An ACI Standard

Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures (ACI 562-19) and Commentary

Reported by ACI Committee 562

ACI 562-19

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Reported by ACI Committee 562

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ACI 562-19, "Code Requirements for Assessment, Repair and Rehabilitation of Existing Concrete Structures," 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 562-19 supersedes ACI 562-16, was adopted May 1, 2019, and was published May 2019.

PREFACE

This code provides minimum requirements for assessment, repair, and rehabilitation of existing structural concrete buildings, members, systems and where applicable, nonbuilding structures. 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. When this code is adopted as a stand-alone code, Appendix A should be used in place of Chapter 4.

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, and design and construction of 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 where noted herein.

Key changes from ACI 562-16 to ACI 562-19 include:

(a) Text was added to simplify use of new materials that have the equivalent of an ICC-ES evaluation report in Chapter 1.

(b) The requirements for the basis of design report were simplified in Chapter 1.

(c) Requirements related to detailing of existing reinforcing steel in Chapter 4 have been clarified.

(d) The commentary in Chapter 8 was updated to include a listing of exposure categories that may affect durability.

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CHAPTER 1—GENERAL REQUIREMENTS

1.1—General

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

1.1.2 *Scope*—This code shall apply to assessment, repair, and rehabilitation of existing concrete structures as:

1. A code supplementing the International Existing Building Code (IEBC)
2. As part of a locally adopted code governing existing buildings or structures
3. Or as a stand-alone code for existing concrete structures

1.1.3 The intent of this Code is to safeguard the public by providing minimum structural requirements for existing structural concrete members, systems, and buildings.

1.1.4 All references in this code to the licensed design professional shall be understood to mean persons who possess the knowledge, judgment, and skills to interpret and properly use this code and are licensed in the jurisdiction where this code is being used. The licensed design professional for the project is responsible for, and in charge of, the assessment or rehabilitation design, or both.

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R1—GENERAL REQUIREMENTS

R1.1—General

R1.1.2 This code defines assessment, design, construction and durability requirements for repair and rehabilitation of existing concrete structures. Throughout this code, the term "structure" means an existing building, member, system, and, where applicable, nonbuilding structures where the construction is concrete or mixed construction with concrete and other materials.

Chapter 4 provides assessment, repair, and rehabilitation criteria if this code is used as a supplement to the International Existing Building Code (IEBC) for concrete members and systems.

Appendix A provides assessment, repair, and rehabilitation criteria when this Code is adopted, including Appendix A, as a stand-alone code for repair of existing concrete structures.

R1.1.3 The intent of this code is to address the safety of existing structures through assessment requirements that demonstrate an approximation of the structural reliability using demand-capacity ratio limits of Chapter 4 or Appendix A and, if necessary as determined by the assessment, increase the structural capacity by repair or rehabilitation.

Unless prohibited by the authority having jurisdiction, if an existing structure is shown to be potentially dangerous in accordance with 4.3 or A.3, the structure should be rehabilitated using 4.3 or A.3.

Using the demand-capacity ratio limits of 4.5.1 or A.5.1, repair of the existing structural concrete to its predeteriorated state is permitted based on material properties specified in the original construction (per Chapter 6), and substantiated engineering principles of the original design. Where requirements of the original building code are appreciably changed in the current building code, the licensed design professional may consider using 4.5.2 or A.5.2.

Beyond the restoration assessment requirements of 4.5.1 and 4.5.3 or A.5.1 and A.5.3, the structural reliability principles of 4.5.2 or A.5.2 are permitted. These alternative requirements provide acceptable safety if the current building code demand exceeds the original building code demand or if the regulations of the original building code provide an unacceptable level of structural reliability.

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1.1.5 The requirements of this code are provided using strength design provisions for demands and capacities, unless otherwise noted.

1.2—Criteria for the assessment and design of repair and rehabilitation of existing concrete structures

1.2.1 The "existing building code" refers to the code adopted by a jurisdiction that regulates existing buildings or structures.

1.2.2 The "current building code" refers to the general building code adopted by a jurisdiction that regulates new building design and construction.

1.2.3 The "original building code" refers to the general building code applied by the authority having jurisdiction to the structure in question at the time the existing structure was permitted for construction.

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R1.1.5 When this code permits the original building code regulations to be used and that code uses allowable stress design, the following should be considered: those provisions should be substituted for strength design as noted in 4.5.3 or A.5.3; the licensed design professional is not required to use, but should consider using strength design provisions of this code as a check in the assessment of existing structures originally designed with allowable stress methods.

R1.2—Criteria for the assessment and design of repair and rehabilitation of existing concrete structures

R1.2.1 The code governing existing buildings in the United States is commonly the IEBC developed by the International Code Council (ICC). The IEBC provides regulations for evaluations of damage and the limit for damage to be repaired using the original building code.

R1.2.2 The current building code establishes the design and construction regulations for new construction. Strength design regulations of the current building code include:

(a) Required strengths computed 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

(d) Strength reduction factors, which 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 are obtained through rational design code calibration procedures to achieve the targeted reliability indices which produce historically acceptable structural safety for new structures. The targeted reliability indices are generally based on past structural behavior, engineering experiences, costs and consequences of loss, among other criteria. The resulting demand-capacity ratios for new structures provide the limits that are not to be exceeded if designing new construction, but these demand-capacity ratio limits need not to be the same as those for existing structures as noted in sections 4.5.2 and A.5.2.

