New editions of each part of the *ACI Manual of Concrete Practice* are issued annually and include the latest ACI standards and committee reports.
ACI Certification Programs

The final quality of a concrete structure depends on qualified people to construct it. ACI certification programs identify craftsmen, technicians, and inspectors who have demonstrated their qualifications. The following programs are administered by ACI to fulfill the growing demand in the industry for certified workers. More information about these programs is available at www.acicertification.org.

- ACI/CRSI Adhesive Anchor Installer
- Aggregate Testing Technician—Levels 1 & 2
- Tilt-Up Supervisor & Technician
- Concrete Construction Special Inspector
- Shotcrete Nozzleman (Dry-Mix Process)
- Concrete Transportation Construction Inspector
- Shotcrete Nozzleman (Wet-Mix Process)
- Associate Concrete Transportation Construction Inspector
- Specialty Commercial/Industrial Concrete Flatwork Finisher
- CSA-Based Concrete Construction Special Inspector
- Concrete Flatwork Finisher & Technician
- CSA-Based Concrete Field Testing Technician—Grade I
- Concrete Field Testing Technician—Grade I
- Concrete Quality Technical Manager
- Concrete Strength Testing Technician
- Masonry Field Testing Technician
- Aggregate Base Testing Technician
- Masonry Laboratory Testing Technician
- Concrete Laboratory Testing Technician—Levels 1 & 2
- Concrete Field Testing Technician—Grade I

This document may already contain reference to these ACI certification programs, which can be incorporated into project specifications or quality control procedures. If not, suggested guide specifications are available on request from the ACI Certification Department.

Enhancement of ACI Documents

ACI documents are subject to periodic review, and suggestions for their improvement are invited. All comments regarding ACI documents should be addressed to the Managing Director of Engineering at ACI.

AMERICAN CONCRETE INSTITUTE
www.concrete.org

The reports and standards herein are reprints of copyrighted material.

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

The reports and standards herein were the latest approved version at the time this edition was published. The content of each report or standard is subject to periodic review and to revision whenever the developments in concrete design and construction warrant a change. Since this is a continuing process, some reports or standards in this volume may have been superseded in the interim since publication. Inquiries concerning revisions or additional material in a subject area are welcome and should be directed to Institute headquarters.

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 expressed 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.
ACI MANUAL OF CONCRETE PRACTICE—2015

The ACI Manual of Concrete Practice is a seven-part compilation of current ACI standards and committee reports.

Part 1—ACI 117-10 to ACI 228.1R-03
Part 2—ACI 228.2R-13 to ACI 314R-11
Part 3—ACI 318-14 to ACI 346-09
Part 4—ACI 347R-14 to ACI 355.2-07
Part 5—ACI 355.3R-11 to ACI 440R-07
Part 6—ACI 440.1R-06 to ACI 533.1R-02
Part 7—ACI 543R-12 to ACI ITG-7-09

Some of the most important work of the Institute is performed by its technical committees that prepare the committee reports and standards contained in the Manual. Technical committees of the Institute are organized into the following five groups with regard to their function: 100—General, 200—Materials and Properties of Concrete, 300—Design and Construction, 400—Concrete Reinforcement and Structural Analysis, and 500—Specialized Applications and Repair. Committees are assigned numbers that indicate their group or general area of responsibility.

Each standard of the Institute bears a hyphenated number to identify it. The first three digits identify the committee originating the standard, and the last two digits identify the year it was adopted. Thus, standard ACI 305.1-14 was prepared by Committee 305 and was adopted as a standard in the year 2014.

Committee reports are also identified by a hyphenated number with the addition of an “R” to indicate a report rather than a standard. For committee reports, the last two digits refer to either the year of original publication or, in a few cases, to the year of adoption of a related standard.

The following list contains the numbers and titles of all committee reports and standards found in the 2015 ACI Manual of Concrete Practice. Reports and Standards are listed numerically and the location in the Manual follows the title.

