An ACI Standard

Building Code Requirements for Structural Concrete (ACI 318-19)

Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19)

Reported by ACI Committee 318
The “Building Code Requirements for Structural Concrete” (“Code”) provides minimum requirements for the materials, design, and detailing of structural concrete buildings and, where applicable, nonbuilding structures. This Code was developed by an ANSI-approved consensus process and addresses structural systems, members, and connections, including cast-in-place, precast, shotcrete, plain, nonprestressed, prestressed, and composite construction. Among the subjects covered are: design and construction for strength, serviceability, and durability; load combinations, load factors, and strength reduction factors; structural analysis methods; deflection limits; mechanical and adhesive anchoring to concrete; development and splicing of reinforcement; construction document information; field inspection and testing; and methods to evaluate the strength of existing structures.

The Code was substantially reorganized and reformatted in 2014, and this Code continues and expands that same organizational philosophy. The principal objectives of the reorganization were to present all design and detailing requirements for structural systems or for individual members in chapters devoted to those individual subjects, and to arrange the chapters in a manner that generally follows the process and chronology of design and construction. Information and procedures that are common to the design of multiple members are located in utility chapters. Additional enhancements implemented in this Code to provide greater clarity and ease of use include the first use of color illustrations and the use of color to help the user navigate the Code and quickly find the information they need. Special thanks to Bentley Systems, Incorporated, for use of their ProConcrete software to produce many of the figures found in the Commentary.

Uses of the Code include adoption by reference in a general building code, and earlier editions have been widely used in this manner. The Code is written in a format that allows such reference without change to its language. Therefore, background details or suggestions for carrying out the requirements or intent of the Code provisions cannot be included within the Code itself. The Commentary is provided for this purpose.

Some considerations of the committee in developing the Code are discussed in the Commentary, with emphasis given to the explanation of new or revised provisions. Much of the research data referenced in preparing the Code is cited for the user desiring to study individual questions in greater detail. Other documents that provide suggestions for carrying out the requirements of the Code are also cited.

Technical changes from ACI 318-14 to ACI 318-19 are outlined in the August 2019 issue of Concrete International and are marked in the text of this Code with change bars in the margins.

KEYWORDS

admixtures; aggregates; anchorage (structural); beam-column frame; beams (supports); caissons; cements; cold weather; columns (supports); combined stress; composite construction (concrete to concrete); compressive strength; concrete; construction documents; construction joints; continuity (structural); contraction joints; cover; curing; deep beams; deep foundations; deflections; drilled piers; earthquake-resistant structures; flexural strength; floors; footings; formwork (construction); hot weather; inspection; isolation joints; joints (junctions); joists; lightweight concretes; load tests (structural); loads (forces); mixture proportioning; modulus of elasticity; moments; piles; placing; plain concrete; precast concrete; prestressed concrete; prestressing steels; quality control; reinforced concrete; reinforcing steels; roofs; serviceability; shear strength; shotcrete; spans; splicing; strength analysis; stresses; structural analysis; structural design; structural integrity; structural walls; T-beams; torsion; walls; water; welded wire reinforcement.
INTRODUCTION

ACI 318-19, “Building Code Requirements for Structural Concrete,” hereinafter called the Code or the 2019 Code, and ACI 318R-19, “Commentary,” are presented in a side-by-side column format. These are two separate but coordinated documents, with Code text placed in the left column and the corresponding Commentary text aligned in the right column. Commentary section numbers are preceded by an “R” to further distinguish them from Code section numbers. The two documents are bound together solely for the user’s convenience. Each document carries a separate enforceable and distinct copyright.

As the name implies, “Building Code Requirements for Structural Concrete” is meant to be used as part of a legally adopted building code and as such must differ in form and substance from documents that provide detailed specifications, recommended practice, complete design procedures, or design aids.

