



MODERN STONE CLADDING

Design and Installation
of Exterior Dimension
Stone Systems



MICHAEL D. LEWIS AIA



MANUAL 21

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**Design and Installation of
Exterior Dimension Stone Systems**

MICHAEL D. LEWIS, AIA

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and share the technology of ...
“rocks” on buildings.*

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ABSTRACT

THIS book documents a sequenced procedure to design exterior dimension stone cladding. The design approach avoids arbitrary safety factors by considering performance variables that can establish true safety and durability. This text presents a process to select, design, and install dimension stone cladding and support systems.

Within a sequenced format, extensive explanations with new engineering applications enhance recognized industry practices and include successful exemplars to guide objective and rational decisions.

This approach increases awareness of the individual influences that affect exterior wall performance. These influences, termed “uncertainties,” can each be researched to establish their impact on the risk of failure. They must be correlated to existing work. Evaluated individually, they formulate load and resistance factor design for dimension stone. This approach tends to provide safe and durable stone projects.



FOREWORD

THE intent of this manual is to outline the process of selecting, designing, and installing stone cladding systems for exterior walls. Stone’s physical nature and cladding retention systems vary widely. Their potential applications are widespread.

The engineering process should recognize exemplars before tests. Modern construction should include successful walls enduring in the real-world “laboratory.” It should not duplicate the failures. These past lessons, not just fresh tests, should guide selection, testing, design, engineering, and installation. This approach identifies those variables known to influence stone cladding system performance. Each variable is considered separately within the process to optimize the solution. Applying this process results in better projects for all parties involved. Better walls are more efficient to construct and maintain. Well constructed walls are more durable. And more durable walls are safer and create more comfortable space for the public. This manual is not a code that formulates objective limits. Further structured practice and research can objectively measure the variables that influence performance. This manual organizes the principles that base such research on those variables.

Chapter 1, *Introduction to Modern Stone Cladding* and Chapter 2, *Precedents to Modern Stone Cladding*, discuss the history of stone as it evolved into modern “thin,” non-loadbearing cladding.

Chapter 3 on *Determining Responsible Design Values* and Chapter 4 on *The Future of Stone*, outline a variable-based design procedure analogous to load-and-resistance factor design.

Chapter 5, *Guide Specification for Stone Systems*, advises owners, architects, engineers, and contractors about the specialty of modern stonework.

This manual comprises a process that assists users to rationally select, design, and install stone cladding for exterior walls.

This manual is sponsored by Committee C-18 on Dimension Stone.



Michael D. Lewis, AIA

ABOUT THE AUTHOR

AS LEAD CONSULTANT for the Facade Group at THP Limited in Cincinnati, Ohio, Lewis works on both existing and new building facades. He investigates existing facade distress and its causes and develops rehabilitations to restore their integrity. Using knowledge from these exemplars, he develops new stone facade systems that simplify production and installation techniques while optimizing quality and

durability. His combined environmental, structural, architectural, and installation expertise allows a comprehensive approach to facades. He is also an Adjunct Professor of Architecture at the University of Cincinnati, teaching construction theory, structural economy, and curtain wall science.

Mr. Lewis is a registered architect and holds a Master of Science in Structural Engineering. His facade expertise includes historic preservation, construction management, and building technology. Notable recent projects include repair of the terra cotta facade of Cincinnati's Central Trust Tower (34 stories designed by Architect Cass Gilbert), rehabilitations for the College Conservatory of Music at the University of Cincinnati. (Architects Pei Cobb Freed and NBBJ-Roth), the stone skin for the Dubai National Bank Headquarters on the Persian Gulf shore, Harrah's Jazz Casino in New Orleans (Perez Ernst Farnet, Architects) and the Federal Reserve Bank of Cleveland (Architects Hellmuth, Obata, Kassabaum with VanDijk Pace).

Lewis began his professional career researching and developing special lightweight dome, cable, and envelope structures with the engineering firm of Geiger-Berger Associates PC of New York. He then was project engineer for specialty facade subcontractor Industrial First and directed engineering of the stone facades of two Chicago high-rises; 190 South LaSalle (42-stories by Architect Philip Johnson and John Burgee) and AT&T Corporate Center (70-stories by Architect Skidmore, Owings, and Merrill). Later, Lewis joined Harmon Contract W.S.A.'s Commercial Construction Division as a Project Manager in the Major Projects Group. With Harmon he directed the engineering, manufacture, assembly, installation, and contract administration of total envelope systems for Cincinnati's Chemed Center (32-stories by Architect Skidmore Owings and Merrill) and the University of Cincinnati's Engineering Research Center (8-stories by Architect Michael Graves and KZF).

As chairman of ASTM C18.06 on Dimension Stone Anchors and Anchoring Systems, Lewis directs standard development for cladding engineering such as ASTM C1242 *Standard Guide for the Design, Selection, and Installation of Exterior Dimension Stone Anchors and Anchoring Systems*, under the advisement of many experts on the committee. He is also an active member of other C18 committees responsible for specifications, testing, and durability standards for dimension stone. As a member of Committee E6 on Building Performance, he is also involved with promulgating standards for exterior building wall performance, historic building technology, and rehabilitation.

Mr. Lewis is a member of the American Institute of Architects, the Marble Institute of America, the National Trust for Historic Preservation, the Association for Preservation Technology, and Terra Cotta Conservation Group. He has authored and contributed to articles published in *Stone World*, *Dimensional Stone*, *Architecture*, and *Standardization News* and has presented lectures on exterior cladding to many audiences.