100—General
117-10 Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary, Part 1
117.1R-14 Guide for Tolerance Compatibility in Concrete Construction, Part 1
121R-08 Guide for Concrete Construction Quality Systems in Conformance with ISO 9001, Part 1
122R-14 Guide to Thermal Properties of Concrete and Masonry Systems, Part 1

200—Materials and Properties of Concrete
201.1R-08 Guide for Conducting a Visual Inspection of Concrete in Service, Part 1
201.2R-08 Guide to Durable Concrete, Part 1
207.1R-05 Reapproved 2012 Guide to Mass Concrete, Part 1
207.2R-07 Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, Part 1
207.3R-94 Reapproved 2008 Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, Part 1
207.4R-05 Reapproved 2012 Cooling and Insulating Systems for Mass Concrete, Part 1
207.5R-11 Report on Roller-Compacted Mass Concrete, Part 1
209R-92 Reapproved 2008 Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Part 1
209.1R-05 Report on Factors Affecting Shrinkage and Creep of Hardened Concrete, Part 1
209.2R-08 Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete, Part 1
# 300—Design and Construction

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>301-10</td>
<td>Specifications for Structural Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>SP-15(10)</td>
<td>Field Reference Manual (Synopsis only), <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>302.1R-04</td>
<td>Guide for Concrete Floor and Slab Construction, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>302.2R-06</td>
<td>Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>303R-12</td>
<td>Guide to Cast-in-Place Architectural Concrete Practice, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>303.1-97</td>
<td>Standard Specification for Cast-in-Place Architectural Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>304R-00</td>
<td>Reapproved 2009 Guide for Measuring, Mixing, Transporting, and Placing Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>304.2R-96</td>
<td>Reapproved 2008 Placing Concrete by Pumping Methods, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>304.3R-96</td>
<td>Reapproved 2004 Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>304.4R-95</td>
<td>Reapproved 2008 Placing Concrete with Belt Conveyors, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>304.6R-09</td>
<td>Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>305R-10</td>
<td>Guide to Hot Weather Concreting, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>305.1-14</td>
<td>Specification for Hot Weather Concreting, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>306R-10</td>
<td>Guide to Cold Weather Concreting, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>307-08</td>
<td>Code Requirements for Reinforced Concrete Chimneys (ACI 307-08) and Commentary, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>308R-01</td>
<td>Reapproved 2008 Guide to Curing Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>(308-213)R-13</td>
<td>Report on Internally Cured Concrete Using Prewetted Absorptive Lightweight Aggregate, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>308.1-11</td>
<td>Specification for Curing Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>309R-05</td>
<td>Guide for Consolidation of Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>309.1R-08</td>
<td>Report on Behavior of Fresh Concrete During Vibration, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>309.2R-98</td>
<td>Reapproved 2005 Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>309.5R-00</td>
<td>Reapproved 2006 Compaction of Roller-Compacted Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>310R-13</td>
<td>Guide to Decorative Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>311.1R-07</td>
<td>ACI Manual of Concrete Inspection—SP-2(07) (Synopsis only), <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>311.4R-05</td>
<td>Guide for Concrete Inspection, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>311.5-04</td>
<td>Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>311.6-09</td>
<td>Specification for Ready Mixed Concrete Testing Services, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>311.7-14</td>
<td>Inspection Services Specification for Cast-in-Place Concrete Construction, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>313-97</td>
<td>Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>313R-97</td>
<td>Commentary on Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>314R-11</td>
<td>Guide to Simplified Design for Reinforced Concrete Buildings, <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>SP-66(04)</td>
<td>ACI Detailing Manual (Synopsis only), <strong>Part 2</strong></td>
<td></td>
</tr>
<tr>
<td>318-14</td>
<td>Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14), <strong>Part 3</strong></td>
<td></td>
</tr>
<tr>
<td>318-14</td>
<td>Building Code Requirements for Concrete Thin Shells (ACI 318.2-14) and Commentary (ACI 318.2R-14), <strong>Part 3</strong></td>
<td></td>
</tr>
<tr>
<td>325.10R-95</td>
<td>Reapproved 2001 Report on Roller-Compacted Concrete Pavements, <strong>Part 3</strong></td>
<td></td>
</tr>
<tr>
<td>325.11R-01</td>
<td>Accelerated Techniques for Concrete Paving, <strong>Part 3</strong></td>
<td></td>
</tr>
<tr>
<td>325.12R-02</td>
<td>Reapproved 2013 Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, <strong>Part 3</strong></td>
<td></td>
</tr>
<tr>
<td>Document Number</td>
<td>Title</td>
<td>Part</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>325.13R-06</td>
<td>Concrete Overlays for Pavement Rehabilitation, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>329R-14</td>
<td>Guide to Performance-Based Requirements for Concrete, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>330R-08</td>
<td>Guide for the Design and Construction of Concrete Parking Lots, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>330.1-14</td>
<td>Specification for Unreinforced Concrete Parking Lots and Site Paving, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>332-14</td>
<td>Residential Code Requirements for Structural Concrete (ACI 332-14) and Commentary, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>332.1R-06</td>
<td>Guide to Residential Concrete Construction, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>334.1R-92</td>