The Code is intended to cover all buildings of the usual types, both large and small. Requirements more stringent than the Code provisions may be desirable for unusual construction. The Code and Commentary cannot replace sound engineering knowledge, experience, and judgment.

A building code states only the minimum requirements necessary to provide for public health and safety. The Code is based on this principle. For any structure, the owner or the licensed design professional may require the quality of materials and construction to be higher than the minimum requirements necessary to protect the public as stated in the Code. However, lower standards are not permitted.

The Code has no legal status unless it is adopted by the government bodies having the police power to regulate building design and construction. Where the Code has not been adopted, it may serve as a reference to good practice even though it has no legal status.

The Code and Commentary are not intended for use in settling disputes between the owner, engineer, architect, contractor, or their agents, subcontractors, material suppliers, or testing agencies. Therefore, the Code cannot define the contract responsibility of each of the parties in usual construction. General references requiring compliance with the Code in the project specifications should be avoided because the contractor is rarely in a position to accept responsibility for design details or construction requirements that depend on a detailed knowledge of the design. Design-build construction contractors, however, typically combine the design and construction responsibility. Generally, the contract documents should contain all of the necessary requirements to ensure compliance with the Code. In part, this can be accomplished by reference to specific Code sections in the project specifications. Other ACI publications, such as “Specifications for Structural Concrete (ACI 301)” are written specifically for use as contract documents for construction.

The Commentary discusses some of the considerations of Committee 318 in developing the provisions contained in the Code. Emphasis is given to the explanation of new or revised provisions that may be unfamiliar to Code users. In addition, comments are included for some items contained in previous editions of the Code to make the present Commentary independent of the previous editions. Comments on specific provisions are made under the corresponding chapter and section numbers of the Code.

The Commentary is not intended to provide a complete historical background concerning the development of the Code, nor is it intended to provide a detailed résumé of the studies and research data reviewed by the committee in formulating the provisions of the Code. However, references to some of the research data are provided for those who wish to study the background material in depth.

The Commentary directs attention to other documents that provide suggestions for carrying out the requirements and intent of the Code. However, those documents and the Commentary are not a part of the Code.

The Commentary 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 information it contains. ACI disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom. Reference to the Commentary shall not be made in construction documents. If items found in the Commentary are desired by the licensed design professional to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the licensed design professional.

It is recommended to have the materials, processes, quality control measures, and inspections described in this document tested, monitored, or performed by individuals holding the appropriate ACI Certification or equivalent, when available. The personnel certification programs of the American Concrete Institute and the Post-Tensioning Institute; the plant certification programs of the Precast/Prestressed Concrete Institute, the Post-Tensioning Institute, and the National Ready Mixed Concrete Association; and the Concrete Reinforcing Steel Institute’s Voluntary Certification Program for Fusion-Bonded Epoxy Coating Applicator Plants are available for this purpose. In addition, “Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection” (ASTM E329-18) specifies performance requirements for inspection and testing agencies.

Design reference materials illustrating applications of the Code requirements are listed and described in the back of this document.
TABLE OF CONTENTS

PART 1: GENERAL

CHAPTER 1
GENERAL
1.1—Scope of ACI 318, p. 9
1.2—General, p. 9
1.3—Purpose, p. 9
1.4—Applicability, p. 10
1.5—Interpretation, p. 12
1.6—Building official, p. 13
1.7—Licensed design professional, p. 13
1.8—Construction documents and design records, p. 13
1.9—Testing and inspection, p. 14
1.10—Approval of special systems of design, construction, or alternative construction materials, p. 14

CHAPTER 2
NOTATION AND TERMINOLOGY
2.1—Scope, p. 15
2.2—Notation, p. 15
2.3—Terminology, p. 31

