Construction CANADA

Photo courtesy Ceramiques Hugo Sanchez

Designing Barrier-free Showers

By Dale Kempster, CSC, CTC, TTMAC

Over the last decade, it seems the demand and desire for barrier-free bathrooms has grown dramatically. Aside from the importance of accessibility and universal design for those with physical challenges, this phenomenon can be partially attributed to 'baby boomers' who are now finding they are not as mobile as in the past; some are having difficulty stepping into a tub or even over a 150-mm (3-in.) high shower curb. Additionally, the popularity of large hot tubs in bathrooms seems to have run its course. Many builders have started to switch from using space-consuming and somewhat energy-inefficient luxury fixtures and are instead installing multiple shower heads and sometimes a steam generator into shower spaces.

Another factor, the 'aging-in-place' phenomenon, has seniors not selling their homes and moving into retirement villages or assisted-living quarters; instead, they are modifying their homes to make them more user-friendly as they age.

In 1971, Statistics Canada cited eight per cent of the country's population as being 65 years and older. Last year, this number had increased to almost 15 per cent—nearly five million people. The number of people older than 65 is forecast to grow by an additional 900,000 in the next five years, suggesting the need for barrier-free housing will continue to increase.

Over the last couple of years, advancement in building material technology allows for barrier free bathrooms that are relatively easy to construct, functional, and perform extremely well.

The main objective of this article is to identify the various challenges of constructing a barrier-free bathroom and offer several solutions and recommendations to make the design and building of these spaces relatively painless.

Controlling moisture

One of the top challenges when designing and building barrier-free showers is moisture management. This is a systematic method to contain water in both liquid and vapour form and enable it to pass through an assembly predictably and efficiently using materials not adversely affected by moisture.

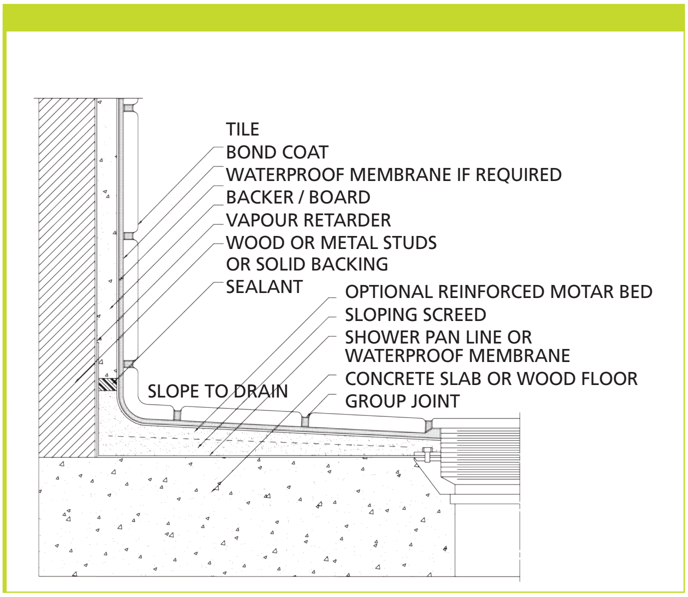
Virtually no material can completely eliminate water vapour transmission. In recognition of this fact, the terminology for a vapour 'barrier' was changed a few years ago to vapour 'retarder'—the only true vapour barrier would be solid glass or metal. The standard for thin, load-bearing waterproof membranes that can have tile directly bonded to them is American National Standards Institute (ANSI) A118.10, *Load-bearing, Bonded, Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installations*. This standard, however, is only for waterproofing and does not have any performance criteria for vapour transmission which is commonly tested under ASTM E96, *Standard Test Methods for Water Vapor Transmission of Materials*.

Given the mentioned prospect of multiple shower heads and steam-generators, it is very important the substrates (*i.e.* walls, floors, and showers) are waterproof and, in most cases, resistant to steam/vapour. The Tile, Terrazzo, and Marble Association of Canada (TTMAC) has recently revised its Detail 321 SR, "Tile Installed in Steam Rooms," in the 2011–12 *Specification Guide 09 30 00 Tile Installation Manual*, calling out that the waterproofing membrane should have a perm rating of 0.5 or less (previously < 1.0) using ASTM E96 at 90 per cent humidity. This is in recognition of the high service requirements found in steam-shower and steam-room applications.

Construction height

Another challenge in barrier-free applications is limiting construction height. This is a particular challenge when using a shower pan method with a two-stage drain and a mortar-bed (Figure 1). This method will create excessive construction height as the minimum thickness of the mortar bed will be 31 mm (1.2 in.) at the lowest point which will then increase by approximately 6 mm (0.24 in.) in every 305 mm (12 in.) to create the slope required for drainage. Depending on the size of the shower the construction height can easily increase to 54 mm (2.1 in.) or thicker, which in barrier-free construction will cause impediments at the entrance to the bathroom.