<td><em>Reapproved 2002</em> Concrete Shell Structures—Practice and Commentary, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>334.3R-05</td>
<td>Construction of Concrete Shells Using Inflated Forms, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>336.1-01</td>
<td>Specification for the Construction of Drilled Piers, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>336.2R-88</td>
<td><em>Reapproved 2002</em> Suggested Analysis and Design Procedures for Combined Footings and Mats, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>336.3R-14</td>
<td>Report on Design and Construction of Drilled Piers, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>341.2R-14</td>
<td>Report on Analysis and Design of Seismic-Resistant Concrete Bridge Systems, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>341.3R-07</td>
<td>Seismic Evaluation and Retrofit Techniques for Concrete Bridges, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>343R-95</td>
<td><em>Reapproved 2004</em> Analysis and Design of Reinforced Concrete Bridge Structures, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>343.1R-12</td>
<td>Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>345R-11</td>
<td>Guide for Concrete Highway Bridge Deck Construction, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>345.1R-06</td>
<td>Guide for Maintenance of Concrete Bridge Members, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>345.2R-13</td>
<td>Guide for Widening Highway Bridges, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>346-09</td>
<td>Specification for Cast-in-Place Concrete Pipe, <em>Part 3</em></td>
<td></td>
</tr>
<tr>
<td>347R-14</td>
<td>Guide to Formwork for Concrete, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>347.2R-05</td>
<td>Guide for Shoring/Reshoring of Concrete Multistory Buildings, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>347.3R-13</td>
<td>Guide to Formed Concrete Surfaces, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>SP-4</td>
<td>Formwork for Concrete (Synopsis only), <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>349-13</td>
<td>Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-13) and Commentary, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>349.1R-07</td>
<td>Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>349.2R-07</td>
<td><em>Reapproved 2014</em> Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>349.3R-02</td>
<td><em>Reapproved 2010</em> Evaluation of Existing Nuclear Safety-Related Concrete Structures, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>350-06</td>
<td>Code Requirements for Environmental Engineering Concrete Structures (ACI 350-06) and Commentary, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>350.1-10</td>
<td>Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures (ACI 350.1-10) and Commentary, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>350.2R-04</td>
<td>Concrete Structures for Containment of Hazardous Materials, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>350.3-06</td>
<td>Seismic Design of Liquid-Containing Concrete Structures (ACI 350.3-06) and Commentary, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>350.4R-04</td>
<td>Design Considerations for Environmental Engineering Concrete Structures, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>350.5-12</td>
<td>Specifications for Environmental Concrete Structures, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>351.1R-12</td>
<td>Report on Grouting between Foundations and Bases for Support of Equipment and Machinery, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>351.2R-10</td>
<td>Report on Foundations for Static Equipment, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>351.3R-04</td>
<td><em>Reapproved 2011</em> Foundations for Dynamic Equipment, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>352R-02</td>
<td><em>Reapproved 2010</em> Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures, <em>Part 4</em></td>
<td></td>
</tr>
<tr>
<td>352.1R-11</td>
<td>Guide for Design of Slab-Column Connections in Monolithic Concrete Structures, <em>Part 4</em></td>
<td></td>
</tr>
</tbody>
</table>
Qualification of Post-Installed Mechanical Anchors in Concrete (ACI 355.2-07) and Commentary, Part 4
Guide for Design of Anchorage to Concrete: Examples Using ACI 318 Appendix D, Part 5
Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4-11) and Commentary, Part 5
Report on Floating and Float-In Concrete Structures, Part 5
Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, Part 5
Code for Concrete Containments (Synopsis only), Part 5
Guide to Design of Slabs-on-Ground, Part 5
Reapproved 2013 Guide for Structural Maintenance of Parking Structures, Part 5
Report on High-Strength Concrete, Part 5
Guide to Quality Control and Assurance of High-Strength Concrete, Part 5
Guide for Evaluation of Concrete Structures before Rehabilitation, Part 5
Increasing Shear Capacity within Existing Reinforced Concrete Structures, Part 5
Guide for Cementitious Repair Material Data Sheet, Part 5
Treatment of Exposed Epoxy-Coated Reinforcement in Repair, Part 5
Determining the Load Capacity of a Structure when As-Built Drawings are Unavailable, Part 5
Importance of Modulus of Elasticity in Surface Repair Materials, Part 5
Reapproved 2011 Concrete Removal in Repairs Involving Corroded Reinforcing Steel, Part 5
Reapproved 2011 Evaluation and Minimization of Bruising (Microcracking) in Concrete Repair, Part 5
Reapproved 2011 Use of Hydromatolysis for Concrete Removal in Unbonded Post-Tensioned Systems, Part 5
Reapproved 2011 Cracks in a Repair, Part 5
Rehabilitation of Structure with Reinforcement Section Loss, Part 5
Service-Life Prediction, Part 5
Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary, Part 5
Report for the Design of Concrete Structures for Blast Effects, Part 5
Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, Part 5
Guide to Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, Part 5
Reapproved 2014 Acceptance Criteria for Moment Frames Based on Structural Testing (ACI 374.1-05) and Commentary, Part 5
Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases (ACI 376-11) and Commentary (Synopsis only), Part 5

