membrane, properly detail the waterproofing system's design, and monitor the installation for exacting compliance to the design documents and the manufacturer's specifications.

As a rule, Hoffmann Architects specifies that all membranes be fully adhered to the substrate. That helps localize any leaks that may occur, making repair an easier undertaking. (Conversely, a loose-laid membrane allows water to travel freely throughout the plaza. Pinpointing the source of a leak is extremely difficult and often requires removal of the whole plaza overburden to do so.) Once installation is complete, a 24-hour flood test of the adhered membrane is strongly recommended to check for and repair any leaks or weak areas.

The following three waterproofing membrane types are leading products in the industry. Each has its benefits and drawbacks, and should be selected based on its appropriateness to the specific needs of the project. All three membrane types will deteriorate with exposure to UV light, and must be adequately covered, including any flashing installed above the surface of the plaza.

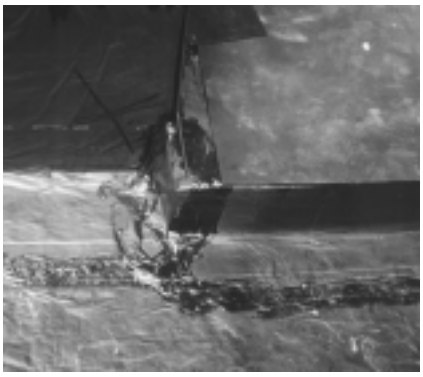
Rubberized asphalt sheet: The key advantage of using a rubberized asphalt sheet is its uniform thickness and the consistent quality control that comes with a factory-made product. It is relatively easy to install, even in intricate situations or

on complex flashings and vertical surfaces. The sheets are flexible enough to be applied to uneven surfaces without tearing and will bridge small cracks up to 1/4" wide. The sheet is also "self-healing" when punctured.

Because the sheet is only available in 3' wide rolls, however, multiple seams are required, each of which must be field-fabricated. Each seam must be perfectly made to achieve waterproofing. Because of this, a two-layer installation is recommended, where a second sheet is laid over the first to create staggered seams. This approach will also help the membrane resist damage from construction operations and overburden loading.

Adhered butyl sheet: Manufactured in varying thicknesses, and available in rolls up to 20 feet wide and 100 feet long, butyl sheet requires minimal seams. It too is capable of bridging small cracks and can be formed around pipes, flashings, and other penetrations. As a manufactured product, it offers uniform thickness and quality control. Installation is relatively easy on both vertical and horizontal surfaces. Although it may be "loose-laid" over the substrate, optimum waterproofing is best achieved by fully adhering the sheet. The substrate must be thoroughly cleaned before adhering the sheet, and dust and debris must be kept off the adhesive as it sets up in order to achieve a complete bond.

Its greatest disadvantage is its vulnerability to adhesive failure at the seams. Field conditions must be carefully controlled to minimize blowing dust and other contaminants as the adhesive cures. Surface preparation and caution during



The waterproofing system is chosen for its ability to accommodate intricate details.

installation are even more critical at the seams. A sharp object dropped on the membrane will puncture the sheet, as will any small protuberance — a pebble or rough spot — on the substrate surface.

Hot-applied rubberized asphalt: The rubberized asphalt is delivered to the site in a solid state and then heated in kettles for a liquid application. In some cases, the hot asphalt is applied over a reinforcing mesh. On the plus side, this approach provides a monolithic waterproofing system with no seams that resists punctures. Pipe penetrations and complex roof configurations are relatively easy to flash using this liquid installation. On the negative side, however, field installation offers many opportunities for future problems. Skilled installers are essential, but even then uneven thickness in application and variable temperatures while heating the asphalt may compromise its integrity. Any high spots, pebbles, or projections will not receive an equally thick coating. This system's ability to bridge cracks is limited to little more than 1/8th of an inch. In addition, vertical installation requires the use of neoprene flashing, an uncured rubber that may crack or become brittle over time. For these reasons, use of this system is not encouraged. ■

Flood testing is recommended after installation of the new waterproofing membrane.

Recommended Schedule for Plaza Maintenance

	daily	weekly	monthly	quarterly annually	semi annually	annually	other
AESTHETIC							
1. Cleaning							
• Localized sweeping	✗						
• Full sweeping		✗					
• Clean expansion joints		✗					
• Empty trash cans	✗						
• Wash down plaza				✗ *			
2. Landscaping							
• Remove trash	✗						
• Mow, trim, and weed		✗					
• Remove and replace dead plants			✗				
• Inspect sprinkler system					✗		
FUNCTIONAL							
1. Plumbing/Drainage System							
• Check for proper operation:							
Irrigation		✗					
Plaza drains		✗					
Sump pump		✗					
• Drain water systems for winter (where appropriate)							
• Check for icy spots	✗						
• Remove snow and ice	✗						
2. Roofing and Waterproofing							
• Check and repair leaks, wear, and deterioration in:							
Roofing/waterproofing							✗**
Joint sealant			✗				
Expansion joints			✗				
Mortar joints			✗				
SAFETY							
1. Safety Checks							
• Handrails and guardrails		✗					
• Walkway and stair lights		✗					
• Emergency lights		✗					
• Tripping hazards	✗						
STRUCTURAL							
1. Structural System						***	
• Check roof deck for:							
Deterioration				✗			
Water leakage				✗			
Cracking of concrete				✗			
Rusting of steel				✗			
2. Painting							
• Check and repair rust spots on:							
Handrails and guardrails				✗			
Conduits				✗			
Other metal				✗			

Notes: * Plaza washdowns should be done at least twice a year, although quarterly cleaning is recommended.
** Inspect and repair as soon as possible after leaks are reported.
*** Structural inspections should be performed each spring to allow any needed repairs and maintenance to be completed during the summer.

