



Designation: ~~C1354/C1354M – 21~~ C1354/C1354M – 22

Standard Test Method for Strength of Individual Stone Anchorages in Dimension Stone¹

This standard is issued under the fixed designation C1354/C1354M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method provides procedures for determining the ultimate strength of an assembly consisting of stone with mechanical anchor (anchorage). Load is applied, separately, perpendicular to the surface of the panel and parallel to the surface of the panel. This test is intended to represent the interaction of the anchor with the stone panel. However, influence of the backup structure on the strength of the assemblies is not included.

1.2 This test method is applicable to stone panels supported by mechanical anchors.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the 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

[C1242 Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems](#)

[C1799 Guide to Dimension Stone Test Specimen Sampling and Preparation](#)

[E4 Practices for Force Calibration and Verification of Testing Machines](#)

[E575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies](#)

3. Terminology

3.1 *Definitions:*

3.1.1 *anchor, n—in general*, a metal shape inserted into a slot or hole in the stone panel that provides for the transfer of loads from the stone to the building structure, either directly or through an intermediate structure.

¹ This test method is under the jurisdiction of ASTM Committee C18 on Dimension Stone and is the direct responsibility of Subcommittee C18.01 on Test Methods. Current edition approved Oct. 1, 2021; Jan. 1, 2022. Published November 2021; February 2022. Originally approved in 1996. Last previous edition approved in 2015; 2021 as C1354–15–21. DOI: 10.1520/C1354_C1354M-21; 10.1520/C1354_C1354M-22.

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.

3.1.2 *anchorage, n*—assembly consisting of a stone panel with a mechanical anchor.

3.1.3 *panel, n*—cut stone with large face dimensions in relation to its thickness, for placement in a building structure or frame assembly.

4. Summary of Test Method

4.1 Test specimens consisting of a stone panel sample and a mechanical anchor are fabricated in the same manner and of the same materials as their intended construction uses. The mechanical anchor is connected to a test support. A test load is applied perpendicular or parallel to the face of the stone panel. The test load is applied gradually using a calibrated test machine; load is increased until the stone or the mechanical anchor fails.

4.2 The load at failure and mode of failure of each test specimen is observed and recorded. The test as described above is repeated five times for each combination of stone and anchor to be tested and for each direction of load to be tested.

5. Significance and Use

5.1 This test method is intended to provide information from which applicable design data can be determined for a given anchor used to support a dimension stone panel. The strength of a limited length of anchor may be related to a longer length of support when the flexibility of the support is properly considered by the designer. Refer to Guide C1242.

6. Testing Machine

6.1 The testing machine shall conform to the requirements of Practices E4.

6.2 The load from the testing machine shall be applied through appropriate devices (a lubricated ball-and-socket or a lubricated universal joint) to apply direct tension to the test specimen without bending.

7. Support Frame and Loading Device

7.1 The support frame (excluding the anchor to be tested) shall have sufficient strength to not yield while supporting maximum applied load. In addition, the support frame shall be sufficiently stiff to limit deflection to less than 0.04 in. [1 mm] at maximum test load and to limit rotation to less than 2°.

7.2 For load perpendicular to the surface of the stone panel:

7.2.1 A rubber pad or a setting gypsum bed shall be used between the stone and the loading or restraint surface to avoid concentration of stress in the surface of the stone sample.

7.2.2 A frame to support a stone sample with anchor in the side edge of the stone is shown in Fig. 1. Fig. 1 represents outward loading on a single stone panel. At the designer's option, two stone panels can be tested on a single split anchor.

7.2.2.1 The test specimen is supported at one end by the anchor. The anchor shall be attached to the support frame in the same way it will be attached to the backup structure in construction. The sample of stone is supported at the opposite end by a 1 in. [25 mm] diameter rod.

7.2.2.2 The load from the testing machine is applied to the stone sample through a 1 in. [25 mm] diameter rod, located as close as possible to the anchor that supports the stone but at a distance not less than the thickness of the panel.

7.2.3 A frame to test a stone sample with anchor in back of the stone and the load applied in a direction perpendicular to the panel are shown in Figs. 2 and 3. The sample of stone panel is held down while the upward load is applied through a single sample of anchor. The stone sample may be held down by independent anchors as shown in Fig. 2 or by the device used to apply load as shown in Fig. 3.