CHAPTER 3
REFERENCED STANDARDS
3.1—Scope, p. 47
3.2—Referenced standards, p. 47

CHAPTER 4
STRUCTURAL SYSTEM REQUIREMENTS
4.1—Scope, p. 51
4.2—Materials, p. 51
4.3—Design loads, p. 51
4.4—Structural system and load paths, p. 52
4.5—Structural analysis, p. 54
4.6—Strength, p. 55
4.7—Serviceability, p. 56
4.8—Durability, p. 56
4.9—Sustainability, p. 56
4.10—Structural integrity, p. 56
4.11—Fire resistance, p. 57
4.12—Requirements for specific types of construction, p. 57
4.13—Construction and inspection, p. 59
4.14—Strength evaluation of existing structures, p. 59

PART 2: LOADS & ANALYSIS

CHAPTER 5
LOADS
5.1—Scope, p. 61
5.2—General, p. 61
5.3—Load factors and combinations, p. 62

CHAPTER 6
STRUCTURAL ANALYSIS
6.1—Scope, p. 67
6.2—General, p. 67
6.3—Modeling assumptions, p. 72
6.4—Arrangement of live load, p. 73
6.5—Simplified method of analysis for nonprestressed continuous beams and one-way slabs, p. 74
6.6—Linear elastic first-order analysis, p. 75
6.7—Linear elastic second-order analysis, p. 84
6.8—Inelastic analysis, p. 85
6.9—Acceptability of finite element analysis, p. 86

PART 3: MEMBERS

CHAPTER 7
ONE-WAY SLABS
7.1—Scope, p. 89
7.2—General, p. 89
7.3—Design limits, p. 89
7.4—Required strength, p. 91
7.5—Design strength, p. 91
7.6—Reinforcement limits, p. 92
7.7—Reinforcement detailing, p. 94

CHAPTER 8
TWO-WAY SLABS
8.1—Scope, p. 99
8.2—General, p. 99
8.3—Design limits, p. 100
8.4—Required strength, p. 103
8.5—Design strength, p. 109
8.6—Reinforcement limits, p. 110
8.7—Reinforcement detailing, p. 113
8.8—Nonprestressed two-way joist systems, p. 125
CHAPTER 9
BEAMS
9.1—Scope, p. 127
9.2—General, p. 127
9.3—Design limits, p. 128
9.4—Required strength, p. 130
9.5—Design strength, p. 133
9.6—Reinforcement limits, p. 135
9.7—Reinforcement detailing, p. 139
9.8—Nonprestressed one-way joist systems, p. 150
9.9—Deep beams, p. 152

CHAPTER 10
COLUMNS
10.1—Scope, p. 155
10.2—General, p. 155
10.3—Design limits, p. 155
10.4—Required strength, p. 156
10.5—Design strength, p. 157
10.6—Reinforcement limits, p. 157
10.7—Reinforcement detailing, p. 158

CHAPTER 11
WALLS
11.1—Scope, p. 165
11.2—General, p. 165
11.3—Design limits, p. 166
11.4—Required strength, p. 166
11.5—Design strength, p. 167
11.6—Reinforcement limits, p. 170
11.7—Reinforcement detailing, p. 171
11.8—Alternative method for out-of-plane slender wall analysis, p. 172

CHAPTER 12
DIAPHRAGMS
12.1—Scope, p. 175
12.2—General, p. 176
12.3—Design limits, p. 177
12.4—Required strength, p. 178
12.5—Design strength, p. 181
12.6—Reinforcement limits, p. 188
12.7—Reinforcement detailing, p. 188

CHAPTER 13
FOUNDATIONS
13.1—Scope, p. 191
13.2—General, p. 193
13.3—Shallow foundations, p. 197
13.4—Deep foundations, p. 199

CHAPTER 14
PLAIN CONCRETE
14.1—Scope, p. 203
14.2—General, p. 204
14.3—Design limits, p. 204
14.4—Required strength, p. 206
14.5—Design strength, p. 207
14.6—Reinforcement detailing, p. 210

