Recent Developments in Below-Grade and Plaza Waterproofing Systems

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Abstract

Waterproofing manufacturers, like roofing manufacturers, routinely introduce new materials and systems that present additional challenges to the designer. They may not have been subjected to the tests necessary to establish them as viable systems, nor have they accumulated a cadre of experienced applicators.

Designers are confronted with a confusing assortment of choices. Due to the extraordinary cost involved in a waterproofing failure, cost-cutting measures should never be considered, and this should be discussed from the beginning with the owner. This paper will discuss the latest developments in below-grade and plaza waterproofing and the roles that the designer, manufacturer(s), and contractor play in the selection and installation of waterproofing systems.

Speaker

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INTRODUCTION

There is a belief in our industry that roofing and waterproofing are interchangeable. Some people, in fact, believe that they are mirror images, where the principles of roofing can be translated to waterproofing. Designers who specialize in both roofing and waterproofing, and in particular below-grade waterproofing, know that this is a fallacy. Prevention of water intrusion may be the primary purpose of both systems, but that is where the relationship ends.

Waterproofing manufacturers, like roofing manufacturers, routinely introduce new materials and systems that present additional challenges to the designer. They may not have been subjected to the tests necessary to establish them as viable systems, nor have they accumulated a cadre of experienced applicators.

When a new roofing system fails, it is readily repaired or replaced. This is not the case with basement waterproofing, which may be buried under several feet of concrete. Although some plaza waterproofing systems do not share the replacement problem of below-grade systems, accessing and removing failed membranes can be very costly.

Producers of plaza waterproofing systems misguided attempt to recommend them for below-grade installations. Nowhere is this more prevalent than membranes recommended for blindside applications. Failure of blindside waterproofing systems is even more catastrophic because of their inaccessible.

Roofing failures have taught the industry valuable lessons over the years. Roofing membrane manufacturers have made it a priority to educate designers on material limitations and provide reference details. Although waterproofing membrane manufacturers have been reaching out to architects, consultants, and contractors regarding their systems and applications, they still lag behind in educating the designers and contractors.

Additionally, a host of waterproofing materials have come on the market in past years, most by reputable waterproofing manufacturers. This paper will not discuss the specific manufacturers of those materials. However, waterproofing designers should be aware of some interesting facts. Very few manufacturers list water absorption, as well as resistance to hydrostatic pressure, in their table of physical properties.

Those of you who are accustomed to writing warranty requirements in specifications will find that no manufacturer provides for workmanship of the membrane in the warranty. Nearly all waterproofing warranties are limited to replacement of materials or are warranted to be free of defects in manufacturing only at the time of shipment from their factory. Werner Gumpertz, PE, of Simpson, Gumpertz & Heger, Inc. once classified these types of guarantees as “parachute warranties.” If you personally return your failed parachute to the manufacturer, they will replace it “free of charge.”

This paper will discuss the latest developments in below-grade and plaza waterproofing. The paper will provide attendees with the following learning objectives:

1. Difference between plaza and below-grade waterproofing
2. Industry standards on waterproofing performance
3. Waterproofing materials
4. Electronic field vector mapping

BACKGROUND

To start, it is necessary to clarify the definition of what waterproofing is and its meaning. Waterproofing is not:

- A coating applied to above-grade masonry or concrete walls
- A membrane that covers a spandrel beam
- A membrane in split-slab construction under a mechanical or shower room
- A coating application on a parking garage deck or a water containment structure

Moreover, waterproofing should not be confused with dampproofing. ASTM International Committee D08 on Roofing and Waterproofing defines waterproofing as the “treatment of a surface or structure to prevent the passage of water under hydrostatic pressure.”

This same ASTM Committee defines dampproofing as the “treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure.”

Waterproofing differs from roofing in that waterproofing is formulated and manufactured to perform in the presence of continuous moisture and to prevent the passage of water under hydrostatic pressure, either continuously or intermittently. Waterproofing does not fare well against ultraviolet (UV) exposure. Roofing, on the other hand, is manufactured to withstand UV degradation, but does not perform well in ponding conditions.

