AB CERAMIC SERVICES

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RILEM tube: measurement of water absorption of masonry walls

Excerpts from RILEM site

For measuring the rate at which water moves through porous materials such as masonry Rilem Tubes used in the Rilem Test Method 11.4 provides a simple method for measuring the volume of water absorbed by a masonry material within a specified time period. The test can be performed at the site or in the laboratory and can be used to measure vertical or horizontal water transport. Water permeability measurements can be used to assess the degree of weathering that the material has undergone. This testing can also determine the degree of protection afforded by a water repellent treatment.

View image about RILEM tube for rain absorption of masonry walls View image: RILEM tube for rain absorption of masonry walls

MEASUREMENT OF WATER ABSORPTION UNDER LOW PRESSURE:

RILEM TEST METHOD NO. 11.4

Introduction

RILEM (Reunion Internationale des Laboratoires D'Essais et de Recherches sur les Materiaux et les Constructions), with headquarters in Paris, is the International Union of Testing and Research Laboratories for Materials and Structures. As with our American Society for Testing and Materials (ASTM), Technical Committees are formed within RILEM to develop standard methods for measuring properties and evaluating the performance and durability of many different building materials.

One such technical committee, Commission 25-PEM, has developed tests to measure the deterioration of stone and to assess the effectiveness of treatment methods. The standard tests drafted by Commission 25-PEM fall within several categories, including methods for determining internal cohesion (111.), for measuring mechanical surface properties (IV.), and for detecting the presence and movement of water (11.). Within category II., is Test Method No. 11.4, designed to measure the quantity of water absorbed by the surface of a masonry material over a definite period of time.

RILEM Test Method 11.4 provides a simple means for measuring the rate at which water moves through porous materials such as masonry. The test can be performed at the site or in the laboratory and can be used to measure vertical or horizontal water transport. Water permeability measurements obtained in the laboratory can be used to characterize unweathered, untreated masonry. Measurements made at the site (or on samples removed for laboratory testing) can be used to assess the degree of weathering that the material has undergone. Test Method 11.4 can also be used to determine the degree of protection afforded by a water repellent treatment. A description of the equipment and procedure for conducting this test is provided in paragraphs below. The theoretical basis on which the method is based and the several applications of test data are discussed.

Theory

Because masonry building materials are porous, they are all somewhat permeable to water. The interior structure of a masonry material is a system of fine interconnected pores. Wetting by liquid water involves capillary conduction (suction) through this pore system, proceeding along both vertical and horizontal pathways. Vertical transport occurs when water enters as ground water at the base of a structure or as rain water through leaking gutters. Penetration of driving rain into wall surfaces results in horizontal transport. (Under actual conditions, the amount of rain penetration depends on prevailing wind conditions as well as on the composition and condition of the exposed surface.)

When liquid water comes into contact with a masonry surface, wetting proceeds through the material as a front. Accurate measurements of the advance of this wetting front made on a variety of masonry building materials have demonstrated that the characteristic wetting rate and pattern of each material are directly related to its capillary structure and port size distribution. In fact, rate constants have been measured for brick, limestone and other masonry materials. RILEM Test Method 11.4 provides a simple method for measuring the volume of water absorbed by a material within a specified time period.

Equipment

The equipment necessary for measuring water absorption under low pressure is simple. The test can be performed at the site or in the laboratory with a test apparatus available in two forms. One is designed for application to vertical surfaces and measures horizontal transport of water, or, its resistance to wind-driven rain penetration.*

A second form is designed for application to horizontal surfaces and measures vertical transport. Figure 1 illustrates the pipe-like apparatus designed for vertical surfaces. Its flat, circular brim (at the bottom end of the pipe) is affixed to the masonry surface by interposing a piece of putty. The open, upper end of the pipe has an area of 5.7 cm2. The vertical tube is graduated from 0 to 4 cm3 with each gradation representing an increment of 0.1 cm3 (it is therefore possible to estimate to 0.05 cm3.) The total height of the column of water applied to the surface, measured from the center point of the flat, circular brim to the topmost gradation, is 9.8 cm. This corresponds to a pressure of 961.38 pascals (approximately 0.14 psi), or, a dynamic wind pressure of 142.6 kilometers per hour (approximately 88.5 mph). The apparatus designed for application to horizontal surfaces, is similar to the one for vertical surfaces as described above.