PART 4: JOINTS/CONNECTIONS/ANCHORS

CHAPTER 15
BEAM-COLUMN AND SLAB-COLUMN JOINTS
15.1—Scope, p. 211
15.2—General, p. 211
15.3—Detailing of joints, p. 212
15.4—Strength requirements for beam-column joints, p. 213
15.5—Transfer of column axial force through the floor system, p. 214

CHAPTER 16
CONNECTIONS BETWEEN MEMBERS
16.1—Scope, p. 217
16.2—Connections of precast members, p. 217
16.3—Connections to foundations, p. 222
16.4—Horizontal shear transfer in composite concrete flexural members, p. 225
16.5—Brackets and corbels, p. 227

CHAPTER 17
ANCHORING TO CONCRETE
17.1—Scope, p. 233
17.2—General, p. 234
17.3—Design Limits, p. 235
17.4—Required strength, p. 236
17.5—Design strength, p. 236
17.6—Tensile strength, p. 246
17.7—Shear strength, p. 261
17.8—Tension and shear interaction, p. 270
17.9—Edge distances, spacings, and thicknesses to preclude splitting failure, p. 270
17.10—Earthquake-resistant anchor design requirements, p. 272
17.11—Attachments with shear lugs, p. 277
PART 5: EARTHQUAKE RESISTANCE

CHAPTER 18
EARTHQUAKE-RESISTANT STRUCTURES
18.1—Scope, p. 285
18.2—General, p. 285
18.3—Ordinary moment frames, p. 291
18.4—Intermediate moment frames, p. 292
18.5—Intermediate precast structural walls, p. 299
18.6—Beams of special moment frames, p. 299
18.7—Columns of special moment frames, p. 305
18.8—Joints of special moment frames, p. 311
18.9—Special moment frames constructed using precast concrete, p. 314
18.10—Special structural walls, p. 317
18.11—Special structural walls constructed using precast concrete, p. 336
18.12—Diaphragms and trusses, p. 336
18.13—Foundations, p. 343
18.14—Members not designated as part of the seismic-force-resisting system, p. 351

PART 6: MATERIALS & DURABILITY

CHAPTER 19
CONCRETE: DESIGN AND DURABILITY REQUIREMENTS
19.1—Scope, p. 355
19.2—Concrete design properties, p. 355
19.3—Concrete durability requirements, p. 357
19.4—Grout durability requirements, p. 369

CHAPTER 20
STEEL REINFORCEMENT PROPERTIES, DURABILITY, AND EMBEDMENTS
20.1—Scope, p. 371
20.2—Nonprestressed bars and wires, p. 371
20.3—Prestressing strands, wires, and bars, p. 378
20.4—Headed shear stud reinforcement, p. 382
20.5—Provisions for durability of steel reinforcement, p. 382
20.6—Embedments, p. 390

PART 7: STRENGTH & SERVICEABILITY

CHAPTER 21
STRENGTH REDUCTION FACTORS
21.1—Scope, p. 391
21.2—Strength reduction factors for structural concrete members and connections, p. 391

CHAPTER 22
SECTIONAL STRENGTH
22.1—Scope, p. 397
22.2—Design assumptions for moment and axial strength, p. 397
22.3—Flexural strength, p. 399
22.4—Axial strength or combined flexural and axial strength, p. 400
22.5—One-way shear strength, p. 401
22.6—Two-way shear strength, p. 411
22.7—Torsional strength, p. 420
22.8—Bearing, p. 428
22.9—Shear friction, p. 430

CHAPTER 23
STRUT-AND-TIE METHOD
23.1—Scope, p. 435
23.2—General, p. 436
23.3—Design strength, p. 443
23.4—Strength of struts, p. 443
23.5—Minimum distributed reinforcement, p. 445
23.6—Strut reinforcement detailing, p. 446
23.7—Strength of ties, p. 447
23.8—Tie reinforcement detailing, p. 447
23.9—Strength of nodal zones, p. 448
23.10—Curved-bar nodes, p. 449
23.11—Earthquake-resistant design using the strut-and-tie method, p. 452

