

Dimension Stone Use in Building Construction

Kurt R. Hoigard
Michael J. Scheffler
Editors



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Each paper published in this volume was evaluated by two peer reviewers and at least one editor. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM International Committee on Publications.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of the peer reviewers. In keeping with long-standing publication practices, ASTM International maintains the anonymity of the peer reviewers. The ASTM International Committee on Publications acknowledges with appreciation their dedication and contribution of time and effort on behalf of ASTM International.

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Foreword

This publication, *Dimension Stone Use in Building Construction*, contains twelve peer reviewed papers presented at the symposium of the same name held in Tampa, Florida on October 31, 2007, and published in the Journal of ASTM International. The symposium was sponsored by ASTM Committee C18 on Dimension Stone and co-chaired by Kurt R. Hoigard, P.E. of Raths, Raths & Johnson, Inc., Willowbrook, Illinois, USA, and Michael J. Scheffler, P.E. of Wiss, Janney, Elstner Associates, Inc., Northbrook, Illinois, USA.

Front and Rear Cover Images

Constructed as part of a cooperative study by ASTM Committee C18 on Dimension Stone and the National Bureau of Standards (NBS, the predecessor to the National Institute of Standards and Technology, NIST) to study weathering effects on dimension stone, the NIST Stone Exposure Test Wall is approximately 38 feet long, 13 feet high, and incorporates 2,352 individual dimension stone samples. The stone samples represent the merging of several collections including: the Centennial Collection of U.S. Building Stones displayed at the 1876 centennial exhibition in Philadelphia, PA; commercial building stones assembled for the 1880 United States census; and building stones from other countries originally displayed in the Smithsonian Institution. Erected in 1948 at the old NBS facility in Washington, D.C., the wall was moved to its current site on the NIST campus in Gaithersburg, MD in 1977 where it remains under the care of the Building Materials Division of the NIST Building and Fire Research Laboratory and is periodically visited by ASTM Committee C18. Additional information can be found at www.stonewall.nist.gov.

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Overview

This book represents the work of 19 authors that prepared papers for presentation at the Symposium on Dimension Stone Use in Building Construction held in Tampa, Florida, USA on October 31, 2007, and publication in the Journal of ASTM International. Prior to publication, each paper underwent two reviews by peers knowledgeable of the subject matter. Sincere thanks are offered to the writers, presenters, and reviewers who donated countless hours of their time in order to share their knowledge and without whom neither the symposium nor this book would have been possible.

The symposium was held in conjunction with a regularly scheduled meeting of the symposium sponsor, ASTM Committee C18 on Dimension Stone. Its objective was to promote information exchange regarding the state of the art in the use of dimension stone in building and pavement construction. In the eight years since the 1999 Symposium on Dimension Stone Cladding, and the subsequent publication of *ASTM STP 1394, Dimension Stone Cladding: Design, Construction, Evaluation, and Repair*, a substantial amount of work has been done in the fields of new dimension stone design and the assessment and rehabilitation of existing stone installations. Twelve presentations were grouped into four sessions: strength testing, design, evaluation and investigation, and durability. Written versions of all twelve of these presentations are assembled in this book.

Strength Testing

Both of the papers in this section address testing to determine strength characteristics of dimension stone cladding panels. Authors Naggatz and Gerns discuss differences in test results obtained using the relatively small test specimens prescribed by ASTM C 880 and the larger ASTM C 1201 specimens which include entire cladding panels and their connections. Scheffler and Kneezel address strength, durability and performance characteristics of composite stone-faced aluminum honeycomb cladding panels, the performance of which is highly dominated by the aluminum portion.

Design

The four papers in this section cover a wide range of topics. Hensel presents the advantages and disadvantages of three common dimension stone paving installation techniques, including pertinent stone material properties and detailing issues. Authors Lammert and Hoigard discuss relationships between stone material strength, anchorage strength, and induced stress states for four common dimension stone cladding anchorage configurations. Conroy and Hoigard address the interaction of stone, anchorage, and back-up structure relative stiffness on dimension stone cladding anchor loads and panel stresses under lateral loads. Lewis provides an update on ASTM Committee C18's progress toward developing building code requirements for exterior stone cladding installations.

Evaluation and Investigation

The three papers in this section offer author observations regarding investigations into the causes of dimension stone cladding deterioration and failure. Authors Erdly and Valentino describe their

experience investigating granite and limestone failures on a 100+ year old church facade. Lewis discusses various issues that can affect the integrity of thin dimension stone cladding. Chin addresses the mineralogy, structure, strengths, and weaknesses of travertine as a cladding material and some common causes of travertine cladding failures.

Durability

The three papers in this section address the complex issue of dimension stone durability using three different approaches. Authors Grelk, Christiansen, Schouenborg, and Malaga summarize findings from a review of over 140 papers on this topic published between 1897 and 2006. Schouenborg, Grelk, and Malaga describe a large-scale European research project to investigate the causes of marble and limestone cladding panel bowing, develop preconstruction testing parameters to assess bowing potential, and assess proposed remedial efforts to reduce or inhibit ongoing bowing. Authors Bortz, Powers, and Wonneberger describe a proposed laboratory test to estimate weathering-related stone strength loss and provide correlations with strength loss caused by natural weathering.

Summary

The papers assembled in this book demonstrate a continuing advancement in the understanding of dimension stone use in building construction. Investigations of distressed stone installations, historical review of in-place performance, laboratory testing, and computerized analysis continue to improve the knowledge base from which designers of new buildings and restorers of older buildings can draw.

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ASTM Committee C18 members at the NIST Stone Exposure Test Wall in Gaithersburg, MD.

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