

FLOODED TILES DON'T ALWAYS NEED DEMOLITION

Flooding over floor tiles presents a number of unexpected influences acting on the tiling system, over and above what would be considered normal building service conditions, writes **Andrew Golle**.

Tiles may debond from the substrate, grout crack and dislodge, tiles break and peak off of the floor, allowing contamination to enter the tiling system as solid sludge or pathogenic contaminants through grey and black water inundation.

Tiling is not considered an easily replaceable building element, such as flood affected carpet, underlays, cabinetry or even internal wall linings. Tiling should therefore be inspected for defects and assessed against future serviceability to determine whether replacement is warranted, or localised repairs considered as an effective remediation.

Functional defects occur where the intended performance of the building system fails. For example, the intended function of a tile is to be adhered in place to the substrate, and not break under the intended normal use and building movement. If that tile becomes loose, drummy, or cracks under normal use, the function has failed and therefore is defective.

Tiling that has been inundated by events such as rising rivers, overflowing septic systems may be contaminated to the point that it is a potential health risk and adversely affects the health and amenity of the building occupants.

NCC [National Construction Code] and Australian Standard AS 3958.1 – 2007 *Guide to the Installation of Ceramic Tiles*, provide performance requirements of the building and prescriptive requirements for tiling installation. Breaches of these requirements may adversely affect the performance of the tiling system and be contributing factors in functional defects appearing when a flooding incident occurs. Prescriptive breaches are also defects that may adversely affect the overall service performance of the tiling system, and should be noted and taken into consideration when assessing the causes of functional failure.

Common installation breaches that may impact on the performance of the tiling system are:

1. Ineffective movement joints may result in cracked grouting or bond failure. Intermediate movement joints isolate tiled areas into separate bays, allowing for differential substrate movements and shearing action experienced throughout the life of the tiling system. Bays that are not isolated with compressible jointing will apply stress on surrounding tiles, compounding differential movement stress throughout the floor. This may place the adhesives under shear stress over and above expected parameters, especially when exposed to the shock cyclic movement experienced through saturation and then forced rapid drying.



Tiles peaked floor.



Tiling pinned skirting.

2. Sub-sized grout joints, may impact on the movement tolerance of the tiling system, where independent movement between tiles is compromised. AS 3958.1– 5.4.6[c] requires a minimum floor joint size of 3mm for dust pressed floor tiles. Large format floor tiling with a 1.5mm grout joint or even smaller is a breach of the Standard and compromises independent movement between tiles where, in some cases tiles are actually abutting each other at the base of the joint.
3. Minimised adhesive bed thickness compromises the shear tolerances expected within the tiling system. Most thin bed

adhesives require a final adhesive thickness of 3-5mm. This is achieved by selecting the correct sized notched trowel, back buttering of the tile and allowing for inconsistencies in substrates and tiles. Most S1 and S2 adhesives rely on polymer modification within cement-based paste, some containing fillers. Up to 5mm of shear tolerance for S1 adhesives, and above 5mm for S2 adhesives is expected where the correct glue thickness is achieved. *You will notice that I am referring to shear tolerance and not flexibility.* The bed thickness becomes critical where deformations to the expected ranges are catered for. Minimal adhesive bed thicknesses result in broken bonds where the shear tolerance doesn't even reach 1 to 2mm.

DEFECT INSPECTION PROCEDURES & WATER BASED DIRT

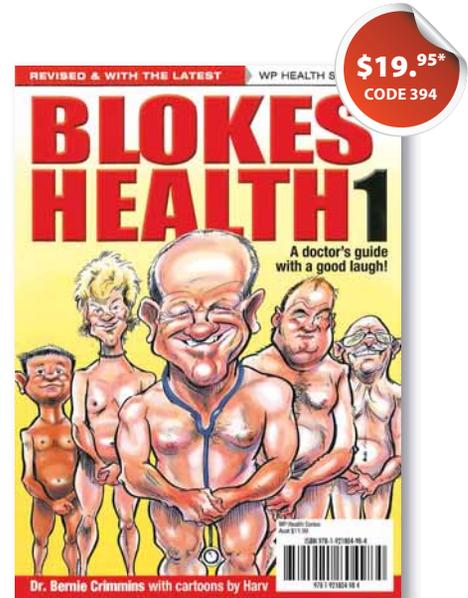
Sludge inundation over tiles does not automatically indicate that sludge contamination will be beneath the tiles. Tiling that is bonded and sound, at the time of 'sludging' will act as a sand filter. Mud, or 'water based dirt' will leave sludge contaminants on the surface of the tiles, as water permeates the porous tiling system through capillary action and hydrostatic pressure. Any sludge contamination beneath tiles would indicate that the tiles were already loose prior to the flooding event, allowing solids to flow and fill in available cavities under the tiles.

Tiles with residual moisture beneath them are not considered defective, unless black water contamination has occurred. Tiles, grouts, adhesives and screeds are all porous and water resistant. Suspect areas should be allowed to dry out and then re-inspected and resonance tested for bond failure.

