CERAMIC TILE INSTITUTE OF AMERICA, INC.

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CTIOA REPORT 2003-7-22

SUBJECT: 2003 WORKING WITH PORTLAND CEMENT CONCRETE
Use in conjunction with CTIOA Field Report CTI 84-2-2

By: CTIOA Inc. Concrete Slab Committee

INTRODUCTION

For purposes of revision, the CTIOA Concrete Slab Committee reviewed the original Field Report "WORKING WITH PORTLAND CEMENT CONCRETE, CTI 84-2-21 A questionnaire, based on the original report's question and answer was formulated and given to the committee at large for open discussion. This report reflects changes to Standards and/or Methods (where applicable) discussed in CTI 84-2-2 as they relate to the installation of Ceramic and Modular Stone tiles over Portland Cement Concrete slabs.

Questions from original (1984) CTI 84-2-2 Field Report are listed below. The current Committee Response takes into consideration the evolution in construction technologies' industry practices and new product innovations.

Direct Bonding (of Ceramic Tile and/or modular stone tiles) to Concrete Slab.

For Ceramic Tile: Scarify all concrete substrates for direct bond methods, though use of a light broom finish accepted as alternative slab preparation method. Follow current TCA method limitations and materials manufacturers explicit instructions.

Current residential tract home practice is to smooth finish slab on grade installations because of the multiple final choices of floor finishes that are offered to new home buyers. The smooth finish practice mandates scarifying slab surface when using a direct bond method of installation of ceramic tile.

For natural stone, the market demand for usage of natural stone tiles has increased as has the number of natural stone failures. The Marble Institute of America (MIA) now recommends a crack suppression membrane over all concrete slabs. The committee agrees to this recommendation. Recommendations in this section exclude Epoxy installations.

Rule-1/4" in Ten Feet.
ANSI A108-99 language states "requirements for concrete slabs ¼ inch in 10 feet for both direct bond and under wire reinforced concrete."
" Concrete sub-floor surfaces to receive ceramic tile or stone by a thin-set installation method should have a maximum variation from required plane of ¼-inch in 10 feet (6 mm in 3 m) per ANSI A-3.1.4.1.1. The sub-floor should be flat, without undulations greater than 1/16" per foot within each 10-foot span and no greater variation than 1/16" within the transition of one span to its adjacent span. Sub-floor surfaces not meeting this requirement should be flattened to meet requirement by grinding off excessively high spots and filling in low spots with an appropriate patch material."

Anti Fracture Membrane
Use Anti Fracture Membrane that complies with ANSI A118.10. Follow individual manufacturers explicit instructions for installation and product use.
For ease of identification, Anti Fracture Membranes have been placed into the following five categories: Sheet goods, Cork, Liquid Applied, Trowelable and Uncoupling.

Thin Load Bearing Direct Bond Waterproofing Membranes: ANSI A118.10
Originally developed to waterproof areas where traditional waterproofing systems would require a mortar bed, thus making the finished floor elevations too high. They have special properties to allow for reasonable shear bond values when tiles are laminated directly to them and they in turn are laminated directly to a structurally sound substrate. The physical properties of these membranes such as shear bond, waterproofing, resistance to bioorganic growths, tear strengths, etc. are described in ANSI A118.10. These membranes are often used as crack suppression membranes. However, since there is no Industry consensus at this time as to how to assess their crack suppressing capability, you must check with the Manufacturers for usage when crack suppression is the intent.

Crack Isolation Membranes
There are currently no industry standards that compare CIM'S
These membranes are typically of the same materials as the thin load bearing direct bond waterproofing membranes. They are used to prevent cracks that are present in an existing substrate from transferring through to the tilework while maintaining a relatively thin profile. As with the 118.10

membranes, they should maintain a reasonable shear bond value in a direct bond scenario. No Industry standards to describe their minimum capabilities have been established at this time.

Uncoupling Membrane
There are currently no industry standards for these membranes.
Slip Sheet:
Incorrectly used term, used to describe all of the above. Term used by the Ceramic Tile Institute to describe when materials such as 15 lb. felt building paper, scribing felt, or craft paper is used in a direct lamination scenario to reduce materials and labor costs. They are not recognized as acceptable alternatives to those materials that comply with ANSI A118.10 standards. This is due to their initial low tensile (shear bond) values and their rapid deterioration when exposed to moisture condensation and alkalines common when capping off concrete slabs on grade.