---

400—Concrete Reinforcement and Structural Analysis

Reapproved 2012 Bond and Development of Straight Reinforcing Bars in Tension, Part 5
Report on Bond of Steel Reinforcing Bars Under Cyclic Loads, Part 5
Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension and Commentary, Part 5

Guide to Shear Reinforcement for Slabs, Part 5

Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates, Part 5

Recommendations for Concrete Members Prestressed with Unbonded Tendons, Part 5


Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems, Part 5

Test Method for Bleed Stability of Cementitious Post-Tensioning Tendon Grout, Part 5

Reapproved 2000 Control of Deflection in Concrete Structures, Part 5

Reapproved 1997 Observed Deflections of Reinforced Concrete Slab Systems, and Causes of Large Deflections (Synopsis only), Part 5

Strength Evaluation of Existing Concrete Buildings, Part 5

Load Tests of Concrete Structures: Methods, Magnitude, Protocols, and Acceptance Criteria, Part 5

Code Requirements for Load Testing of Existing Concrete Structures (ACI 437.2-13) and Commentary, Part 5

Types of Mechanical Splices for Reinforcing Bars, Part 5


Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Part 5

Guide for the Design and Construction of Structural Concrete Reinforced with FRP Bars, Part 6

Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Part 6

Guide Test Methods for Fiber-Reinforced Polymer (FRP) Composites for Reinforcing or Strengthening Concrete and Masonry Structures, Part 6

Reapproved 2011 Prestressing Concrete Structures with FRP Tendons, Part 6

Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars, Part 6

Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement, Part 6


Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures, Part 6

High-Strength Concrete Columns, Part 6

Reapproved 2009 Recent Approaches to Shear Design of Structural Concrete, Part 6

Report on Torsion in Structural Concrete, Part 6

Reapproved 1999 Fracture Mechanics of Concrete: Concepts, Models and Determination of Material Properties (Abstract only), Part 6

