

Floorensics Inc.'s Perspective on the Impact of Flooding on Ceramic Tile Flooring Installed Over Concrete

An Official Position Paper by Floorensics Inc.

At Floorsincs Inc., we aim to provide clear, factual information about the performance of ceramic tile flooring installed over concrete when exposed to water or prolonged saturation. This paper outlines the factors that influence the durability of tile floors, focusing on Portland cement-based thin-set mortar or other mortar beds. While properly installed tile flooring is generally resistant to water-related damage, failures often occur due to improper installation practices, inadequate substrate preparation, or outdated methods that relied on non-standard materials.

Position Statement

Properly installed ceramic tile floors using Portland cement-based mortar over concrete are highly resistant to water saturation. However, failures can result from improper installation methods, inadequate substrate preparation, or long-term exposure to elevated moisture levels. This position paper highlights these factors and explains the specific circumstances under which tile floors may fail.

Floorensics Inc.'s position in such cases is that if a ceramic tile floor sustains water damage that could have been avoided with proper installation, the primary cause of the damage is improper installation, with water intrusion acting as the triggering factor. In other words, if a ceramic tile floor fails due to stresses that a properly installed floor would have been designed to withstand, the root cause of the damage is improper installation.

Floorensics Inc. does not take a position on property liability coverage in cases where a triggering event alters the condition of an improperly installed floor—if the floor's condition would not have changed without the triggering event, regardless of the improper installation. Our goal in such cases is to provide an accurate assessment of the triggering event's impact and other contributing factors, such as material properties and installation methods. This ensures that stakeholders can make informed decisions regarding property liability insurance and related matters.

Key Considerations

Installation

1. Improper Substrate Preparation

Proper substrate preparation is critical for achieving a strong, durable bond between the mortar and the concrete. Contaminants on the slab can compromise this bond, especially under wet conditions. Common contaminants include but are not limited to:

Paint Overspray: This creates a physical barrier that prevents adhesion. Overspray can dissolve in moisture and interact with elevated alkalinity in the concrete, weakening the bond.

Dust, Oil, and Curing Agents: These create a physical barrier that prevents adhesion.

Old Flooring Adhesive Residue: Residue from previous installations resists bonding and increases the likelihood of failure.

Removing contaminants and preparing the slab to meet industry standards are essential for ensuring the durability of tile floors. The National Tile Contractors Association guideline states:

“Remove all surface contaminants to expose a clean concrete substrate using a grinder or by shot blasting to achieve a minimum ICRI profile of 3. Remove all loose contaminants using a vacuum. Do not use a scrape away type machine as this may leave a thin residue which is difficult to bond to.”

© *NTCA Reference Manual*. 2018 / 2019 ed., Chapter 2: Substrates, The National Tile Contractors Association.

2. Expansion Joints and Structural Design

Expansion Space: Proper expansion spaces are essential in tile floor installations to accommodate natural movement caused by changes in moisture levels, temperature, or humidity. Without these spaces, moisture-sensitive materials—such as wood baseboards, cabinets, or other adjoining components—may expand during flooding, placing compressive stress on the tile floor. This stress can create shear forces that break the bond between the tile and the substrate.

Inadequate expansion space can lead to issues such as bond failure, grout damage, cracking, and even "tenting" due to normal substrate movement. To prevent these problems, industry standards, including EJ 171 from the Tile Council of North America (TCNA), provide guidance on the proper placement of expansion joints.

Grout Joint Spacing: Sufficient grout joint spacing is critical in tile installations to accommodate natural movement caused by changes in moisture levels, temperature, or humidity, as well as to ensure proper alignment and adhesion. Grout joints provide the necessary flexibility to absorb movement, reducing the risk of tile stress or failure.

Industry standards explicitly state that grout joints must never be less than 1/16 of an inch. Smaller joints can restrict movement and lead to issues such as cracking, bond failure, or tile "tenting." For larger tiles or tiles with dimensional variations, grout joint spacing should be increased to account for irregularities and to maintain the structural integrity of the installation.

Properly sized grout joints also play a vital role in the aesthetic and functional performance of the floor, helping to prevent issues like lippage and ensuring that the grout bonds effectively to the tile edges. Following these guidelines, as outlined by industry standards, helps prevent failures and ensures a long-lasting, professional installation.

3. Non-Industry Standard Crack Isolation Membranes

Industry-approved crack isolation membranes are generally resistant to water and are unlikely to fail under saturation. However, improper practices involved the use of non-standard materials that are highly susceptible to moisture-related damage, including:

Scribing Felt: Contractors in the past sometimes used scribing felt as a crack isolation membrane. The adhesives used with scribing felt and the felt itself are highly susceptible to water damage, and their bonds to the substrate and tile deteriorate when exposed to moisture. Additionally, scribing felt can act as a food source for microbial growth in saturated conditions.

