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Post-Installed Mechanical Anchors in Concrete—Qualification Requirements and Commentary

Reported by ACI Committee 355

ACI CODE-355.2-22

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ACI CODE-355.2 prescribes testing programs and evaluation requirements for post-installed mechanical anchors intended for use in structural applications addressed by ACI 318 and subjected to static or seismic loads in tension, shear, and combined tension and shear. Criteria are prescribed for determining whether anchors are acceptable for use in uncracked concrete only, or in cracked as well as uncracked concrete. Performance categories for anchors are established, as are the criteria for assigning anchors to each category. The anchor performance categories are used by ACI 318 to assign capacity reduction factors and other design parameters.

Keywords: anchors; cracked concrete; expansion anchors; fasteners; mechanical anchors; post-installed anchors; screw anchors; undercut anchors.

This Code was developed by an ANSI-approved consensus process.

ACI CODE-355.2-22 supersedes ACI 355.2R-19 and was adopted and published in September 2022.

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CONTENTS

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CODE

CHAPTER 1—GENERAL

1.1—Scope

ACI CODE-355.2 prescribes testing and evaluation requirements for post-installed mechanical anchors intended for use in concrete designed under the provisions of ACI 318. Criteria are prescribed to determine whether anchors are acceptable for use in uncracked concrete only, or in cracked as well as uncracked concrete. Criteria are prescribed to determine the performance category for each anchor. The anchor performance categories are used by ACI 318 to assign capacity reduction factors and other design parameters.

1.2—General

ACI CODE-355.2 describes the tests required to qualify a post-installed mechanical anchor or anchor system for use under the provisions of ACI 318.

1.3—Purpose

ACI CODE-355.2 applies to post-installed mechanical anchors (torque-controlled expansion anchors, displacement-controlled expansion anchors, undercut anchors, and screw anchors) placed into predrilled holes and anchored within the concrete by mechanical means.

1.4—Applicability

ACI CODE-355.2 applies to expansion, undercut, and screw anchors with a minimum effective embedment depth of 1-1/2 in. and with a nominal diameter of 1/4 in. or larger. Screw anchors are limited to a maximum effective embedment of $10d_a$.

COMMENTARY

CHAPTER R1—GENERAL

R1.1—Scope

ACI CODE-355.2 prescribes the testing programs required to qualify post-installed mechanical anchors for use with the design method of ACI 318-19 Chapter 17, where it is assumed that anchors have been tested either for use in uncracked concrete or for use in cracked and uncracked concrete. This testing is performed in concrete specimens controlled by the testing laboratory as a means of simulating concrete, both cracked and uncracked, that might occur in actual structures. Post-installed mechanical anchors exhibit a range of working principles, proprietary designs, and performance characteristics. ACI 318-19 Chapter 17 addresses this situation by basing capacity reduction factors for anchors on anchor performance categories. ACI CODE-355.2 is intended to develop the data required by ACI 318-19 Chapter 17 to confirm an anchor's reliability and place it in the appropriate anchor category.

ASTM E488/E488M includes some details for cracked concrete test members similar to those in this document. ASTM E488/E488M also has detailed test procedures for testing in cracked concrete.

R1.4—Applicability

The design method deemed to satisfy the anchor design requirements of ACI 318-19 Chapter 17 is based on an analysis of a database of anchors with a maximum diameter of 2 in. and an embedment depth not greater than 25 in. ACI CODE-355.2 can be used for anchors with those maximum dimensions. While ACI CODE-355.2 gives no limitations on maximum anchor diameter or embedment depth, for anchors beyond these dimensions, the testing authority should decide if the tests described herein are applicable or if alternative tests and analyses are more appropriate. The minimum diameter of 1/4 in. is based on practical considerations regarding the limit of structural anchor applications. The current database of screw anchors contains products with an embedment up to $h_{ef} = 10d_a$ due to practical limits of manufacturing and ability to install at deep embedments. This database has been shown to satisfy the design requirements of ACI 318-19 Chapter 17.

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