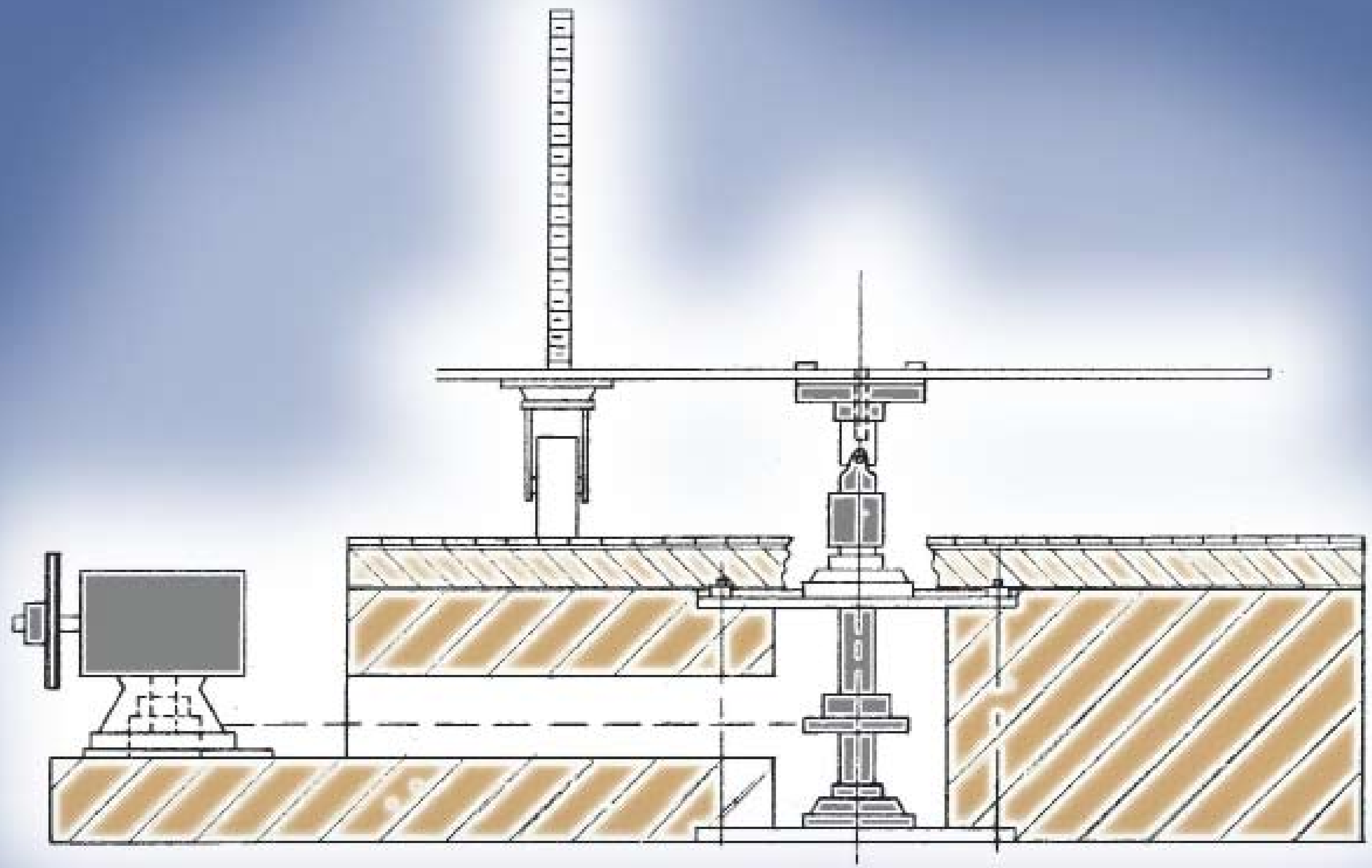

Here's to you, Mr. Robinson

By Bill Griese

Above: Cutaway diagram: A ¾-horsepower motor, attached to a drive shaft that protrudes out from underneath the center of the assembly, rotates the steel cart over a sample floor section at a rate of 15 revolutions per minute.

What is the Robinson Floor Test?