Areas inundated by grey or black waters should be assessed for microbial pathogens, be sanitised, and retested prior to considering the tiles being suitable for occupied use.

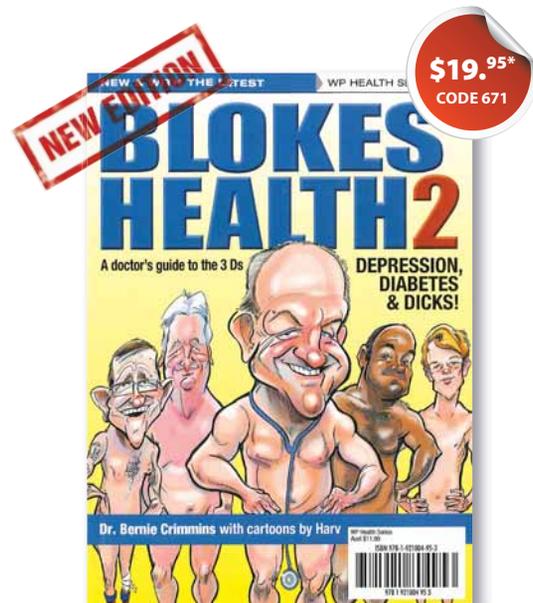
INSPECTION CONSIDERATIONS

- Tiles may become drummy or debonded as a result of saturation through flooding, and shock differential movement associated with drying cycles.
 - Silt and sludge will rarely permeate sound bonded tiles as the grout, tile and adhesives act as a filtration, like a sand filter. Debonded tiles as a result of flooding will normally be clean beneath the tile, even though mud and sludge is above.
 - Sludge residue beneath debonded tiles will indicate that the tiles were already debonded prior to the flooding event.
 - Suspected tiles can be investigated by drilling through the grout joint adjacent to the drummy tile. The drill tailings should be observed.
 - Any sludge residue would indicate defective tiles prior to the event.
 - Clean grout residue would indicate bond failure as a result of the event
 - Wet or damp grout tailings do not indicate a defect as yet, and the area should be allowed to dry before retesting for bond failure.



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- Flood affected tiling should be thoroughly dried out with extractor fans, or de-humidifiers. Sludge or black water affected tiles should be tested for pathogens, and sanitised.
- General tiling installation falls under the regulation of AS 3958.1 – 2007, *Guide to the Installation of Ceramic Tiles*. Tiling older than 2007 will be regulated by AS 3958.1 – 1991.
- Visual inspection of suspected defective tiling should include observation of functional failure defects such as broken tiles, compression of movement joints, cracked grouting and drummy tiles.
- Dislodged tiles and cracked grouting should be inspected for evidence of previous damage as a long standing defect. Encrusted dirt, hair and other contaminants in cracks or beneath debonded tiles are evidence that the defect may have been existing prior to the flooding event.
- Resonance testing of drummy tiles should be conducted, and assessed against AS 3958.1 requirements.

AS 3958.1 4.7 Bond Failure.

- "... where more than 20% of the tile sounds hollow when tapped ('drummy') would have to be considered suspect over the long term... depending on.. Whether the tile is fixed to floor or wall
- Anticipated form and amount of traffic

AS 3958.1 5.6.4.2 Minimum Recommended Contact Coverage

- Internal residential walls 65%
- Residential floors 80%
- Commercial & industrial walls 80%
- Commercial & industrial floors 90%
- Wet areas 90%
- Swimming pools 90%
- External walls 90%
- Exterior floors, decks & roofs 90%

- Visual inspection of tiling should take into consideration the age of tiling at installation. Wet area tiling is subject to compliance with AS 3740 – 2010, as referenced by NCC. This applies to installations post BCA 2012. Installations pre 2012 would refer to AS 3740 – 2004.
- Waterproofing membranes, installed in wet areas, may be subject to bond failure as a result of negative pressure occurring behind the membranes during the flooding event. This is prevalent where optimum bond to substrate is compromised by the plaster setting of sheet joints, external corners and sheet fixings beneath the membrane. Membrane manufacturers should be consulted to assess the likely performance of their products when a flooding event is a factor.
- Functional isolated water testing to wet area membrane systems should be carried out, following drying out procedures and minor isolated repairs, should the existing membrane system be left in place.

Consideration should also be given to pressure build up and sudden release upon removal of fittings, skirtings and wall linings. Often tiling systems are pinned down by such



Tile sludge floor .



Tiles adhesive shear.

elements, and sudden removal may shock tiling from its bonded state to the substrate.

Flooding events can be catastrophic; however it doesn't necessarily mean that the bulldozers need to knock everything over and to rebuild from scratch.

Assessment and guidance from adhesive and membrane manufacturers, and consideration given to contributing factors and ongoing performance of the tiling system need to be weighed up against the disruption associated with complete removal and replacement of flooded tiling. ■