

**ACI 562-13**

**Code Requirements for Evaluation,  
Repair, and Rehabilitation of  
Concrete Buildings (ACI 562-13)  
and Commentary**

An ACI Standard

Reported by ACI Committee 562



**American Concrete Institute®**



**American Concrete Institute®**  
*Advancing concrete knowledge*

First Printing  
March 2013

## **Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings and Commentary**

Copyright by the American Concrete Institute, Farmington Hills, MI. All rights reserved. This material may not be reproduced or copied, in whole or part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of ACI.

The technical committees responsible for ACI committee reports and standards strive to avoid ambiguities, omissions, and errors in these documents. In spite of these efforts, the users of ACI documents occasionally find information or requirements that may be subject to more than one interpretation or may be incomplete or incorrect. Users who have suggestions for the improvement of ACI documents are requested to contact ACI via the errata website at [www.concrete.org/committees/errata.asp](http://www.concrete.org/committees/errata.asp). Proper use of this document includes periodically checking for errata for the most up-to-date revisions.

ACI committee documents are intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. Individuals who use this publication in any way assume all risk and accept total responsibility for the application and use of this information.

All information in this publication is provided “as is” without warranty of any kind, either express or implied, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose or non-infringement.

ACI and its members disclaim liability for damages of any kind, including any special, indirect, incidental, or consequential damages, including without limitation, lost revenues or lost profits, which may result from the use of this publication.

It is the responsibility of the user of this document to establish health and safety practices appropriate to the specific circumstances involved with its use. ACI does not make any representations with regard to health and safety issues and the use of this document. The user must determine the applicability of all regulatory limitations before applying the document and must comply with all applicable laws and regulations, including but not limited to, United States Occupational Safety and Health Administration (OSHA) health and safety standards.

Participation by governmental representatives in the work of the American Concrete Institute and in the development of Institute standards does not constitute governmental endorsement of ACI or the standards that it develops.

Order information: ACI documents are available in print, by download, on CD-ROM, through electronic subscription, or reprint and may be obtained by contacting ACI.

Most ACI standards and committee reports are gathered together in the annually revised ACI Manual of Concrete Practice (MCP).

**American Concrete Institute**  
**38800 Country Club Drive**  
**Farmington Hills, MI 48331**  
**U.S.A.**  
**Phone: 248-848-3700**  
**Fax: 248-848-3701**

**[www.concrete.org](http://www.concrete.org)**

ISBN-13: 978-0-87031-808-5  
ISBN: 0-87031-808-X

# Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings (ACI 562-13) and Commentary

An ACI Standard

Reported by ACI Committee 562

Lawrence F. Kahn, Chair

Keith E. Kesner, Secretary

Tarek Alkhrdaji  
James Peter Barlow  
F. Michael Bartlett  
Randal M. Beard  
Casimir Bognacki  
Eric L. Edelson  
Garth J. Fallis  
Paul E. Gaudette  
Fred R. Goodwin  
Carl J. Larosche  
Marjorie M. Lynch

Tracy D. Marcotte  
James E. McDonald  
Myles A. Murray  
Antonio Nanni  
Kelly M. Page  
Jay H. Paul  
Randall W. Poston  
Halil Sezen  
Constadino Sirakis  
Gene R. Stevens

*Voting subcommittee members*  
Gregg G. Cohen  
Kevin Conroy  
Venkatesh Kumar R. Kodur  
Yasser Korany  
Andrzej S. Nowak  
Predrag L. Popovic  
J. Gustavo Tumialan  
  
*Consulting member*  
Peter Emmons

*This code provides minimum requirements for the evaluation, repair, rehabilitation, and strengthening of existing concrete buildings and, where applicable, nonbuilding structures.*

*This code does not provide complete design procedures or construction means and methods. The code comprises both prescriptive and performance requirements. Commentary is provided for both the prescriptive and performance requirements, and is intended to provide guidance to the licensed design professional and referenced sources for additional information on the material presented in the code provisions.*

*The code and commentary is intended for use by individuals who are competent to evaluate the significance and limitations of its content and recommendations, and who will accept responsibility for application of the material it contains.*

*The materials, processes, quality control measures, and inspections described in this code should be tested, monitored, or performed as applicable only by individuals holding the appropriate ACI Certifications or equivalent.*

## CONTENTS

### Introduction, p. 3

### Chapter 1—General, p. 5

- 1.1—Scope, p. 5
- 1.2—Applicability, p. 6
- 1.3—Jurisdictions without a general existing building code, p. 7
- 1.4—Administration and enforcement, p. 8
- 1.5—Responsibilities, p. 8
- 1.6—Contract documents, p. 9
- 1.7—Maintenance and monitoring, p. 10

### Chapter 2—Notation and definitions, p. 11

- 2.1—Notation, p. 11
- 2.2—Definitions, p. 11

---

ACI 562-13 supersedes ACI 562-12 (provisional), was adopted February 20, 2013, and was published March 2013.

