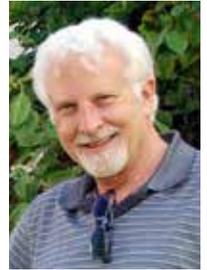


Tile and stone lippage: *What is acceptable tile lippage and how do you avoid excessive tile lippage through quality tile and stone installations?*



By Donato Pompo, CTC, CSI, CDT, MBA

Tile lippage is the vertical displacement between two adjacent tiles of a ceramic, glass, or stone tile installation. Excessive lippage can lead to a number of problems: the edge of the tile with excessive lippage can have a propensity to chip; furniture and appliances can get caught on edges and not slide easily across the floor; and most important today is that excessive tile lippage can be a safety hazard particularly to the elderly with our aging population. Tile lippage is an inherent characteristic of installed tile. It is not possible to eliminate it completely, but it can be minimized within reason.

(Ed. note: This is part one of a two part article. Part two will appear in a future issue of TileLetter.)

Standards for tile lippage

There are industry standards for determining what is acceptable or excessive tile lippage. The American National Standards Institute (ANSI) A108.02-2013–4.3.7 for the installation of ceramic tile states that for grout joints less than 1/4" (6 mm) wide, the allowable lippage is 1/32" (1 mm) plus the inherent warpage of the tile. For grout joints that are 1/4" (6

mm) wide or wider, the allowable lippage is 1/16" (2 mm) plus the inherent warpage of the tile. There has been some confusion in the interpretation of this standard, which is discussed in detail later. The Marble Institute of America (MIA) simply says that there can be no more than 1/32" (1 mm) lippage for natural stone tile installations.

Substrate tolerances

The challenge in trying to meet the standards to minimize tile lippage has to do with a number of compounding conditions. One of those



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conditions is the condition of the substrate in terms of flatness, which can affect tile lippage particularly when you are adhering direct to a concrete slab. Per industry standard ANSI A108.02-2013-4.1.4.3.1-2, the substrate needs to be prepared prior to the tile installation so that the maximum allowable variation from the required plane for tiles with all edges shorter than 15 inches (380 mm), is no more than 1/4" in 10 feet (6 mm in 3 m) and no more than 1/16" in 1 foot (1.6 mm in 0.3 m). For tiles with at least one edge 15 inches (380 mm) or longer, the maximum allowable variation from the required plane is not more than 1/8" in 10 feet (3 mm in 3 m) and no more than 1/16" in 2 feet (1.6 mm in 0.6 m). A very irregular substrate makes it difficult for the tile installer to compensate and install the tile so lippage is minimized.



Stone tile that does not have excessive lippage. Photo from Premier Tile of Oaksmall, Calif.

**Medium bed thin-set mortars:
not designed to compensate for
out-of-tolerance substrates**

Many tile installers and specifiers misunderstand the use of medium bed thin-set mortars. There is a misperception that medium bed thin-set mortar adhesives – which can be applied as thick as 3/4" with some products – will compensate for substrates that are excessively out of plane. Industry standards for thin-set mortar adhesives, such as modified dry-set cement mortars standard ANSI A118.4-2012-2.1, clearly state that *thin-set mortars are designed as direct-bond adhesives and are not intended to be used in truing or leveling underlying substrates or the work of*

others. Substrates need to be prepared before adhering the tile to them. High spots on concrete slabs need to be ground down and low spots need to be filled with special patching mortars. Cementitious self-leveling mortars can be used over concrete and wood subfloors to achieve the appropriate flatness or slope to meet project require-



Limestone with excessive lippage.

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ments. Medium-bed mortars are only meant to be used for large-and-heavy tiles so they don't sink into the thin-set mortar during the installation, or to be used to compensate for ungauged tiles that vary significantly in thickness from each other. Because of this common misunderstanding, the industry is in the process of eliminating the name "medium-bed mortar," and changing it to "dry-set mortar for large- and-heavy tile (LHT mortar), which is limited to 1/2" (12 mm) thickness after embedment.

Tile warpage

Another compounding factor that can contribute to excessive tile lippage is how much warpage the tile has. Today with such large tiles, particularly the rectangle shapes whose long-to-short-side ratios can be extreme, tile warpage can cause unavoidable actual or perceived lippage, which is discussed later.

Please note that *all* ceramic tiles, including porcelain tiles -- which are a type of ceramic tile -- have some degree of warpage. This isn't anything new. The irregularities in ceramic tile, just as in natural stone, are what give these products their character and desirable appearance. Ceramic tiles have always had warpage and other dimensional variations, although today's current manufacturing technology results in greater consistency in ceramic tile production. The ANSI A137.1 Specifications for



Limestone installation without excessive lippage.



