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Standard Guide for Reduction of Efflorescence Potential in New Masonry Walls[1]

This standard is issued under the fixed designation C1400; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers methods for reducing efflorescence potential in new masonry walls.

1.2 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.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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]

C43 Terminology of Structural Clay Products (Withdrawn 2009)[3]

C67 Test Methods for Sampling and Testing Brick and Structural Clay Tile

C270 Specification for Mortar for Unit Masonry

C1180 Terminology of Mortar and Grout for Unit Masonry

C1209 Terminology of Concrete Masonry Units and Related Units (Withdrawn 2009)[3]

C1232 Terminology of Masonry

3. Terminology

3.1 *Definitions:*

3.1.1 Terminology defined in Terminologies C43, C1180, C1209, and C1232 shall apply in this guide.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cryptoflorescence, n*—a crystalline deposit of water-soluble compounds in the pores of masonry

3.2.2 *efflorescence, n*—a crystalline deposit, usually white, of water-soluble compounds on the surface of masonry.

3.2.2.1 *Discussion*—The color of stains produced by acid-soluble vanadium compounds in clay masonry is usually yellow or green. The color of stains produced by acid-soluble manganese compounds is usually brown or gray.

4. Significance and Use

4.1 This guide provides information that, if implemented, will reduce efflorescence potential in new masonry walls. However, its implementation will not always completely prevent efflorescence.

4.2 This guide may be augmented by related information contained in the appendixes of Specification C270, the additional material listed at the end of this specification, and other publications.

5. Principles of Efflorescence

5.1 Efflorescence is directly related to the quantity of water-soluble compounds within, or exposed to, the wall; and to the quantity of water exposed to these compounds. Since neither water nor water-soluble compounds can be completely eliminated from an exterior masonry wall, the potential for efflorescence is reduced by reducing water-soluble compounds and water within the wall.

5.2 While water penetration is reduced through proper design and construction, water can penetrate into masonry walls through cracks and separations in the surface and the top of the wall. It can penetrate voids in the mortar joints or the interface between the unit and mortar, and, to a lesser degree through the masonry units and the hardened mortar.

5.3 If a significant amount of water penetrates the wall, the water will dissolve water-soluble compounds that may exist in the masonry units, mortar components, grout, admixtures or other secondary sources, and may deposit them on the exterior surface of the masonry when it migrates to the wall surface

[1] This guide is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.05 on Masonry Assemblies.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

through evaporation. Deposits may also form within the masonry resulting in cryptoflorescence.

5.4 The most common efflorescence deposits contain two or more of the following: potassium, sodium, calcium, sulfates, carbonates, bicarbonates, chlorides, and hydroxides.

5.5 Some water-soluble compounds deposited on the surface of masonry can chemically react to form compounds that are not water-soluble. Calcium carbonate ($CaCO_3$) deposits on masonry are a fairly common example. They are a result of reaction between the efflorescence compound calcium hydroxide and carbon dioxide after the calcium hydroxide is deposited on the surface of the masonry and is exposed to the air.

5.6 Under some circumstances, particularly when exterior coatings are present, efflorescence compounds can be deposited below the surface of the masonry units. This condition is called cryptoflorescence. When cryptoflorescence occurs, the forces resulting from its confinement can cause disintegration of the masonry surfaces.

6. Reduction of Efflorescence Potential in New Masonry Walls

6.1 Efflorescence on a new masonry wall is reduced when water penetration of the wall is minimized; when water that penetrates or condenses in the wall is quickly drained from the wall; when contact between dissimilar masonry units is avoided; and when potential efflorescence compounds in the wall materials are minimized.

6.2 The amount of water from wind-driven rain that is able to penetrate a masonry wall is minimized by:

6.2.1 Good bond and full contact between masonry units and mortar. This condition is achieved by using mortar that is compatible with the masonry units; completely filled head and bed mortar joints in solid unit masonry; completely filled face shells head and bed joints in hollow unit masonry; compacted concave, V, or grapevine mortar joints on the exterior face of the wall; cold weather construction practices that prevent masonry materials from freezing; and by hot weather construction practices that prevent newly placed mortar from drying rapidly.

6.2.2 Construction practices that protect the tops and sides of uncompleted walls and openings from rain or snow during construction.

6.2.3 The use of flashing at the intersection of roofing and masonry walls.

6.2.4 The use of sills, copings, and chimney caps of solid masonry units, stone, reinforced concrete, or corrosion resistant metal. To be most effective, masonry, stone, and concrete sills, copings, and chimney caps should project beyond the face of the wall; have drips that are at least 1 in. (25 mm) from the face of the wall, and have functional flashing and weep holes. In addition, all sills, copings, and chimney caps should be sloped a minimum of 1+4; be mechanically anchored to the wall, and should have properly sized, located, and sealed movement joints when necessary.

6.2.5 Properly sized, located, and sealed movement joints in wall and around openings in wall.

6.2.6 Overhangs to protect the wall from rain.

6.2.7 Utilization of compatible water repellent coating on concrete masonry walls or integral water repellent admixtures in concrete masonry units.

6.3 Water that penetrates a masonry wall is quickly drained out of the wall by:

6.3.1 Unobstructed drainage in air space of drainage walls.

6.3.2 Functional, unpunctured flashing and weep holes at base of wall above grade; above openings in wall, shelf angles, lintels, wall-roofing intersections, chimneys, and bay windows, and below window sills and copings. The flashing should be extended beyond the exterior face of the wall. The flashing should have end dams at its discontinuous ends, and properly sealed splices and laps at its joints.

6.4 Contact between dissimilar masonry units is avoided by:

6.4.1 The use of cavity walls with unobstructed 2 in. (50 mm) minimum drainage air space to separate the exterior masonry wythe from the backup wall consisting of a dissimilar masonry unit.

6.4.2 The use of flashing between masonry wall and sills, copings, and chimney caps of a dissimilar material.

6.4.3 The use of flashing or separator between changes in materials in wall.

6.5 Potential efflorescence compounds in the wall materials can be minimized by:

6.5.1 Preconstruction testing of all masonry materials, water, cleaning agents, and admixtures to be used in a masonry wall to evaluate their potential to contribute to efflorescence. The results of these tests should be evaluated together with the influence of construction practices and design in predicting efflorescence potential in masonry walls. Available preconstruction tests include: Test Methods C67 efflorescence test for brick; chemical analysis of cements to determine water soluble alkali (Na_2 O K_2O) content; chemical analysis of hydrated lime to determine calcium sulfate content; and chemical analysis of sand, water, admixtures and cleaning agents to determine alkali, chloride, and sulfate content. Ion chromatography is a chemical analytical technique that can be used to perform preconstruction testing of masonry materials. Presently, there is no ASTM efflorescence test for concrete masonry units or mortar. The potential for efflorescence increases with increasing amounts of water-soluble alkali, chlorides, and sulfates in the masonry wall materials.

6.5.2 Storage and protection of all masonry materials prior to use to prevent contact with dissimilar materials and to protect materials from moisture.

6.5.3 Protection of all masonry materials during transportation when there is a probability of contamination from road salts, fertilizers, and airborne contaminants.

6.5.4 Utilization of proper cleaning materials and procedures on new masonry walls.

7. Keywords

7.1 efflorescence; end dam; flashing; masonry units; mortar; preconstruction testing; water penetration; weep holes

ADDITIONAL MATERIAL

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(5) "Efflorescence Causes and Mechanisms, Part I of II," *Technical Notes 23* (revised), Brick Institute of America, Reston, VA, May 1985.

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