The prototypical and historical waterproofing project (which, according to some, may not have existed), was the Hanging Gardens of Babylon. The project consisted of vaulted terraces raised one above another and resting upon pillars. The Gardens were waterproofed with bitumen, baked brick, and lead to keep the under vaults dry. The terraced structure was covered with growing media deep enough to support large trees and irrigation machines to keep them watered.

At the beginning of the twentieth century, which is where we will begin, waterproofing projects involved mostly utilitarian structures, including cellars that contained boilers, coal storage, oil tanks and electrical rooms, tunnels, dams, pools, and other water-containment structures. Cellar vaults that extended under sidewalks in urban locations were also protected, normally with built-up coal-tar pitch membranes. These built-up bituminous waterproofing membranes were comprised of alternate layers of cotton or burlap organic felts and coal tar pitch. Prior to World War I, built-up waterproofing was applied to building foundations, vertically to brick and tile walls, and horizontally to mud slabs in hot coal-tar pitch or asphalt. Standard assemblies for these early waterproofing membranes were comprised of four to six plies; and for dampproofing, a bituminous coating or a bituminous coating with reinforcing.
BELOW-GRADE WATERPROOFING VS. PLAZA WATERPROOFING

Below-grade/plaza waterproofing systems differ from protected membrane roof (PMR) assemblies. In a PMR assembly, the membrane is placed directly on the deck under the insulation, instead of in its conventional, weather-exposed location atop the insulation.

The unique feature that separates a PMR from a waterproofed plaza system is the accessibility to the membrane in the event of failure. For this reason (accessibility), manufacturers are willing to issue long-term or performance system guarantees.

When pavers are installed on pedestals or directly over insulation, manufacturers will generally issue a guarantee because the membrane is easily accessible. A PMR system is not considered to be plaza waterproofing in either the roofing or the waterproofing industry.

When the membrane is rendered inaccessible by covering it with brick, tile, or stone, in a mortar setting bed, the system is classified as waterproofing, and manufacturers will not guarantee the performance of the system.

The major distinction between below-grade waterproofing and a plaza waterproofing system is that few plaza waterproofing systems are designed to resist significant hydrostatic pressure. In fact, only a few manufacturers list resistance to hydrostatic pressure as a property, and some manufacturers limit the use of their products to below-grade use.

INDUSTRY STANDARDS ON WATERPROOFING PERFORMANCE

Although waterproofing has been in use at least from the time of the Hanging Gardens of Babylon, it is ironic that standards on waterproofing, both for below-grade and plazas, did not achieve significance until the 1970s.

The standard waterproofing assembly consisted of a four- or five-ply coal tar pitch membrane mopped to a concrete slab and covered with a concrete wearing surface. There was no thought of installing insulation, since coal and oil were inexpensive. The heat loss from the uninsulated assembly kept the coal tar pitch fluid and self-healing.

Coal tar pitch was replaced by asphalt because it was less expensive and less irritating. Many designers and contractors thought they were interchangeable because both were black, heated, and applied in a similar fashion. When coal tar pitch was deemed to be a carcinogen, its replacement by asphalt was accelerated. However, asphalt membranes did not have the self-healing capability of coal tar pitch, and many failed.

It wasn’t until the 1970s that plaza waterproofing design took a gigantic step forward when Charles J. Parise, FAIA, published an article on plaza waterproofing in the ASTM Journal entitled “Architectural Considerations in Plaza Membrane Waterproofing Systems, BRI Fall Program 1971.” This article introduced a slope-to-drain and a water-pervious drainage course.

Parise’s article lead to the development of several ASTM International standards on plaza waterproofing design. The first standard was approved in 1976, followed by another in 1978. At the time, these standards were under the jurisdiction of ASTM Committee C24 on Building Seals and Sealants and included C836, Standard Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course, (1976); and C898, Standard Guide for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course (1978). Both of these standards apply to waterproofing membranes subject to minimal hydrostatic pressure.