Roofing Paper or Asphalt Felt: Materials like 15-pound felt or roofing paper were occasionally used as makeshift moisture vapor retarders/crack isolation membranes. These materials, along with their adhesives, are vulnerable to water damage, and the organic content of the paper can contribute to microbial propagation when wet.

Abandoned Sheet Vinyl: Old sheet vinyl left in place under tile installations presents similar risks. Adhesives beneath the vinyl and the vinyl itself can degrade under prolonged moisture exposure, leading to tile debonding and potential microbial concerns.

Tile floors installed with these non-industry standard materials generally require removal if substrate moisture is detected following flooding or prolonged saturation.

Effects of Water Intrusion

Ceramic tile floors installed over concrete are generally water-resistant or waterproof, providing a durable and reliable surface for various environments. However, certain conditions may impact their performance.

1. Expansion of Saturated Materials

Ceramic tile floors can become damaged or lose their mortar bond when insufficient expansion space is included during installation. During flooding, moisture-sensitive materials like baseboards, drywall, or cabinets can expand into the tile, placing the floor under compressive stress. This compression creates shear forces that can break the bond between the tile and the substrate. Additionally, the lack of

expansion space makes it difficult to remove wet materials, such as baseboards or cabinets, without causing further damage to the tile, exacerbating the problem and complicating repairs.

2. Localized Failures from Slab Leaks

When slab leaks occur, especially hot water leaks, localized issues such as thermal expansion or substrate rehydration can lead to mechanical bond failures. These failures are typically confined to the area directly above or near the slab leak.

Identification: A high concentration of hollow-sounding tiles directly over the affected area is a common indicator of slab leak-related damage. By contrast, a uniform distribution of hollow tiles throughout the floor is more likely due to systemic installation issues or substrate deficiencies.

Cause: The expansion of the substrate or tile caused by thermal changes or water absorption generates shear forces that exceed the bond strength of the thin-set mortar.

Every type of building material has a coefficient of thermal expansion, which describes the relationship between temperature changes and material expansion. Although the surface area expansion of tile floors or concrete slabs is relatively small compared to many other materials, even minimal movement can result in mortar shear. This is why movement joints are essential in tile flooring installations.

3. Trapped Moisture and Long-Term Risks

While short-term moisture in a concrete substrate is rarely problematic for properly installed tile flooring, long-term saturation can lead to several issues:

Moisture Vapor Emissions: Prolonged moisture retention in the slab can lead to moisture vapor emissions, which may, in extreme cases, occur in areas beneath cabinets or fixtures. These emissions can be mitigated with a vapor retarder, depending on the amount of trapped moisture.

Salt Migration: When water dissolves salts in the concrete and evaporates, the salts migrate upward and recrystallize. This process can create pressure that damages thin-set mortar, other mortar beds, and grout.

Custom Concerns: In situations where trapped moisture volume may not pose a significant risk, elevated substrate moisture readings detected by an electronic moisture meter can still raise concerns for homeowners. Addressing these concerns effectively can be challenging for mitigation or flooring contractors, potentially leading to misunderstandings or liability risks if the homeowner's concerns are not sufficiently resolved.

4. Clay Tiles and Saltillo Pavers

Clay-Based Tiles and Saturation: Clay-based tiles, such as Saltillo pavers, are more vulnerable to long-term saturation compared to porcelain tiles. Although their glazed or sealed surfaces are water-resistant or waterproof, the underside of a clay tile can absorb up to 7% of its weight in water, making them susceptible to moisture-related issues over time.

Water Absorption and Expansion: These tiles can absorb water from the underside, leading to expansion and eventual debonding from the substrate.

Organic Composition: Some clay tiles contain organic compounds that can support microbial growth in wet conditions, raising concerns for homeowners.

Conclusions

Properly installed ceramic tile flooring over concrete is designed to withstand short-term water saturation. Failures typically arise from one or more of the following:

1. Insufficient space for expansion, including inadequate grout joint spacing.
2. Improper substrate preparation, including the presence of contaminants like paint overspray, dust, or adhesive residue.
3. Use of non-industry standard crack isolation membranes such as scribing felt, roofing paper, or abandoned sheet vinyl.
4. Localized mechanical stresses caused by slab leaks or excessive substrate saturation.
5. Long-term substrate moisture retention, which can in some instances result in excessive moisture vapor emissions, salt migration, or microbial concerns.

By adhering to industry standards for substrate preparation, material selection, and installation practices, most water-related failures can be prevented.

This document is provided as an informative resource and reflects the professional stance of Floorsinck Inc. on ceramic tile installations over concrete. We aim to help stakeholders understand the conditions under which these installations can fail and emphasize the importance of proper practices in ensuring durability.

Sources

© NTCA Reference Manual. 2018 / 2019 ed., The National Tile Contractors Association.

© TCNA Handbook for Ceramic, Glass, and Stone Tile Installation. 2020 ed., Tile Council of North America.

© Portland Cement Association. *Design and Control of Concrete Mixtures.* 14th ed., 2002.

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