Tile/Stone Talk:
Avoiding Indent Fractured Tile Assemblies

By Gregory Mowat, Forensic Tile Consultants

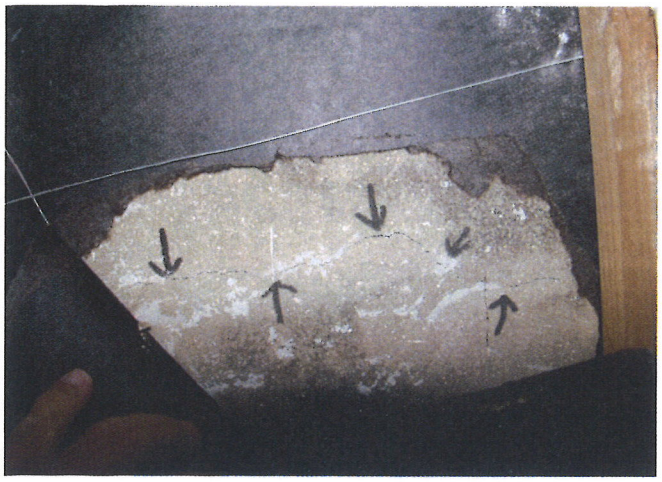
Indent fractures start as very fine, barely perceptible hairline cracks coinciding with extremely slight depressions or indents in the tile surface. Indent fractures are noticed within weeks or months after the tile or stone is installed.

An indent fracture is a stress crack which progresses (continues to grow in length and/or width in time) and transfers upward and outward from the underlying assembly through the tile or stone and grout. The indent creases may be a straight line — where a backerboard is not installed to the backerboard manufacturer's requirements, or in a random spider web or eggshell cracking pattern, which is typical where the mortar is installed thicker than the mortar manufacturer recommends or with uneven thickness.

The **most common causes** and solutions of indent fractures on **walls** are:

- **The result of inconsistent thickness of the scratch coat and/or mortar bed (brown coat):** Inconsistent scratch coats can be solved by installing and lapping paper-to-paper and wire-to-wire. Properly fasten the expanded metal lath into wood studs, or metal studs. Do not fasten the expanded metal lath into any drywall backing. Do not use ½" staples to fasten the expanded metal lath into the substrate. A recommended assembly is W222 with a one coat float over solid backing for consistent depth of the assembly.
- **Lack of proper fastening of 2.5 or 3.4 pounds per square yard expanded metal lath into the studs or solid backing.**
- **Inadequate installation of backer board:** To install backer board, follow the manufacturer's installation instructions explicitly. See ANSI A118.9 American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units and ANSI A108.11 Interior Installation of Cementitious Backer Units, if needed.

Indentation caused by concrete slab crack.



Cracked mortar at thin location of mortar caused indentations.

- **Inadequate coverage and contact of the setting mortar:** To solve this problem, apply mortar following ANSI installation standards with the flat side of the trowel over an area no greater than what can be covered with tile before the mortar skims over. Using a notched trowel recommended by the mortar manufacturer, comb the mortar to obtain an even setting bed without scraping the backing material. Cover the surface uniformly with no bare spots with sufficient mortar to ensure a minimum mortar thickness of 3/32" (2mm) between the tile and backing **after** the tile has been beaten into place. Then, press the tile into freshly combed mortar, ensuring contact with tile. Maintain joint alignment and spacing. Keep an adequate joint depth open for grouting.

  Average uniform contact area shall be not less than 80% except on exterior or shower installations where contact area shall be 95% when no less than three tiles or tile assemblies are removed for inspection. The 80% or 95% coverage shall be sufficiently distributed to give full support for the tile with attention paid to this support under all corners of the tile.
- If 95% coverage is specified in the project specifications, then back butter each tile with bond coat; or select a notched trowel to facilitate the proper coverage, key the mortar into the substrate with the

Photos courtesy Forensic Tile Consultants

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Improper scratch coat, not lapped paper-to-paper, wire-to-wire.

flat side of the trowel, and comb with the notched side of the trowel in one direction. Embed the tile in the mortar by beating it in, pushing in a direction perpendicular to the combed ridges, or other means to achieve the specified coverage. The method used should produce maximum coverage with the corners and edges fully supported. Periodically remove a tile to assure that proper coverage is attained.

- **Not following the mortar manufacturer's mixing and installation directions and installing too lean or too rich a mortar.**
- **Wall deflection:** Follow industry standards. Wood studs to be dry and well braced, minimum depth 3½", metal studs well braced; 20-gauge or heavier; minimum depth 3½" for residential application or 35/8" for commercial applications. Avoid green lumber wood studs and make sure stud spacing is not too far apart.

