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ABSTRACT:

When designing large format tile floor installations, there are a number of factors that can adversely affect the finished system and must be addressed:

1. Type and stability of Substrate.
2. "Flat" condition of substrate.
3. Tile setting materials and system.
4. Type, size, and quality of tile.
5. Design pattern and use of tiles, and workmanship.

FILING:

[UniFormat™ C3020](#) - Floor Finishes
[MasterFormat™ 09 30 00](#) - Tiling.

KEYWORDS:

Tile, large format, mortar, grout.

REFERENCE STANDARDS:

ANSI A108 - American National Standard Specifications For The Installation of Ceramic Tile

ACI 318 - Building Code Requirements for Structural Concrete and Commentary

ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

TCNA - Tile Council of North America Handbook for Ceramic Tile Installation.

Ceramic Tile Institute of America Field Report #59- Installation Of Large Format Tiles.

Large Format Tile Installations

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Problem

The increasingly popular use of large format tile in floor design has generated a considerable quantity of complaints about the finished product including wavy plane, lippage (uneven tile edges), cracking tiles, and cracking grout joints.

There are critical differences between a "standard" tile (up to 12" x 12") floor system and a large format tile floor system, which can incorporate tiles 36 and even 48 inches square. Failure to acknowledge and address those differences can result in a disappointing finished product.

Four of the issues we believe to be most critical will be explored here.

Quick Tip:

"When specifying a large format tile installation, take advantage of your tile and mortar product reps. Review the project, get their input, and determine if a manufacturer's presence on the project will help ensure success."

"Many reps are willing to instruct installers, as well as observe and approve the preparation of substrate and installation of the tiles."

1. Substrate Condition

The condition of the substrate must always be assessed, but the substrate assumes much greater importance in the design of a large format tile floor system. Basic substrate conditions to be assessed: Is the substrate surface free of contaminants; is it sound; is it level; and most importantly, is it FLAT?

The substrate defect that can most grossly affect finish quality is the "flatness", because large format tiles are unforgiving of undulations in the substrate. Not to be confused with "level", "flatness" refers to the consistency of the plane of the substrate, regardless of whether or not it is technically level.

ANSI A108 and TCNA Handbook for Ceramic Tile Installation 2008 recommend a standard minimum tolerance for flatness of 1/4 inch variation in 10 feet. Literature from some mortar manufacturers suggests tolerance improvements to 1/16 inch in 10 feet for a system using 16X16 inch tile or greater. Careful design of substrate for large format tile should include much tighter tolerances for flatness.

(Standard "F Number" system of "flatness" is not included in this discussion.)

The recommended method of achieving a level and flat surface on an existing substrate is by installing a wired mortar bed, which creates a minimum floor system thickness of 2-1/2 to 3-1/2 inches depending on tile thickness. On renovation or remodeling projects this can be impractical.

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A second remedial method for substrates is the application of a self leveling mortar. Care must be taken to select a product with high compressive strength- 4,000 psi or above. This will ensure a stable substrate.

2. Tile Manufacture

Another predominant factor contributing to disappointment in large format tile installations is the tile itself. The greater the size of a tile the more warpage occurs in the manufacturing process. Most warpage occurs at the center of the tile in both concave and convex planes. This condition can result in less than sufficient embedment of tiles into a mortar bed or thinset mortar. Tile warpage also manifests in great difficulty trying to make the edges of adjacent tiles meet properly, especially in running bond applications.

The effects of tile warpage are magnified when floor design calls for split courses, where the center of the tiles are laid next to other tile edges, often with dismal results.

To address these problems manufacturers are producing "rectified" tiles, which are ground along the edges to minimize the effects of warpage.

This edge grinding process softens the edges of the tiles making it very difficult to set the tile with extremely narrow joints. Tile manufacturers are beginning to recommend that grout joints be no less than 1/8 inch in a large format floor system.

While "rectification" has mitigated the effects of the warping of tiles during manufacture, careful consideration of the specified tile and the installation procedures is still imperative.

3. Mortars

Regardless of the condition of the substrate, using thinset mortar to install large format tile is nearly guaranteed to result in disappointing results in the finished floor. As previously stated, the differences in the plane of large tiles can leave significant gaps between the back of the tile and the setting mortar.

Mortar technology is always improving with the introduction of many "high performance" mortars as well as "medium bed" mortars. Materials in the latter category have been found to contribute to greater success in large format tile installations.

A medium bed mortar is one formulated to have a consistency similar to quickset mortars, but with a lower slump. As their name implies, medium bed mortars are designed to be applied at depths of up to 3/4 inch. This provides a much more appropriate setting medium for the larger tiles.

4. Workmanship

A pre-installation meeting including installers, A/E, and manufacturer's representatives to review conditions and techniques is recommended. Trade sources such as CTIOA Field Report #59 report that some helpful application techniques to use with medium bed mortar are:

A. Apply enough mortar: do not try to spread mortar too thin.

B. Use a trowel with the appropriate sized notches (up to 3/4 inch) to get enough material in place.

C. Rather than using the traditional swirl pattern of troweling out thinset, install medium bed mortar in straight lines in one direction which results in a more consistent mortar bed.

D. In setting the tiles, work the tiles back and forth in a perpendicular direction to the mortar lines, creating the best possible contact between tile and mortar, and substrate.

E. With extremely problematic conditions, do not hesitate to use the timeless technique of "back buttering" the tiles to achieve full coverage and contact between the tile and the substrate.

F. If at all possible, avoid installing "split" courses of 1/3 or 1/2 width tiles.

Conclusion

As with the evolution of materials, the trade authorities also develop new ways of dealing with problems. The TCNA and manufacturers are working together to develop new guidelines, and our trade sources tell us that soon there will be more definitive guidance coming from the industry on the installation of large format tile systems.

As the demand increases for floor systems that incorporate larger and larger tiles, the designer can minimize disappointment in finished product by incorporating the concepts discussed herein. Used in conjunction with the skill and knowledge of installers and the advice of product reps, these concepts can contribute to a successful project.



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