

ACI 364.1R-19

Guide for Assessment of Concrete Structures before Rehabilitation

Reported by ACI Committee 364



American Concrete Institute
Always advancing



Guide for Assessment of Concrete Structures before Rehabilitation

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 <http://concrete.org/Publications/DocumentErrata.aspx>. 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, 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 the ACI Collection of Concrete Codes, Specifications, and Practices.

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: +1.248.848.3700
Fax: +1.248.848.3701

www.concrete.org

Guide for Assessment of Concrete Structures before Rehabilitation

Reported by ACI Committee 364

Ashok M. Kakade, Chair

Paul E. Gaudette, Secretary

Randal M. Beard
Benoit Bissonnette
Ryan Alexander Carris
Larry D. Church
Bruce A. Collins
Timothy R. W. Gillespie

Fred R. Goodwin
Pawan R. Gupta
Ann Harrer
John L. Hausfeld
Robert L. Henry
Charles J. Hookham

Liyang Jiang
Keith E. Kesner
John S. Lund
Marjorie M. Lynch
Surendra K. Manjrekar
James E. McDonald

Murat B. Seyidoglu
K. Nam Shiu
Kyle D. Stanish
David A. VanOcker
David W. Whitmore

Consulting Members

Robert V. Gevecker
Stephen A. Johanson

Emory L. Kemp
Weilan Song

Dela Tharmabala
Robert Tracy

Alexander M. Vaysburd
William F. Wescott

This guide presents general procedures for assessment of concrete structures before rehabilitation. Among the subjects covered are preliminary assessment, detailed assessment, review of documentation, field observation and condition survey, sampling and material testing, evaluation, and final report. Evaluation to identify seismic or building code deficiencies is beyond the scope of this guide.

Keywords: assessment; condition survey; deterioration; distress; investigation; rehabilitation; sampling; testing.

CONTENTS

CHAPTER 1—INTRODUCTION AND SCOPE, p. 2

- 1.1—Introduction, p. 2
- 1.2—Scope, p. 2

CHAPTER 2—DEFINITIONS, p. 2

CHAPTER 3—INVESTIGATION, p. 3

- 3.1—Introduction, p. 3
- 3.2—Assessment: overview, p. 4

3.3—Preliminary assessment, p. 4

3.4—Detailed assessment, p. 4

CHAPTER 4—DOCUMENT REVIEW, p. 4

- 4.1—Introduction, p. 4
- 4.2—Design information, p. 5
- 4.3—Materials information, p. 5
- 4.4—Construction information, p. 5
- 4.5—Service history, p. 6
- 4.6—Project documents, p. 6

CHAPTER 5—FIELD INVESTIGATION, p. 6

- 5.1—Introduction, p. 6
- 5.2—Preparation and planning, p. 6
- 5.3—Field verification of as-built construction, p. 7
- 5.4—Condition survey and visual inspection, p. 8
- 5.5—Exploratory openings, p. 9
- 5.6—Unsafe or potentially hazardous conditions, p. 10

CHAPTER 6—SAMPLING AND TESTING, p. 10

- 6.1—Introduction, p. 10
- 6.2—Determination of sampling and testing requirements, p. 10
- 6.3—Testing and evaluation, p. 12
- 6.4—Test methods, p. 12
- 6.5—Sampling techniques, p. 13
- 6.6—Test reporting, p. 14

ACI Committee Reports, Guides, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is 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. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

ACI 364.1R-19 supersedes ACI 364.1R-07 and was adopted and published April 2019. Copyright © 2019, 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 7—EVALUATION, p. 14

- 7.1—Introduction, p. 14
- 7.2—Determining causes, p. 14
- 7.3—Evaluating the consequences of damage, p. 15
- 7.4—Structural evaluation, p. 15
- 7.5—Evaluation of rehabilitation approaches, p. 16