The general building code in the United States is usually 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.

R1.2.3 This definition of "original building code" is consistent with the building code in effect at the time of original permitted construction per the IEBC. In assessing existing structures, the licensed design professional may need to consider changes in the codes enforced by the local authority

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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.

Reference to design requirements of the original building code should include: demands determined using either nominal loads, load factors, and load combinations of the original building code, or using allowable design loads and load combinations of the original building code; capacities determined using either strength design and reinforcement detailing provisions, and strength reduction factors of the original building code or using allowable stress design provisions of the original building code; and construction materials. Requirements for concrete design and construction include previous versions of ACI 318, concrete codes predating ACI 318, or concrete provisions within the original building code. A structural assessment using allowable stress design provisions of the original building code should be coupled with an evaluation using current standards or the strength design and reinforcement detailing provisions of this code to increase the understanding of structural behavior.

For a structure constructed prior to the adoption of a building code, the licensed design professional should research available standards and practices in effect at the time of construction. The Historic American Engineering Record, a program of the United States Park Service, has information on construction and preservation of historic structures (https://www.nps.gov/hdp/haer/).

1.2.4 *Design-basis code criteria*

1.2.4.1 The design-basis code criteria in this Code shall be used to assess and design repairs of existing members, systems, and structures.

R1.2.4 *Design-basis code criteria*

R1.2.4.1 The design-basis code criteria include requirements for assessment of the existing structure and for design when repairs are required based upon assessment results.

If a jurisdiction has adopted the IEBC and ACI 562 is used, then the design-basis code criteria are based on the IEBC with supplemental requirements of this code for potentially dangerous structural conditions, damage less than substantial structural damage, deterioration of concrete and reinforcement, faulty construction, serviceability issues, and durability of existing concrete.

For substantial structural damage, additions, alterations, and changes in occupancy, the IEBC establishes limits to which an assessment and design of repair and rehabilitation can occur in accordance with the original building code. Above these limits, an assessment and design of the repair and rehabilitation is in accordance with the current building code. Current and original building code provisions are supplemented by this code to address existing concrete members, systems, and structures.

Appendix A applies if a jurisdiction has not adopted the IEBC and has adopted this code. Appendix A of this code can provide design-basis code criteria for potentially dangerous

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structural conditions, substantial structural damage, damage less than substantial structural damage, deterioration of concrete and reinforcement, faulty construction, additions, alternations, changes in occupancy, serviceability issues, and durability of existing concrete.

1.2.4.2 Assessment and design-basis criteria and the requirements for applying these criteria are provided in Chapter 4 and Appendix A. Chapter 4 applies if a jurisdiction has adopted the International Existing Building Code (IEBC) as the existing building code. Appendix A applies if a jurisdiction has not adopted the IEBC or if a jurisdiction has adopted this code.

R1.2.4.2 Classifying the work category using criteria and requirements of Chapter 4 or Appendix A defines the design-basis criteria, which is used to design the repair or rehabilitation work.

1.2.4.3 Assessment criteria shall be used to classify the work and to establish the design-basis criteria.

1.2.4.3.1 It shall be permitted to use the current building code as the assessment criteria for all existing structures.

R1.2.4.3.1 Use of the current building code for assessment criteria may result in a conservative assessment of an older structure. The design professional should review use of the current building code with the Owner at the start of the project (refer to R1.3.1).

1.2.4.4 Design-basis criteria shall be used to establish the applicable building code for repair and rehabilitation design.

1.2.4.5 The current building code shall be the design-basis code for new members and for connection of new members to existing structures.

1.2.4.5.1 The exceptions to 1.2.4.5 occur for the following: 1) when seismic retrofits are designed using the alternate design criteria of ASCE 41, or 2) when new members are added within the work area using the original building code as the design-basis code criteria for the repair.

R1.2.4.5.1 The performance-based criteria in ASCE 41 may result in new member design that will not satisfy current code requirements for strength, stiffness, or detailing. New concrete members and reinforcement may be designed by the original building code if integrated with the work area repair construction of the existing structure when the repair design-basis criteria for the existing structure is the original building code. The detailing of these new members and the connection of these members to the existing concrete should be according to the current building code.

1.3—Applicability of this code

1.3.1 This code provides minimum requirements when performing an assessment, repair or rehabilitation design and remedial construction of the structural components of existing concrete structures, including buildings and nonbuilding structures.

R1.3—Applicability of this code

R1.3.1 In typical U.S. practice, Owners are required to maintain existing structures to prevent unsafe conditions from occurring, or repair an existing structure when unsafe conditions are present. The minimum level of repair for an existing building will typically address these unsafe and potentially unsafe conditions.

The licensed design professional is permitted to perform assessment, design, and quality assurance activities that exceed the minimum requirements of this Code. Considerations beyond the minimum requirements of this Code, such as those for progressive collapse resistance, redundancy, or integrity provisions are permitted. Exceeding the code minimum requirements is not a violation of this Code.

1.3.1.1 Regulations of the current building code need not be exceeded when assessing, designing repair and rehabilitation work, or installing remedial work of existing structures.