



Journal of architectural technology published by Hoffmann Architects, Inc., specialists in the rehabilitation of building exteriors.

Journal

Fundamentals of Plaza Design

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A plaza can be an attractive amenity, especially in an urban area where open space is at a premium. But when age, deferred maintenance, design defects, or faulty construction lead to unsightly weed growth and pooling water; dangerous tripping hazards and ice buildup, or costly maintenance demands, it might be prudent to protect that amenity by rehabilitating it.

The question is, "how?" (And, reasonably, "how much?") The answer depends on the type of system that's in place, the type you opt to install, the use of the plaza space, and the complexity and requirements of planters, stairs, fountains, seating, and other features. To begin, a team of architects and/or engineers should evaluate the existing plaza or terrace and help establish a realistic rehabilitation budget. Then, the design team should guide you in balancing project variables to achieve the desired look while meeting cost objectives.

A well-designed plaza or terrace not only reduces upkeep costs, it also attracts tenants, increases property value, and enhances outdoor space. With reductions in energy and maintenance expenses afforded by "green" design principles and sophisticated water movement strategies, plaza

or terrace rehabilitation can provide excellent return on investment.

Plaza Use and Configuration

When considering options for plaza or terrace design, an architect or engineer will first assess the function and composition of the space. A plaza over which vehicles routinely drive demands a different type of assembly than does a roof terrace that sees only maintenance foot traffic.

Similarly, a private terrace for the exclusive use of building tenants has different design considerations than does a plaza classified as "privately owned public space" or one in a busy campus setting. Access, circulation, furniture, decorative elements, and plantings must be coordinated to facilitate intended usage. Paving assemblies and materials, as well as any waterproofing systems, are thus dictated not only by the form of the plaza or terrace space, but also by its function. Historic planning regulations may place further restrictions on surfacing options.

Types of Paving Assemblies

The surfacing system needs to accommodate the volume and type of anticipated traffic, while meeting



▲ **Plaza investigation** by an experienced architect or engineer uncovers the causes of water damage or deterioration.

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Plazas Over Occupied Space

Waterproofing is the central concern for a terrace or plaza that is also a roof.

The membrane. Once the waterproofing has been installed on a plaza or terrace, it is buried beneath tons of overburden, making it virtually impossible to access should problems arise. In all horizontal waterproofing applications, choosing and correctly applying the membrane is critical, but plazas and terraces demand a more conservative approach than do roofs or parking structures. Generally speaking, the options are:

Comparison of Waterproofing Systems for Plazas and Terraces					
Membrane system	Installation	Puncture resistance	Crack bridging	Strong suit	Weak spot
Single-ply	Sheets adhered to deck, with glued, taped, or welded seams.	Poor	Fair	Cold, low-odor application.	Seam quality depends on skilled installation. No redundancy.
Multi-layer and combination	Multiple sheets bonded in layers by flame or by cold adhesive.	Excellent	Moderate	Redundancy, via layered materials.	Height restrictions may preclude use in some retrofit applications.
Fluid-applied	Liquid binder applied to deck, with embedded reinforcing.	Good	Poor	Seamless, with smooth transition from horizontal to vertical.	Poor adhesion or uneven coverage if prepared or applied incorrectly.

Choice of membrane is situation-specific, and demands holistic consideration of the entire plaza. Only by analyzing all variables, from weather to traffic to load limits to space constraints, can a design professional determine the appropriate assembly.

The substrate. The deck should be cleaned of debris and properly prepared to facilitate adhesion. A fully adhered system prevents moisture that does penetrate the membrane from travelling underneath it. Spot repairs can then be completed without tearing up the entire plaza in search of the water entry point.

The protection. Drainage mats atop the membrane system direct water to drains, and protection boards can provide additional coverage in high-wear areas. Insulation helps control energy costs.

The paving. Structural analysis must confirm that the building can accommodate the chosen paving system, as well as additional loading from snow, ice, wind, pedestrians, and plantings.

The result. Waterproofing concerns shouldn't undermine a plaza's allure. A well-designed, properly installed plaza or terrace creates usable outdoor space above a built structure, a valuable asset in a dense urban setting. ■



▲ Installation of a paver-on-pedestal system. Pavers are supported only at corners, with fully open joints.

design goals for drainage, loading, siting, and usage. What are the benefits, drawbacks, and appropriate applications for each type of system? Here are the basics:

Light Duty

If the plaza or terrace is designed to function as an extension of the building interior, with space for dining, seating, or entertaining, then the finish surface will need to be nearly level, while still allowing for the effective removal of water. For light pedestrian traffic, there are two basic options: a **paver-on-pedestal** or **sand-set** system.