CHAPTER 24
SERVICEABILITY
24.1—Scope, p. 455
24.2—Deflections due to service-level gravity loads, p. 455
24.3—Distribution of flexural reinforcement in one-way slabs and beams, p. 460
24.4—Shrinkage and temperature reinforcement, p. 461
24.5—Permissible stresses in prestressed concrete flexural members, p. 463

PART 8: REINFORCEMENT

CHAPTER 25
REINFORCEMENT DETAILS
25.1—Scope, p. 467
25.2—Minimum spacing of reinforcement, p. 467
25.3—Standard hooks, seismic hooks, crossties, and minimum inside bend diameters, p. 469
25.4—Development of reinforcement, p. 471
25.5—Splices, p. 488
25.6—Bundled reinforcement, p. 493
25.7—Transverse reinforcement, p. 494
25.8—Post-tensioning anchorages and couplers, p. 504
25.9—Anchorage zones for post-tensioned tendons, p. 505
PART 9: CONSTRUCTION

CHAPTER 26
CONSTRUCTION DOCUMENTS AND INSPECTION
26.1—Scope, p. 515
26.2—Design criteria, p. 516
26.3—Member information, p. 517
26.4—Concrete materials and mixture requirements, p. 517
26.5—Concrete production and construction, p. 528
26.6—Reinforcement materials and construction requirements, p. 535
26.7—Anchoring to concrete, p. 540
26.8—Embedments, p. 542
26.9—Additional requirements for precast concrete, p. 543
26.10—Additional requirements for prestressed concrete, p. 544
26.11—Formwork, p. 546
26.12—Evaluation and acceptance of hardened concrete, p. 548
26.13—Inspection, p. 554

PART 10: EVALUATION

CHAPTER 27
STRENGTH EVALUATION OF EXISTING STRUCTURES
27.1—Scope, p. 559
27.2—General, p. 559
27.3—Analytical strength evaluation, p. 560
27.4—Strength evaluation by load test, p. 561
27.5—Monotonic load test procedure, p. 562
27.6—Cyclic load test procedure, p. 564

APPENDICES & REFERENCES

APPENDIX A
DESIGN VERIFICATION USING NONLINEAR RESPONSE HISTORY ANALYSIS
A.1—Notation and terminology, p. 567
A.2—Scope, p. 567
A.3—General, p. 568
A.4—Earthquake ground motions, p. 568
A.5—Load factors and combinations, p. 569
A.6—Modeling and analysis, p. 569
A.7—Action classification and criticality, p. 570
A.8—Effective stiffness, p. 571
A.9—Expected material strength, p. 573
A.10—Acceptance criteria for deformation-controlled actions, p. 574
A.11—Expected strength for force-controlled actions, p. 576
A.12—Enhanced detailing requirements, p. 577
A.13—Independent structural design review, p. 578

APPENDIX B
STEEL REINFORCEMENT INFORMATION

APPENDIX C
EQUIVALENCE BETWEEN SI-METRIC, MKS-METRIC, AND U.S. CUSTOMARY UNITS OF NONHOMOGENOUS EQUATIONS IN THE CODE

COMMENTARY REFERENCES

INDEX
CHAPTER 1—GENERAL

CODE

1.1—Scope of ACI 318

1.1.1 This chapter addresses (a) through (h):

(a) General requirements of this Code
(b) Purpose of this Code
(c) Applicability of this Code
(d) Interpretation of this Code
(e) Definition and role of the building official and the licensed design professional
(f) Construction documents
(g) Testing and inspection
(h) Approval of special systems of design, construction, or alternative construction materials

1.2—General

1.2.1 ACI 318, “Building Code Requirements for Structural Concrete,” is hereafter referred to as “this Code.”

1.2.2 In this Code, the general building code refers to the building code adopted in a jurisdiction. When adopted, this Code forms part of the general building code.

