

NTSA Forensic Methods Series

Finding the Failed Interface

Why “The Tile Debonded” Does Not Explain Where or Why the Assembly Failed

We have examined installations where everyone agreed that the tile had debonded. The phrase sounded precise. It was not.

At one location, mortar remained firmly attached to the substrate while the tile back was nearly clean. At another, the membrane lifted with the mortar. Elsewhere, mosaic pieces separated within a factory-applied mounting system. Each area ended with loose tile, but the assembly did not fail at the same place.

That distinction can change the entire causation analysis. “The tile debonded” describes the result. It does not identify the failed interface, the mechanism that produced the separation, or the work or product that should be investigated next.

Before an expert explains why an assembly failed, the expert must first determine where it failed.

“Debonded” Is a Result, Not a Location

Tile and stone assemblies may contain several materials and several interfaces. Tile may be bonded to mortar. Mortar may be bonded to a membrane, underlayment, mortar bed, or substrate. Mosaics may include mesh and mounting adhesive. Stone may include resin, reinforcing fabric, coatings, or other factory-applied materials.

Separation may occur between two materials or within one of them. Calling the condition a debond identifies that the assembly no longer remained together as intended. It does not identify where continuity was lost.

Read the Assembly Layer by Layer

A useful investigation reconstructs the assembly in the order it was built. What is attached to the back of the finish material? Which setting material was used? Is there a membrane, coating, resin, mesh, or primer? What supports the bond coat? Which layer remained with each side after separation?

If mortar remains on the substrate and little remains on the tile, the tile-to-mortar interface deserves attention. If the mortar and membrane lift together, the membrane-to-substrate interface may be more important. If a factory-applied backing separates internally, the field-applied mortar may not explain the release at all.

The interface does not determine causation by itself. It identifies where the investigation should concentrate.

Adhesive, Cohesive, and Mixed Separation

A separation between two materials is commonly described as adhesive failure. A fracture within one material is commonly described as cohesive failure. Field conditions, however, are often mixed.

ISO 10365:2022 provides standardized designations for the principal failure patterns of bonded assemblies and can assist in distinguishing adhesive, cohesive, substrate, and mixed failure patterns.

Mortar may remain on both surfaces because it fractured internally. A membrane may split while portions remain attached to each side. Stone, resin, mesh adhesive, or a coating may fail within its own thickness. The expert should describe what is present rather than forcing a complex fracture into a single label.

Residue can support the analysis, but it does not decide it. Fracture texture, contamination, moisture exposure, curing history, and the method of removal may all affect what remains visible.

Removal Can Create a New Separation Plane

The interface exposed during destructive removal is not automatically the interface that failed during service.

A loose tile may release with little force and preserve the original plane. An intact tile may require prying, impact, cutting, or leverage that creates a new fracture in the mortar, membrane, substrate, or tile.

ASTM E860-22 establishes procedures for documenting evidence when examination, disassembly, or testing may alter its nature, state, or condition and potentially limit later examination.

Residue may be transferred or smeared. A membrane may peel after the bond coat has already fractured. A factory-applied backing may tear because of the removal process rather than the original distress.

This does not make destructive examination unreliable. It means the tools, force, sequence, and condition before removal must remain part of the interpretation.

Compare Both Mating Surfaces

A removed component and the exposed surface below should be documented as a matched pair. If mortar remains on the substrate, what remains on the tile? If a coating or mesh appears on one side, is the corresponding material missing from the other? Do the surfaces fit together, or has removal created additional damage?

Orientation and location should be preserved. Photographing only the back of the removed piece can produce an incomplete record. Cleaning, scraping, washing, or stacking materials may erase residue or relationships that later become important.

ASTM E1188-23 provides corresponding guidance for collecting, identifying, and preserving information and physical items so that the evidence remains traceable to the incident and available for later analysis.

One Project May Contain More Than One Failed Interface

Large installations do not always fail uniformly. One area may separate at the tile-to-mortar interface, another at a membrane, and a third within the substrate or a factory-applied backing. Product changes, exposure, repairs, different crews, and local construction details may produce different conditions within the same project.

The expert should map where each interface was observed and whether it corresponds with the reported distress. A single dramatic sample should not be treated as the condition of the entire installation without support.

Performing areas can also be informative. If the same alleged deficiency exists where the installation remains sound, the expert should identify what distinguishes the failed area. A reliable theory should explain both where distress occurred and why apparently similar areas continued to perform.

Testing Must Answer the Interface Question

Testing is useful when field evidence leaves a specific uncertainty involving material identity, moisture sensitivity, contamination, bond performance, a factory-applied coating, or residue at the separation plane.

The selected test should address that uncertainty. A general material test may provide valid data while doing little to explain the interface. A bond-strength test may create a new fracture plane. A laboratory finding from an unrepresentative specimen may not describe the installed condition.

The expert should be able to explain why the specimen was selected, what question the test was intended to answer, and how the result relates to the field evidence.

The Report Should Name What Failed

A report that states only that “the tile debonded” leaves the most important part of the analysis unstated. More precise language identifies the observed separation plane and the limits of the finding.

For example: Removal at the sampled location exposed separation primarily between the porcelain tile back and the field-applied mortar, with mortar remaining attached to the membrane below.

A different location may require different language: The sampled mosaic pieces separated within the factory-applied mounting system, while the field-applied mortar remained attached to the mesh-backed sheet.

Those statements do not automatically establish why the interface failed.

They create a traceable factual foundation for the causation analysis. The report should then explain the supporting evidence, meaningful alternatives, the effect of removal, and whether the sampled locations represent the broader installation.

Under oath, the expert should be prepared to explain where the assembly separated, how the in-service plane was distinguished from test damage, whether other samples failed the same way, and what evidence connects that interface to the assigned cause.

Final Thoughts

Loose tile is an observable condition.

A failed interface is a technical finding.

A failure mechanism is an opinion that must connect that finding to the full body of evidence.

Those steps should not be collapsed into one word.

Because saying that the tile debonded tells us what the installation looked like at the end. It does not tell us where the failure began.

Technical References

- [ASTM E860-22, Standard Practice for Examining and Preparing Items That Are or May Become Involved in Criminal or Civil Litigation](#)
- [ASTM E1188-23, Standard Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator](#)
- [ISO 10365:2022, Adhesives: Designation of Main Failure Patterns](#)

Gil Chotam, CTC, CSI, CDT

Principal Forensic Consultant
and

Greg Andrews, CTC

Principal Forensic Consultant
National Tile and Stone Authority

For forensic consulting or expert-witness assistance involving tile, stone, waterproofing, or pool-tile matters, submit a brief [NTSA inquiry](#).