Features. *Paver-on-pedestal:* Waterproofing membrane adheres to substrate, which slopes to drains. Columnar pedestals are individually set, at graduated heights, atop the insulation or a protection board, to create a level support. Pavers are then supported by a pedestal at each corner. Open joints allow water to flow directly down to the sloped surface below and on to drains. *Sand-set:* Pavers are set atop compacted sand, with small butt joints (approx. 1/16 of an inch), into which additional sand is swept. Walking surface is pitched to bi-level drains.

Benefits. Quick and easy to install. Depending on material selection, light-weight systems can also be the

least expensive. Should any problems develop, the loose-laid pavers can be readily removed for maintenance, investigation, and repair.

Drawbacks. Open joints are notoriously problematic for high-heeled shoes, and they can create tripping hazards should pavers become displaced. Snow removal must be done with a blower or shovel, as plows can dislodge pavers. Weight limitations may preclude not only snowplows but also, in the case of a plaza at the front entrance to a building, emergency vehicles. It is possible to accommodate occasional vehicular access with an open-joint system, but at a significantly greater construction cost.

Medium Duty

Frequent and heavy foot traffic, such as on a college campus or in a shopping mall, demands a more resilient system. An **asphalt-set system** with sand-swept joints can provide a landscaped pedestrian setting while holding up to the abuses of shoes and occasional light vehicles, like golf carts.

Features. Modular brick, stone, or concrete pavers are set on an asphalt/

sand composite bed, atop asphalt or cast-in-place concrete slabs separated by expansion joints. Drainage takes place predominantly at the surface level, although bi-level drains should be used to remove any water that does penetrate below the pavers.

Benefits. The asphalt-set paver system can accommodate much greater loads without cracking or displacement than can a paver-on-pedestal system, because the load is supported across the entirety of each paver, rather than only at corners. Although the setting bed is still 90% sand, the addition of asphalt creates a more durable paving assembly than the simple sand-set system. Application of a neoprene tack coat adds further resilience.

Drawbacks. As the frequency and weight of traffic increases, so do costs. Medium duty plazas are more expensive to install than are light duty plazas, and the level of traffic demands more vigilant maintenance. Because asphalt-set pavers are more secure than are their light-duty counterparts, removal and replacement present challenges, as does accessing underlying waterproofing membranes.

Heavy Duty

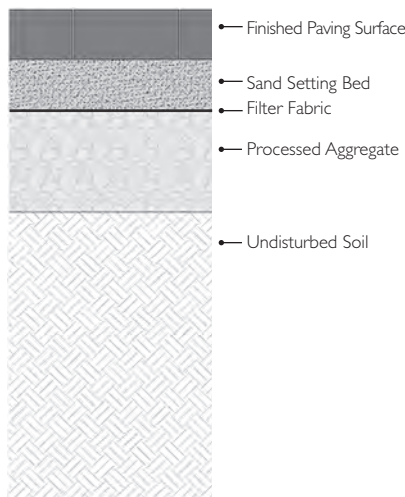
Plazas can also be designed to withstand heavier vehicle traffic. The two options for durable support of cars and trucks are **cast-in-place concrete** or **closed-joint paving systems**.

Features. Where the plaza is set on grade, the subgrade must be well compacted. Insufficient compaction can result in cracking, heaving, and premature deterioration of the paving assembly. To withstand the rigors of vehicle traffic, hard joints, with mortar or sealant, are preferred. A cementitious setting bed adds durability.

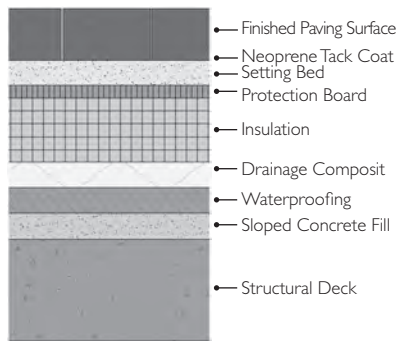
Benefits. Aggressive resistance to traffic. Closed-joint systems can be designed to support 40 tons or more without damage.

Drawbacks. Material costs for high-traffic plazas are greater than for other plaza types. Maintenance, particularly of joints, can be demanding, and replacement of pavers is difficult. Overly aggressive cleaning can blow out joints. Mortar or sealant lifespan should be considered as part of the cost equation, as joint material may need replacement every 7-10 years.