Copyright © 2013, American Concrete Institute.

All rights reserved including rights of reproduction and use in any form or by any means, including the making of copies by any photo process, or by electronic or mechanical device, printed, written, or oral, or recording for sound or visual reproduction or for use in any knowledge or retrieval system or device, unless permission in writing is obtained from the copyright proprietors.

**Chapter 3—Referenced standards, p. 15**

**Chapter 4—Basis for compliance, p. 17**

- 4.1—General, p. 17
- 4.2—Compliance method, p. 17
- 4.3—Preliminary evaluation, p. 17

**Chapter 5—Loads, load combinations, and strength reduction factors, p. 19**

- 5.1—General, p. 19
- 5.2—Load factors and load combinations, p. 19
- 5.3—Strength reduction factors for repair design, p. 20
- 5.4—Strength reduction factors for evaluation, p. 20
- 5.5—Load combinations for structures repaired with external reinforcing systems, p. 21

**Chapter 6—Evaluation and analysis, p. 22**

- 6.1—Requirements for structural evaluation, p. 22
- 6.2—Structural assessment, p. 22
- 6.3—Material properties, p. 23
- 6.4—Test methods to determine or confirm material properties, p. 26
- 6.5—Structural analysis of existing structures, p. 29
- 6.6—Structural serviceability, p. 30
- 6.7—Structural analysis for repair design, p. 30
- 6.8—Strength evaluation by load testing, p. 31

**Chapter 7—Design of structural repairs, p. 32**

- 7.1—General, p. 32
- 7.2—Strength and serviceability, p. 32

- 7.3—Behavior of repaired systems, p. 32
- 7.4—Bond, p. 34
- 7.5—Materials, p. 35
- 7.6—Design and detailing considerations, p. 36
- 7.7—Repair using supplemental post-tensioning, p. 39
- 7.8—Repair using fiber-reinforced polymer (FRP) composites, p. 40
- 7.9—Performance under fire and elevated temperatures, p. 41

**Chapter 8—Durability, p. 44**

- 8.1—General, p. 44
- 8.2—Cover, p. 45
- 8.3—Cracks, p. 46
- 8.4—Corrosion and deterioration of reinforcement and metallic embedments, p. 47
- 8.5—Surface treatments and coatings, p. 49

**Chapter 9—Construction, p. 50**

- 9.1—Stability and temporary shoring requirements, p. 50
- 9.2—Temporary conditions, p. 51
- 9.3—Environmental issues, p. 51

**Chapter 10—Quality assurance, p. 52**

- 10.1—Inspection, p. 52
- 10.2—Testing of repair materials, p. 53
- 10.3—Construction observations, p. 54

**Chapter 11—Commentary references, p. 55**

## INTRODUCTION

The purpose of this code is to provide minimum material and design requirements for the evaluation, repair, and rehabilitation of structural concrete members.

**CODE****COMMENTARY****CHAPTER 1—GENERAL****1.1—Scope**

**1.1.1** The scope, purpose, applicability, exclusions, interpretation, principles, language, and units of measure are defined in this chapter.

**1.1.2** The “existing building code” refers to the code adopted by a jurisdiction that regulates existing buildings.

**1.1.3** The “current building code” refers to the general building code adopted by a jurisdiction that regulates new building design and construction. The “original building code” refers to the general building code adopted by a jurisdiction at the time the existing building was constructed.

**1.1.4** The “design basis code” is the general building code or the original building code under which the evaluation, repair, and rehabilitation are implemented. If a jurisdiction has adopted a general existing building code, the design basis code shall be determined in accordance with Chapter 4. If a jurisdiction has not adopted a general existing building code, 1.3 applies.

