Mitigating Reflective Cracks in Epoxy Terrazzo Finishes

Since the days of the Roman Empire terrazzo floors have provided beautiful, durable and easy to maintain finishes. With the "Renaissance of Terrazzo" and the growth of thin-set epoxy systems, the industry has focused much effort on controlling cracks in epoxy terrazzo finishes. Cracks in epoxy terrazzo can occur in the terrazzo matrix itself or propagate from the structural substrate. In this discussion, we will review the causes of cracks and recommendations for preventing or controlling cracks in the epoxy terrazzo.

Thin-set Epoxy Terrazzo

Thin-set Epoxy Systems were introduced over 40 years ago. The Morricite Thin-set Epoxy Terrazzo incorporates 100% solids epoxy resins that exhibit no significant volume change during the curing process. Although heat is generated by the epoxy hardening process (exotherm), its effect is insignificant due to the large mass of chips and filler in the mix and the high surface to volume ratio that they create. In addition, Morricite epoxy has a low modulus of elasticity, 6% tensile elongation and a very high tensile strength, (over 3,000 psi). These properties provide superior resistance to cracking from internal stresses as compared to cementitious systems.

Morricite Thin-set Epoxy Systems have also performed well over time in resisting substrate induced stresses. The modulus, tensile and elongation properties alone place Morricite Thin-set Epoxy close to the performance of the isolated Sand Cushioned Cement Terrazzo.

In the 1990’s, MasterFlex Membrane was introduced to provide additional isolation and further mitigate reflective cracking induced by the substrate. When utilizing MasterFlex Membrane, Morricite Thin-set Epoxy Systems become comparable to Sand Cushion Cement Terrazzo, in resistance to substrate stresses and are superior to Sand Cushioned Cement Terrazzo Systems in resisting internal curing stresses.

Controlling Substrate Induced Cracking for Hard Surfaced Finishes

Over the years, concrete contractors have tried to pour concrete slabs without cracks. While cracks in slabs may not always affect structural integrity, they may cause problems with hard surfaced finishes. It is often difficult to predict if shrinkage cracks are dynamic or static (non-moving). To better understand the nature of cracks and their effect on terrazzo, it is necessary to understand the causes of cracks, implement measures to control cracking, and detail cracks to help prevent crack reflection through the finish.

Types of Slab Cracks

- **Shrinkage Cracks** are a result of the volume change that occurs as the excess water (water of convenience) leaves the concrete. Control joints are cut or formed in the slab in an attempt relieve the resulting stress and force the shrinkage to occur at pre-determined locations. By the time terrazzo is typically installed, most of the volume change has occurred. At this point the cracks usually are relatively static. Movement will occur only when there is either structural settlement, deflection from heavy load transfer or expansion and contraction from thermal cycling.

- **Settlement Cracks** occur mainly in slab-on-grade construction. These cracks are a result of differential settlement between walls and slabs, from poorly compacted sub-bases, inadequate provisions to compensate for expansive clay soils, or loads in excess of anticipated capacity. To control these cracks, isolation joints are located at perimeter walls and/or interior columns.

- **Deflection Cracks** result from heavy load transfer or inappropriately engineered elevated slabs. Thin-set epoxy floors have been tested with deflection values up to L/240. (L= Length of Span
Concrete Substrate Crack Detailing Guidelines

Thermal Expansion can induce stresses leading to new cracks in slabs or cause movement in existing cracks. Large temperature changes may cause tensile stresses in the terrazzo finish as well as the concrete substrate. Thermal cycling occurs in buildings when permanent climate control has not yet been installed. Often finishes in buildings are installed while operating under temporary heat, which is then turned off over nights or weekends, or in summer heat where temperatures greatly exceed those encountered under permanent climate control. This creates excessive stresses compared to those experienced under normal use in both substrates and finishes. If at all possible, install terrazzo flooring after the building is under permanent HVAC.

Types of Concrete Joints

- **Construction Joints** or cold joints are located at the beginning and end of each day’s pour. In slab-on-grade construction, these joints are often keyed or doweled together, especially where there is significant load transfer across the joint.

- **Control Joints** or saw cuts are formed or cut into green concrete to induce shrinkage cracking at selected locations. Control joints will form a separation through the entire thickness of the concrete slab. They are to be cut within 8-24 hours after placement of the concrete, as soon as practical that they can be sawed without the edges raveling.