Cleavage Membranes: D226 - 97A D227 - 97A D4397 – 96 (ASTM Test Methods).
Tiles cannot be laminated directly to a 15 lb. felt building paper or 6 ml polyethylene sheeting that is not laminated to a substrate nor can tiles be laminated to them. A wire reinforced mortar bed is required for use over these two said cleavage membranes.

The following materials: Roofing Felt, Scribing Felt are not acceptable for use as slip sheets under F111 assemblies.

Curing Compounds
ANSI A-3.1.1 states, "All surfaces shall be structurally sound, clean, dry, and free of oily or waxy films and all foreign matter. Concrete shall be free of form oil, curing compounds, and laitance."
Curing compounds found for example on tilt-up construction casting slabs/slab on grade structural slab or tilt-up walls themselves where tile is intended for a direct bond method.
See separate Field Report CTIOA 2002-10-15 for a more detailed account of curing compounds and related issues.

Expansion Joints
" Probable Failure" likely when installing tile direct bond to un-reinforced concrete. It is always best to install over reinforced concrete, but if un-reinforced concrete is necessary, then project engineer needs to specifically design the concrete for maximum performance and incorporate more frequent use and placement of expansion joints.

All ceramic tile and stone surfaces, whether horizontal or vertical, whether indoors or outdoors, must have movement joints placed per current TCA

method EJ121, and shall conform to architectural details. Type and placement of movement joints should be determined by qualified engineer and specified by the architect. The type of tile or natural stone materials may play as a critical factor in size and placement of expansion joints. Existing joints in subsurface should be carried through tile work. Expansion joints shall be installed where tile abuts restraining surfaces, such as perimeter walls, curbs, columns, corners, etc. Expansion joints shall be installed at all "changes of planes" in the tile work.

Concrete Expansion Joints Max. spacing 20ft. O.C. Interior, 16ft O.C. Exterior, ACI 302,
Class AA Finish. Using sealant type Expansion Joint materials, follow mfg. explicit instructions.

Plan for and implement schedule for continuous expansion joint sealant maintenance.

Trueness of Plane
One quarter of one inch in ten feet (6mm in 3m) for concrete and finished tile surface. 2

Concrete Slump
The lowest possible slump helps minimize shrinkage, capillary action, and efflorescence and equates to less shrinkage and cracking.

Structural Lightweight Concrete Suitable for Substrate for Ceramic Tile
Lightweight concrete suitable for substrate for ceramic tile only if properly prepared per individual manufacturers Lightweight Concrete explicit instructions and written conditions. The minimum deflection criteria for ceramic tile are l/360, for modular stone tiles use l/7203 unless a greater deflection criteria applies.

Efflorescence
Greatly reduce percolation by placing concrete slab over 6 to 8 inches layer of course graded aggregate and/or perforated manufactured drainage material.

Reinforcing for Concrete
Reinforcing bar and welded wire mesh as per UBC/IBC placed 1/3 from the top of slab. Responsibility of project engineer to determine proper design for intended use of individual project on a project-by-project basis.

Post Tensioned Concrete
Isolate tile assembly from concrete slab for above grade as per F1114.
Use anti-fracture membrane as specified for intended installation as per

explicit manufacturers instructions. (See Anti Fracture Membranes section above). Refer to CTIOA Report 2003-7-21 on Post Tensioned Concrete.

Specifying Types of Concrete Resources
For further information please contact: Portland Cement Association
www.portcement.org
5420 Old Orchard Rd.
Skokie, IL 60077
Phone: Voice-847-966-6200
Fax: 847-966-8389
And:
• American Concrete Institute
www.aci-int.net
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: 248-848-3800, 248-848-3700
Fax: 248-848-3701

CONCLUSION
Portland Cement Concrete continues to be one of the most widely used building materials worldwide. Placement of concrete in "normal" and in severe climates conditions calls for proper pre-job planning and proper detailed installation techniques. In the some twenty years since CTI 84-2-2 was written, the installation of ceramic and natural stone tiles failures continue to occur. It is of the utmost importance that the following steps be addressed during the total construction process:

1. Proper design of site conditions
2. Preplanning of finished surfaces prior to execution of drainage and footing placement
3. Preparation of concrete surfaces that adhere specifically to a given installation methodology.
4. A high standard of tile installation practices that fit the site conditions, design criteria and finish materials chosen.

Footnotes:

1. www.thetiledoctor.com (REPORTS)
2. ACI Committee 117 recommend: finish tolerances in "Standard Tolerances for ACI 117-81.
3. Marble Institute of America Installation of Modular Stone Tile: Thin-set Method, Part 3.02
4. Tile Council of America Method F111-03

The preceding article was researched and written by CTIOA Inc. Concrete

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