IN-LB Inch-Pound Units

An ACI Standard

Assessment, Repair, and Rehabilitation of Existing Concrete Structures—Code and Commentary

Reported by ACI Committee 562

ACI CODE-562-21

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ACI CODE-562-21, "Assessment, Repair and Rehabilitation of Existing Concrete Structures—Code Requirements and Commentary," was developed to provide design professionals a code for the assessment of the damage and deterioration, and the design of appropriate repair and rehabilitation strategies. The Code provides minimum requirements for assessment, repair, and rehabilitation of existing structural concrete buildings, members, systems and, where applicable, nonbuilding structures. ACI 562-19 was specifically developed to work with the International Existing Building Code (IEBC) or to be adopted as a stand-alone code.

Keywords: assessment; bond; corrosion; damage; durability; evaluation; existing structure; fiber-reinforced polymer (FRP); interface bond; licensed design professional; maintenance; rehabilitation; reliability; repair; strengthening.

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ACI 562-21 supersedes ACI 562-19, was adopted November 10, 2021, and was published November 2021.

PREFACE

This code provides minimum requirements for assessment, repair, and rehabilitation of existing concrete structures, members, and systems. This code was developed by an ANSI-approved consensus process. This code can supplement the International Existing Building Code (IEBC), supplement the code governing existing structures of an authority having jurisdiction, or act as a stand-alone code in a locality that has not adopted an existing building code.

The Code is specifically written for use by a licensed design professional. This code provides minimum requirements for assessment, design and construction, or implementation of repairs and rehabilitation, including quality assurance requirements, for structural concrete in service. This code has no legal status unless it is adopted by the authority having jurisdiction. Where the code has not been adopted, it serves as a standard to provide minimum requirements for assessment, design, and construction for the repair and rehabilitation of existing structural concrete. ACI 318 provides minimum requirements for the materials, design, and detailing of structural concrete buildings and, where applicable, nonbuilding structures, and for new construction within existing structures were noted herein.

Key changes from ACI 562-19 to ACI 562-21 include:

(a) The revised code, 562-21, to be used with any existing structures code (not just IEBC).

(b) Chapters 1 and 4 have been combined. Chapter 4 was reduced to meet the goal in (a).

(c) The content of Appendix A was revised and moved into the body of ACI 562, Chapter 4.

(d) The deletion of Appendix A.

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CODE

CHAPTER 1—GENERAL REQUIREMENTS

1.1—Scope

This Code shall apply to assessment, repair, and rehabilitation of existing concrete structures as:

1. A code supplementing an existing building code, or
2. A stand-alone code for existing concrete structures when an existing building code is not adopted.

1.2—General

1.2.1 ACI 562, "Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures," is hereafter referred to as "this Code."

1.2.2 The *licensed design professional* is responsible for the assessment or repair and rehabilitation design, or both.

1.2.3 The requirements of this Code use strength design provisions for demands and capacities, unless otherwise noted.

1.3—Purpose

1.3.1 The purpose of this Code is to safeguard the public by providing minimum requirements for assessment, repair, and rehabilitation of existing concrete structures.

1.4—Applicability of this Code

1.4.1 This Code provides minimum requirements for assessment, repair, and rehabilitation of structural concrete components in existing structures, including buildings and non-building structures.

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R1—GENERAL REQUIREMENTS

R1.1 This Code provides assessment, design, construction, and durability requirements for repair and rehabilitation of existing concrete structures. Throughout this Code, the term "structure" means an existing building, non-building structure, member, system, or element, if the construction is concrete or mixed construction with concrete and other materials.

This Code can be used in combination with an existing building code adopted by an authority having jurisdiction. For buildings, this is anticipated to be the state or local adoption of the International Existing Building Code (IEBC) developed by the International Code Council (ICC). Other codes may be applicable to non-building structures, or to structures that are not addressed in the IEBC. The provisions of this Code are intended to be used with the IEBC and similar codes.

If an existing building code is not adopted, Chapter 4 provides requirements for use as a stand-alone code.

R1.2—General

R1.2.3 If the existing building code or this Code permits the original building code to be used and that code uses allowable stress design, the licensed design professional should consider using the strength design provisions of this Code as a check in the evaluation of existing structures originally designed with allowable stress methods. Allowable stress design methods can result in designs that have inconsistent levels of structural reliability compared with modern strength design provisions (MacGregor 1974, Ellingwood et al. 1980).

R1.4—Applicability of this code

R1.4.1 This Code focuses on buildings and non-building structures as addressed by building codes or an authority having jurisdiction.

For buildings or structures similar to buildings, members that are addressed by this Code include but are not limited to foundations, soil-supported slabs, concrete portions of composite members, and precast and prestressed concrete.