CHAPTER 8—REPORT, p. 16

- 8.1—Introduction, p. 16
- 8.2—Purpose, objective, and scope of assessment, p. 17
- 8.3—Project, background, and history, p. 17
- 8.4—Documentation obtained to support assessment, p. 17
- 8.5—Field observations and condition survey, p. 17
- 8.6—Sampling and material testing results, p. 17
- 8.7—Evaluation, p. 17
- 8.8—Findings and recommendations, p. 17

CHAPTER 9—REFERENCES, p. 18

- Authored documents, p. 19

CHAPTER 1—INTRODUCTION AND SCOPE**1.1—Introduction**

The guide outlines the approach and general procedures for the assessment of concrete structures before rehabilitation. This guide should be used in conjunction with **ACI 562**. An assessment, prior to rehabilitation, is generally performed for one or more of the following purposes:

- a) Evaluate the current condition of a structure
- b) Evaluate the extent of deterioration due to environmental conditions
- c) Evaluate structural damage or distress due to applied loadings and support displacements
- d) Verify the structural adequacy and integrity of a structure or selected members within a structure
- e) Assess the capacity of a structure to accommodate increased loads
- f) Determine the feasibility of changing the use of a structure
- g) Modify or restore a structure
- h) Change the appearance of a structure
- i) Estimate the remaining service life of a structure (**ACI 365.1R**)
- j) To assess the safety and structural capability of the structure to support the repair activities and to identify temporary support requirements.

The objective of the condition assessment is to determine the need, type, and extent of the rehabilitation, and to develop the goals of the project. As the initial planning activity, the assessment can also help identify operational and economic requirements that impact the rehabilitation plan.

1.2—Scope

The purpose of this guide is to provide general procedures for the assessment of concrete structures before rehabilitation. Evaluation of structures other than concrete buildings is beyond the scope of this guide, although the approach for condition assessment for such structures may be similar to those outlined in this guide.

This guide is general in character and intended to provide an approach for assessment of a concrete structure to meet one or more of the objectives listed in 1.1. The owner and licensed design professional should understand and agree on the objectives and goals of the assessment prior to the start of the assessment.

The first step in the assessment is the investigation and concludes with the evaluation, at either a preliminary or detailed level, depending upon the project requirements. After completion of the preliminary assessment, a detailed assessment can proceed if deemed desirable or necessary. Assessments generally involve four major tasks: 1) reviewing available pertinent documents; 2) performing field observations and condition assessments; 3) sampling and material testing; and 4) evaluation and structural analysis. Based on results of the investigation, evaluation and analysis can be performed and the results summarized in a report. The flowchart in Fig. 1.2 identifies the methodology and major tasks that are commonly undertaken in an assessment conducted before rehabilitation.

CHAPTER 2—DEFINITIONS

Please refer to the latest version of ACI Concrete Terminology for a comprehensive list of definitions. Definitions provided herein complement that resource.

assessment—process of investigating by systematically collecting information that affects the performance of an existing structure; evaluating the collected information to make informed decisions regarding the need for repair or rehabilitation; detailing of findings as conclusions and reporting recommendations for the examined structural concrete work area (member, system, or structure).

damage—changes in capacity of an existing structure resulting from events, such as loading and displacements.

deterioration—1) physical manifestation of failure of a material; 2) decomposition of material either during testing or exposure to service.

distress—physical manifestation of cracking and distortion in a concrete structure as a result of stress, chemical action, or both.

evaluation—process of determining and judging the structural adequacy of a structure, member, or system for its current intended use or performance objective.

investigation—collection and review of field data for the structure, such as geometry, material properties, conditions, symptoms of distress, extent of damage, measurement of displacements, environmental factors, and reinforcement sizes and placement. Also includes the collection of background data, such as plans, construction records, original and current codes governing existing buildings, and historical events.

rehabilitation—repairing or modifying an existing structure to a desired useful condition.

repair—reconstruction or renewal of concrete parts of an existing structure for the purpose of its maintenance or to correct deterioration, damage, or faulty construction of members or systems of a structure.