DESIGN TIPS – TECHNICAL BULLETIN #40

FREEZE/THAW DURABILITY

Architectural Cast Stone is a product, which has been used for many decades in all types of climatic conditions. In order to reasonably assure the user that the Cast Stone being supplied by a particular producer is durable in freeze/thaw conditions, the Cast Stone manufacturer has two options. The first, and most common method is to show the purchaser similar architectural Cast Stone products made from the same materials by the manufacturer, which have been in service for many years. The second option is to subject samples of architectural Cast Stone to laboratory testing.

Recent research has shown that architectural Cast Stone, as well as other dry cast concrete products, can be evaluated for durability when subjected to a modified version of ASTM C 666, Procedure A - Test Method for Resistance of Concrete to Rapid Freezing and Thawing. This technical bulletin outlines the modifications to ASTM C 666, Procedure A that is necessary to properly judge Cast Stone durability performance.

Test Cast Stone using ASTM C 666, Procedure A, but evaluate the product based on cumulative percent weight loss and not its relative dynamic modulus of elasticity or durability factor as is described in ASTM 666. Research has shown that certain cast stone may have a high durability factor, but its outer surface may deteriorate badly. Therefore, cumulative percent weight loss is more representative of the aesthetic performance of Cast Stone.

After the Cast Stone is 14 days of age or older, wet saw three 3” x 4” x 16” (76 mm x 102 mm x 406 mm) beams from a single sample of cast stone to represent three specimens for a single test. One surface of each beam is to be from the exposed formed face of the sample, and the remaining sides shall be cut from the sample with saws. The allowable size tolerance of the specimens shall be ± 1/8 inch (3.2 mm). Do not oven dry the beam specimens until all freeze / thaw cycles are completed. Submerge each beam specimen in lime-saturated water at 73.4 ± 3° F (23 ± 1.6°C) at least 48 hours prior to beginning freeze / thaw cycling. Subject each beam to freezing and thawing as described in Method C 666, Procedure A. Inspect each specimen every 30 to 36 cycles and collect all spalled material caused by freeze / thaw cycling from each specimen individually to monitor weight loss during testing. For each specimen, oven dry and weigh the spalled material until loss in mass is not more than 0.2% in two hours of drying. Record the data individually and cumulatively for each specimen throughout the test until 300 cycles are completed, or 10% of the specimen’s estimated mass has been lost due to spalling, whichever occurs first. Specimens for this test shall then be oven dried at a temperature of 212 to 230° F (100 to 110° C) until the loss in mass is not more than 0.1% in 24 hours of drying. They shall be removed from the oven and allowed to cool at room temperature for approximately 30 minutes before measuring final dry weight. The initial dry weight of each specimen is considered to be the final dry weight of the specimen plus the total dry weight of spalled material collected from the beam throughout the test.

Calculate the cumulative percent weight loss for each beam specimen as follows:

CPWL (Beam) % - [S/(S+B)] x 100 where:

CPWL (Beam) = Cumulative Percent Weight Loss,
S = Total Dry Weight of Spalled Material, and
B = Oven Dried Beam Weight at the end of the test.

Calculate the Cumulative Percent Weight Loss, CPWL, for the sample. The CPWL of the sample is the average CPWL (Beam) of the three specimens.

The CPWL shall be less than 5% after 300 freeze / thaw cycles.