Measuring 1.8 mm (9/128") of tile lippage, which is excessive for stone, but acceptable for ceramic tile.



Measuring excessive tile lippage in stone at 4 mm (5/32") on a floor tile.



Natural stone slate floor installation that shows excessive tile lippage due to improper installation

Ceramic Tile standard has established allowable tolerances criteria for each type or category of ceramic tile.

Calibrated versus rectified tiles

Porcelain ceramic tiles are much denser and are more controllable in their manufacturing, although they do have warpage. Standard calibrated porcelain tiles have tolerance requirements that allow more variation in warpage and sizing dimensions. Rectified porcelain ceramic tiles have been ground after manufacturing so their dimensional tolerance variations are much more limited. This allows the tile to be installed with a narrower grout joint width. Some manufacturers will say the grout joint can be as narrow as 1/16" (2 mm), although I never recommend a grout joint less than 1/8" (4 mm) wide. A 1/16" (2 mm) wide grout joint is too narrow to adequately fill to full depth for maximum support of the tile edge. Failure to fully fill the joint can result in grout coming loose later.

The 1/16" (2 mm) wide grout joint also isn't wide enough to allow for adjustments during the installation to help compensate for dimensional tile variations and

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Staggered tile pattern standards

Tile warpage generally occurs at the tile corners or at the center of the tile. For that reason the ANSI A108.02 standards state for running bond tile patterns (tiles are installed in a staggered or offset pattern) using tiles where any tile side is greater than 15" (380 mm), the grout joint size shall be on average a minimum of 1/8" (4 mm) wide for rectified tiles, and a minimum of 3/16" (5 mm) wide for calibrated tiles. The grout joint width shall be increased over the minimum requirement by the amount of edge warpage on the longest edge of the tiles being installed. For example, for a rectified tile exhibiting 1/32" (1 mm) edge warpage on the longest edge of the tile, the minimum grout joint width will be 1/8" (4 mm) + 1/32" (1 mm) or 5/32" (5 mm) for running bond tile patterns. Again, the wider the grout joint the more you can minimize irregularities in the tile and minimize tile lippage.

Warpage concentration limitations

Currently the ANSI A137.1 standards don't limit how much warpage can be concentrated within certain spans of the tile. This can be problematic because the tile might not exceed the maximum allowable warpage, but its warpage could be concentrated at the tile corner or at the center of the tile, for which the

tile installer can't fully compensate. For this reason the ANSI committee is currently considering adding language to the standards to limit warpage concentration.

Staggered tile pattern limitations

Because tile warpage can be so much more problematic with tiles that are being installed in a running bond pattern, there are other limitations stated in ANSI A108.02-2013-4.2.3.8.2. This particular standard covers the compounding effects of the warpage from two adjacent tiles. It states that tiles being installed in a running bond pattern where the tile side being offset is greater than 18" (457 mm) long, the running bond offset cannot exceed 33% of the tile length, unless otherwise specified by the tile manufacturer. Mock-ups should always be required for approval prior to the tile installation to make sure that the end user understands what they are getting and to avoid any false expectations.

How to calculate allowable tile lippage

Now let's go back to the allowable tile lippage standard that says that the allowable lippage is either 1/32" (1 mm) or 1/16" (2 mm), depending on the tile and the width of the grout joint, in addition to the inherent warpage of the tile manufactured in accordance

with ANSI A137.1. Tile Council of North American (TCNA) website (www.tcnatile.com) interprets this as meaning that the inherent warpage of a particular tile is the *actual warpage* that the specific tile has when installed. Some people incorrectly interpret this to mean that you can take the maximum allowable warpage stated in ANSI

A137.1 and add that to the respective allowable lippage value. If that were true, then in my opinion, from a standard-of-care point of view for professional tile installations, the calculated lippage would be unreasonable and excessive.

Square edge versus chamfered edge tile

Another compounding factor that can contribute to excessive tile lippage is whether the tile being installed has a sharp square-edge or if it has an arris with a slight chamfered edge. The sharp square-edge tiles are more prone to showing tile lippage and other variations, where the chamfered edge tile will be more forgiving. The chamfered edge will make the grout joint width wider at the tile surface.

Donato Pompo, CTC, CSI, CDT, MBA, is the founder of Ceramic Tile and Stone Consultants (CTaSC), and of the University of Ceramic Tile and Stone (UofCTS). He has more than 35 years of experience in the ceramic tile and stone industry from installation to distribution to manufacturing of installation products. Donato provides services in forensic investigations, quality control (QC) services for products and installation methods, training programs, testing, and onsite quality control inspection services. He received the 2012 Construction Specifier Magazine Article of the Year. Donato can be reached at donato@ctasc.com.

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