1.2.3 The official version of this Code is the English language version, using inch-pound units, published by the American Concrete Institute.

1.2.4 In case of conflict between the official version of this Code and other versions of this Code, the official version governs.

1.2.5 This Code provides minimum requirements for the materials, design, construction, and strength evaluation of structural concrete members and systems in any structure designed and constructed under the requirements of the general building code.

1.2.6 Modifications to this Code that are adopted by a particular jurisdiction are part of the laws of that jurisdiction, but are not a part of this Code.

1.2.7 If no general building code is adopted, this Code provides minimum requirements for the materials, design, construction, and strength evaluation of members and systems in any structure within the scope of this Code.

1.3—Purpose

1.3.1 The purpose of this Code is to provide for public health and safety by establishing minimum requirements for

COMMENTARY

R1.1—Scope of ACI 318

R1.1.1 This Code includes provisions for the design of concrete used for structural purposes, including plain concrete; concrete containing nonprestressed reinforcement, prestressed reinforcement, or both; and anchoring to concrete. This chapter includes a number of provisions that explain where this Code applies and how it is to be interpreted.

R1.2—General

R1.2.2 The American Concrete Institute recommends that this Code be adopted in its entirety.

R1.2.3 Committee 318 develops the Code in English, using inch-pound units. Based on that version, Committee 318 approved three other versions:

(a) In English using SI units (ACI 318M)
(b) In Spanish using SI units (ACI 318S)
(c) In Spanish using inch-pound units (ACI 318SUS).

Jurisdictions may adopt ACI 318, ACI 318M, ACI 318S, or ACI 318SUS.

R1.2.5 This Code provides minimum requirements and exceeding these minimum requirements is not a violation of the Code.

The licensed design professional may specify project requirements that exceed the minimum requirements of this Code.

R1.3—Purpose

R1.3.1 This Code provides a means of establishing minimum requirements for the design and construction of
1.3.2 This Code does not address all design considerations.

1.3.3 Construction means and methods are not addressed in this Code.

1.4—Applicability

1.4.1 This Code shall apply to concrete structures designed and constructed under the requirements of the general building code.

1.4.2 Provisions of this Code shall be permitted to be used for the assessment, repair, and rehabilitation of existing structures.

1.4.3 Applicable provisions of this Code shall be permitted to be used for structures not governed by the general building code.

1.4.4 The design of thin shells and folded plate concrete structures shall be in accordance with ACI 318.2, “Building Code Requirements for Concrete Thin Shells.”

1.4.5 This Code shall apply to the design of slabs cast on stay-in-place, noncomposite steel decks.

R1.3.2 The minimum requirements in this Code do not replace sound professional judgment or the licensed design professional’s knowledge of the specific factors surrounding a project, its design, the project site, and other specific or unusual circumstances to the project.

R1.4—Applicability

R1.4.2 Specific provisions for assessment, repair, and rehabilitation of existing concrete structures are provided in ACI 562-19. Existing structures in ACI 562 are defined as structures that are complete and permitted for use.

R1.4.3 Structures such as arches, bins and silos, blast-resistant structures, chimneys, underground utility structures, gravity walls, and shielding walls involve design and construction requirements that are not specifically addressed by this Code. Many Code provisions, however, such as concrete quality and design principles, are applicable for these structures. Recommendations for design and construction of some of these structures are given in the following:

- “Code Requirements for Reinforced Concrete Chimneys and Commentary” (ACI 307-08)
- “Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials” (ACI 313-97)
- “Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary” (ACI 349)
- “Code for Concrete Containments” (ACI 359)

R1.4.5 In its most basic application, the noncomposite steel deck serves as a form, and the concrete slab is designed to resist all loads, while in other applications the concrete slab may be designed to resist only the superimposed loads. The design of a steel deck in a load-resisting application is given in “Standard for Non-Composite Steel Floor Deck”
1.4.6 For one- and two-family dwellings, multiple single-family dwellings, townhouses, and accessory structures to these types of dwellings, the design and construction of cast-in-place footings, foundation walls, and slabs-on-ground in accordance with ACI 332 shall be permitted.

