the construction specifier

Designing Barrier-free Bathrooms

Combining utility and modern design

by Sean Gerolimatos

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THE WAY WE BUILD BATHROOMS IS CHANGING. OWNERS OF HOMES, CONDOMINIUMS, HOTELS, AND SPAS WANT MORE THAN JUST UTILITY—THEY ARE SEEKING A RETREAT-LIKE ATMOSPHERE WITH THE LATEST DESIGN ELEMENTS, WHILE STILL REQUIRING RELIABILITY AND DURABILITY. AT THE SAME TIME, MANY WANT THEIR BATHROOMS TO BE BARRIER-FREE.

These latest bathroom designs include curb-free showers, along with large-format tiles extending from the floor into the shower, and custom building elements like shower seats and vanities. Offering design flexibility and enduring performance, these applications continue to grow in popularity for various reasons.

For some, limited mobility due to disability or age makes barrier-free showers a necessity for access. Other owners simply want to plan for the future, ensuring they have an accessible bathroom that allows them to age in their home with security and independence. According to a report from the Federal Interagency Forum on Aging-related Statistics, the number of Americans over the age of 65 will increase from 40 million in 2010 (13 percent of the population) to an estimated 72 million in 2030 (20 percent of the population)—this represents an 82 percent increase in total and a 47 percent increase in share.[1]

The coming population shift has brought more focus on the building needs of the elderly and opportunities for building professionals in the market. For example, the National Association of Home Builders (NAHB) offers the Certified Aging-In-Place Specialist (CAPS) program to educate and certify building professionals in this area.[2]

Moisture management

Ceramic tile coverings are not inherently waterproof—therefore, waterproofing is required behind the tiles to protect the substrate.[3] However, this is only one component in an effective moisture management system. Moisture management is a systematic method to contain water in both liquid and vapor form and enable it to pass through an assembly efficiently using materials not adversely affected by moisture.

Traditional tiled showers use what can be described as a 'water-in/water-out' system wherein an unbonded pan liner is laid on a slope on the floor and clamped to the drain. Material options for the pan liner include:

- polyvinyl chloride (PVC) meeting ASTM D4551, *Standard Specification for PVC Plastic Flexible Concealed Water-containment Membrane*; or
- chlorinated polyethylene (CPE) meeting ASTM D4068, *Standard Specification for CPE Sheeting for Concealed Water-containment Membrane.*

A vapor retarder, such as polyethylene or tar paper, is applied to the walls and lapped over the pan liner. A mortar bed must be placed over the pan liner to provide support and a bonding surface for the tiles. Mortar may be floated on the walls to perform a similar function, but many tile-setters are not trained in floating mortar and instead use a tile backerboard, such as a cementitious backer unit.

As the shower is used, liquid water passes through the tile covering and seeps through the mortar base to the weep holes in the drain. Similarly, water vapor passes through the tile covering, condensing on the vapor retarder, and ultimately passing through the shower base assembly. When properly constructed, these showers can provide good performance and service life. However, common mistakes can lead to problems. For example, if no pre-slope is provided under the pan liner, water can collect in the mortar base and become a haven for mold growth. Or, if no vapor retarder is provided on the walls, moisture can enter the wall cavity and damage moisture-sensitive materials such as framing members, wall board opposite the wall cavity, and wood subfloors.

The modern approach to moisture management in tiled showers produces a 'sealed' enclosure. This approach employs bonded waterproofing membranes meeting the requirements of American National Standards Institute (ANSI) A118.10, *American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installation*, which are applied atop the shower base and walls, and connected to the drain at the top of the assembly via an integrated bonding flange.

