An ACI Standard

# Specifications for Structural Concrete

Reported by ACI Committee 301

ACI 301-16



American Concrete Institute
Always advancing

First Printing
May 2016
ISBN: 978-1-942727-86-6

# Specifications for Structural Concrete



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 ACI Manual of Concrete Practice (MCP).

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

**www.concrete.org**

# ACI 301-16

# Specifications for Structural Concrete

## An ACI Standard

## Reported by ACI Committee 301


James N. Cornell, Chair

Michelle L. Wilson, Secretary

### Voting Members

Jon B. Ardahl
Roger J. Becker
Nicholas J. Carino
Domingo J. Carreira
Mark F. Chrzanowski
Teck L. Chua
Anthony R. DeCarlo Jr.*
Christopher C. Ferraro
Sidney Freedman
John W. Gajda*
Thomas M. Greene
David P. Gustafson
Charles S. Hanskat
Kenneth C. Hover
Steven C. Jaycox*
Larry B. Krauser*
Colin L. Lobo
Ward R. Malisch
Frank Stephen Malits
W. Calvin McCall
David R. Nau
Aimee Pergalsky
Henry B. Prenger*
G. Michael Robinson
Richard S. Szecs[illegible]
Scott M. Tar[illegible]
Daniel B. Toon*
[illegible] B. Turner
Miroslav F. Vejvoda
Arthur T. Weiss Jr.
Michael A. Whisonant
Dennis M. Wittry*

*Subcommittee Chairs.

### Subcommittee Members

Asit N. Baxi
Jason P. Bray
Kenneth Carlson
Ramon L. Carrasquillo
Steven R. Close
Stephen J. Crawford
Jack L. David
Daniel P. Dorfmueller
Chris Forster
William A. Giorgi
Todd R. Hawkinson
Michael G. Hernandez
Gardner P. Horst
John C. Hukey
Robert S. Jenkins
Roger S. Johnston
Alfred L. Kaufman
Robert G. Ke[illegible]
Neel R. [illegible]
Donald F[illegible]
Lionel A. Lemay
Kevin A. MacDonald
Arthur W. McKinney†
Andrew S. McPherson
Brian D. Miller
Harry R. Moss Jr.
Theodore L. Neff
Joseph F. Neuber Jr
Lance Osbourne
John W. Rohrer
David B. Scott
Matthew J. Sheehan
Edith G. Smith
Jason Swagert
Kuntay L. Talay
Michael D. A. Thomas
Ralph H. Tulis
Gregory R. Wagner
William H. Wolfe
Zuming Xia

*Deceased.

### Consulting Member

Eric S. Peterson



*This is a Reference Specification that the Architect/Engineer can apply to any construction project involving structural concrete by citing it in the Project Specifications. A mandatory requirements checklist and an optional requirements checklist are provided to assist the Architect/Engineer in supplementing the provisions of this Specification as required or needed by designating or specifying individual project requirements.*

*The first five sections of this Specification cover general construction requirements for cast-in-place structural concrete and slabs-on-ground. These sections cover materials and proportioning of concrete; reinforcement and prestressing steel; production, placing, finishing, and curing of concrete; formwork performance criteria and construction; treatment of joints; embedded items; repair of surface defects; and finishing of formed and unformed surfaces. Provisions governing testing, evaluation, and acceptance of concrete as well as acceptance of the structures are included. The remaining sections are devoted to architectural concrete, lightweight concrete, mass concrete, post-tensioned concrete, shrinkage-compensating concrete, industrial floor slabs, tilt-up construction, precast structural concrete, and precast architectural concrete.*



**Keywords:** architectural; cold weather; compressive strength; consolidation; curing; durability; finish; formwork; grouting; hot weather; industrial floors; inspection; joints; lightweight concrete; mass concrete; mixture proportions; placing; post-tensioned; precast; prestressing steel; repair; reshoring; shoring; shrinkage-compensating; slab; slabs-on-ground; steel reinforcement; testing; tilt-up; tolerance; welded wire.

ACI 301-16 supersedes ACI 301-10, was adopted April 1, 2016, and published May 2016.

## CONTENTS



## SECTION 1—GENERAL REQUIREMENTS

### 1.1—Scope

**1.1.1** This Specification covers construction of cast-in-place concrete, architectural concrete, lightweight concrete, mass concrete, post-tensioned concrete, shrinkage-compensating concrete, industrial floor slabs cast on ground, tilt-up construction, precast structural concrete, and precast architectural concrete.

**1.1.2** Sections 1 through 5 apply to projects where this Specification is referenced. Work covered by Sections 6 through 14 apply only if that Work is designated in Contract Documents.

**1.1.3** This Specification becomes part of the Contract Document and provides requirements for Contractor.

**1.1.4** This Specification governs for construction within its scope, except Contract Documents govern if there is a conflict.