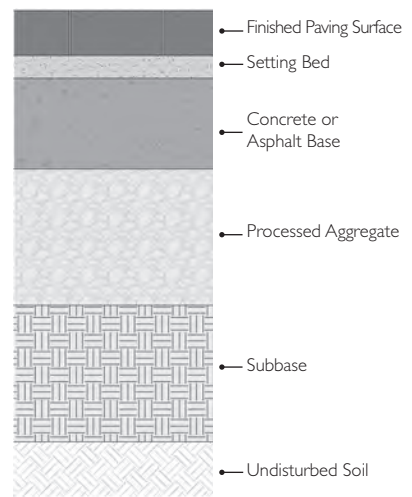
Representative Illustrations of Paving Assemblies



Light-Duty on grade



Medium-Duty over suspended slab



Heavy-Duty on grade

Drawings not to scale. Components can vary.

THE REHABILITATION PROCESS Columbia University, College Walk



A The existing plaza.



A Construction of concrete retaining walls.



A Installation of granite curbs.



A Asphalt setting bed, ready to receive hexagonal asphalt pavers.



A The reconstructed pedestrian street. The redesigned paving system can withstand frequent, heavy pedestrian traffic, as well as vehicle use, while preserving the aesthetic character of the original plaza.

Code Compliance

When a plaza retrofit project is already underway is not the time to discover that building codes have changed, and that the seating for 20 must now be increased to 200, or that the plan needed to incorporate wheelchair access ramps. Local regulations stipulate when a plaza rehabilitation is significant enough to demand updated code compliance. Plazas classified as “privately held public spaces” are generally subject to fairly rigid parameters governing occupancy, circulation, and hours of use, all of which will necessarily impact design.

Federal, state, and municipal regulations incorporate evolving “green” building codes, including provisions for plaza and terrace lighting, energy conservation, and water use. Security measures may also be dictated by local law. The design team can coordinate lighting, signage, access pathways, and landscape elements to maximize safety while meeting ecological building standards.

Weight Limits

A plaza or terrace must support the weight of pavers, landscaping elements, seating, fountains, pedestrians, and, in some cases, vehicles. Grade-level terraces may also need to bear fire equipment, in an emergency. Retrofitting an existing plaza or terrace requires consideration of structural load-bearing capacity, especially when a new type of system is being installed that carries significant load beyond that of the existing assembly.

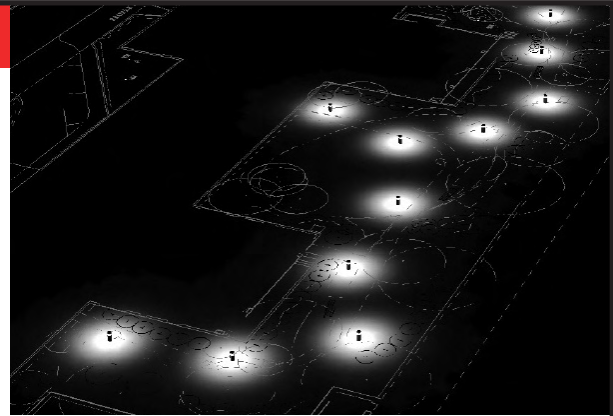
To avoid serious structural failure, the project architect or engineer should assess load-bearing capacity before plaza rehabilitation is undertaken.

Fields of Green

As green building initiatives are prompting federal, state, and local mandates on efficiency and sustainability, building codes and regulations change to reflect evolving ecological guidelines. Relevant requirements for efficient water use, storm water runoff management, light pollution reduction, and energy conservation should be researched as part of the plaza or terrace design process. Some green ideas:

- **Reuse pavers**, where possible, after replacing a waterproofing membrane, both to reduce waste and save on material expenses.
- **Use “dark sky” technology**, which employs strategically positioned, low-radiance lighting, low-angle spotlights, and low-reflectance surfaces to cut down on light pollution. See sample plaza lighting diagram, above.
- **Choose materials that reduce the “heat island effect.”** Heat-trapping materials like asphalt, tar, and non-pigmented concrete raise air temperatures in cities. Besides plantings, which dissipate heat through evapotranspiration, certain building materials, like light-colored pavers, can help moderate temperature differences.
- **Select native or adaptive plantings** to conserve water and provide a habitat for bird and insect populations. Limit sod and turf grasses, which demand copious irrigation, mowing, and pest/weed control.
- **Use efficient drip systems** or subsurface sprinklers, in conjunction with reclaimed water, wherever irrigation is needed.
- **Install “smart” controllers** that vary light and water use by season, time of day, and weather.
- **Employ mulching, alternate mowing, and composting**, low-tech solutions that protect the environment and cut upkeep costs.