Figure 1



Images courtesy Schluter-Systems

A shower pan assembly using a two-stage drain.

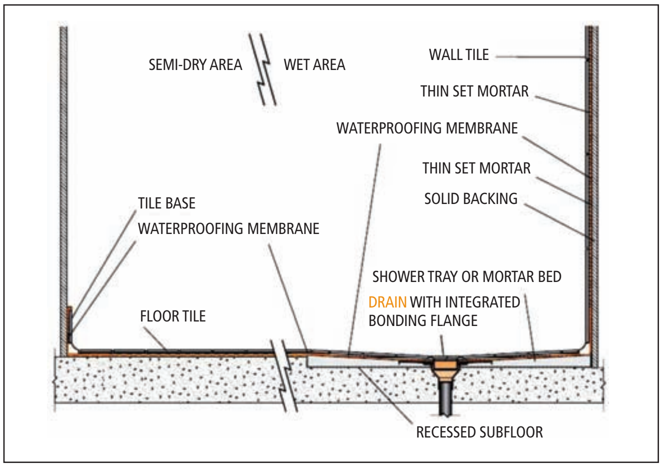
Options with drains

The early 1990s' arrival of ANSI A118.10 membranes was followed about a decade later by the introduction of drains with an integrated bonding flange. This way, a thin, load-bearing waterproof membrane could be adhered to the drain, making a waterproof connection at the top of the assembly. The advantage of this method is the low construction height can be maintained as these types of drains can be directly installed onto the substrate, with no mortar bed required.

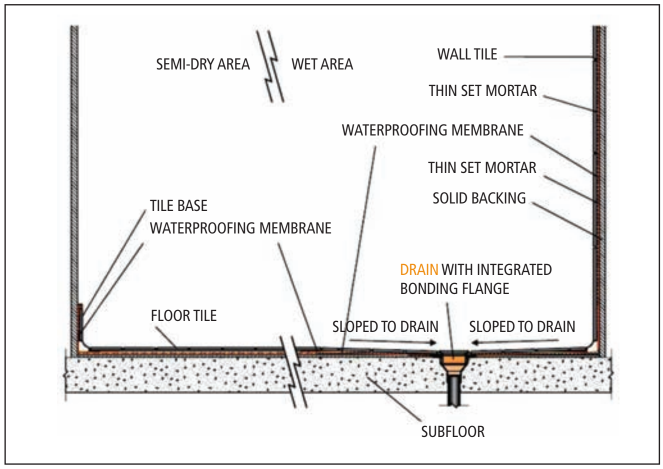
Slope can be started from almost zero and, again, depending on the size of the shower room, heights can be maintained relatively low. For instance, a shower with a 1220-mm (48-in.) radius will have a construction height of only 24 mm (1 in.). These membranes are typically continued up the wall onto solid backing to ensure the assemblies are waterproof. In other cases, a high-density expanded polystyrene (EPS) board with bondable/waterproof facers can be substituted if nothing has been attached to the studs. The advantages of these boards are their light weight, R-value, vapour resistance, and the fact they can be cut with a utility knife onsite.

Another new entry into barrier-free bathrooms that expands the design opportunities is the introduction of linear drains. Several manufacturers have launched products that allow drains to be placed in different strategic locations. Most of them work with an ANSI A118.10 membrane and, like the integrated bonding flange drains, the linear drains allow for low construction height assemblies as they can be installed directly onto the substrate. Additionally, employing a linear drain enables the design of floors that have only one or two slopes, which allows for large-format tile or even stone slabs to be installed in the shower area.

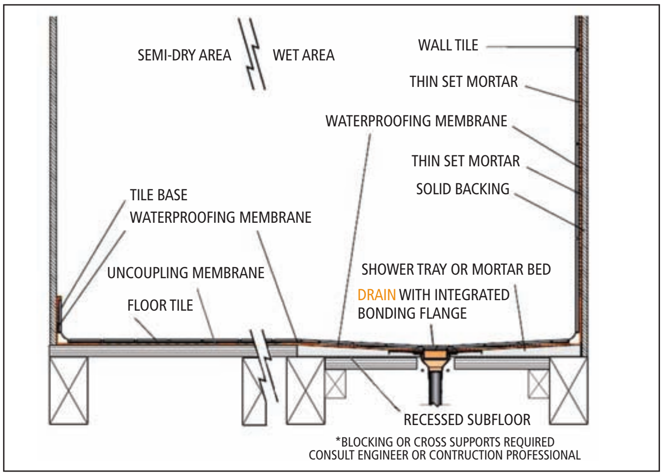
Standard drains that are 100 to 150 (4 to 6 in.) x 100 to 150 mm only allow use of small-format tile because the floor either has to be designed in a cone configuration or made into four planes to direct water to the drain. In most cases, tiles no larger than 305 x 305 mm (12 x 12 in.) can be used to evacuate water. Linear drains, on the other hand, can be placed:



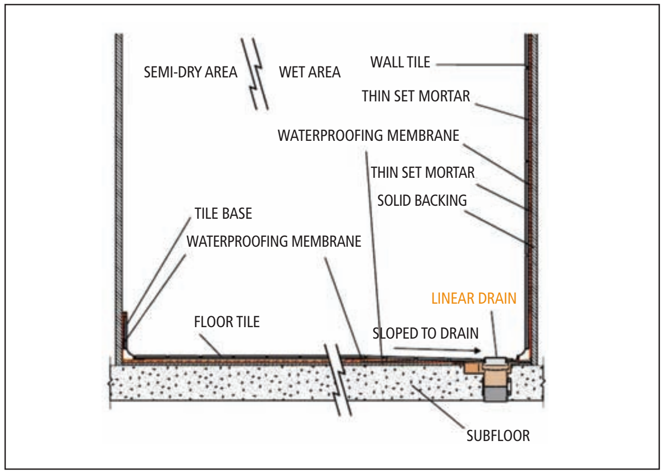
This assembly shows a recessed subfloor in the shower area, using a mortar bed or prefabricated tray over a concrete slab, with a special drain and a bonding flange that tie into the surface-applied waterproofing membrane.



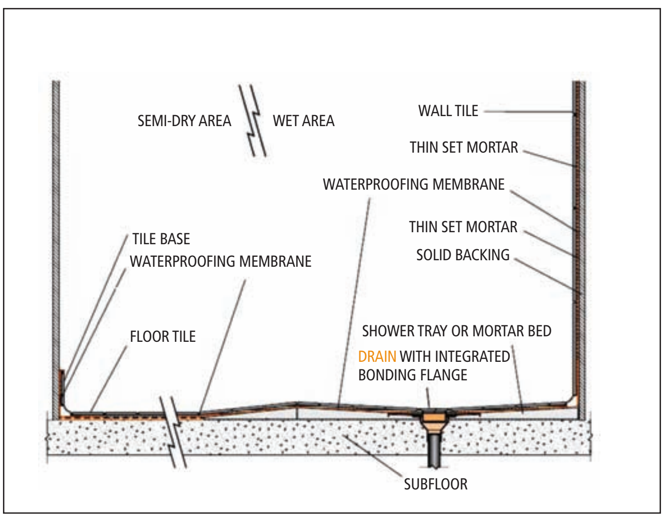
In this situation, the bathroom floor has been raised outside the shower area, with the pre-slope to the drain falling away from the raised bathroom floor. It uses a drain with a bonding flange, surface-applied waterproofing, and small tiles on the shower floor.



This assembly shows construction over a wood subfloor. The subfloor in the shower area is recessed, which means there is no change in floor height outside of the shower area.



The bathroom floor area has been raised, and it falls away from the shower threshold to a linear drain that has been located on the furthest wall. The single slope allows large tiles on the shower floor.



The floor area has been built up over a concrete slab. The floor inside the shower area slopes to a centre drain, and the floor outside the shower area slopes away to the bathroom door.

- adjacent to the wall where the showerhead is located, which would allow for a single slope;
- in the middle of the shower floor that would have two slopes converging to the drain; or
- in the threshold in front of the shower area, which also would allow for a single-slope floor.

Avoiding slips and falls

The number-one culprit of injury in both residential and commercial applications is slip-and-fall incidents. Until recently, the main test method used by the tile industry to determine slip resistance was ASTM C028, *Standard Test Method for Determining the Static Co-efficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-meter Method*, which is also known as the static co-efficient of friction (SCOF) test.

However, this test method was somewhat controversial as test results were not always consistent; there were also concerns for the testing of wet conditions regarding a condition called 'stiction'—a surface tension phenomenon similar to how two plates of glass with

Photos courtesy Ceramiques Hugo Sanchez

The importance of accessibility for an aging population means an increase in barrier-free showers. Fortunately, advancement in building material technology allows these spaces to be not only easily constructed, but also eye-catching.

water in between stick together. This would give artificially higher ratings in comparison to the actual traction of the surface in question.