1.4.7 This Code does not apply to the design and installation of concrete piles, drilled piers, and caissons embedded in ground, except as provided in (a) through (c):

(a) For portions of deep foundation members in air or water, or in soil incapable of providing adequate lateral restraint to prevent buckling throughout their length
(b) For precast concrete piles supporting structures assigned to Seismic Design Categories A and B (13.4)
(c) For deep foundation elements supporting structures assigned to Seismic Design Categories C, D, E, and F (Ch. 13, 18.13)

1.4.8 This Code does not apply to design and construction of slabs-on-ground, unless the slab transmits vertical loads or lateral forces from other portions of the structure to the soil.

1.4.9 This Code does not apply to the design and construction of tanks and reservoirs.

1.4.10 This Code does not apply to composite design slabs cast on stay-in-place composite steel deck. Concrete used in the construction of such slabs shall be governed by this Code, where applicable. Portions of such slabs designed as reinforced concrete are governed by this Code.
1.5—Interpretation

1.5.1 The principles of interpretation in this section shall apply to this Code as a whole unless otherwise stated.

1.5.2 This Code consists of chapters and appendixes, including text, headings, tables, figures, footnotes to tables and figures, and referenced standards.

1.5.3 The Commentary consists of a preface, introduction, commentary text, tables, figures, and cited publications. The Commentary is intended to provide contextual information, but is not part of this Code, does not provide binding requirements, and shall not be used to create a conflict with or ambiguity in this Code.

1.5.4 This Code shall be interpreted in a manner that avoids conflict between or among its provisions. Specific provisions shall govern over general provisions.

1.5.5 This Code shall be interpreted and applied in accordance with the plain meaning of the words and terms used. Specific definitions of words and terms in this Code shall be used where provided and applicable, regardless of whether other materials, standards, or resources outside of this Code provide a different definition.

1.5.6 The following words and terms in this Code shall be interpreted in accordance with (a) through (e):

(a) The word “shall” is always mandatory.
(b) Provisions of this Code are mandatory even if the word “shall” is not used.
(c) Words used in the present tense shall include the future.
(d) The word “and” indicates that all of the connected items, conditions, requirements, or events shall apply.
(e) The word “or” indicates that the connected items, conditions, requirements, or events are alternatives, at least one of which shall be satisfied.

1.5.7 In any case in which one or more provisions of this Code are declared by a court or tribunal to be invalid, that ruling shall not affect the validity of the remaining provisions of this Code, which are severable. The ruling of a court or tribunal shall be effective only in that court’s jurisdiction, and shall not affect the content or interpretation of this Code in other jurisdictions.

1.5.8 If conflicts occur between provisions of this Code and those of standards and documents referenced in Chapter 3, this Code shall apply.

1.5.9 Supports is a common example where a portion of the slab is designed in conformance with this Code.

R1.5—Interpretation

R1.5.4 General provisions are broad statements, such as a building needs to be serviceable. Specific provisions, such as explicit reinforcement distribution requirements for crack control, govern over the general provisions.

R1.5.5 ACI Concrete Terminology (2018) is the primary resource to help determine the meaning of words or terms that are not defined in the Code. Dictionaries and other reference materials commonly used by licensed design professionals may be used as secondary resources.

R1.5.7 This Code addresses numerous requirements that can be implemented fully without modification if other requirements in this Code are determined to be invalid. This severability requirement is intended to preserve this Code and allow it to be implemented to the extent possible following legal decisions affecting one or more of its provisions.
1.6—Building official

1.6.1 All references in this Code to the building official shall be understood to mean persons who administer and enforce this Code.

