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Standard Guide for Repair and Restoration of Dimension Stone¹

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1. Scope

1.1 This guide describes materials and procedures for restoring facades constructed of or finished with dimension stone. All of the materials, procedures, and principles are suitable for restoration of historic and nonhistoric structures.

1.2 This guide is not intended to address restoration of interior dimension stone, although many of the materials and procedures may be suitable for interior use.

1.3 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- C5 Specification for Quicklime for Structural Purposes
- C10 Specification for Natural Cement
- C91 Specification for Masonry Cement
- C119 Terminology Relating to Dimension Stone
- C141 Specification for Hydrated Hydraulic Lime for Structural Purposes
- C150 Specification for Portland Cement

¹ This guide is under the jurisdiction of ASTM Committee C18 on Dimension Stone and is the direct responsibility of Subcommittee C18.07 on Environmental Properties, Behavior, and Cleaning.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

C207 Specification for Hydrated Lime for Masonry Purposes

C270 Specification for Mortar for Unit Masonry

C1180 Terminology of Mortar and Grout for Unit Masonry

C1242 Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems

C1324 Test Method for Examination and Analysis of Hardened Masonry Mortar

C1489 Specification for Lime Putty for Structural Purposes

C1515 Guide for Cleaning of Exterior Dimension Stone, Vertical And Horizontal Surfaces, New or Existing

C1521 Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints

C1707 Specification for Pozzolanic Hydraulic Lime for Structural Purposes

2.2 OSHA Directive:³

STD 1-12.026 Abrasive Operations Using Cut Off Wheels and Masonry Saws

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, other than those listed below, refer to Terminology C119 and Terminology C1180.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *defect, n*—naturally occurring flaw in the stone.

3.2.2 *dimension stone restoration consultant, n*—one who is knowledgeable and experienced with the care, restoration, and repair of building dimension stone.

3.2.3 *distress, n*—localized damage of stone units such as cracks, chips, holes, deterioration, bowing, and projections that have been broken off or worn down caused by wear, erosion, settlement, displacement, or other adverse chemical or mechanical actions.

3.2.4 *dutchman repair, n*—a stone repair method whereby a portion of a stone unit is cut out and replaced with another piece of stone (called a dutchman). The dutchman is usually rectangular or square in shape, but may also be rounded, and is usually at a corner or edge of the stone unit.

3.2.5 *pointing, v*—placing mortar in the outer portion of the joints between stone units. To point stone joints, the outer

³ Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, <http://www.osha.gov>.

portion of the joints must either be left open during installation or cut or ground out, that is, have the mortar removed from the outer portion of the joint. New mortar is then pressed into the joint with a pointing tool. The increased compaction of the new mortar provides an improved resistance to water penetration at the joint compared to the primary stone setting mortar.

3.2.5.1 *repointing, v*—the removal of existing mortar from the outer portion of the joints between stone units and the subsequent pointing of the joints.

3.2.5.2 *tuck pointing (tuckpointing, tuck-pointing), v*—this term is intentionally not used in this standard, because it is often used inconsistently. It is variously used to mean repointing, simply pointing, or applying a raised bead of mortar (often of a different color) down the middle of mortar joints.

3.2.6 *proprietary repair mortar, n*—an exclusively manufactured product formulated from cementitious compounds, fine aggregates, mineral pigments, possibly bonding agents, and other additives. It is used for filling cracks, holes, and other depressions in stone units or for rebuilding the surface of damaged stone units to their original profile.

3.2.7 *repair mortar, cement-based, n*—repair mortar utilizing portland cement, masonry cement, blended cement, mortar cement, or natural cement as the primary binder.

3.2.7.1 *repair mortar, polymer-modified, n*—cement-based repair mortar incorporating a dry or liquid polymer modifier as a secondary binder, to alter the performance properties

3.2.7.2 *repair mortar, polymer-based, n*—repair mortar consisting of a polymer binder and aggregates, without cement or hydraulic components.

4. Significance and Use

4.1 The purpose of this guide is to assist those who wish to restore facades constructed of or finished with dimension stone. It is an aid to owners, building managers, architects, engineers, contractors and others involved with restoring dimension stone.

4.2 This guide is not meant to supersede manufacturers' directions and recommendations for the use of their specific products, or written directions from the architect or building owner. When manufacturers' directions are in conflict with this guide, follow their recommendations or consult with their technical staff for further direction.

4.3 Prior to undertaking a full-scale repair or cleaning procedure, the methods under consideration for repair, patching or cleaning should be tested on an area not easily visible or on sample stones. The test will assist in judging the effectiveness of the chosen method and permit assessment of potential damage to the building stone. Completely evaluate the success of the sample repairs before undertaking the full-scale cleaning or repair procedure.

5. Condition Survey and Restoration Plan

5.1 The first step in a restoration project is to conduct a project survey consisting of a review of existing original architectural drawings and specifications and any original stone shop drawings that may be available. The stone shop drawings

contain detailed information on stone and anchoring that is not always found in the architectural drawings. The shop drawing review is followed by a thorough examination of all exposed stone surfaces and related elements of the building envelope. Document distressed areas and existing repairs. Determine the causes of observed distress to avoid performing cosmetic repairs while failing to correct the underlying problems. As an example, if problems result from water damage, the source of water penetration must be found and corrected if the repairs are to be successful and long lasting. If the damage to the stone is a result of structural instability, that structural issue must be addressed before repairs are made.

5.1.1 A dimension stone restoration consultant experienced in natural stone facade design and construction should participate in the condition survey. If structural distress is observed, consult with a qualified engineer with stone facade design experience. For stone displaying deterioration with an unknown cause, a petrographer specializing in dimension stone analysis can be consulted to determine whether a failure is related to inherent properties or mineralogical composition of the stone.

5.1.2 During the condition survey, identify and document repairs performed during previous restorations. The condition of existing repairs should be assessed to determine if they are stable, if they have failed, if they are a potential threat to the building fabric, or if they are posing a safety risk. Existing repairs can be made more apparent or can be damaged by cleaning or other restoration processes. The restoration consultant will be able to help with the proper procedures concerning previous repairs.

5.1.3 When necessary, appropriate field or laboratory testing, or both, is normally included with the condition survey to verify the nature of existing materials and the extent of the work needed to restore the project to the desired condition. Cleaning compounds and repair materials under consideration should be evaluated and tested to confirm that they will be effective and will perform without detrimental effects to the stone for the life of the building.

5.2 Once the condition survey is complete, prepare a restoration plan describing the repair and restoration work to be done. Perform the repairs and cleaning in a systematic, sequential order that will avoid damage to previously completed phases of the project.

5.2.1 Structural repairs must precede cosmetic repairs. For example, if expansion from rusting anchors is causing the stone to crack, the anchors must be replaced or treated before repairing cracks.

5.2.2 Perform testing of existing materials sufficiently in advance of restoration work to allow suitable cleaning, patching, repair, and replacement materials to be identified.

5.2.3 When chemical cleaners are used, perform the cleaning before the patching. Some cleaning compounds adversely affect the color and strength of the installed patch. Performing the cleaning first will help prevent damage or discoloration of the patching materials and will also allow the patch materials to be matched to the cleaned surfaces of the original material.

5.2.4 If mortar in the joints is missing or deteriorated to the extent that water intrusion will occur, the joints must be