Finite Element Analysis of Fracture in Concrete Structures, Part 6

Report on Dynamic Fracture of Concrete, Part 6

Reapproved 2003 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, Part 6

Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate, Part 6

548.13-14 Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, Part 7
549R-97 Reapproved 2009 Report on Ferrocement, Part 7
549.2R-04 Reapproved 2013 Report on Thin Reinforced Cementitious Products, Part 7
549.3R-09 Report on Glass Fiber-Reinforced Concrete Premix, Part 7
550.1R-09 Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Part 7
551.1R-14 Guide to Tilt-Up Concrete Construction Guide, Part 7
551.2R-10 Design Guide for Tilt-Up Concrete Panels, Part 7
555R-01 Removal and Reuse of Hardened Concrete, Part 7
562-13 Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings (ACI 562-13) and Commentary
ITG-4.1-07 Specification for High-Strength Concrete in Moderate to High Seismic Applications, Part 7
ITG-4.2R-06 Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Part 7
ITG-4.3R-07 Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Part 7
ITG-5.1-07 Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing and Commentary, Part 7
ITG-5.2-09 Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1 (ACI ITG-5.2-09) and Commentary, Part 7
ITG-6R-10 Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, Part 7
ITG-7-09 Specification for Tolerances for Precast Concrete, Part 7
SP-17(14) The Reinforced Concrete Design Manual in Accordance with ACI 318-14 (Synopsis only), Part 7
is a nonprofit, nonpartisan organization of engineers, architects, scientists, constructors, and individuals associated in their technical interest with the field of concrete and dedicated to public service. The purpose of the Institute is to further engineering and technical education, scientific investigation and research, and development of standards for the design and construction of concrete structures. Members of the Institute are involved in gathering, correlating, and disseminating information for the improvement of the design, construction, manufacture, use, and maintenance of concrete products and structures. The Institute and its members also promote improved technology, technical competence, and good design and construction practices.

Since 1904, the objectives of the Institute have been achieved by a combined membership effort. Individually and through committees, and with the cooperation of many public and private agencies, members have correlated the results of research, from both field and laboratory, and of practices in design, construction, and manufacture.

The work of the Institute is available to the concrete industry through seminars, workshops, chapter functions, and publications. The Institute publishes three periodicals, the *ACI Structural Journal*, *ACI Materials Journal*, and *Concrete International*. The Institute also has an extensive nonperiodical publications program, which includes committee reports, building code requirements and other standards, symposia, manuals, design handbooks, monographs, education bulletins, certification program workbooks, and the *ACI Manual of Concrete Practice*.

Some of the most recent publications are:

- **CP-1S(10)** Concrete Field Testing Technician — Grade I Workbook (Spanish)
- **CP-10(10)** Concrete Flatwork Finisher & Flatwork Technician
- **CP-50S(07)** Tilt-Up Supervisor and Technician Workbook (Spanish)
- **CP-60S(09)** Shotcrete Nozzleman Workbook (Spanish)
- **CP-70(14)** Masonry Testing Technician Workbook
- **CP-80PACK** Adhesive Anchor Installer Workbook with companion DVD
- **SP-294** Advances in Green Binder Systems
- **SP-295** Recent Advances in the Design of Prestressed Concrete Piles in Marine Structures in Seismic Regions
- **SP-296** Symposium Honoring James O. Jirsa’s Contributions in Structural Concrete: A Time to Reflect
- **SP-297** Seismic Assessment of Existing Reinforced Concrete Buildings—New Developments
- **SP-298** Advanced Materials and Sensors towards Smart Concrete Bridges: Concept, Performance, Evaluation, and Repair
INDEX

with ACI CONCRETE TERMINOLOGY
MCP INDEX

The subject index contains all documents included in the seven parts of the 2015 ACI Manual of Concrete Practice. Following each topic is a list of documents. Entire documents that relate to the topic are listed first, followed by documents that contain a chapter (or chapters) that relate to the topic, which are followed by documents that have a section (or sections) that relate to the topic. Refer to the numerical listing in the front of each Manual of Concrete Practice to see which part the document is in.

Abrasion, see also Erosion
210R—Erosion of Concrete in Hydraulic Structures
201.2R—Guide to Durable Concrete, Ch. 8
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.20
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.8

Abrasion resistance, see also Wear resistance
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.20
223R—Guide for the Use of Shrinkage-Compensating Concrete, 4.5.7
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 5.5, 5.6

Absorption
211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete, 2.1
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.15
506.5R—Guide for Specifying Underground Shotcrete, 8.5

Abutments
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges, 4.7
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 11.5

Accelerated curing, see also Curing
325.11R—Accelerated Techniques for Concrete Paving
308R—Guide to Curing Concrete, 2.8
318—Building Code Requirements for Structural Concrete, 26.5.3.2(c)

Accelerating admixtures, see also Admixtures
212.3R—Report on Chemical Admixtures for Concrete
306R—Guide to Cold Weather Concreting, Ch. 9
506.5R—Guide for Specifying Underground Shotcrete, 4.1