**1.1.5** *Work not specified*—The following Work is not in the scope of this Specification:

(a) Manufactured concrete products specified by ASTM standards
(b) Environmental concrete structures
(c) Heavyweight shielding concrete
(d) Paving concrete
(e) Terrazzo
(f) Insulating concrete
(g) Refractory concrete
(h) Nuclear containment structures
(i) Concrete piles; drilled piers; and caissons assigned to Seismic Design Categories A, B, and C
(j) Fire safety (Underwriter Laboratories [UL] designs)
(k) Shotcrete
(l) Slipformed concrete walls

**1.1.6** This Specification governs if there is a conflict with referenced materials and testing standards.

**1.1.7** Contractor is permitted to submit written alternatives to any provision in this Specification.

**1.1.8** Ignore provisions of this Specification that are not applicable to the Work.

**1.1.9** *Units*—Values in this Specification are stated in inch-pound units.

**1.1.10** Unless otherwise stated, the inch-pound system of units shall be applicable in ASTM combined standards referenced in this Specification.

**1.1.11** The Notes to Specifier are not part of this Specification.

## 1.2—Interpretation

**1.2.1** Unless otherwise explicitly stated, this Specification shall be interpreted using the following principles:

**1.2.1.1** Interpret this Specification consistent with the plain meaning of the words and terms used.

**1.2.1.2** Definitions provided in this Specification govern over the definitions of the same or similar words or terms found elsewhere.

**1.2.1.3** Headings are part of this Specification and are intended to identify the scope of the provisions or sections that follow. If there is a difference in meaning or implication between the text of a provision and a heading, the meaning of the text governs.

**1.2.1.4** Notes to a table are part of this Specification. The meaning of the provision text governs in the event of a difference in meaning or implication between the provision text and a note to a table.

**1.2.1.5** If a provision of this Specification involves two or more items, conditions, requirements, or events connected by the conjunctions "and" or "or," interpret the conjunction as follows:

(a) "And" indicates that all of the connected items, conditions, requirements, or events apply.

(b) "Or" indicates that the connected items, conditions, requirements, or events apply singularly.

**1.2.1.6** The use of the verbs "may" or "will" indicates that the specification provision is for information to Contractor.

**1.2.1.7** The phrase "as indicated in Contract Documents" means the specifier included the provision requirements in Contract Documents.

**1.2.1.8** The phrase "unless otherwise specified" means the specifier may have included an alternative to the default requirement in Contract Documents.

## 1.3—Definitions

**acceptable** or **accepted**—determined to be satisfactory by Architect/Engineer.

**acceptance**—acknowledgment by Architect/Engineer that submittal or completed Work is acceptable.

**ACI Concrete Field Testing Technician Grade I**—a person who has demonstrated knowledge and ability to perform and record the results of ASTM standard tests on freshly mixed concrete and to make and cure test specimens; knowledge and ability shall be demonstrated by passing prescribed written and performance examinations and having credentials that are current with the American Concrete Institute.

**aggressive environment**—an environment that exposes a structure to moisture and external sources of chlorides from deicing chemicals, salt, brackish water, seawater, or spray from these sources; for stressing pockets subject to wetting or direct contact with soils during service.

**Architect/Engineer** or **Engineer/Architect**—Architect, Engineer, architectural firm, engineering firm, or architectural and engineering firm issuing Contract Documents or administering the Work under Contract Documents, or both.

**architectural concrete**—concrete that is typically exposed to view, is designated as architectural concrete in Contract Documents, and therefore requires care in selection of the concrete materials, forming, placing, and finishing to obtain the desired architectural appearance.

**backshores**—shores placed snugly under a concrete slab or structural member after the original formwork and shores have been removed from a small area at a time, without allowing the slab or member to deflect, to support its own weight or existing construction loads.

**cast-in-place concrete**—concrete that is deposited and allowed to harden in the place where it is required to be in the completed structure.

**check test**—test performed to verify result of previous test result of freshly mixed concrete.

**Contract Documents**—a set of documents supplied by Owner to Contractor as the basis for construction; these documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

**Contractor**—the person, firm, or entity under contract for construction of the Work.

**defective work**—construction or material that does not comply with Contract Documents.

**design reference sample**—sample of precast architectural concrete color, finish, and texture that is submitted for initial verification of design intent.

**duct**—a conduit in a concrete member to accommodate the prestressing steel of a post-tensioning tendon and provide an annular space for protective coating.

**encapsulated tendon**—a tendon that is enclosed completely in a watertight covering from end to end, including anchorages, sheathing with coating, and caps over the strand tails.

**equivalent diameter of bundle**—the diameter of a circle having an area equal to the sum of the bar areas in a bundle of reinforcing bars.

**expansive cement**—a cement that, when mixed with water, produces a paste that, after setting, increases in volume and is used to compensate for volume decrease due to shrinkage or to induce tensile stress in reinforcement.

**exposed to view**—portion of structure that can be observed by the public during normal use.

**high-early-strength concrete**—concrete that, through the use of additional cement, high-early-strength cement, admixtures, or other acceptable methods, has accelerated early-age strength development.

**jack clearance**—minimum space required to safely install, operate, and remove a hydraulic jack through its full range of movement in stressing of a tendon.

**licensed design engineer**—an individual retained by the Contractor who is licensed to practice engineering as defined