- **Isolation Joints** are located at perimeter load bearing walls or columns, and are formed to allow for differential settlement between the load bearing wall or column and the slab. Isolation joints can often be eliminated by doweling or tying the slab into the footer supporting the wall or column.

- **Expansion Joints** are true joints located through the entire structure in large buildings or in addition to an existing building. These joints are typically 1” wide or greater and require true pre-formed expansion joint systems.

Terrazzo Crack and Joint Details

**Crack “Band-Aid” for Cracks Less than 1/16”**

All cracks in the concrete slab up to 1/16” wide shall be treated with a “band-aid” of MasterFlex Membrane and MasterFlex Reinforcing Fabric at 25-30 mils thick. Hairline cracks may be treated with Morricle Primer and Fabric. (See Detail 1)
Crack “Band-Aid” for Cracks Greater than 1/16”

After placement of terrazzo divider strips, all panels with shrinkage cracks, control joints or construction joints shall be treated with MasterFlex Membrane at a minimum of 25-30 mils Dry Film Thickness (DFT) in an 18”-24” wide band-aid. Panels with an excessive number of cracks are treated strip-to-strip to transfer movement to the strips. (See Detail 2)

Typical Epoxy Terrazzo Control Joints/Saw Cuts

Back-to-back divider strips, which are then filled with ColorFlex Flexible Epoxy Joint Sealant, can form control joints in terrazzo. (See Detail 3)
Concrete Substrate Crack Detailing Guidelines

Optional Joint Detail for Control Joints/Saw Cuts

This detail provides the installer the option of installing a low profile 16 gauge divider strip, instead of the filled back-to-back strip in Detail 3. This detail does provide limited movement compared to Detail 3. (See Detail 4)

Full Membrane Treatment over Entire Slab Sections to Receive Epoxy Terrazzo with Fabric Reinforcement over Cracks

In applications where permanent climate control is operating, MasterFlex Membrane applied over the entire slab isolates epoxy terrazzo from existing cracks and helps prevent future cracking. Membrane is installed at 25-30 mils DFT with an additional reinforced detail coat at cracks. Strips are installed on top of the membrane. (See Detail 5)
Full Membrane Treatment with Fabric Reinforcement over Entire Slab

For use when large temperature changes are expected, or significant movement in existing cracks is anticipated, Morricle Membrane is installed over entire slab in two coats. The first coat is 25 mils non-reinforced with the second coat 15 mils with Morricle Membrane Fabric Reinforcing. Strips are installed on top of membrane. (See Detail 6)

Recommendations for Crack Detailing

The key to proper design and detailing is to involve all members of the Terrazzo Team. It is good practice to review the creative layout from the designer or architect with structural engineers to determine correct placement and joint detailing.

- **Architect** – Coordinate and review terrazzo layout, detailing and specifications with all parties. Specifications should cross reference Division 3, Cast-in-Place Concrete where necessary. Specifications, where possible, should require epoxy terrazzo finishes to be installed under permanent HVAC climate control. Specs should cover Pre-Installation meeting to address concrete slabs and site conditions. Wherever possible, epoxy terrazzo control joints should coincide with control joints in the concrete slab.

- **Interior Designer** – Overlay creative layout onto structural drawings to determine locations of control, isolation and expansion joints in slab. Where possible, locate isolation joints behind column covers and wall partitions. Where isolation joints are located in the terrazzo finish area, create direct reference joint with Typical Epoxy Terrazzo Control Joints/Saw Cuts. (See Detail 3)

- **Structural Engineer** – Design all slabs to receive terrazzo with maximum live and dead load deflection of L/240. If Designer does not wish to have Isolation Joints in concrete to receive terrazzo, slabs must be tied into load bearing columns or walls.

- **Epoxy Terrazzo Manufacturer** – Provide details and recommendation for treating various joints in substrate and epoxy terrazzo finish. Attend Pre-Installation Conference with General and Terrazzo Subcontractor to review site and slab conditions.

- **Epoxy Terrazzo Contractor** – Provide shop drawing and legend of cracks, as well as, control, isolation and construction joints to ensure all are detailed accordingly.
Millions of square feet of thin-set epoxy terrazzo has been successfully installed over the past 40 years. Many of these installations included simple fabric “band-aids” in rigid epoxy over cracks. The advent of flexible epoxy membranes, the use of the appropriate details (outlined above) and the Team Approach for design review allows owners and designers to use epoxy terrazzo with confidence.

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