Above all, correct design and installation is the best way to build an environmentally sound plaza. When poor construction shortens a plaza’s lifespan, resources are wasted on rebuilding. The most ecological plaza is the one built to last. ■



Courtesy ERCO Lighting, Inc.

The Final Design

Drainage

Once owner’s expectations, usage, weight limitations, applicable building codes, and traffic exposure have been considered and a plaza system selected, it’s time to prepare the deck slope. Some original concrete decks were constructed dead level, leading to standing water and leaks. To correct the problem, slope fill may need to be added, which can create waterproofing challenges during construction, as well as raise load-bearing concerns. For areas that will contain tables and chairs, a 1/4 inch per foot slope is generally sufficient and maintains a suitable walking surface. However, a 1/4 to 1/2 inch per foot slope or more provides better drainage.

Drains should allow for water removal not only at the surface, but at the membrane or deck level, as well. Bi-level drains prevent trapped water from pooling atop the membrane, leading to premature deterioration. A combination of *trench drains*, which collect water from a larger area but are not designed for subsurface drainage, and *area drains*, which are smaller but both efficient and bilevel, is often the best strategy for optimal drainage.

Appearance

Materials. Plaza design must integrate the aesthetics of the outdoor space with those of the structure and surrounding area. Pavers of natural stone, brick, or concrete are the most common options, and care must be taken to balance appearance of these

materials with their durability.

To avoid slippery surfaces, the coefficient of friction of various finishes must be considered, as well. Ice and snow removal approaches will also need to vary depending on the material selected, as some pavers respond better than others to deicing chemicals and snowplows.

Landscaping. Caretaking demands for landscaping can vary widely. Some plantings will demand daily mowing, weekly pruning, or monthly replacement, as well as costly irrigation systems, while many native or adaptive plants can get by with only natural rainfall and minimal attention. Ecologically conscious landscaping design therefore saves not only on natural resources, but on costs.

Additionally, planters require special waterproofing considerations, including root barriers and other extra protection over the membrane to avoid puncture. Structural load capacity may also be an issue when selecting plantings; beyond the weight of the plants themselves, growing media ranges in density and can add significant load.

Water features. Fountains and pools demand extra attention to waterproofing, especially over occupied space. Generally, a continuous waterproofing system is preferred, which can smoothly accommodate transitions from horizontal to vertical surfaces. Size and position of water features may also be dictated by traffic patterns, drainage sloping, and structural capacity, as well as aesthetics.

Furniture. Seating can rest atop pavers, as with dining chairs and other temporary furniture, or it can be anchored to the plaza. Waterproofing and paving system options therefore may be dependent on the quantity and design of any furniture or ornamental elements.

Lighting. Safety and appearance of a plaza or terrace at night depend on the quality and positioning of illumination. A plaza which sees significant nighttime traffic will need thoughtfully designed lighting, including within fountains and around planters, to preserve the ambiance and protect pedestrians. More is not necessarily better: indiscriminate use of bright lights casts stark shadows and can actually diminish visibility, and it also contributes to light pollution.

Budget

Initial installation and materials costs play a role in plaza design, but so do maintenance expenses. Be sure to understand up front what upkeep will be required for any systems under consideration. Some paving assem-

Maintaining Your Investment

You've invested in rehabilitating your plaza or terrace, and it looks great. How do you keep it up?



A little prevention goes a long way. By catching small problems before they become big ones, you can extend the lifespan of your plaza and avoid the undue expense of major repairs.

Daily. Sweep and remove trash and debris. Check for and treat ice and snow accumulation and clear tripping hazards.

Weekly. Wash down plaza. Clean joints and check drains and sump pumps. Trim and weed plantings and check for proper operation of irrigation systems. Do a safety check of railings, stairs, and lights.

Monthly. Replace dead plantings. Repair deteriorated mortar or sealant in joints.

Seasonally. Inspect sprinkler systems. Perform checks of the deck for deterioration, leaks, cracks, or rust. Repair rust spots on railings, conduits, and other metal.

Annually. *Fall:* Drain irrigation and sprinkler systems for winter. *Spring:* Conduct a structural inspection to plan for summer repairs.

Every 3-5 years. Replace sand in sand-swept butt joints.

If any leaks are reported, inspect and repair the waterproofing system as soon as possible to avoid further damage. Know your rights within the waterproofing warranty. If the problem persists, a design professional experienced in plaza remediation may need to conduct a more thorough investigation. ■

blies, such as sand-set systems, can be significantly cheaper to install, but demand vigilant maintenance to keep overgrown weeds from making the plaza look ragged and unkempt.

