CERAMIC TILES AND FROST-PROOFING

Most parts of New Zealand experience frosts, but use of frost-proof tiles alone will not render an exterior tile installation frost-proof. You need a complete tile system.

By Scott Worthington, Managing Director, Aqua Mix New Zealand

Because New Zealand enjoys a mainly temperate climate, there is a misconception that only locations that actually experience snow or ice require frost-proofing consideration, but frost damage is a potential problem wherever you get a number of seasonal freeze/thaw cycles. During the winter, this applies to most of New Zealand, with the possible exception of parts of the far north.

Another common misconception is that, to design a frost-proof ceramic tile installation, all you need to do is specify a frost-proof ceramic tile. What you actually need is a complete tile system that can resist the damaging freeze/thaw cycle.

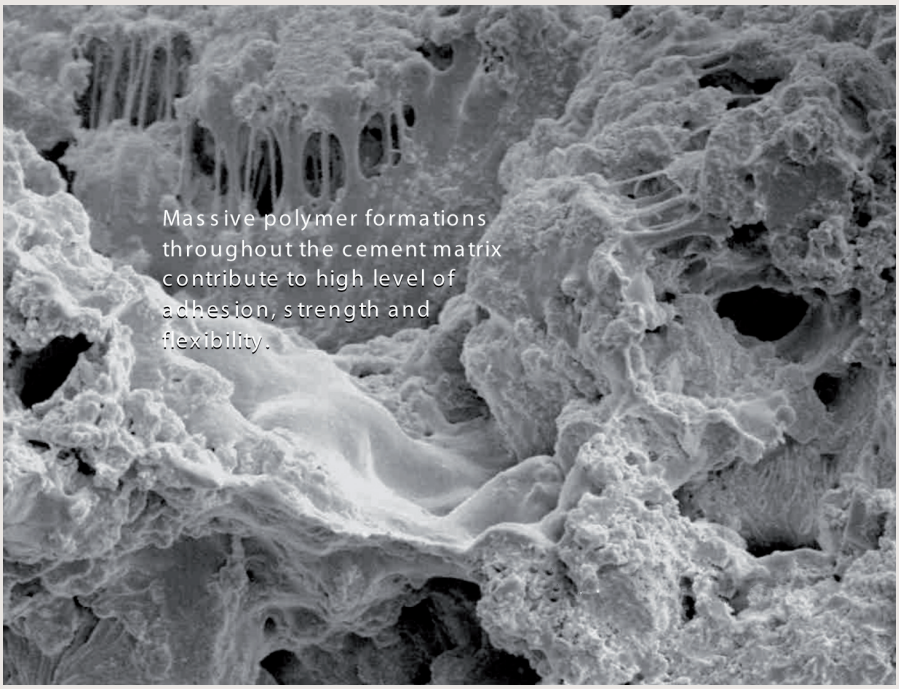

Figure 1: Massive polymer formations throughout the cement matrix contribute to high levels of adhesion, strength and flexibility. Width of field = 69 μm.

It's all about water

Designing a frost-proof ceramic tile installation is about the management of water. When water penetrates a tile or any part of the installation and freezes, it solidifies. As it solidifies, it increases in volume. This volumetric change creates mechanical stresses that increase and become more damaging as the freezing and thawing cycles continue. The stress can damage the body of the tile, its surface (especially if it is glazed), the adhesive (in some cases creating a loss of bond) and the grout, hence the need to specify a complete installation system and not just a frost-proof tile.

The main design goal of such a system is to avoid water penetration and retention as much as possible. This can be done by use of waterproof membranes, latex or polymer modified adhesives and grouts, and appropriate sealers. Making sure the fall is right and that the flexible joints are correctly placed are also important.

Frost-proof tiles

The ceramic tile industry has a uniform standard to test and recognise frost-proof tiles – UNE-EN ISO 10.545-12. Tiles that pass this test exhibit the manufacturer's frost-proof icon, and only such tiles should be used for frost-proof installations.

Use a waterproof membrane

Keep the substrate as dry as possible, so that it does not retain water. This may be by using a load-bearing waterproof membrane or a damp-proof membrane for slab on grade installations.

Adhesives and grouts

Cement is widely known to shrink during cure. Control of this shrinkage is critical to the final bond strength and density. The denser the final cement mortar, adhesive or grout, the stronger it is, the less water it will absorb and the less prone it will be to frost damage.

Latex or polymer modification of cement achieves controlled shrinkage and gives →

the cement the ability to withstand some expansion and contraction created by thermal cycles. The strands of polymer act as 'shock absorbers' and bridges to help accommodate thermal cycles (see Figure 1).

Install correct fall

Correct falls direct water towards appropriately placed drains. Installing correct falls is very important so that water is not retained on or in the system where it can freeze. General design standards are falls of 1:40 for tiled decks that are over habitable spaces and 1:50 for on-grade tiled installations.

Grout joint widths

With the advent of rectified ceramic tiles (tiles cut to exactly the same dimensions), there has been an increase in the number of tiles that are installed with no joints. This is *not* good practice, especially when you are designing a frost-proof installation. Closed joints render the tiled surface more rigid and increase the tensile stresses induced by any movement of the layers under the tile. This reduces the ability of the tiled surface to accommodate the stresses set up by frost.

Full adhesive contact

Full adhesive contact is important to promote bond strength and minimise the risk of voids appearing under the tile. Such voids could collect and retain water and then freeze.

Using the correct notch trowel and beating and/or twisting the tile into place are both important in maximising adhesive contact.

Use and place flexible joints properly

One of the main collection points of water is at floor to wall junctions. It is imperative to direct this water off the tiled surface into drains. Flexible joints are waterproof and so assist in making sure water is not absorbed at these collection points by the tiled system. They are also used to fill the appropriately placed expansion and/or control joints that are also an integral part of accommodating the stresses of frost.

Use a sealer

If the tile or stone is frost-proof and is not fully glazed, it can still absorb water. An appropriate sealer (that is not affected by frost) can be applied to reduce this absorption and therefore minimise water retention. Even if the tile is glazed, or has little to no water absorption, remember that most grout (even polymer modified) has relatively high water absorption. The grout can therefore benefit from the application of a sealer to greatly reduce this.

The frost-proof warranty claims of most ceramic tile manufacturers are dependent on the use of a full system along with a frost-proof tile for the warranty to be valid. With New Zealand experiencing frost cycles in most places, it is prudent to design exterior tiled installations with this in mind.