Designation: C1892/C1892M – 22

Standard Test Methods for Strength of Anchors in Masonry [1]

This standard is issued under the fixed designation C1892/C1892M; 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 These test methods address the tensile and shear strengths of post-installed and placed-during-construction anchors in masonry test specimens made of masonry assemblies. Environmental exposures include freezing and thawing, moisture, decreased and elevated temperatures and corrosion. These test methods provide basic testing procedures for use with product-specific evaluation and acceptance standards and are intended to be performed in a testing laboratory. Product-specific evaluation and acceptance standards may add specific details and appropriate parameters as needed to accomplish the testing. Only those tests required by the specifying authority need to be performed.

1.2 Loadings include quasi-static, dynamic, fatigue and shock. Environmental exposures include freezing and thawing, moisture, decreased and elevated temperatures and corrosion.

1.3 These test methods are intended for use with post-installed and placed-during-construction anchors designed for installation projecting from the surface of a masonry test specimen.

1.4 This standard prescribes separate procedures for static, dynamic, fatigue and shock testing. Nothing in this standard, however, shall preclude combined tests incorporating two or more of these types of loading (such as dynamic, fatigue and shock tests in series).

1.5 The text of this standard refers to notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.6 Both inch-pound and SI units are provided in this standard. The testing may be performed in either system and reported in that system and the results converted to the other. However, anchor diameters, threads, and related testing equipment shall be in accordance with either inch-pound or SI provisions.

1.7 *Units*—The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.8 *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.*

1.9 *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:*

C1180 Terminology of Mortar and Grout for Unit Masonry
C1232 Terminology for Masonry
E4 Practices for Force Calibration and Verification of Testing Machines
E468 Practice for Presentation of Constant Amplitude Fatigue Test Results for Metallic Materials
E575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies
E631 Terminology of Building Constructions

2.2 *Other Standards:*

ANSI B212.15 American National Standard for Cutting Tools—Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills

3. Terminology

3.1 For definitions of general terms related to building construction used in this standard, refer to Terminology E631. For definitions of terms related to masonry refer to Terminology C1180 or C1232.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *adhesive anchor, n*—an anchor that derives its holding strength from the chemical compound between the wall of the hole and the anchor rod.

[1] This test method is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.04 on Research.

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*A Summary of Changes section appears at the end of this standard

3.2.1.1 *Discussion*—The compounds used include epoxy, cementitious material, polyester resin, and other similar types.

3.2.2 *anchor spacing, n*—the distance between anchors measured centerline to centerline.

3.2.3 *displacement, n*—movement of an anchor relative to the masonry assembly.

3.2.3.1 *Discussion*—For tension tests, displacement is measured along the axis of the anchor, and for shear tests, displacement is measured perpendicular to the axis of the anchor.

3.2.4 *dynamic test, n*—a laboratory test that applies load cycles of varying magnitude and frequency to an anchorage system for the purpose of simulating dynamic loads such as a seismic event (earthquake).

3.2.5 *edge distance, n*—the distance from the centerline of an anchor to the nearest edge of a masonry test specimen.

3.2.6 *embedment depth, n*—distance from the masonry test specimen surface to the installed end of the anchor.

3.2.6.1 *Discussion*—The embedment depth is measured prior to any movement that results from anchor setting.

3.2.7 *expansion anchor, n*—an anchor that derives its holding strength through a mechanically expanded system which exerts forces against the sides of the drilled hole.

3.2.8 *fatigue test, n*—a laboratory test that applies repeated load cycles to an anchorage system for the purpose of determining the fatigue life or fatigue strength of that system.

3.2.9 *linear variable differential transformer (LVDT), n*—a device used for measuring the displacement or movement of an anchor or anchor system.

3.2.10 *masonry test specimen, n*—the masonry assembly in which an anchor is installed and which resists forces from the anchor.

3.2.11 *placed-during-construction anchor, n*—an anchor that is installed prior to the placement of grout or mortar.

3.2.11.1 *Discussion*—The anchor typically derives its holding strength from plates, lugs, or other protrusions that engage with the masonry assembly.

3.2.12 *post-installed anchor, n*—an anchor that is installed after the placement and hardening of masonry.

3.2.13 *run-out, n*—a condition in which a failure does not occur in the specified number of load cycles in a fatigue test.

3.2.14 *safe working loads, n*—the allowable or design load obtained by applying factors of safety to the ultimate load of the anchorage device.

3.2.15 *screw anchor, n*—a post-installed anchor that is an externally threaded mechanical fastener installed in a predrilled hole.

3.2.15.1 *Discussion*—The anchor derives its capacity from the mechanical interlock of the fastener threads with the grooves cut into the base material during the anchor installation.

3.2.16 *shear test, n*—a test in which an anchor is loaded perpendicular to the axis of the anchor and parallel to the surface of the masonry test specimen.

3.2.17 *shock test, n*—a laboratory test that simulates shock loads on an anchorage system by the application of a short duration external load.

3.2.18 *static test, n*—a test in which a load is slowly applied to an anchor according to a specified rate such that the anchor receives one loading cycle.

3.2.19 *tensile test, n*—a test in which an anchor is loaded axially in tension.

3.2.20 *undercut anchor, n*—a post-installed anchor that derives its holding strength from an expansion of an embedded portion of the anchor into a portion of the hole that is larger in diameter than the portion of the hole between the enlarged section and the surface of the masonry test specimen.

3.2.20.1 *Discussion*—The enlarged diameter section of the hole is predrilled or enlarged by an expansion process during installation of the anchor.

3.3 *Notation:*

A_N = instrument readings at a given load, in. [mm].
A_I = initial instrument readings, in. [mm].
C_a = minimum distance from the center of an anchor shaft to the edge of masonry test specimen, determined from tests, in. [mm].
d = nominal diameter of anchor, in. [mm].
d_m = diameter of carbide-tipped drill bit with diameter on low end of tolerance range for new bit, representing moderately used bit, in. [mm].
d_{max} = diameter of carbide-tipped drill bit with diameter on high end of tolerance range for new bit, representing bit as large as would be expected in use, in. [mm].
d_{min} = diameter of carbide-tipped drill bit with diameter less than the low end of the tolerance range for new bit representing a well-used bit, in. [mm].
d_o = outside diameter of anchor, in. [mm].
f'_m = specified masonry compressive strength, psi [MPa].
h_{ef} = effective embedment depth, measured from the masonry test specimen surface to the deepest point at which the anchor tension load is transferred to the masonry, in. [mm].
F_s = safe working load, lb [N].
N_w = tensile load in tests of anchors located in cracks whose opening width is cycled, lb [N].
s_{min} = minimum anchor spacing, determined from test, in. [mm].
S = anchor spacing, in. [mm], measured centerline to centerline.
Δ_T = uncorrected displacement for tension tests, in. [mm].
Δ_S = uncorrected displacement for shear tests, in. [mm].

4. Significance and Use

4.1 These test methods are intended to provide reproducible data from which acceptance criteria, design data, and specifications can be developed for anchors intended to be installed in masonry assemblies.

5. Apparatus

5.1 *Equipment:*

5.1.1 *General Laboratory*—Use calibrated electronic load and displacement measuring devices meeting the specified