In the early 1990s, ASTM D08 on Roofing and Waterproofing established Subcommittee D08.22-Waterproofing and Dampproofing. The scope of this subcommittee as defined included, but was not limited to, the preparation of standards for:

1. Waterproofing systems incorporating reinforcing materials such as organic and glass felts, glass fabric, and polyester sheets
2. Other systems used, such as for dampproofing, which may or may not contain reinforcing materials
3. Specialty applications such as cavity wall waterproofing and dampproofing
4. Drainage composite materials
5. Surface preparation prior to application of membrane system
6. Testing for membrane integrity

The standards that were originally under the jurisdiction of ASTM International Committee C24 – Building Seals and Sealants, Subcommittee C24.80 on Building Deck Waterproofing (i.e., C836, C998, C957, etc.) were transferred to D08.22 when C24.80 was disbanded in 2006.

However helpful the standards produced by Subcommittee D08.22 were, none was more recently beneficial to the industry than D7832, Standard Guide for Performance Attributes of Waterproofing Membranes Applied to Below-Grade Walls/Vertical Surfaces (Enclosing Interior Spaces). The standard states that:

A waterproofing membrane should maintain its watertight integrity for the life of the building in a continuously or intermittently moist environment and may be subject to continuous or intermittent hydrostatic pressure. It should resist chemicals that can harm the membrane and root growth. This guide lists minimum performance attributes required of waterproofing membranes applied to below-grade walls. Products not previously used as waterproofing membrane materials require additional tests beyond the scope of this guide. This guide is not intended for use on in-service waterproofing materials. Waterproofing membranes and other components should conform to ASTM product standards, if available.

Since new waterproofing membranes have and will continue to be introduced to the market for below-grade applications, it became clear that a standard needed to be developed to establish a guide for minimum levels of performance. Using ASTM D6630 as a baseline, D7832 was developed for positive-side waterproofing membrane applications of nonbentonite-based systems applied to below-grade grade basement walls. Dorothy Lawrence once stated of waterproofing materials, “The key to proper material development is that the developer must know what the materials do.” The biggest concern she notes regarding the material development industry at this time is that “products are sales-driven and designed to solve one problem. The technical people rarely go into the field to see how the materials perform in actual conditions.”

The test methods listed in D7832 (Table 1) are intended to establish a minimum level of acceptable performance attributes.
Design of Waterproofing Assembly

**Waterproofing Membrane**—The waterproofing membrane may be single ply or multi-ply or a reinforced film of one or more component liquid-applied materials, depending on the materials involved. Where applicable, the properties of the waterproofing membrane shall meet or exceed the minimum values shown in Tables 1-3.

### Table 1 - Waterproofing Material Physical Properties for Types I and II

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Resistance to Hydrostatic Pressure</td>
<td>Test Method D6385</td>
<td>No leaks at 103 kPa (15 psig) (34.65 ft head) or at the maximum hydrostatic pressure determined by the subsurface soil investigation per IBC para. 1002.2.3</td>
</tr>
<tr>
<td>B. Resistance to Deterioration from Organisms and Substances in Contacting Soil</td>
<td>Test Method D7281</td>
<td>Pass</td>
</tr>
<tr>
<td>C. Adhesion to Substrate (Except for Grade 1, Class 2)</td>
<td>Specification E1745</td>
<td>Section 7 (using a 3 in. thick precast concrete paver in lieu of cast-in-place concrete).</td>
</tr>
</tbody>
</table>

### Table 2 - Waterproofing Material Physical Properties for Type I

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Low Temperature Unrolling Type 1A</td>
<td>Test Method D5636</td>
<td>No Cracking at 0°C [32°F]</td>
</tr>
<tr>
<td>B. Crack Bridging</td>
<td>Test Method D6849</td>
<td>Test Condition 1, Test Condition 2, or Test Condition 5 for 500 cycles select appropriate temperature for the weather conditions for which the membrane is applied.</td>
</tr>
<tr>
<td>C. Flexibility</td>
<td>Test Method D5683</td>
<td>No Cracking</td>
</tr>
<tr>
<td>D. Water Absorption</td>
<td>Test Method D903</td>
<td>Procedure BW, &lt;2 % by weight. Run 45 cycles of immersion in water at 23°C and 50°C [73°F and 122°F] for 24 h for start of test and after 45 circulating cycle.</td>
</tr>
</tbody>
</table>

