By Katelyn Luedeke

Stone Testing Provides Valuable Information and Technical Solutions

Over the past year, the Tile Council of North America's (TCNA) Product Performance Testing Laboratory has addressed performance inquiries on a wide variety of stone. Our customers find that stone testing results help them know if a specific product meets project design parameters and can be safely used. TCNA testing provides this assurance.

Ceramic tiles have relatively uniform properties, which can be controlled during manufacturing. Stone, on the other hand, can change dramatically with even a slight variance in color. One way to predict how a stone product will react in an installation is through product testing to known standards.

What does ASTM testing offer?

ASTM International has approximately a dozen test procedures which are applicable to natural stone evaluation. Of these procedures, there are five major ASTM tests that are used most frequently by the stone industry. Results from these tests are needed for an architect or engineer to design the structure in which the stone will be installed, in addition to making decisions regarding the specifics of the stone product itself.

It is important for a designer to know the weight of the stone with which they are designing to be sure the structure is sufficiently strong. Density and absorption are also factors in evaluating a stone's durability. An assessment of the stone's porosity is also useful. ASTM C97 will answer these questions. This test method is for water absorption and bulk specific gravity. Water absorption, which gives an indication of the level of porosity, is the percent weight change after the stone is submerged in the water until full saturation is achieved, which normally takes about 48 hours. Bulk specific gravity can be used to determine the density of the stone.

If a stone is to be installed in heavy traffic areas, it is beneficial to know how it will hold up. ASTM C1353 is the test method for abrasion resistance using a Taber abraser machine. In this test, abrasive wheels rotate over the stone surface for 1,000 revolutions, grinding the surface of the stone away. The loss in weight of the original material is used in the calculation. If the stone is unusually soft and has a very low abrasion resistance, then the stone should not be used in an installation with commercial foot traffic.

ASTM C170 test method for compressive strength tests the level of compressive forces a stone can support before crushing. The results of this test seldom have a direct correlation to the application, because it is

Photo courtesy of Tile Council of North America's Testing Laboratory

Figure 1: ASTM C99 Modulus of Rupture establishes the bending strength of the material using a three-point beam loading fixture.

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Figure 2: ASTM C880 Flexural Strength test, due to the constant bending moment region created by the 4-point loading fixture, has a better chance of breaking the stone at its weakest location than does the M.O.R.

rare that stones are used in service where the anticipated compressive forces approach the capacity of the stone. This test is used more as a general benchmark of stone strength, and when performed in different directions, is also useful in evaluating the level of anisotropy in the stone.

There are forces a stone will need to endure other than compressive forces. Whether installed on a floor or wall, there will always be flexing and shifting within the building structure that can inflict many types of bending forces on the stone. Also, when installed in a floor, the stone may have various types of equipment rolling over it or furniture sitting on top of it. ASTM C99 test method for modulus of rupture and ASTM C880 test method for flexural strength will both give a designer an idea how the stone will react to different bending forces. Modulus of rupture (M.O.R.) is a three-point bend with supporting knife edges (See Figure 1). Flexural strength is a four-point load with 1-in. diameter supports (See Figure 2). The span-to-thickness ratio of the flexural strength test specimen must be a minimum of ten-to-one, which eliminates the "thick beam behavior" that can occur in the modulus of rupture test. The flexural strength test can test a larger portion of the specimen, because the load is split in half at the two loading points and the entire center portion of the sample is subjected to the same bending forces. This differs from the modulus of rupture test, in which the bending stresses are highly concentrated at the point of load application. Of the two procedures, the flexural strength test is considered to produce more reliable data for evaluation of thin stone applications. If the stone has low M.O.R. or flexural strength values, it may not be suitable for the intended application.

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How does your stone measure up?

ASTM not only has standard test methods for dimension stone but also standard specifications of property values for different types of stone. These standard specifications give maximum and minimum values for each of the tests mentioned above. ASTM C503 Standard Specification for Marble Dimension Stone, ASTM C568 Standard Specification for Limestone Dimension Stone, and ASTM C615 Standard Specification for Granite Dimension Stone are just three of the many stone specifications that ASTM publishes. These specifications are available on the ASTM web site, www.astm.org.

How can you find out more information about designing with stone?

The Marble Institute of America (MIA) is a trade organization that represents nearly 1,800 companies associated with the stone industry. MIA publishes the *Dimension Stone Design Manual*, which is a helpful tool for designing with stone. The manual can be ordered through the MIA web site, www.marble-institute.com. **TILE**

About the Author

Katelyn Luedeke works for the Tile Council of North America's Product Performance Testing Laboratory as a Laboratory Engineer. She is responsible for testing of tile, stone, and other installation materials to ASTM, ANSI, and ISO standards. She is also involved in the development and revision of ASTM and ANSI standards. Ms. Luedeke earned her B.S. degree in Ceramic and Materials Engineering from Clemson University. She would like to acknowledge Chuck Muehlbauer for his help with writing this article.