Forensic Tile Consultants
9541 Vervain Street
San Diego, CA 92129-3523
(858) 484-8118,
Fax (858) 484-8302
E-mail tile4n6@aol.com (Greg),
E-mail showerxpert@yahoo.com (Don)

Indent Fractured Ceramic Tile and Stone Tile Assemblies
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Indent fractures are distinct stress cracks found in ceramic tile and stone tile assemblies. The locations of the indent fractures can vary from horizontal surfaces, such as floors or decks, to vertical surfaces, such as shower walls and veneer.

The indent fracture is a stress crack which transfers from the underneath side of the tile or stone tile assembly. The Indent fracture is a crack which is progressive (continues to grow with time) and transfers upward/outward through the surface of the ceramic tile or stone tile assembly. The surface of the ceramic tile or stone tile is the last part of the assembly to actually break. The indent fracture cracks are first discovered by observing the ceramic tile or stone tile surface in a reflected light. Typically indent fractures first appear as an indent crease or fold which shows up on the surface of the tile or stone assembly. At first the indent fractures are not completely cracked through to the surface of the tile or stone assembly. The creases may be in a straight line or, as more often found, in a random “spider web” or “eggshell” cracking pattern. On floor assemblies, the indent fractures (creases/cracks) normally show up in foot traffic areas first.

Floors

Causes of the indent fractures on floors can vary from substrate deflection issues or improperly prepared concrete, to moisture issues, and mortar shrinkage issues.

Substrate deflection issues or improperly prepared concrete include:
Loss of bond due by adhesion failure due to contaminants not scarified from the top of concrete slab. Contaminants include paint, drywall mud, cabinet stain overspray, mastic remaining from carpet or resilient floor removal, curing compounds, and/or over burnished concrete slab;
Improper installation of backer boards by not following manufacturer' explicit instructions;
Improper designed or installation of wood sub floor and/or framing support including plywood not thick enough, too wide of spacing of joists, or oriented strand board;
Attachment of wire reinforcing into wood sub floor in which wire reinforcing transfers stresses from the wood sub floor movement into the ceramic tile or stone tile assembly;
Installation of ceramic tile or stone tiles with direct bond to concrete slab which allows cracking occurring in a concrete slab to transfer up through the ceramic tile or stone tile assembly;
Lightweight underlayment improperly installed with shrinkage cracking of underlayment transferring up through the ceramic tile or stone tile assembly;

Moisture issues include:
Stone and stone tiles installed over a waterproof membrane and/or crack isolation membranes in which the membrane has no perm rating or has 0 perm rating and excess moisture/vapor from the curing of the mortar is only up through the stone and stone tile assembly. The moisture/vapor migration creates uneven hydration of the stone or stone tiles and may result in doming or curling of the stone and stone tiles;
Installing slip sheet with mastic directly bonded to the concrete slab. Long term moisture migration/vapor emission from the concrete slab and/or break down of

the mastic contributes to loss of bond between the concrete slab and the slip sheet.

Mortar shrinkage issues include:

Installing manufactured thin set thicker than 3/8-inch than the thin set was manufactured for installation of ceramic tile and stone tile installations. The thin set installed too thick creates shrinkage of the thin set which can fracture the ceramic tile and stone tile assemblies, in addition to adding more moisture which can contribute to doming and/or curling of stone tiles;

Medium bed mortars are recommended for large format tiles. Medium bed mortars are designed for less shrinkage and have less moisture. However medium bed mortars installed thicker than ¾-inch creates shrinkage cracking in the mortar during curing, which can fracture the ceramic tile and stone tile assemblies, in addition to adding more moisture which can contribute to doming and/or curling of stone tiles;

Installing too lean of a mortar bed mix, or too rich of mortar bed mix, which creates shrinkage of the mortar which can fracture the ceramic tile and stone tile assemblies;

Installing the ceramic tile or stone assembly with insufficient mortar, which creates stresses between the bonded and unbonded adhesion on the ceramic tile and stone tiles;

Installing too large of an area without expansion joints relief which creates stresses of expansion and contraction on the ceramic tile or stone tile assembly;

Installation of crack isolation membranes meeting ANSI A118.12 where the crack isolation membrane (installed with mastic/organic adhesive) installed will not perform under tension where thin set mortar is installed too thick, medium bed mortar is installed too thick, or excess moisture above the crack isolation membrane contributes to uneven hydration of stone or stone tiles causing doming and/or curling of stone tiles;

Installation of load bearing, bonded, waterproof membranes meeting ANSI A118.10 where the waterproof membrane installed will not perform under tension where thin set mortar is installed too thick, medium bed mortar is installed to

thick, or excess moisture above the load bearing, bonded, waterproof membranes contributes to uneven hydration of stone or stone tiles causing doming and/or curling of stone tiles.