7.3 For load parallel to the surface of the stone panel:

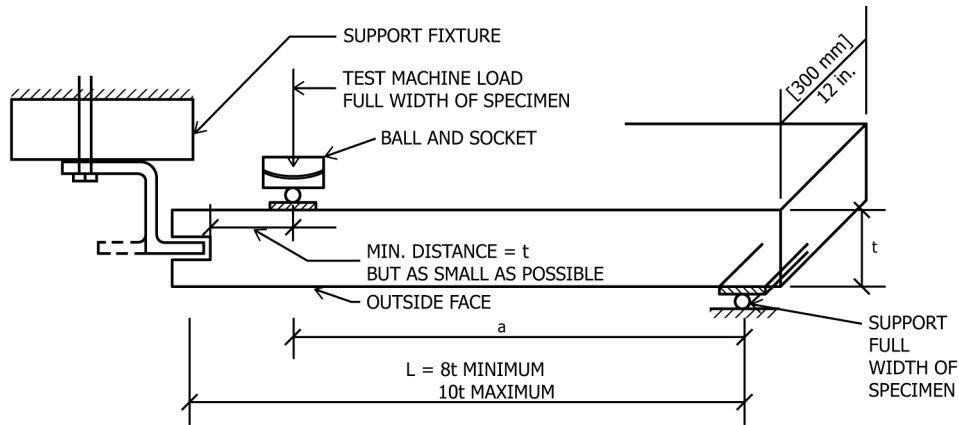


FIG. 1A Edge of Panel Supported by Tab Inserted into Kerf in Edge of Panel

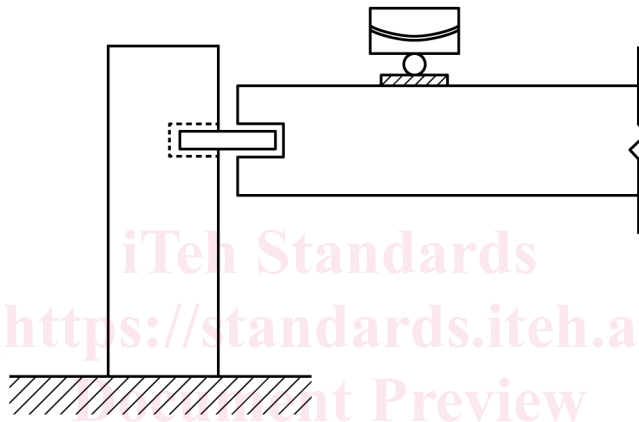


FIG. 1B Edge of Panel Supported by Pin Installed into Hole Drilled into Edge of Panel

FIG. 1 Setup for Testing Connection in Edge of Sample—Test Procedure A

7.3.1 The stone panel sample is restrained in the plane of the panel while a test load is applied parallel to the plane of the panel as shown in Fig. 4. The area beneath the anchor shall be kept unsupported to prevent restraint of spalls that may artificially increase the strength. The surface between the loading plate and the stone panel sample shall be lubricated.

8. Test Specimens

8.1 *Anchorage System*—The anchorage system shall be representative of the type to be used in field construction and shall include the anchor to be used and all accessories normally required to attach the anchor to the backup structure. If sealant, epoxy, or other form of kerf filler is specified to be used in field construction, the bond between the sealant, epoxy, or other form of kerf filler shall be intentionally prevented in the test assembly. Alternatively, provisions may be made to distribute the load from the anchor to the stone with a soft bearing material. At the designer's option, the sealant or epoxy may be allowed to bond.

8.2 *Anchor Installation*—Install the anchor and accessories in accordance with the specified design.

8.3 *Number of Specimens*—For each combination of stone and anchor to be tested, test at least five specimens. Where edge connections are used, a set of five specimens shall be tested with connection made in each of the two perpendicular edges.

NOTE 1—More specimens may be needed depending on the variability of the test results. If necessary, determine suitable statistical parameters to evaluate the composite variability and to select the number of specimens needed for obtaining a given minimum precision in determining the capacity of the anchorage system.

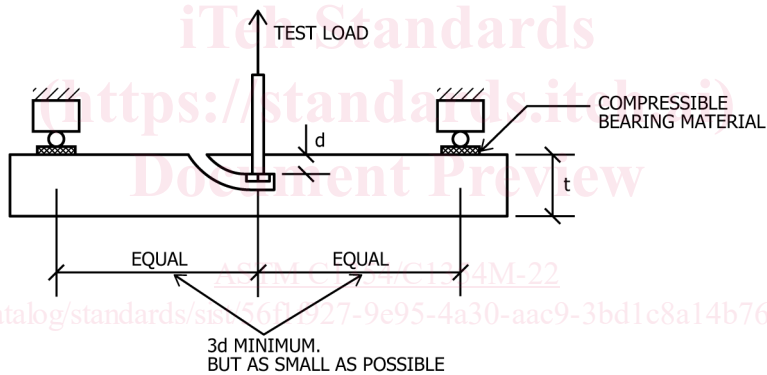
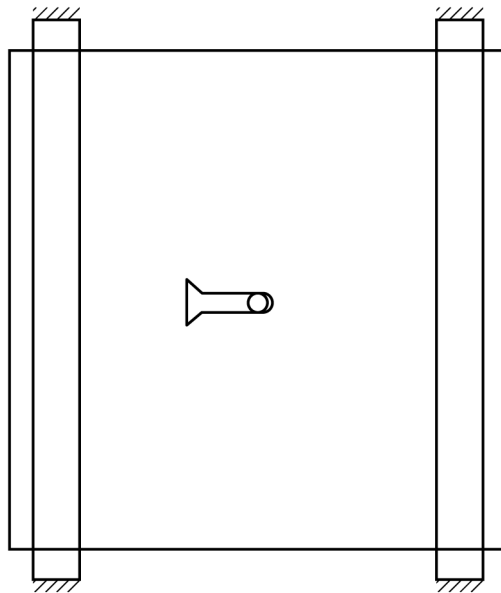


FIG. 2 Setup for Load Testing of Stone Panel with Connection in Back of Sample and Sample Held Down Independently—Load Applied Perpendicular to Surface

8.4 *Stone Panel Samples*—Select representative samples of dimension stone. Stone samples shall be taken from slabs oriented relative to rift as will be used in construction. Stone suppliers shall provide the following information: name of stone used for tests, stone type, quarry source, rift orientation, and stone finish.

8.5 *Anchor Samples*—Use anchor and accessories representative of that specified for the intended construction. If it is desired to measure fracture strength of stone when it exceeds the strength of the metal anchor, an additional set of tests shall be performed using a stiffer anchor or an anchor with a higher yield strength.

8.6 *Preconditioning*—Stone panel samples shall be preconditioned by immersing in water for 48 h–48 h at 72.72 °F ± 4 °F [22 °C ± 2 °C]. Test specimens immediately upon removing from the bath, wiping the specimen free of surface water. At the designer’s option, stone may be tested in a dry condition.

NOTE 2—Refer to Guide C1799 for additional information on selecting, preparing, and conditioning test specimens.

9. Procedure

9.1 For a load applied perpendicular to the panel, one set of five specimens shall be tested with the load applied outward, and one