### Table 3 - Waterproofing Material Physical Properties for Type II

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Water Absorption</td>
<td>Test Method D570</td>
<td>&lt;3 % by weight when tested per Section 7A</td>
</tr>
<tr>
<td></td>
<td>Test Method D471</td>
<td>&lt;3 % by weight when tested per Section 12 at 23°C [73°F] for 2989 h</td>
</tr>
<tr>
<td>B. Linear Dimension Change (PVC only)</td>
<td>Specification D4551</td>
<td>&lt;5 % at 70°C [158°F] 1 h per Test Method D1204</td>
</tr>
<tr>
<td>C. Extensibility After Heat Aging</td>
<td>Test Method C1522</td>
<td>6.4 mm [1/4 in.]</td>
</tr>
<tr>
<td>D. Crack Bridging Ability</td>
<td>Test Method C1305</td>
<td>No Cracking</td>
</tr>
<tr>
<td>E. Low Temperature Flexibility and Crack Bridging for Liquid-Applied Membranes</td>
<td>Test Method C1305</td>
<td>Pass</td>
</tr>
<tr>
<td>F. Resistance of Plastics to Bacteria</td>
<td>Specification D4551</td>
<td>No effect of 12 samples pass</td>
</tr>
<tr>
<td>G. Resistance to Chemical Reagents</td>
<td>Practice D886</td>
<td>No delamination, blistering, emulsification, or (undiluted deterioration 15 N/gP/SPotash)</td>
</tr>
<tr>
<td>H. Resistance to Petroleum</td>
<td>Test Methods E154 Section 14</td>
<td>&lt;0.3 perms</td>
</tr>
</tbody>
</table>

The membrane material selected for use shall pass the tests outlined in Table 1, modified to reflect the below-grade conditions anticipated for the locality of use (see 4.2).


for reinforced or laminated waterproofing membranes applied to below-grade walls. Performance is defined as the ability of all essential properties to meet or exceed specified test values. ASTM Standard D7832 lists ten performance attributes that a waterproofing membrane should meet, including:

- Perform under continuously moist conditions and alternate wetting and drying
- Perform under hydrostatic pressure
- Possess low water absorption
- Adhere tenaciously to the substrate
- Capable of resisting fungus and bacteria in soils
- Possess sufficient flexibility to enable unrolling and curing
- Possess crack bridging capabilities
- Resist puncture for membranes that lack a protection course
Adhere tenaciously to the substrate
• Resist acids, alkalis, and other chemicals, including those contained in fertilizers and soil poisons.

The standard classifies membranes into two types: bituminous and nonbituminous organic; and single-ply and liquid-applied.

ASTM Standard D7832 was nearly 10 years in its creation. It was only through diligence and extraordinary efforts by the task group that it became a standard. In its present form, it is a departure point for further development. Nevertheless, at this time it provides the waterproofing industry with a benchmark to measure the suitability of a new product as it becomes available on the market.

Some of the referenced standards may require reexamination as to their applicability. Other property values listed need to have specific material types subjected to round-robin testing.

An example is C1305, which is a laboratory procedure for determining the ability of a waterproofing membrane to bridge a substrate crack and has little relationship to real-world conditions. The test consists of applying a membrane over two concrete blocks that are placed tightly together. The blocks are then separated at the rate of 1/8 in. per hour until the space between the blocks is 1/8 in. The cycle is repeated 10 times. Unfortunately, this test method has no relationship to reality. Cracks form instantaneously when the tensile strength of the substrate material is exceeded. In reality, after the initial substrate crack forms, the crack width will vary over time. Although the current crack ability test method provides valuable information, a new test method needs to be developed that more closely mimics field conditions that may occur through cracking.