The Robinson Floor Test is a common "measuring stick" for predicting a floor's performance under several different loads. In 1958, during the development of the thin-set method for installing ceramic tile, a gentleman by the name of Donald Robinson, then head of engineering research at the Tile Council Research Center, designed a testing machine to evaluate the performance of such a method on floors. His testing machine would soon be known as the 'Robinson Floor Testing Machine,' and eventually be adopted as an ASTM test method, C627, in 1970.

How does it work?

The Robinson Floor Testing Machine consists of a three-wheel cart that rotates about its center atop a sample section of a tile floor. Per ASTM C627, the tile floor sample can be constructed using a Portland cement mortar bed, a thin-bed application over a concrete base, or a plywood or composition base assembly.

The cart, a 1/2"-thick hot-rolled steel plate, is in the shape of an equilateral triangle and has a swivel caster wheel on each corner. The three wheels are equally spaced in a circle 15 inches from the cart's center. Above each wheel is a rod along which weights can be stacked. A 3/4-horsepower motor drives the assembly, and the cart rotates at a rate of 15 revolutions per minute.

The test is run according to a loading schedule with 14 different cycles. For each cycle, the schedule specifies a type of wheel to be used (soft rubber, hard rubber, or steel), the amount of weight to be stacked above each wheel, and the total number of cart revolutions to be executed. After the completion of each cycle, the sample floor section is visually examined for chipped tiles, broken tiles, loose tiles, popped-up grout joints, cracked grout joints, and powdered grout joints. The test method defines each of these characteristics, and quantifies the degree to which each one can be observed prior to designating failure of the tile floor sample.

Above: The assembly pictured above is on cycle number 12. Once the cart has completed the 450 revolutions required by cycle 12, the sample will undergo a visual examination to determine whether or not cycle 13 will commence.

How are Robinson Floor Test results interpreted?

To interpret Robinson Floor Test results, users of the method commonly refer to the TCA Handbook for Ceramic Tile Installation. According to the Floor Tiling Guide on page 15 of the 2009 TCA Handbook, the incremental completion of ASTM C627 cycles without failure can be categorized into one of five different service levels.

According to the Guide:

- Sample floor sections completing cycles 1 through 3 without failure are assigned a "Residential" rating
- Samples completing cycles 1 through 6 are assigned a "Light" commercial rating
- Samples completing cycles 1 through 10 are assigned a "Moderate" commercial rating
- Samples completing cycles 1 through 12 cycles are assigned a "Heavy" commercial rating
- Sample floor sections completing all 14 cycles without failure are assigned an "Extra Heavy" commercial rating.

Test results and TCA Handbook classifications

For each floor tile installation method in the TCA Handbook, a representative assembly was tested on the Robinson Floor Testing Machine. Based on test results, the methods were assigned service level designations. Provided that the same materials and practices used to construct the test assembly are utilized in the field, a Handbook user may assume that a method will deliver the prescribed service level. However, such an interpretation cannot be made when one or more of the system's components are substituted, such as with smaller tiles, a thinner subfloor, or a weaker setting material.

For example, a method that withstood the 12 cycles required to receive a "Heavy" commercial classification when constructed with 12" x 12" tiles might only achieve a "Moderate," or even "Light" rating when constructed with 2" x 2" tiles. This does not mean that 2" x 2" tiles cannot be used in the harshest and most demanding environments—in fact, they regularly are. Rather, it points to the stiffening effect that tile has on a floor assembly. So, it is always important to see if there is a tile size limitation listed in a TCA Handbook detail and to remember that service-level classifications in the TCA Handbook are only general recommendations. While they are a very good way to quickly predict the durability of a floor, it is always a good idea to consult with product manufacturers for additional test data and specific assembly requirements.

Clarification through test assembly standardization

Due to the wide variety of thin-set mortars currently on the market, many of which have extraordinary and innovative properties, a group of grout and mortar experts proposed standardizing the mortar used for Handbook-related Robinson Floor Testing. The TCA Handbook Committee approved their proposal unanimously. Test assemblies for prospective Handbook methods are now tested with one of three thin-set mortar options: TCNA A118.1 Standard Performance Thin-Set Mortar; TCNA A118.4/A118.11 Standard Performance Thin-Set Mortar; or TCNA A118.4/A118.11 High Performance Thin-Set Mortar. Each of these mortars was selected after extensive industry research, and is warehoused in plain packaging at the Tile Council of North America (TCNA). Testing with one of these three mortars is now expected for a Handbook submission prior to its consideration as an industry approved method. If a method should be submitted where testing was performed with a non-standard mortar, such would be clearly stated and, if approved, the method would be published with the non-standard aspects noted.