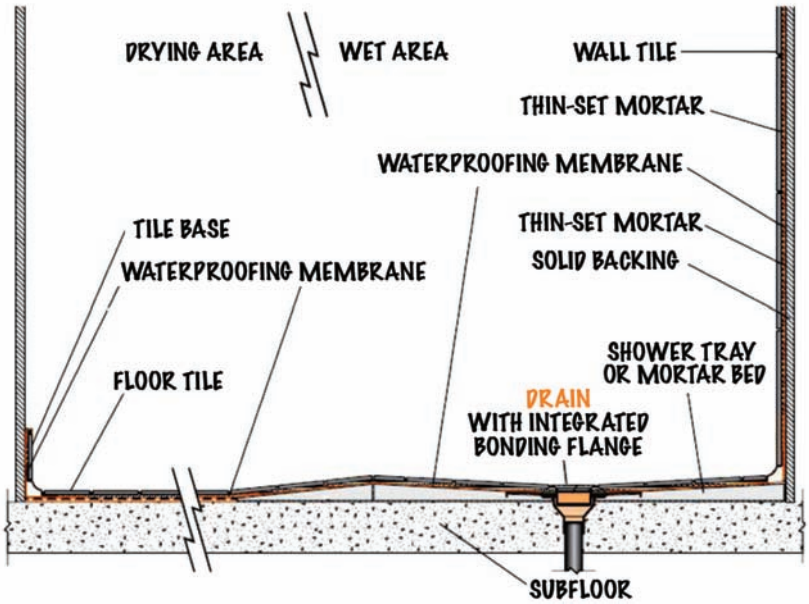
Bonded waterproofing membranes are applied to all surfaces in the shower area, including the bench and partition wall, to create a fully 'sealed' enclosure.

As the shower is used, liquid water passes through the tile covering, but is contained just under the surface by the membrane. The resulting assembly provides superior moisture management as it does not permit moisture to penetrate into the mortar bed or solid backing, allowing the assembly to completely dry between uses and reducing the potential for efflorescence and mold growth within the system.

Water vapor permeance

According to ASTM E96, *Standard Test Methods for Water Vapor Transmission of Materials*, water vapor permeance is:

> the time rate of water vapor transmission through unit area of flat material or construction induced by unit vapor pressure difference between two specific surfaces, under specified

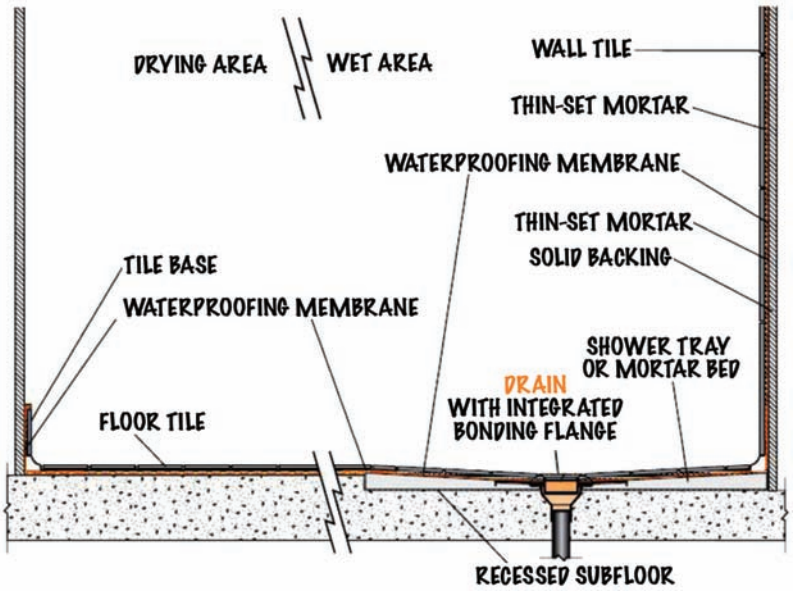


When recessing the floor is not an option, a ramp may be provided in lieu of a curb. The wet area is sloped to the drain to contain water during shower use.