Other test methods that are listed are D7234, which is a test method that covers a procedure for evaluating the pull-off adhesion strength of a coating on concrete, and D903, a test method that covers the determination of the comparative peel or stripping characteristics of adhesive bonds. D903 is a “T-Peel” test, and D7234 is a direct-pull normal to test assembly. Currently these test methods are the only two available for testing membrane adhesion. However, waterproofing membranes can be disbonded by shear forces created by settlement of backfill or sliding of blindside membrane-support components. This movement produces shear at the interface of the membrane and concrete surfaces. T-peel forces are nonplanar, and testing membrane adhesion using D903 is almost impossible to duplicate in the field. A new ASTM standard needs to develop a vertical shear adhesion test method to simulate the forces that can be imposed on a membrane when adhered to a concrete substrate.

In short, ASTM D7832 has been approved through an industry consensus process and currently satisfies the need for evaluating waterproofing membranes. It is not perfect and needs to be reviewed by the industry and revised to more closely reflect real-world conditions.

MATERIALS

For years, the industry was limited in available waterproofing membranes. Prior to World War I, built-up coal tar pitch waterproofing was the predominant system. Environmental and safety constraints became a significant factor that led to the ultimate demise of built-up waterproofing systems. However, this opened the
door for their replacement by environmentally friendly systems: liquid-applied membranes, single-ply sheets, cold-applied systems, and water-based (instead of solvent-based) primers.

We are now at the next generation of waterproofing membranes, which have been vastly improved. In the last 10-12 years, these systems included:

- Single-ply sheets
- Bentonite systems
- Liquid-applied membranes

**Single-Ply Sheets**

Single-ply sheets—both thermosetting (vulcanized rubber) and thermoplastic—have undergone vast improvements over the years. Butyl membranes have faded from the waterproofing marketplace. Ethylene propylene diene monomer (EPDM) sheets are limited to plaza waterproofing with taped seams.

Thermoplastic waterproofing sheets, glass fiber-reinforced PVC in gauges up to 120 mils, are a preferred choice when used as a waterproofing membrane. PVC sheets modified with ketone ethylene ester (KEE) or ethylene interpolymer (EiP) with welded seams are becoming a popular membrane for use on plazas.

The manufacturers of polyvinyl chloride (PVC) sheets and blends such as KEE or EiP claim to have the essential properties of low water absorption and low permeance. These sheets have been found suitable for waterproofing.

Thermoplastic polyolefin (TPO), other plastic roofing sheets, and laminated PVC are not suitable for below-grade waterproofing because of their high permeability and high water absorption. However, one manufacturer markets a TPO sheet coated with a butyl alloy for use on blindside applications that it claims has superior resistance to absorption and permeance. The TPO membrane is coated with a polyisobutylene rubber. The adhesive on the TPO sheets for use under slabs is formulated to resist damage from construction traffic. The sheet comes in two different grades: one for vertical applications (Figure 1), and one for horizontal applications (Figure 2). Sheets are seamed by removing a release liner at the selvage edge and mating the two sheets together.

PVC waterproofing differs from PVC roofing in both thickness (59 to 120 mils for waterproofing versus 45 to 80 mils maximum for roof membranes) and also in composition. Additives have been introduced to resist algae and alkalis. UV stabilizers and high-temperature inhibitors have been removed.

Both PVC and KEE offer excellent resistance to bacteria, fungi, and soil chemicals. However, EPDM can deteriorate in contact with petroleum-based soil poisons and oils. Hydrocarbons can similarly promote deterioration of PVC.

A major distinction that differentiates thermosetting synthetic rubber sheets from thermoplastic polymer sheets is that the former requires adhesives for seaming, whereas the seams of the latter are heat-fused.

Another category of waterproofing membrane consists of a thermoplastic high-density polyethylene (HDPE) or TPO coated with an adhesive. This should not be confused with thin (15-mil) HDPE or thick (60-mil) PVC sheets coated with a layer of modified bentonite. Both are intended for use as preapplied membranes. The first type is designed to adhere to pressure slabs on grade and foundation walls—both chemically and from the pressure exerted by the weight of the freshly cast concrete. The second type relies on the bentonite swelling and forming a water-impervious gel between the soil and the concrete.

The adhesive-coated membrane consists...
Bentonite Systems

Contemporary bentonite products evolved from the basic material first used for waterproofing in the mid-1920s. Used only in granular form in those days, bentonite was limited to sealing pond liners and compacted-earth dams until the late 1950s, when it was introduced to the building waterproofing market.

