



Standard Test Method for Pullout Strength of Hardened Concrete¹

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1. Scope

1.1 This test method covers determination of the pullout strength of hardened concrete by measuring the force required to pull an embedded metal insert and the attached concrete fragment from a concrete test specimen or structure. The insert is either cast into the fresh concrete or installed in hardened concrete.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information purposes only.

1.3 The text of this test method references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this test method.

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

2. Referenced Documents

2.1 ASTM Standards:

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens²

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials²

E 4 Practices for Force Verification of Testing Machines²

3. Summary of Test Method

3.1 A metal insert is either cast into fresh concrete or installed into hardened concrete. When an estimate of the in-place strength is desired the insert is pulled by means of a jack reacting against a bearing ring. The pullout strength is determined by measuring the maximum force required to pull the insert from the concrete mass.

4. Significance and Use

4.1 For a given concrete and a given test apparatus, pullout

strengths can be related to compressive strength test results. Such strength relationships depend on the configuration of the embedded insert, bearing ring dimensions, depth of embedment, and level of strength development in that concrete. Prior to use, these relationships must be established for each system and each new combination of concreting materials. Such relationships tend to be less variable where both pullout test specimens and compressive strength test specimens are of similar size, compacted to similar density, and cured under similar conditions.

NOTE 1—Published reports (1-16)³ by different researchers present their experiences in the use of pullout test equipment. Refer to ACI 228.1R (14) for guidance on establishing a strength relationship and interpreting test results. The Appendix provides a means for comparing pull-out strengths obtained using different configurations.

4.2 Pullout tests are used to determine whether the in-place strength of concrete has reached a specified level so that, for example:

- (1) post-tensioning may proceed;
- (2) forms and shores may be removed; or
- (3) winter protection and curing may be terminated.

In addition, post-installed pullout tests may be used to estimate the strength of concrete in existing constructions.

4.3 When planning pullout tests and analyzing test results, consideration should be given to the normally expected decrease of concrete strength with increasing height within a given concrete placement in a structural element. The measured pullout strength is indicative of the strength of concrete within the region represented by the conic frustum defined by the insert head and bearing ring. For typical surface installations, pullout strengths are indicative of the quality of the outer zone of concrete members and can be of benefit in evaluating the cover zone of reinforced concrete members.

4.4 Cast-in-place inserts require that their locations in the structure be planned in advance of concrete placement. Post-installed inserts can be placed at any desired location in the structure provided the requirements of 6.1 are satisfied.

4.5 This test method is not applicable to other types of post-installed tests that, if tested to failure, do not involve the same failure mechanism and do not produce the same conic frustum as the cast-in-place test. (16).

¹ This test method is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.64 on Nondestructive and In-Place Testing.

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² Annual Book of ASTM Standards, Vol 04.02.

³ The boldface numbers refer to the list of references at the end of this test method.