The most common causes of indent fractures on tile and stone floor assemblies include:

- **Too thick of mortar resulting in shrinkage cracking of the mortar:** Level the floor prior to installation.
- Improper installation of backer boards: Follow backer board installation instructions explicitly. Marble will have white stress lines directly above the seam intersection when the backer board is not properly installed. Tile and stone will crack directly above the seam intersections when the backer board is not properly installed. Where the backer board is installed by others, verify that the installation meets the manufacturer's installation requirements.
- **Installation over concrete slab subject to cracking:** Tile or stone, directly bonded to concrete slab and concrete slab above grade, are subject to cracking where the underlying concrete slab cracks. Even post-tensioned concrete slabs are known to have shrinkage cracks. Minor shrinkage cracks transferring through the tile or stone may be avoided by installing an ANSI A118.10 waterproof membrane, an ANSI A118.12 crack isolation membrane or a membrane meeting both ANSI A118.10 and ANSI A118.12 requirements.

  The Natural Stone Institute recommends installing an ANSI A118.10 waterproof membrane any time stone is to be installed over a concrete slab. Where the membrane is installed by others, verify the membrane meets tile industry standards and the membrane is not a roofing membrane. Portland cement mortar is not compatible for direct bond of tile and stone to roofing membranes. Confirm that the concrete slab is without contaminants including paint, drywall mud, stain overspray applied to cabinet finishes, curing compounds, waxy or oily films, mastic residue or laitance.
- **Inadequate installation of radiant heat assembly:** The solution to inadequate installation of radiant heat assembly is to follow the radiant heat manufacturer's instructions explicitly, and/or installation detail in the *Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation.* Where the area is large, validate if movement joints are necessary and coordinate installation or all movement joints as such. Where the assembly is subject to moisture intrusion, verify the assembly will egress moisture out of the assembly. An exterior deck assembly requires proper planning and installation for slope, egress of moisture in the assembly and movement joints.
- **Inadequate installation of sound rated assembly:** Follow the sound-rated assembly by the manufacturer's installation instructions explicitly and/or installation detail in the *Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation*. Where the area is large, check if movement joints are necessary and coordinate installation or all movement joints. Bonded sound reduction membranes may be trowel-applied, sheet, or use composite membranes that are bonded to a suitable substrate so the tile can be directly bonded to the sound control membrane.

  Further, the sound control membrane for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation is ANSI A118.13. Verify the sound control membrane being installed meets the industry standard. Again, **follow the sound control membrane manufacturer's installation instructions explicitly.** Confirm that the floor is level/flat and acceptable prior to the installation of sound control membrane. The finish flatness requirement for the floor prior to installation of a sound control membrane is ¼" in 10 ft. for tile and 1/8" in 10 ft. for stone tile installations. Do not install thin, self-leveling underlayment over the top of sound control membranes.
- **Attachment of wire reinforcing into wood subfloor:** Wire reinforcing into wood subfloor is only for very small areas of tile or stone. Wire reinforcing attached to a wood substrate will transfer movement that occurs in the wood substrate caused by moisture,

temperature, and/or movement of the wood substrate. A wire-reinforced mortar setting bed following ANSI A1081A, A108.1B, or A18.1C is not recommended to be attached to the wood subfloor.

- **Direct bond to wood substrate:** Above-grade concrete slabs are subject to curling or having one area higher in elevation. Peel-and-stick membranes include maximum thickness of setting mortar at 3/8" after beat-in for installation of tile. Do not use spot-set mortar, and make sure to follow mortar manufacturer's installation. See the ANSI installation recommendations mentioned above for applying mortar on walls.

For areas adjacent to perimeter walls and furniture (cabinets), keep in mind:

- The concrete slab must be able to absorb water for installation of tile or stone, installation of an ANSI A118.10 waterproof membrane, ANSI A118.12 crack isolation membrane, radiant heat assembly or sound-rated assembly.
- Pour water on the concrete slab and watch the water absorb into the concrete slab, reject the concrete slab finish, or scarify the concrete slab surface.
- **Always** use perimeter isolation where abutting restricting surfaces.
- **Movement/expansion joints are mandatory** for areas exceeding 24 ft. in length or 12 ft. in length when exposed to sunlight or in wet areas and directly over any cold joints in the underlying concrete slab control joints.
- The solution to installing tile or stone over a floor subject to deflection is to reject the assembly or change to a wire-reinforced mortar setting bed recommended by the mortar manufacturer.

Lastly, the above reference to ANSI A118.10 requirements include installation requirements in ANSI A108.13 Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone. Also, the reference for ANSI A118.12 includes installation requirements in ANSI A108.17 Installation of Crack isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone. **PROINSTALLER**

About the Author:
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