**1.1.5** This code is intended to supplement the evaluation requirements of the general existing building code.

**1.1.6** This code provides minimum material and design requirements for the repair of damaged, deteriorated, or deficient structural concrete members and systems repaired in accordance with the design basis code. Structural repair includes restoring or increasing one or more of the following: strength, stiffness, ductility, and durability of existing members.

**1.1.7** This code supplements the general existing building code and shall govern in all matters pertaining to the evaluation, repair, rehabilitation, and strengthening of concrete members and concrete sections of composite members in existing concrete buildings, except wherever this code is in conflict with the requirements in the general existing

**1.1C—Scope**

**1.1.2C** The general existing building code establishes the limit to which a repair and rehabilitation can occur in accordance with the original building code. Above these limits, the repair and rehabilitation is in accordance with the general building code. The general existing building code in the United States is usually based on the International Existing Building Code (IEBC) developed by the International Code Council (ICC). The IEBC is revised every 3 years and was first published in 2003.

**1.1.3C** The general building code establishes the design requirements for construction materials. The general building code in the United States is usually based on the International Building Code (IBC) published by the ICC. The IBC is revised every 3 years and was first published in 2000. For the design and construction of concrete structures, the IBC and legacy codes reference ACI 318, Building Code Requirements for Structural Concrete and Commentary, with exceptions and additions.

**1.1.4C** The general existing building code establishes limits to which a repair and rehabilitation can occur in accordance with the original building code. Above these limits, the repair and rehabilitation is in accordance with the general building code.

**1.1.5C** This code provides evaluation procedures for existing concrete structures. It also provides material and design requirements that allow the licensed design professional to bring existing concrete structures in compliance with building codes written for new construction.

## CODE

## COMMENTARY

building code. Wherever this code is in conflict with requirements in other referenced standards, this code shall govern.

### 1.1.8 *Provisions for seismic resistance*

**1.1.8.1** Evaluation of seismic resistance and rehabilitation design shall be in accordance with the general existing building code.

**1.1.8.2** Where rehabilitation for seismic resistance is not required by the general existing building code, voluntary rehabilitation for seismic resistance shall be permitted.

**1.1.9** This code is not intended for repair of nonstructural concrete or for aesthetic improvements, except if failure of such repairs would result in an unsafe condition.

### 1.1.10 *Licensed design professional*

**1.1.10.1** All references in this code to the licensed design professional shall be understood to mean persons who possess the knowledge 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 a project is responsible for and in charge of the evaluation or repair design, or both.

**1.1.10.2** The licensed design professional is permitted to require evaluation, design, construction, and quality assurance that exceed the minimum requirements of this code.

## 1.2—Applicability

**1.2.1** The requirements of this code are applicable when performing evaluation, repair, rehabilitation, and strengthening of existing concrete buildings and concrete portions of other existing buildings.

**1.2.2** This code shall govern the evaluation, repair, rehabilitation, and strengthening of nonbuilding concrete structures when required by the building official.

**1.1.8C** Conditions for evaluation of seismic resistance and repair are provided in ACI 369R, ASCE/SEI 31, and ASCE/SEI 41. Significant improvements to a building's seismic resistance can be made using repair techniques that provide less than those detailing and reinforcement methods required for new construction. As an example, providing additional reinforcement to confine concrete in flexural hinging regions will increase the energy dissipation and seismic performance even though the amount of confinement reinforcement may not satisfy the confinement requirements for new structures (Kahn 1980; Priestley et al. 1996; Harris and Stevens 1991).

Components of the seismic-force-resisting system that require strength and ductility should be identified. Force-controlled (nonductile) action is acceptable for some classifications of components of the seismic-force-resisting system (ASCE/SEI 41). The strength requirement of 7.1 is applicable to these force-controlled components. ASCE/SEI 41 and ACI 369R provide information on rehabilitation for seismic resistance. Seismic-resisting components requiring energy-dissipating capability should maintain the ability to dissipate energy when repaired. Design and detailing requirements for proper seismic resistance of cast-in-place or precast concrete structures are addressed in ACI 318 and 369R.

**1.1.10.1C** The licensed design professional is expected to exercise sound engineering knowledge, experience, and judgment when interpreting and applying this code.

## 1.2C—Applicability

**1.2.2C** Such structures can include arches, tanks, reservoirs, bins and silos, blast- and impact-resistant structures, and chimneys.