

Summary

The symposium on The Cleaning of Stone and Other Masonry, which was sponsored by ASTM Committee E-6 on Performance of Building Constructions, and on which this publication is based, resulted in the dissemination of information on cleaning materials and practices, primarily for historic monuments and buildings, and methods for evaluating the effectiveness of cleaning projects. During the past decade, national concern for the preservation and restoration of historic monuments and buildings has steadily increased, which has resulted in a growing recognition that a technical basis for selecting and using cleaning materials and procedures needs to be developed. In addition to improving the appearance of masonry, cleaning can significantly extend the life of the masonry fabric by the removal of deleterious surface deposits. However, the selection of improper cleaning materials and practices can cause serious damage to the masonry. This symposium was organized with the objective of identifying the state of the art of stone and masonry cleaning materials and practices and determining the need for standard test methods, which would form a technical basis for the selection of these methods and practices. Although the symposium emphasized the cleaning of historic structures, it was recognized during the symposium that cleaning also can have an important role in rehabilitation and repair projects, for example, in allowing the inspection of surface conditions before decisions on the extent of needed repairs are made.

The nine papers in this volume describe the state of the art of cleaning practices in the United States, the selection of appropriate cleaning materials and methods, methods for determining the effectiveness of and possible damage caused by cleaning, and cleaning case studies. The authors represent a broad distribution of expertise in stone and masonry cleaning, including presidents of commercial cleaning firms, architects responsible for selecting appropriate cleaning methods, and university and government researchers. The papers are, for the most part, summarized more by category than individually, as follows.

Selection of Cleaning Methods and Materials

Two papers, one by *Boyer* and the other by *Jones*, describe the state of the art of cleaning practices in the United States. Three basic methods are used for cleaning masonry surfaces—water cleaning, abrasive cleaning, and chemical cleaning. The authors expand each of these basic methods further as follows: Water cleaning can be separated into steam cleaning, water soaking, and pressure

washing. Abrasive cleaning techniques include the use of grinding wheels, sanding belts, sanding disks, and grit blasting. Occasionally water and grit blasting are used together. Chemical cleaners include acidic cleaners, alkaline cleaners, and organic solvents. The paper by *Boyer* discusses the advantages and limitations of these cleaning approaches. The use of abrasive cleaning is generally not recommended for restorative stone and masonry cleaning. *Jones* discusses the variables that largely control the level and quality of water pressure cleaning, which are the pressure, volume, and temperature of the water; the nozzle pattern; the attitude or angle of delivery; the operator skill; and chemical additives.

The selection of graffiti removers was addressed by *Clifton and Godette*. Their report discusses a performance test developed to form a technical basis for selecting effective graffiti removers. The effectiveness of the removers and their compatibility with masonry substrates were determined by comparing the color changes of unmarked, marked, and remover-treated masonry surfaces. Test methods were also developed to determine the ability of removers to migrate into masonry.

Salt efflorescence is often removed from masonry by washing the surfaces with water or applying surface-active poultices. *Gauri, Holdren, and Vaughn* discuss the shortcomings of these methods, which are that the first method tends to transport salts into deeper regions by capillary action while removing some salts from the surface and the second method, besides being highly cumbersome, may result in masonry damage due to salt crystallization at the poultice/masonry interface. The authors describe two methods they are developing to remove salt efflorescence, both based on a suction approach.

Historic Structures

The three papers by *Roth, Mack, and Rudder*, respectively, address the cleaning of historic structures. *Roth* discusses the cleaning of interior masonry of public buildings. He presents several case studies that illustrate the range of cleaning problems encountered and the approaches selected for cleaning interior masonry. The paper is summarized by the statement that "no matter what standards are developed or adopted, the cleaning of interior masonry in public buildings will be determined by need, resource availability, site conditions, and the practical application of information, ideas, and experience." *Mack* discusses the cleaning and water-repellent coating of historic masonry buildings from a generalist's point of view. The topics discussed include project planning, the three basic types of cleaning, testing cleaning procedures, and application of water-repellent coatings. A case study was described to summarize the paper. *Rudder* discusses the responsibilities of the parties involved in chemical cleaning during restoration projects. He identifies five basic parties, which are the building owner, the architect, the local preservation officer, the manufacturer of chemical cleaning products, and the contractor.

Case Study

The report by Waite and Cheng discusses a case study involving the cleaning and conservation of marble at the Schenectady City Hall. In recent years, severe deterioration of the exterior marble architectural elements had developed. The study was undertaken to analyze the causes and extent of deterioration and to identify methods for its arrest and control. Deterioration of the marble was attributed to direct chemical attack by sulfuric acid. The sulfuric acid was reported to have been produced on wet surfaces by the heterogenous oxidation of absorbed sulfur dioxide in the presence of catalysts associated with the burning of fossil fuels. A major program for cleaning and conservation of both the exterior and interior marble was prepared and implemented.

Determining the Effects of Cleaning

The last paper describes a method for evaluating the effects of cleaning on erosion of the surfaces of masonry. The author, *Winkler*, reports on research he has been performing in developing a macrostereogrammetric technique for measuring surface erosion losses. His technique is based on the principle used in making topographic maps and terrain profiles by using vertical aerial photograph stereoscopic pairs. First, overlapping close-up photographs of weathered marble were taken using two cameras. The technique was then applied to the comparison of uncleaned and cleaned stone surfaces, in terms of surface shape and surface reduction.

Overall, the symposium provided an excellent view of current masonry cleaning practices and research and should serve as a basis for determining the need for ASTM standards for cleaning materials and processes.

James R. Clifton

National Bureau of Standards, Gaithersburg,
MD 20899; editor.