In typical U.S. practice, owners are required to maintain existing structures to prevent unsafe conditions from occur-

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ring or repair an existing structure if unsafe conditions are present. The minimum level of repair for an existing structure will typically address these unsafe or potentially unsafe conditions.

The licensed design professional can perform assessment, design, and quality assurance activities that exceed the minimum requirements of this Code. Requirements beyond the minimum stated in this Code, such as those for long-term durability, disproportionate collapse resistance, redundancy, or integrity can be considered. Exceeding the code minimum requirements is not a violation of this Code.

The Owner and the licensed design professional should agree on the intent of the repair and rehabilitation program and desired outcome at the onset of the project. The desired outcome may include consideration of the design service life of the repairs, structural reliability, serviceability considerations, and other factors. Due to the uncertain remaining service life of existing structures and the technical requirements of repair construction, quality assurance and construction observation in excess of that required by the general building code is commonly needed.

1.4.2 This Code does not apply to the repair of non-structural concrete or to aesthetic improvements, except if failure of such repairs would result in a dangerous condition.

R1.4.2 If nonstructural concrete requires repair, that repair is not required to comply with the requirements of this Code. The licensed design professional designing repairs to nonstructural concrete should consider the consequence of repair failure to determine if provisions of this Code are applicable.

1.4.3 The term "existing building code" refers to the code adopted by the authority having jurisdiction that regulates existing buildings or structures.

R1.4.3 The code commonly governing existing buildings in the United States is the IEBC, which provides limits on the extent of damage to be repaired using the original building code.

1.4.4 The term "original building code" refers to the general building code adopted by the authority having jurisdiction at the time the existing structure was permitted for construction.

R1.4.4 This description of "original building code" is consistent with the IEBC. In assessing existing structures, the licensed design professional may need to consider changes in the codes adopted by the authority having jurisdiction for the structure from the time of the original design through the time of the completion of construction. For buildings with major alterations or additions, the original building code should refer to the code in effect when the subject portion of the building was permitted, and different portions of a building may have different original building codes.

1.4.5 The term "current building code" refers to the general building code adopted by the authority having jurisdiction that regulates new building design and construction.

R1.4.5 The current building code establishes the design and construction regulations for new construction. Strength design regulations of the current building code typically include:

(a) Required strengths calculated using combinations of factored loads (strength-design demands)

(b) Design strengths (capacities) based on testing of materials, members, and systems

(c) Analytical methods used to calculate member and system capacity

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(d) Strength reduction factors that have been established to be consistent with reliability indices used with the strength-design demands

The load factors and strength reduction factors in the current building code were obtained through design code calibration procedures to achieve the targeted reliability indices that produce historically acceptable structural safety for new structures. The targeted reliability indices are generally based on past structural behavior, engineering experiences, cost and consequences of failure, and other factors. The resulting demand-to-capacity ratios for new structures provide the limits that are not to be exceeded in designing new construction, but these demand-to-capacity ratio limits need not to be the same as those for existing structures as noted in 4.5.3.

The general building code in the United States is typically based on the International Building Code (IBC) published by the ICC. Prior to 2015, Chapter 34 of the IBC included provisions for existing structures. For the design and construction of new concrete structures, the IBC and most other older general building codes often reference ACI 318, Building Code Requirements for Structural Concrete and Commentary, with exceptions and additions.

1.5—Administration

1.5.1 If provisions in this Code conflict with the regulations governing existing structures of the authority having jurisdiction, the regulations of the authority having jurisdiction shall govern.

1.5.2 If provisions in this Code conflict with requirements of standards referenced within this Code, this Code shall govern.

1.5.3 Alternative materials, design, and methods of construction shall be permitted in accordance with the existing building code or by the authority having jurisdiction.

R1.5—Administration

R1.5.3 New methods of design, new materials, and new uses of materials for repair and rehabilitation usually undergo a period of development before being permitted by a code.

Provision 1.5.3 mirrors IEBC 104.11 that permits building official approval of alternative methods, design, or materials on a project-by-project basis, provided that the alternative is demonstrated to the satisfaction of the building official to provide equivalent quality, strength, effectiveness, fire resistance, durability, and safety.

For systems considered under 1.5.3, specific tests, factored load combinations, strength reduction factors, deflection limits, and other pertinent requirements should be set by the authority having jurisdiction and should be consistent with the intent of this Code. Provision 1.5.3 does not apply to scale model testing used to supplement calculations or to strength evaluation of existing structures.

If the existing building code adopted by the authority having jurisdiction includes provisions for approval of alternative materials in new construction, the same process may be used for materials in repair applications, provided the materials conform to the provisions of this Code. Typically, the approval process requires the evaluation to be completed