Bentonite clay still commands a significant market share for blindside application, as well as for positive-side waterproofing. Systems with bentonite clay and polymer-modified bentonite come in a wide variety of laminates, including geotextiles filled with bentonite granules and high-density polyethylene sheets with adhered bentonite granules.

Recently, a thermoplastic reinforced waterproofing sheet with an integral bonded polymer (10% bentonite and 90% polymer) to the backside of the sheet was marketed for both preapplied and post-applied uses (Figure 3). The seams of the thermoplastic sheet are welded (Figure 4) to form a monolithic waterproofing membrane. The manufacturer of this system states that the membrane can be installed over existing membranes, significantly reducing exposure of below-grade spaces to weather elements. This sheet also has lower moisture vapor permeance than traditional bentonite systems, without the polymeric liner.

Figure 4 – Welding seams of thermoplastic sheets. Courtesy of CETCO.

of either a 30- or a 16-mil HDPE sheet with a 16-mil factory-coated adhesive protected with a release film. The seams are adhered and compressed with a roller.

Liquid Membranes

Liquid-applied membranes (LAMs) were first introduced as waterproofing systems as far back as the early 1960s. Polysulfide sealant formulation was modified to increase its breaking strain, as a means of preventing shrinkage cracking in a concrete. In the beginning or ground-breaking days of LAM formulations, liquid polysulfide polymers were blended with coal tar oils. The fatal flaw of polysulfide systems was their temperature sensitivity. At high temperatures, they cure too quickly; and conversely, at lower temperatures, too slowly.

Although liquid-applied waterproofing membranes have been marketed since the late 1970s, they became increasingly popular in the 1990s. In the early days of LAMs, they came in the following types:

- Hot- or cold-applied polymer-modified asphalt
- Single-component coal-tar modified urethanes
- One- or two-component urethanes

These systems are vulnerable to moisture in the substrate and require special primers when the moisture content exceeds the manufacturer’s limits.

Today a new generation of liquid-applied membranes has appeared and include:

- Two- and three-component polyesters
- Two-component polyurethane (PMMA and MMA)
- Polyester systems

Polyester

Polyester waterproofing, currently produced by one manufacturer, is a fleece-reinforced, polyester resin-based, two-component waterproofing system. These systems are generally used for vegetated roof and inverted roof membrane assemblies (IRMA). They can be laid under asphalt, slabs, or paving. Poured asphalt can be laid at 480°F (240°C) without damaging the membrane. The polyester membrane is permanently elastic and bridges cracks up to 2 mm, making it an ideal waterproofing solution for surfaces with vehicular or pedestrian traffic. It is also vapor-permeable within a few hours of application. However, it has a high volatile organic compound (VOC) content.

PMMA

PMMA (or MMA) is currently produced by at least four manufacturers (Figure 5). It is seamless and is reinforced when used over occupied space and un reinforced on balconies. Where used below-grade or on plazas, reinforcing is mandatory. PMMA dries rapidly and can sustain traffic within a day of its application. A major advantage is that it is self-flashing. It is being used for flashing hot-rubberized asphalt waterproofing systems.

Polyether

Polyether systems are cold-applied, single-component, waterproofing membrane systems that cure by exposure to atmospheric and substrate moisture to form a continuous, tough, reinforced elastic seal. They are generally solvent-free. Application is by roller, spray, or squeegee. The manufacturers of this system purport superior adhesion to standard construction materials, including concrete, wood, and metal.

MEMBRANE SELECTION

One of the most significant factors in selecting a basement waterproofing membrane is its proven durability. Most of the above materials have been on the market for at least 10 years. It is inevitable that new products will appear in the market in the future. When the designer is faced with a request to specify one of them, he or she should pursue the following:

1. Request the project names where the product has been used, including the names of the owner, architect, and waterproofing contractor.
2. Determine site conditions where the product may not be used.
3. Request and review in detail the manufacturer’s past performance, including the production of other waterproofing systems.
4. Investigate the manufacturer’s past performance, including the production of other waterproofing systems.
5. Verify that the manufacturer requires applicator training and licensing of the installer.
Governmental and quasi-governmental bodies can also make the designer’s decisions difficult. These groups require that the specifications list at least three manufacturers or that a single manufacturer is specified, accompanied by a list of physical properties together with the expression “or equal” or “approved equal.” When language like this is imposed upon the designer, it can create a quandary. Judging whether a product is sufficiently durable, one should consider potential liability.