1.6.2 Actions and decisions by the building official affect only the specific jurisdiction and do not change this Code.

1.6.3 The building official shall have the right to order testing of any materials used in concrete construction to determine if materials are of the quality specified.

1.7—Licensed design professional

1.7.1 All references in this Code to the licensed design professional shall be understood to mean the engineer in either 1.7.1.1 or 1.7.1.2.

1.7.1.1 The licensed design professional responsible for, and in charge of, the structural design work.

1.7.1.2 A specialty engineer to whom a specific portion of the structural design work has been delegated subject to the conditions of (a) and (b).

(a) The authority of the specialty engineer shall be explicitly limited to the delegated design work.
(b) The portion of design work delegated shall be well defined such that responsibilities and obligations of the parties are apparent.

1.8—Construction documents and design records

1.8.1 The licensed design professional shall provide in the construction documents the information required in Chapter 26 and that required by the jurisdiction.

1.8.2 Calculations pertinent to design shall be filed with the construction documents if required by the building official. Analyses and designs using computer programs shall be permitted provided design assumptions, user input, and computer-generated output are submitted. Model analysis shall be permitted to supplement calculations.

R1.6—Building official

R1.6.1 Building official is defined in 2.3.

R1.6.2 Only the American Concrete Institute has the authority to alter or amend this Code.

R1.7—Licensed design professional

R1.7.1 Licensed design professional is defined in 2.3.

R1.7.1.2(b) A portion of the design work may be delegated to a specialty engineer during the design phase or to the contractor in the construction documents. Examples of design work delegated to a specialty engineer or contractor include precast concrete and post-tensioned concrete design.

R1.8—Construction documents and design records

R1.8.1 The provisions of Chapter 26 for preparing project drawings and specifications are, in general, consistent with those of most general building codes. Additional information may be required by the building official.

R1.8.2 Documented computer output is acceptable instead of manual calculations. The extent of input and output information required will vary according to the specific requirements of individual building officials. However, if a computer program has been used, only skeleton data should normally be required. This should consist of sufficient input and output data and other information to allow the building official to perform a detailed review and make comparisons using another program or manual calculations. Input data should be identified as to member designation, applied loads, and span lengths. The related output data should include member designation and the shears, moments, and reactions at key points in the span. For column design, it is desirable to include moment magnification factors in the output where applicable.

The Code permits model analysis to be used to supplement structural analysis and design calculations. Documentation
1.9—Testing and inspection

1.9.1 Concrete materials shall be tested in accordance with the requirements of Chapter 26.

1.9.2 Concrete construction shall be inspected in accordance with the general building code and in accordance with Chapter 26.

1.9.3 Inspection records shall include information in accordance with Chapter 26.

1.10—Approval of special systems of design, construction, or alternative construction materials

1.10.1 Sponsors of any system of design, construction, or alternative construction materials within the scope of this Code, the adequacy of which has been shown by successful use or by analysis or test, but which does not conform to or is not covered by this Code, shall have the right to present the data on which their design is based to the building official or to a board of examiners appointed by the building official. This board shall be composed of competent engineers and shall have authority to investigate the data so submitted, require tests, and formulate rules governing design and construction of such systems to meet the intent of this Code. These rules, when approved by the building official and promulgated, shall be of the same force and effect as the provisions of this Code.

R1.10—Approval of special systems of design, construction, or alternative construction materials

R1.10.1 New methods of design, new materials, and new uses of materials should undergo a period of development before being covered in a code. Hence, good systems or components might be excluded from use by implication if means were not available to obtain acceptance.

For special systems considered under this section, specific tests, load factors, deflection limits, and other pertinent requirements should be set by the board of examiners, and should be consistent with the intent of the Code.

The provisions of this section do not apply to model tests used to supplement calculations under 1.8.2 or to strength evaluation of existing structures under Chapter 27.