Acceptance, see also Testing or Evaluation
349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
437.1R—Load Tests of Concrete Structures: Methods, Magnitude, Protocols, and Acceptance Criteria
ITG-5.1—Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1
336.3R—Report on Design and Construction of Drilled Piers, Ch. 6
437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary, Ch. 6
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 7
506.5R—Guide for Specifying Underground Shotcrete, Ch. 11
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results, 4.2
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 5.4
228.1R—In-Place Methods to Estimate Concrete Strength, 7.2
301—Specifications for Structural Concrete, 1.7
318—Building Code Requirements for Structural Concrete, 26.12, 27.4
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.6, 20.6
350—Code Requirements for Environmental Engineering Concrete Structures, 5.5, 20.5
506.2—Specification for Shotcrete, 1.9

Acid attack, see Chemical attack

Acrylic latex, see also Polymer concrete
548.3R—Report on Polymer-Modified Concrete, Ch. 4, 3.2.4, 4.2

Adhesives, see also Epoxy or Polymer adhesives
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate
503.4—Standard Specification for Repairing Concrete with Epoxy Mortars
503.5R—Guide for the Selection of Polymer Adhesives with Concrete
548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>372R</td>
<td>Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.11</td>
</tr>
<tr>
<td>440R</td>
<td>Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 4.7</td>
</tr>
<tr>
<td>440.2R</td>
<td>Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.1</td>
</tr>
</tbody>
</table>

**Admixtures**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>207.5R</td>
<td>Report on Report on Roller-Compacted Mass Concrete, 5.7</td>
</tr>
</tbody>
</table>

**Aeration**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>210.7R</td>
<td>Erosion of Concrete in Hydraulic Structures, 5.3</td>
</tr>
</tbody>
</table>

**Aesthetics**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>237R</td>
<td>Self-Consolidating Concrete, 3.4</td>
</tr>
</tbody>
</table>

**Aggregates**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>211.1</td>
<td>Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, Ch. 4</td>
</tr>
<tr>
<td>225R</td>
<td>Guide to the Selection and Use of Hydraulic Cements, Ch. 4</td>
</tr>
<tr>
<td>207.1R</td>
<td>Guide to Mass Concrete, 2.4</td>
</tr>
<tr>
<td>306G</td>
<td>Guide to Cold Weather Concreting, Ch. 9</td>
</tr>
<tr>
<td>325.11R</td>
<td>Accelerated Techniques for Concrete Paving, Ch. 4</td>
</tr>
</tbody>
</table>
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete
301—Specifications for Structural Concrete
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
122R—Guide to Thermal Properties of Concrete and Masonry Systems, Ch. 2
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, Ch. 6
304.2R—Placing Concrete by Pumping Methods, Ch. 4
306R—Guide to Cold Weather Concreting, Ch. 3
533R—Guide for Precast Concrete Wall Panels, Ch. 4
207.1R—Guide to Mass Concrete, 2.5
207.5R—Report on Report on Roller-Compacted Mass Concrete, 6.2
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 3.5
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, 4.8, 4.9
211.5R—Guide for Submittal of Concrete Proportions, 3.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 4.2
224R—Control of Cracking in Concrete Structures, 5.4
229R—Controlled Low-Strength Materials, 3.7
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete, 4.4
302.1R—Guide for Concrete Floor and Slab Construction, 5.4
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 6.2, 7.4
305R—Guide to Hot Weather Concreting, 2.8
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 5.7
318—Building Code Requirements for Structural Concrete, 26.4
325.10R—Report on Roller-Compacted Concrete Pavements, 3.2
325.11R—Accelerated Techniques for Concrete Paving, 4.7
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 3.3
350—Code Requirements for Environmental Engineering Concrete Structures, 3.3
357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, 4.3
363R—Report on High-Strength Concrete, 2.5
364.3R—Guide for Cementitious Repair Material Data Sheet, 3.5
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.3
506R—Guide to Shotcrete, 2.4
506.2—Specification for Shotcrete, 2.2
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 2.4
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 2.1
524R—Guide to Portland Cement-Based Plaster, 4.4
548.5R—Guide for Polymer Concrete Overlays, 3.2
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks, 2.2, 3.6
548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks, 2.2, 3.6
548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks, 2.5, 3.6
555R—Removal and Reuse of Hardened Concrete, 5.2, 5.3
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, 6.5