For some, limited mobility due to disability or age makes barrier-free showers a necessity. For others, it is a matter of planning for the future.

temperature and humidity conditions. Water vapor permeance can be used to characterize the effectiveness of a bonded waterproofing membrane in managing vapor in tiled showers. ANSI A118.10 was developed to evaluate membranes as barriers for liquid water migration and therefore does not include a minimum criterion for water vapor permeance. However, vapor management is essential in tiled showers and steam rooms given the elevated temperatures and relative humidity in these applications.

There is no universal requirement for vapor permeance of membranes in the building industry. The environmental conditions (*i.e.* differences in temperature and relative humidity [RH]), building materials, duration of exposure, and relevant field experience determine the appropriate membrane performance for a given application.



Ideally, the floor will be recessed before installing a sloped mortar bed or prefabricated shower base to allow an even transition at the door threshold. This process can be relatively straightforward in new construction and can also be accomplished in renovations.

Recent developments in the tile industry indicate a maximum water vapor permeance requirement will be implemented in the Tile Council of North America's 2013 TCNA *Handbook for Ceramic, Glass, and Stone Tile Installation* for continuous-use steam rooms (*e.g.* those found in health clubs and spas). Bonded waterproofing membranes for these applications must have a water vapor permeance of 0.5 perms or less when tested according to ASTM E96 using the desiccant method at 38 C (100 F) and 90 percent RH.

Under this scenario, the bonded waterproofing membrane is considered a vapor retarder that can effectively limit vapor transmission within the application and may be bonded to an integrated bonding flange drain. Higher water vapor permeance values may be allowed when a vapor retarder is implemented behind the solid backing on walls and lapped into a pan liner under the mortar base—similar to the traditional tile shower design previously described. In this case, the bonded waterproofing membrane prevents liquid water from infiltrating the mortar bed from the surface. The membrane must be attached to a clamping ring drain in such a way the weep holes remain open and the mortar bed can effectively drain.

Bonded waterproofing technology

Barrier-free showers do not include curbs, and surface water typically may not be completely contained in the enclosure during use or as the individual leaves the shower. For illustrative purposes, the shower enclosure itself can be considered the 'wet area' and the rest of the bathroom the 'drying area.'

The waterproofing membrane must be applied within the wet area over the shower base and up the walls to at least the height of the showerhead. There is no single requirement to guide the specifier in determining where the waterproofing membrane must be applied in the drying area. The conservative, and best, approach is to continue application of the waterproofing membrane across the entire bathroom floor and up the walls to the top of the tile base or wainscoting. This practice provides the highest level of protection without affecting the overall thickness of the tile assembly on the floors or walls.

Bonded waterproofing systems provide a simple and effective means of waterproofing barrier-free installations. The key to this is bonded waterproofing membranes are topically applied. Once the slope to drain is established, the membrane and tile are installed—this minimizes the assembly thickness.

Given the wide range of potential barrier-free configurations, it is impossible to address them all in this article. However, the following guidelines will assist in planning any barrier-free installation. Ideally, the floor will be recessed before installing a sloped mortar bed or prefabricated shower base to allow an even transition at the door threshold.

Waterproof polystyrene building panels can be used to construct tile-ready elements such as partition walls without any wood or metal framing.

This process can be relatively straightforward in new construction and can also be accomplished in renovations. When recessing the floor is not an option, a ramp up into the shower area must be provided.

Recessing the bathroom floor must be done in a way to preserve the structural integrity and safety of the construction, which may require the services of a qualified design professional (*e.g.* architect or engineer). Various building codes and other sources, such as the 2010 *Americans with Disabilities Act* (*ADA*) *Standards for Accessible Design*, include the specific requirements for disabled access in public buildings and must be consulted when applicable. Design considerations include degree of slope, clearance, and supporting structures, such as grab bars.