Just as the wide variety of thin-sets on the market spurred grout and mortar experts to standardize the mortar being used on Handbook-related Robinson Floor Test assemblies, the increasing availability of large format tiles prompted action from tile experts. In addition to generally stiffening the floor, as the tile size used on a Robinson Floor Test sample increases, the number of tiles and grout joints in the wheel path decreases. This reduces the severity of the test and creates a better chance for a floor sample to pass. Further, the strength of the tile could be relevant, so standardized tiles were fabricated with specified properties close to either ANSI A137.1 minimum criteria or market conditions where such regularly exceed ANSI minimums. They proposed that Robinson Floor Test assemblies for Handbook related testing be constructed with standardized 2" x 2" tiles or 8" x 8" tiles. This proposal was also approved unanimously. Approved methods for which testing was conducted using the 8" tiles will be labeled with an 8" size limitation, and methods tested with the 2" tile will not carry a size limitation. Just as with methods using non-standard mortars, if a method should be submitted where testing was performed with a non-standard tile, such would be clearly stated and, if approved, the method would be published with the non-standard aspects noted.

Updating ASTM C627

In addition to the standardization already discussed for the TCA Handbook, revisions to ASTM C627 are being considered. This includes the possible standardization of seam placement for wood-framed and backerboard test assemblies, the location of the wheel path relative to the framing for assemblies with joist spacing wider than 16", and measurements of assembly deflection at various points in the subfloor.

In summary

In its half-century of existence, revisions to the Robinson Floor Test method have been minor. This speaks to the method's success as a reliable predictor of a floor assembly's performance in real-world applications. Standardizing the tile and mortar further improved the test method's relevance to and reliability in the field. As further improvements are made, this simple, yet effective, test is slated to continue on as the most common and widely accepted way to quickly forecast the performance of installed tile floors. TILE

SERVICE REQUIREMENTS
Find required performance level and choose installation method that meets or exceeds it. Performance results are based on ceramic tile meeting ANSI A137.1 or tile designated by tile manufacturer.
EXTRA HEAVY: Extra heavy and high-impact use in food plants, dairies, breweries, and kitchens. Requires quarry tile, packing house tile, or tile designated by tile manufacturer. (Passes ASTM C627 cycles 1 through 14.)
HEAVY: Shopping malls, stores, commercial kitchens, work areas, laboratories, auto showrooms and service areas, shipping/receiving, and exterior decks. (Passes ASTM C627 cycles 1 through 12).
MODERATE: Normal commercial and light institutional use in public space of restaurants and hospitals. (Passes ASTM C627 cycles 1 through 10.)
LIGHT: Light commercial use in office space, reception areas, kitchens, and bathrooms. (Passes ASTM C627 cycles 1 through 6.)
RESIDENTIAL: Kitchens, bathrooms, and foyers. (Passes ASTM C627 cycles 1 through 3.)

Above: According to the Floor Tiling Guide on Page 15 of the 2009 TCA Handbook, the incremental completion of ASTM C627 cycles without failure can be categorized into one of five different service levels.

Below: The smaller the tile size, the larger the number of tiles and grout joints that come in contact with the wheel path. The image above shows an example of "broken tile" and "popped-up" grout joints.

About the Author

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Bill Griese, Standards Development and Green Initiative Manager for the Tile Council of North America, is involved in the development and revision of ASTM, ANSI, ISO, and other industry-specific standards, and the coordination of TCNA's environmental efforts. He serves as Chairman for the ASTM C21 Committee on Ceramic Whitewares and Related Products, and also works closely with TCNA's Product Performance Testing Laboratory. Griese is a LEED Accredited Professional and earned a Bachelor of Science degree in Ceramic and Materials Engineering from Clemson University in Clemson, SC.