There are many waterproofing systems manufactured for plaza and/or below-grade uses. Some membranes that may be suitable for plazas can have similar properties that one can consider as equal for a below-grade project. However, most membranes manufactured for use for below-grade foundations and below pressure slabs are unique and have dissimilar properties. Their applications also differ from other products. It is therefore impossible to specify an “or equal” or even list several manufacturers for a single project that can satisfy this requirement. Self-adhering rubberized asphalt sheets are the exception, and the writers are unaware of any comparable products for use under pressure slabs or for blindside foundation wall applications.

So how is the “or equal” defined by various jurisdictions?
- To possess some performance qualities and characteristics without a decrease in quality, durability, or longevity
- Of the same quantity, size, number, value, degree, or intensity
- The items are identical in all respects without any difference.

The “or equal” problem will continue to plague the industry until such time as the legislative bodies recognize this unachievable requirement.

**GENERAL — QUALITY ASSURANCE**

A failed waterproofing system is expensive to correct. When a roof fails, accessing the membrane is easy. However, when a plaza waterproofing membrane fails, access is difficult and the replacement cost can be four to five times the cost of replacing a failed roof membrane.

It is for this reason that testing a waterproofed deck is advisable. ASTM D5957, Standard Guide for Flood-Testing Horizontal Waterproofing Installations, was the accepted method for testing the watertightness of a waterproofed deck. ASTM D5957 says if a leak occurs during testing:
- Drain water.
- Locate and repair leak.
- Retest area under the same initial conditions.

EFVM is a low-voltage test method that creates an electrical potential difference between a nonconductive membrane surface and conductive structural deck or substrate, which is grounded.

Developed in Germany in the early 1990s, EFVM quickly became a valuable tool for investigating leaks on existing systems. In 2001, EFVM was introduced to North America and has since become the testing procedure of choice for waterproofing verification.

Companies that perform EFVM claim the advantages of utilizing this test procedure are:
- Pinpoint-accurate, quality-control testing method
- Nondestructive integrity and troubleshooting testing
- Ability to test sloped decks and vertical walls
- Defects can be repaired and retested the same day.
- Limited use of water required to conduct test
- Inclement weather will not hinder the test (wet conditions are preferred for electrical flow).
• Overburden installed immediately after the EFVM test
• Eliminates unnecessary removal of overburden to locate a breach when doing a visual inspection
• Membrane can be tested prior to the expiration of the warranty or after traffic has occurred on the membrane.

SUMMARY
The last decade has seen the introduction of many new products for plaza and below-grade waterproofing. Some have fallen by the wayside, but many show great promise. The design professional should minimize risk of leaks and failure when selecting a waterproofing membrane for a project.

No designer can specify a failure-proof system. Therefore, he or she should review and evaluate the waterproofing system on the conservative side. When value engineering is required to control construction cost, the waterproofing system should be the last place to look for economy.

When asked to consider or select a new waterproofing membrane, the designer should take an equally conservative approach. Materials that have little or no history of past performance should be rejected. Manufacturers that push their warranties as part of their system should also be viewed with caution.

REFERENCES
2. Charles Parise, FAIA, was a partner in the firm of Smith Hinchman Grillos, now known as the Smith Group.
4. Dorothy Lawrence was the owner and president of Laurenco, Inc., a manufacturer of a cold-applied reinforced modified asphalt membranes located in Ohio. Lawrence’s comments appeared in the February 2004 issue of Roofing Contractor magazine. “Dorothy Lawrence: The First Lady of Roofing and Waterproofing.”
5. This guide is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.22 on Waterproofing and Dampproofing Systems. Current edition approved July 1, 2014. Published July 2014. DOI: 10.1520/D7832_D7832M-14.