Linear floor drains

In recent years, various manufacturers have introduced linear floor drains with integrated bonding flanges for use in conjunction with bonded waterproofing assemblies. Linear drains offer certain advantages over typical 'point' drains. Shower bases must be sloped from all directions to point drains, limiting tile selection to mosaics or other relatively small-format tiles. However, the shower base can be sloped on a single plane to linear drains, which enables the use of large-format tiles.

Large-format tiles are currently the most popular option for floors. In barrier-free applications using linear drains, the large-format tiles on the floor can be continued into the shower enclosure, creating a seamless transition and furthering the open-concept design. Linear drains can be installed at various locations, including adjacent to walls, intermediate locations, or even at shower entrances. In this last application, the drain is placed to intercept water from the shower; however, secondary drainage (*e.g.* point drain) is recommended in the drying area to capture any overflow.

Slip-resistant flooring

The 2010 *ADA Standards for Accessible Design* states:

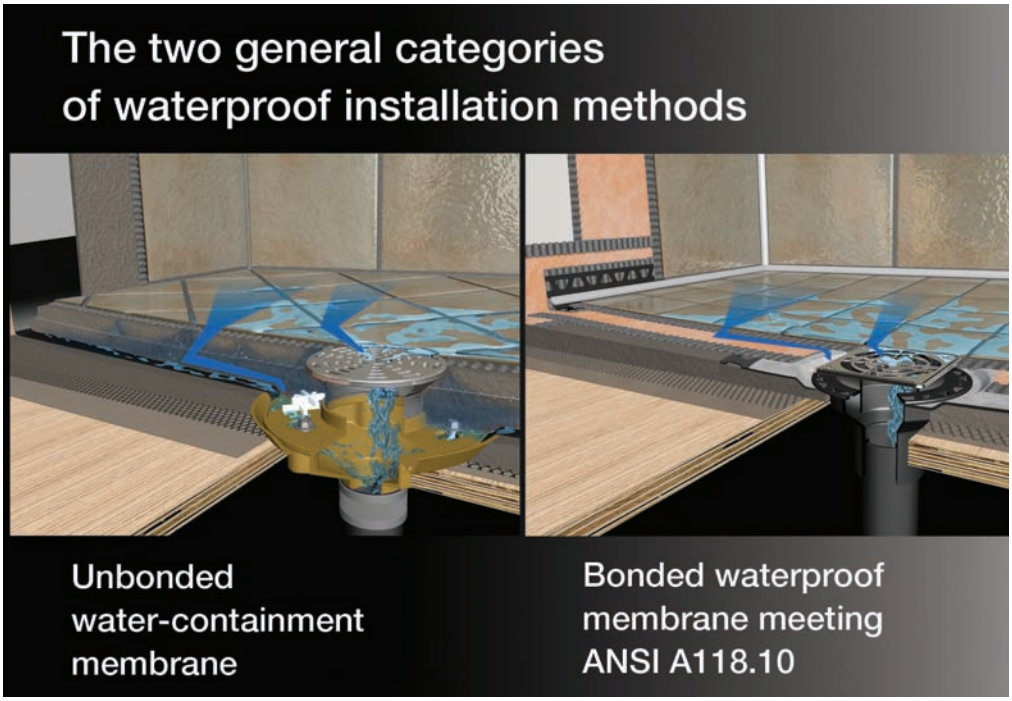
> Floor and ground surfaces shall be stable, firm, and slip resistant … [and] A slip-resistant surface provides sufficient frictional counterforce to the forces exerted in walking to permit safe ambulation.

Previous versions of *ADA* referenced a minimum recommended static coefficient of friction (SCOF) of 0.6, but did not specify a corresponding test method and the reference was subsequently withdrawn. For ceramic tile, the most commonly used evaluation was ASTM C1028, *Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-meter Method*, but its suitability, accuracy, and repeatability were questioned.