*It should be noted that a standard method for measuring water penetration and leakage through masonry is described in ASTM E 514. The ASTM test method is intended to evaluate wall design

and workmanship as well as the degree of weathering and the performance of water repellent treatment. It is therefore necessary to conduct the procedure on a test wall built with a minimum height or length of four feet. The wall is exposed to water (3.4 gallons per square feet per hour) in a test chamber for four hours.

Procedure

The testing apparatus is affixed by interposing a tape of putty between the flat, circular brim of the pipe and the surface of the masonry material. To ensure adhesion, manual pressure is exerted on the cylinder. Water is then added through the upper, open end of the pipe until the column reaches the 0 gradation mark. The quantity of water absorbed by the material during a specified period of time is read directly from the graduated tube. The periods of time appropriate for the test depend on the porosity of the material on which the measurement is being made; generally 5, 10, 15, 20, 30 and 60 minute intervals provide the most useful data. In many cases, it may be important to measure water absorption through the mortar joint as well as through the surface of the brick (or natural stone) substrate.

Report

Results of the test measurements are presented in the form of a water absorption graph with the volume of water absorbed in cubic centimeters reported as a function of time in minutes. The masonry surface tested must be mentioned in the report.

Applications

Water has long been associated with deterioration processes affecting masonry materials. Its presence within the interior pore structure of masonry can result in physical destruction if the material undergoes wet/dry or freeze/thaw cycling. The latter is particularly damaging if the masonry material has a high clay mineral content. Perhaps of greater importance is the fact that the presence of moisture is a necessary precondition for most deterioration processes. Pollutant gases are harmful when they are dissolved in water; fluorescence phenomena are dependent on the migration of salts dissolved in water; moisture is a requirement for the growth of biological organisms. Because of these factors, the water permeability of a masonry material is related to its durability. Thus, results obtained using Test Method 11.4 can be used to predict potential vulnerability of untreated, unweathered masonry materials to water-related deterioration.

Test Method 11.4 also provides useful information when carried out on weathered masonry surfaces. Water permeability of a material is affected when its surface is obscured by the presence of atmospheric soiling or biological growth, or, when there are hygroscopic salts within the interior. The formation of a weathering crust due to mineralogical changes occurring on the exposed (weathered) surface may substantially affect water permeability measurements. By comparing data obtained on masonry that has been exposed to the elements with measurements made on unweathered samples, it is possible to measure the degree of weathering that has occurred.

Finally, RILEM Test Method 11.4 can be used to evaluate the performance of a water repellent treatment. An effective treatment should substantially reduce surficial permeability of the masonry material to water. By so doing, the treatment will reduce the material's vulnerability to water-related deterioration. A comparison of test results obtained on treated masonry samples with those

obtained on untreated samples provides information about the degree of protection that can be provided by the water repellent treatment.

It has been calculated that when the water level in the tube is level with the 0 graduation mark, the water pressure against the surface being tested is approximately 0.17 psi. This is equal to a dynamic wind speed of approximately 98.1 mph, which is a high Category 2 hurricane (74-95 mph). At the zero graduation, exerted pressure is approximately 0.04 psi, which is equal to approximately 49 mph. Refer to the accompanying table, Relationship Between Tube Water Level and Wind Speed
. Isn't it comforting to know that the masonry will resist the wind-driven rain, provided it survives the hurricane?

90 mph is nearly equal to 150 kmph.
(Miles per hour / Kilometers per hour)

RELATIONSHIP BETWEEN TUBE WATER LEVEL AND WIND SPEED

Graduation Mark (ml)	Theoretical Wind Speed (mph)
0	98.1
0.5	94.1
1.0	90.04
1.5	85.7
2.0	81.1
2.5	75.2
3.0	71.1
3.5	65.5
4.0	59.4
4.5	52.8
5	44.8

Data is generated for awareness to customers. Not only we generate data, we also have equipments to measure as above.