Indent fractures are common in tile assemblies where peel and stick type membranes and/or non-bonded waterproof membranes and/or non-bonded sound reduction membranes are installed with natural stone tile material installed with thin set thicker than 3/8-inch and medium bed mortars are installed thicker than ¾-inch;

Installation of moisture sensitive stone tiles with mastic installation as the component directly bonded to the concrete slab. The tension from curling and/or doming from uneven hydration of the moisture sensitive stone tiles are stronger than the adhesion of the mastic to the concrete slab;

Installation without reinforcement wire in a thick mortar bed (thicker than ¾-inch) and/or the use of improper wire reinforcement in a thick mortar bed and/or the wire placed in the wrong position;

Installation of stone tiles with modified backs with other than epoxy;

Installation of stone tiles with modified backs removed with other than epoxy;

Installation of radiant heat tubing in which no crack isolation or waterproof membrane is installed on top of the radiant heat tubing and the radiant heat tubing creates uneven mortar bed thickness which fractures the mortar at thinner mortar locations and fractures ceramic tile or stone tile installations installed above.

Walls

Causes of the indent fractures on walls are usually the result on inconsistent thickness of the scratch coat and/or mortar bed (brown coat), lack of proper mechanical fastening of expanded metal lath to the studs, too lean or too rich of a mortar bed installation, inadequate bond adhesion, inadequate installation of backer board or wall deflection.

Causes of the indent fractures on walls include:

Inconsistent thickness of the scratch coat and/or mortar bed (brown coat)

Improper overlapping of paper-to-paper and wire-to-wire in the mortar bed assembly which creates uneven thickness of the scratch coat resulting in causing the scratch coat to fracture, then the mortar bed to fracture, then the ceramic tile or stone tile to fracture;

Inconsistent thickness of the scratch coat caused by inadequate line wire installation where the mortar bed is applied directly to studs by a lath & plastering contractor;

Wire reinforcing with integral line wire causing weakened plane joint at the line wire location in the mortar;

Lack of mechanical fastening of expanded metal lath or stucco mesh to the studs as required in the International Building Code

One-coat float method as detailed in assembly method W-222, in which there is no mechanical fastening of the expanded metal lath to the studs in the wall. A common failure is caused by using only ½-inch staples and fastening the wire reinforcing into greenboard or drywall without any mechanical fastening into the studs behind the greenboard or drywall;

Too lean or too rich of a mortar bed installation

Installing of a mortar bed mix with too little or too much cement, which creates shrinkage cracks in the mortar, in which cracks in the mortar transfer through the ceramic tile or stone tile assembly.

Inadequate bond adhesion

Installing the ceramic tile or stone tile assembly with insufficient mortar, which creates stresses between the bonded and unbonded adhesion on the ceramic tile and stone tiles.

Inadequate installation of backer board

Improper installation of backer boards by not following manufacturer’s installation instructions explicitly.

Wall deflection

Wood stud installation with green lumber creating stresses on the wall assembly;

Northern California has a history of wood studs installed to wet and during drying contribute to movement and cracking where fasteners are fastened to the wood studs.
Stud spacing too far apart for adequate support contributing to stresses on the wall assembly.

The information above is compiled by the inspections and examinations of failures of which indent fractures have occurred. The inspections and examinations were performed by Don Halvorson and Gregory Mowat. The above list is not intended to be only the list of causes of indent fracturing or ceramic tile and stone tile assemblies. New inspections or examination of failures may add additional findings to this summary.

Written by:
Don Halvorson, CTA, CTC, *CMRS, **CRMI, FCT, ISSI
Gregory Mowat FCSI CDT CTC CFC *CMRS
Forensic Tile Consultants

*Council certified, Certified Microbial Remediation Supervisor (**CMRS)** and a **Council certified, Certified Residential Mold Inspector (**CRMI**) with the American Indoor Air Quality Council.