For elevated plazas or terraces over occupied spaces, it can be tempting to cut costs by going with a less pricey waterproofing option, as the membrane lies below the surface, out of view. However, scrimping on waterproofing can cost more than it saves if the membrane fails prematurely, and the entire paving overburden must be ripped up to replace it.

Accessibility

Local building codes, as well as the Americans with Disabilities Act (ADA), dictate the incorporation of ramps, elevators, railings, and other accessibility provisions. Substantial rehabilitation

of a plaza provides an opportunity to upgrade entrance and egress pathways to admit wheelchairs, strollers, or walkers, without compromising on aesthetics.

Schedule

All rehabilitation projects for plazas over occupied space are, by necessity, on a tight schedule, as removal of the waterproofing system for any period of time opens the building up to water entry. Even plazas on grade may need to remain operational during construction, because of local government requirements, building access issues, or both. Organizing a plaza or terrace project into well-orchestrated phases can permit continuous usage while accomplishing rehabilitation objectives.

The time of year at which a given waterproofing assembly can be

(continued on page 8)

representative projects



Plaza and Terrace Rehabilitation

Hoffmann Architects focuses exclusively on the outsides of existing buildings. A substantial portion of our practice involves diagnosing and correcting problems within plazas, terraces, roof setbacks, and courtyards.

For plazas and terraces over occupied space, Hoffmann Architects solves recurrent water infiltration by treating these areas as roofs that need extra protection, rather than as platforms for traffic on which waterproofing is merely an afterthought.

We create aesthetically appealing, technically appropriate plaza and terrace solutions by locating the sources of deterioration and developing targeted programs of replacement or repair. Project oversight and guidance for ongoing maintenance see the rehabilitation through to a successful outcome, now and in the long term.

Among Hoffmann Architects' plaza and terrace projects are:

College Walk
Columbia University
 New York, New York
Plaza Reconstruction

Phoenix Life Insurance Company
One American Row
 Hartford, Connecticut
Plaza Investigation

The World Bank
 Washington, District of Columbia
Terrace Waterproofing System Design



The George Washington University's Eye Street Pedestrian Mall in Washington, DC.
Plaza Design and Rehabilitation

Royal Bank of Scotland
Greenwich Capital Building
 Greenwich, Connecticut
Plaza Rehabilitation

Purchase Campus Center
State University of New York (SUNY)
 Purchase, New York
Plaza Reconstruction

Franklin & Marshall College
Keiper Hall/Green Room Theatre
 Lancaster, Pennsylvania
Plaza and Stair Rehabilitation

The Ford Foundation
 New York, New York
Plaza Rehabilitation

The Schering-Plough Corporation
 Kenilworth, New Jersey
Plaza Investigation and Design

Paul Rudolph Hall
Yale University
 New Haven, Connecticut
Terrace, Exterior Stair, Roof, and Skylight Rehabilitation and Reconstruction

Babbidge Library, White Building, and Bousfield Hall
University of Connecticut
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Investigation and Rehabilitation of Plazas and Exterior Stairs

Manhattan House
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(continued from page 6)



▲ This multi-level plaza over occupied space coordinates temporary and fixed furniture and planters with high- and low-traffic areas to achieve a practical, aesthetically appealing outdoor space.

installed may also affect a rehabilitation project's scheduling. For example, adhesives and fluid-applied membranes must generally be applied when air temperatures are above approximately 40°F and below 80°F, which may mean scheduling installation for late spring or early fall. Coordinating seasonal restrictions with building usage demands and weather events can pose significant logistical challenges.

When to Rehabilitate: Cost-Benefit Analysis

Plazas and terraces are appealing features that attract tenants, raise property values, and provide aesthetically pleasing outdoor public spaces.

Unfortunately, many suffer from poor design, inappropriate materials selection, faulty installation, or simply the effects of time and the elements. If your plaza or terrace evidences the following or other burdensome conditions, rehabilitation might prove cost-effective:

- Deterioration
- Decreased usage
- Rising maintenance expenses
- Increased liability

Facing an ailing plaza can be daunting. But those who brave a plaza overhaul with forethought and care are rewarded with a functional, pleasant open space that demands little attention or resources once it's in place. ■

JOURNAL is a publication of Hoffmann Architects, Inc., specialists in the rehabilitation of building exteriors. The firm's work includes investigative and rehabilitative architecture and engineering services for the analysis and resolution of problems within roofs, facades, glazing, and structural systems of existing buildings, plazas, terraces and parking garages.

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Editor: Alison Hoffmann
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Printed on 50% recycled paper.