REPRESENTATIVE PROJECTS

Plaza and Terrace Rehabilitation

As specialists in the rehabilitation of the exteriors of existing facilities, Hoffmann Architects is often called on to resolve deterioration problems in plazas and terraces. The firm investigates existing conditions, prepares construction documents to guide the work, and administers the construction contracts for all renovation and restoration services.

The firm's architects and engineers take a three-step approach to help clients solve plaza problems, which can range from minor leaks to full removal and replacement of the waterproofing system. These steps are: 1) investigation and analysis of the causes of deterioration, 2) development of a concise program of repair, and 3) expert guidance and recommendations for long-term maintenance of the rehabilitated plaza or terrace. Each project is approached with an eye on building life cycle costs and other budget issues, as well as addressing the unique characteristics of the plaza or terrace.

Among the firm's plaza and terrace rehabilitation projects are:

One Beacon Street
Boston, Massachusetts
(Prudential Insurance Company of America)

Northeast Bronx Educational Park
Bronx, New York
(Brennan Beer Gorman Architects/New York City School Construction Authority)

Greenwich Plaza
Greenwich, Connecticut
(Albert B. Ashforth, Inc.)

Academic Center Plaza
Washington, District of Columbia
(The George Washington University)

Becton Dickinson
Corporate Headquarters
Franklin Lakes, New Jersey
(Becton Dickinson and Company)

1251 Avenue of the Americas
New York, New York
(Rockefeller Center Management Corporation)

Champion International Headquarters
Stamford, Connecticut
(Jones Lang Wootton)

Atria Complex Plaza
Garden City, New York
(The Chase Manhattan Bank, N.A.)

Rockefeller Center
Channel Gardens and Lower Plaza
New York, New York
(Rockefeller Center Management Corporation)

Yale New Haven Hospital Terrace
New Haven, Connecticut
(Yale New Haven Hospital)

Williams Centre
Tucson, Arizona
(KOLL)

Plaza Building Plaza
Hartford, Connecticut
(Trammell Crow Corporate Services)

GTE World Headquarters
Stamford, Connecticut
(GTE Service Corporation)
■

United States Capitol Terrace in Washington, District of Columbia

1166 Avenue of the Americas in New York, New York

Hoffmann Architects
432 Washington Avenue
North Haven, Connecticut 06473
(203) 239-6660

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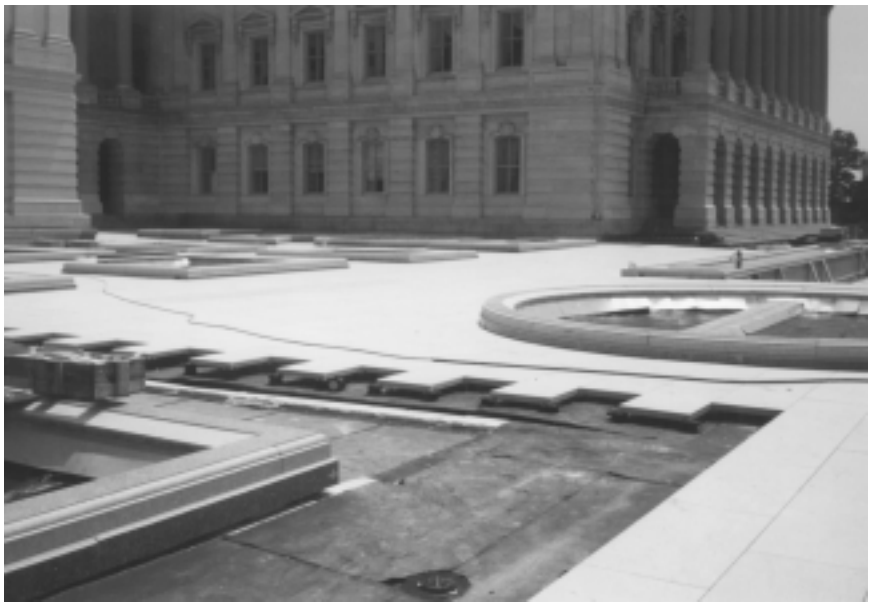

An example of the paver-on-pedestal system.

structural concrete stairs with stone or precast concrete treads set in mortar on top of the waterproofing. ■

Washington, D.C. Office Opens

Hoffmann Architects has opened a Washington, D.C. office in response to a growing number of roofing, facade, plaza/terrace, and parking garage rehabilitation projects in the area. Richard P. Kadlubowski, AIA, is heading up the office, which is located at 601 Pennsylvania Avenue, NW, Suite 900, South Building, Washington, D.C. (202) 434-8168, fax (202) 393-7945. ■

JOURNAL is a publication of Hoffmann Architects, specialists in investigative and rehabilitative architecture/engineering, including the analysis and solution of problems within roofs, exterior walls, glazing, and structural systems of existing buildings, plazas, and parking garages.

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Editor: Emily D. Dowden
Graphic Services: Bligh Graphics
Editorial Services: Jonelle Lawhorn Hobbs Communications