Substantial research has been performed and ANSI A137.1, *American National Standard Specifications for Ceramic Tile*, now references a new test method, the dynamic coefficient of friction (DCOF) AcuTest. Further, for the first time, it requires a minimum performance criterion of 0.42 for level interior spaces expected to be walked on when wet.[3]

Custom building elements

Until the introduction of thin-set tile adhesives in the 1960s, tile-setters could not bond tiles directly to existing substrates. Instead, mortar beds were floated on floors, walls, shower seats, and vanity tops, while the tiles were beat in with a neat coat of portland cement paste when the mortar was still fresh.



In the traditional 'water-in/water-out' system (left) water passes through the tile covering, percolates through the mortar bed to the sloped pan liner, and exits through weep holes in the clamping ring drain. In the 'sealed' system (right), water passes through the tile covering, but is contained just under the surface by the bonded waterproof membrane, allowing the system to dry out between uses.

> As they are topically applied, bonded waterproofing systems can provide a simple and effective means of waterproofing barrier-free installations.

While this method demanded great skill and labor, it offered significant benefits in tile-setters had complete control over the substrate and could produce perfectly flat, level, plumb, and square surfaces for tile installation. Over time, floating mortar became an uncommon skill in the tile industry. Mortar beds gave way to tile backerboards installed over framing and other constructions requiring comprehensive preparation and waterproofing measures.

Lightweight extruded polystyrene (XPS) and expanded polystyrene (EPS) waterproof building panels restore control to the tile-setter. These materials can be integrated into bonded waterproofing assemblies with manufacturer-recommended seaming practices.

Such panels may be installed directly over wall framing with fasteners or spot-bonded to masonry walls to allow the tile-setter to true the walls before tile installation. The panels may also be used to create shower seats, vanities, bathtub platforms, and self-supporting partitions without any wood or metal framing and sheathing underneath.

Panels are assembled and bonded using thin-set mortar or other compatible adhesives and can be further attached or stabilized using anchors and reinforcement profiles as required for specific projects. These assemblies can also significantly reduce dead loads. A 1.2 x 2.4-m (4 x 8-ft) framed partition wall using 2x4 sawn lumber and 13-mm (½-in.) thick gypsum board sheathing could weigh in excess of 74 kg (164 lb), while the same partition constructed using two 50-mm (2-in.) thick layers of XPS foam panel could weigh as little as 32 kg (70 lb). This represents a 42-kg (94-lb) decrease, or about a 57 percent weight saving for the partition construction before tile application.

Conclusion

Market demand is changing the way we approach the renovation and construction of bathrooms. Changing demographics and evolving design ideas are driving these new requirements. New materials and construction methods are making the designs more attainable in many different types of residential and commercial buildings. Today, one can create bathrooms that intertwine strong foundations with unlimited design freedom, while ultimately challenging barriers to provide more freedom. **CS**

Notes

[1] For more information, visit www.agingstats.gov/agingstatsdotnet/Main_Site/Data/2012_Documents/Docs/EntireChartbook.pdf.

[2] Visit www.nahb.org/page.aspx/category/sectionID=686/fromGSA=1.

[3] Visit www.tcnatile.com/trade-news/dcof-acutest.html.

ADDITIONAL **INFORMATION**

Author
Sean Gerolimatos is the technical director for Schluter Systems LP, and has been with the company since 2003. He has served as a member of the *The Council of North America's Handbook* Membrane Subcommittee, written articles for trade publications, and presented seminars at tile industry events, including Qualicer and Surfaces. Gerolimatos' academic background is in civil engineering; he earned a bachelor's degree from Clarkson University and a master's from Cornell University. He can be reached at (888) 472-4588.

Abstract
For some, limited mobility due to disability or age makes barrier-free showers a necessity for access. For others, they recognize that what is comfortable today may become necessary in the future and want to plan for it now. These showers have also become increasingly popular for their aesthetic benefits, as they can integrate seamlessly with surrounding tiled surfaces to enhance an already luxurious environment. Bonded waterproofing systems provide a simple and effective means of waterproofing barrier-free installations.

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