This year, with the revision of the TTMAC *Tile Installation Manual*, it was decided to withdraw use of ASTM C1028 for slip resistance and acknowledge a new test that has been ratified and referenced in ANSI A137.1-2011, *American National Standards Specifications for Ceramic Tile*. This new test method—which has been designated as the dynamic co-efficient of friction (DCOF) Acutest—employs the BOT 3000, a type of testing apparatus that measures parameters in the field of tribology, such as frictional forces, co-efficient of friction, and effects of lubrication.

In the past, using the ASTM C1028 test method, the recommended SCOF was 0.5 wet as recognized by the revised TTMAC *Tile Installation Manual*. Now, employing the new BOT 3000 testing apparatus, the designated threshold value of 0.42 or greater has been designated for interior spaces expected to be walked on when wet. To determine whether a specific tile or stone will meet this criterion, TTMAC or another third party can conduct this test at a nominal charge.

Benches and floor panels

Benches are a desirable and popular feature in barrier-free showers as they allow the user to sit in comfort and safety while bathing. This design feature has been aided by the availability of prefabricated benches made of solid EPS blocks, or assembled-in-place extruded polystyrene (XPS) or EPS foam panels. Both versions allow for benches to be configured in many dimensions that are 100 per cent waterproof and require neither framing nor an elaborate fastening system.

A final new technology available for barrier-free bathrooms is prefabricated floor panels that are made with one, two, or four slopes. Typically, these EPS products are not only user-friendly, but also contribute additional benefits. The reality is utilizing a pre-sloped shower panel makes it simple to create a flat and plumb surface to reduce the possibility of lippage and 'bird baths' in the floor surface of the bathroom.

For example, because they are made of a thermal-resistant material with an R-value of approximately 4 per 25 mm (1 in.) of thickness, the tile has some insulation so it is not as cold as being bonded to a mortar-bed or concrete slab. Additionally, the weight is substantially reduced versus a mortar bed or concrete levelling bed, which weighs approximately 80 kg/m^2 (16 lb/sf) at 38 mm (1 ½ in.). Depending on the density of the XPS panel, there are also sound attenuation contributions. For wood-frame construction, the *National Building Code of Canada* (*NBC*) requires a minimum of 48.82 kg/m^2 (10 lb/sf) dead load and 195.29 kg/m^2 (40 lb/sf) live load, so the saving in weight by using a prefabricated shower tray can eliminate the need to add extra reinforcement such as blocking or an additional I-joist.

These images show two shower areas fully waterproofed and ready for tile. One can see the waterproofing membrane and linear drain inside the shower area, along with the uncoupling membrane outside of the shower area.

Conclusion

Although they can be complicated to construct, with some proper planning and use of new materials such as integrated bonding flange drains, linear drains, prefabricated trays, and EPS wall boards, these types of bathrooms can be more durable. As shown in the photos throughout this article, the 'next-generation' bathroom can be both functional and elegant—it is just a matter of recognizing the challenges and executing the solution.

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Design Tips for Going Barrier-free

The great advantage of barrier-free showers is they are more functional than their traditional counterparts. They provide easy access for anyone—especially children, the elderly, and those with reduced mobility. Further, the absence of doorsills and corners makes them easier to maintain. Seamless floor transitions also maximize floor space by making the shower look and 'feel' bigger. This is particularly true for small bathrooms where glass doors are eliminated to make the space more functional and practical.

Floor thickness options

In basements and condominiums, where all the floors are concrete slabs, there is no other way to go than 'up' to achieve the required slope to the drain. Building up the floor with a mortar bed or pre-formed, sloped trays are the preferred options.

For conventional wood construction, floor thickness can often be reduced by removing the existing floor buildup. This allows the mortar bed to be laid directly atop a single-layer subfloor. In the bathroom areas outside the shower (*i.e.* where there is no mortar bed), it is essential to use an uncoupling member when installing tile over a single-layer subfloor. This membrane provides uncoupling and waterproofing in the bathroom area.

There are also exceptional cases, where the floor substrate could be lowered to accommodate a seamless bathroom floor transition. However, this requires the services of an engineer as the original floor joists cannot be simply cut and weakened without risking serious consequences to the floor assembly and building structure.

Waterproofing

Extending the waterproofing out to cover the whole bathroom floor is always a good practice as water inevitably is carried out beyond the shower, barrier-free or traditional.

Radiant heating

The popularity of heated floors in bathrooms and shower areas has rapidly increased over the last few years. Heated floors come either as electrical radiant wires or hose systems carrying heated water. The former is easier to install and less expensive. Radiant floors can and should be used under shower floors for comfort, but also to help evaporate humidity from the tile assembly, which in turn reduces bacteria buildup on showers with less maintenance.

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