TECHNICAL BULLETIN – TB229

TILE FINISHES – FLOOD WATER IMMERSION

AUGUST 2024

INTRODUCTION

Knowing how flood water affects wall and floor tile finishes is important, particularly in residential dwellings. These effects can be varied depending on circumstances. This bulletin attempts to raise awareness of the factors involved regarding typical tile installations.

Tiles

Tile types are typically described by the ability of the tile to absorb water. The water absorption of a tile is expressed as a percentage of the dry weight of the tile. This can be dictated by the method of manufacture (e.g., extruded or dust pressed, once fired, or twice fired) and by the finish (i.e., glazed or unglazed). As a result, tiles with low water absorption rates (e.g., porcelain) will be unaffected by immersion in flood waters. Tiles with high water absorption rates (e.g., glazed clay tiles and terracotta tiles) will likely exhibit discoloration and staining. Natural stone tiles may also be subject to discolouration.

Installation of tiles

Traditional tile fixing methods involved fixing porous-bodied tiles in a wet cement mortar (i.e., the wet bed method) using a cement slurry as the bonding bridge between the wet mortar and the back of the tile. In this method, the tile was soaked in water before installation.

Due to better manufacturing processes, tiles are now made larger and less porous. These denser tiles are typically adhesive-fixed using thin-bed (i.e., up to 3mm bed thickness) or thick-bed (i.e., average 6mm bed thickness) polymer-modified cement-based adhesives. These adhesives are applied to the dry-prepared substrate using a notched trowel. Soaking before installation is no longer recommended.

The difference between these methods is that the traditional wet bed method usually achieves full contact behind the tile. In contrast, the notched trowel method can leave voids and holes in the adhesive layer under the tile.

Australian Standard 3958 has recommended a minimum adhesive contact area on the back of the tile and the substrate. The Standard provides recommendations in relation to tiles of different sizes. As the tile size increases, so does the recommended minimum notched trowel. This tends to overcome any concavity resulting from the firing process. Large format (i.e., >450mm square face size) tiles may be slightly concave (i.e., domed) across the back of the tile. This could mean the adhesive is not in complete contact to support the centre area of the tile unless the tile is pressed into the wet adhesive layer.

Back buttering of adhesive over the back of the tile is required to ensure the required adhesive coverage is achieved**.** Pressing with a back-and-forth sliding action collapses and squashes the adhesive lines, filling the voids and achieving a high adhesive contact area. The Standard recognizes that adequate adhesion can be achieved with less than 100% adhesive contact between the tile and the substrate except when the tiles are immersed in swimming pools. The Standard recommends solidly bedding the tiles to eliminate voids as completely as possible. Reduced contact of the adhesive to both the substrate and the back of the tile can increase the risk of bond failure. It is recognized that the most used trowel for fixing floor tiles of all sizes is a 10mm notch trowel. This may mean insufficient adhesive to fully bed large format tiles in a continuous adhesive layer.

AS3958 guidelines regarding minimum trowel sizes when fixing tiles of different sizes to internal areas that will dry after the tile installation.

- 200 x 200mm tiles – 8mm notched trowel
- 250 x 250mm tiles – 10mm notched trowel
- 300 x 300mm tiles – 12mm notched trowel
- 400 x 400mm and larger size tiles – 12mm notched trowel + back buttering of tile.

Note: The above trowel size guidelines apply to (C) cement-based & (R) reaction resin-based adhesives that can be applied in a continuous layer up to 10mm thickness. Dispersion (D) premixed paste adhesives are generally for thin bed applications up to 3mm thickness (maximum), as excessive thickness may lead to prolonged drying and shrinkage of the dispersion adhesive. The overriding instruction is that all adhesives will be applied following the manufacturer's instructions regarding bed thickness.

The standard guidelines regarding the recommended minimum contact coverage of the tile adhesive to both the tile and the substrates are as follows:

- Internal residential walls - 65%
- Residential floors – 80%
- Commercial and Industrial walls – 80%
- Commercial /Industrial floors – 90%
- Wet Areas and Swimming Pools – 90%
- External Walls – 90%.
- External floors, decks, and roofs – 90%

Flooding tiled areas with voids/holes in the adhesive layer fill these voids with flood water. The grout between the tiles (if intact) prevents penetration of water-borne contaminants and/or particulate debris. Most tile grouts, however, are cement-based and, therefore, porous.

Flood water

Flood water can contain various contaminants depending on where it has travelled. Water from agricultural areas can include pesticides and fertilizers, animal wastes, and bacteria from dead animals. It can also include fine debris such as grass, silt, and sand. In other areas, sewer systems can be flooded so that the effluent is forced back up the drains, and/or the treatment plants are flooded, so the effluent escapes uncontrolled. Industrial areas may provide contaminants such as oils, paint, hydrocarbon solvents, and other chemicals that may be hazardous and/or damaging to cement-based adhesives and grouts. For example, high concentrations of sulphate (expressed as SO_4^{2-}) can react and erode materials containing Portland cement. This means contaminants in the water may remain trapped in the voids between the tile and the substrate.

Drying

Drying out of tiled installations may take a long time due to the duration and degree of saturation that has occurred. Concrete floors are frequently tiled with dense (low porosity) tiles. Concrete and cement-based topping screeds are porous and relatively absorbent compared to porcelain floor tile. Concrete (and topping screeds) are also much thicker than the tile finish and thus absorb much water depending upon the duration of the flood. The perimeters of the tile finish and the grout lines are the main areas where drying by evaporation can occur after the flood waters have gone. Foul smells can become noticeable, and fungi/mould growth may become evident, along with efflorescent deposits appearing on the surface.

Floor tiling is generally done using cement-based adhesives, which are more suited to immersed conditions. However, the application method of the adhesives raises concerns about holes/voids in the adhesive layer, which can trap contaminants and result in foul smells and unhygienic conditions for the residents.

Concrete floor substrates are generally undamaged in flood events and can be cleaned, sanitized, and prepared for new tile finishes. However, timber flooring is often water-damaged, so removal and replacement are the only options before re-tiling or installing other floor finishes.

Some large-format tile installations may have utilized floor-leveling cement. This specialty leveling cement is typically not moisture resistant and, when immersed, will become soft and mushy. The result is that the tiles become loose, and the entire installation must be removed and redone.

Wall tiling is generally always replaced, as the internal wall substrates and sheet linings tend to be plasterboard and/or fibre cement sheeting. Removing these substrates allows the removal of accumulated sediment deposited in the wall cavities.

The above discussion is an introduction to the aftermath of exposing tile wall and floor finishes to contaminated flood waters.

Replacement of tile finishes has generally only been considered for wall tiling and substrates. Floor tiling generally remains because the appearance of the floor tiles tends to show little or no damage compared to the wall tile finishes. This may not be the safest option when the installation methods of the tiles and the prolonged drying of the contaminated areas are considered.

The effect of flood water immersion on moisture-sensitive tiles (e.g., some natural stone tiles) is not discussed, nor is the effect of substrate movement related to the flood event.

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