Aggressive chemical exposure, see Chemical attack

Aging, see also Creep

209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures

Air content

311.6—Specification for Ready Mixed Concrete Testing Services

309R—Guide for Consolidation of Concrete, 17.3
506.5R—Guide for Specifying Underground Shotcrete, 8.3

Air entrainment, see also Admixtures

212.3R—Report on Chemical Admixtures for Concrete, Ch. 4

211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, 4.2
211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete, 2.4
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 3.7
225R—Guide to the Selection and Use of Hydraulic Cements, 4.1
234R—Guide for the Use of Silica Fume in Concrete, 4.8
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, 6.4
Air voids, see also Voids
309R—Guide for Consolidation of Concrete, 7.7
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 3.2

Alignment, see Tolerances

Alkali
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.6

Alkali-aggregate reactivity (AAR), see also Aggregates, Durability
221.1R—Report on Alkali-Aggregate Reactivity

213R—Guide for Structural Lightweight-Aggregate Concrete, 4.16

Alkali-silica reactivity (ASR), see also Durability
221.1R—Report on Alkali-Aggregate Reactivity
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete

Allowable stress design
530—Building Code Requirements for Masonry Structures, Ch. 2

334.1R—Concrete Shell Structures Practice, 4.1

Alternate design method
350—Code Requirements for Environmental Engineering Concrete Structures, App. I

Alternate strength and load factors
350—Code Requirements for Environmental Engineering Concrete Structures, App. C

Analysis, see Design factors

Anchor ties in masonry
301—Specifications for Structural Concrete, 2.2
530—Building Code Requirements for Masonry Structures, 5.8
530.1—Specification for Masonry Structures, 2.4

Anchorage, post-tensioning devices
222.2R—Report on Corrosion of Prestressing Steels

506.5R—Guide for Specifying Underground Shotcrete, Ch. 5

Anchorage of reinforcement, see also Bond, Development length or Reinforcement – steel
408.2R—Bond under Cyclic Loads
408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

318—Building Code Requirements for Structural Concrete, Ch. 25

350—Code Requirements for Environmental Engineering Concrete Structures, 12.6
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, 5.4
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.16, 2.17
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.10, 4.3
437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary, 6.1.4, R6.1.4, R6.1.5
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 4.9
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 7.2.1, 7.2.2, 7.2.3
530—Building Code Requirements for Masonry Structures, 2.1.4

Anchorage to concrete
349.2R—Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete
355.3R—Guide for Design of Anchorage of Concrete: Examples using ACI 318 Appendix D
355.4-10—Acceptance Criteria for Qualification of Post-Installed Adhesive Anchors in Concrete

318—Building Code Requirements for Structural Concrete, Ch. 17
349—Code Requirements for Nuclear Safety-Related Concrete Structures, App. D
440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 2
SP-17—The Reinforced Concrete Design Manual, Ch. 9

336.1—Specification for the Construction of Drilled Piers, 3.8

350—Code Requirements for Environmental Engineering Concrete Structures, 12.6

351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 6.2

351.2R—Report on Foundations for Static Equipment, 5.2

351.3R—Foundations for Dynamic Equipment, 4.4

376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.10, 9.7

423.7—Specification for Unbonded Single-Strand Tendon Materials, 5.4, 8.3

437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary, 6.1.5, R6.1.4, R6.1.5

440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.10

506R—Guide to Shotcrete, 5.5

533R—Guide for Precast Concrete Wall Panels, 4.8

546R—Guide to Concrete Repair, 5.5

546.2R—Guide to Underwater Repair of Concrete, 4.4

Anchors, see Anchorage to concrete

Aramid fibers, see also Fiber-reinforced polymer (FRP)

440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures

440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures

544.1R—Report on Fiber-Reinforced Concrete, 4.2.2

Architectural concrete

303R—Guide to Cast-in-Place Architectural Concrete Practice

303.1—Standard Specification for Cast-in-Place Architectural Concrete

533.1R—Design Responsibility for Architectural Precast-Concrete Projects


301—Specifications for Structural Concrete, Sec. 6

533R—Guide for Precast Concrete Wall Panels, 5.3.4.5

551.1R—Guide to Tilt-Up Concrete Construction, 5.2

Ash, see Fly ash

Autoclaved aerated concrete (AAC)

523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels

530—Building Code Requirements for Masonry Structures, Ch. 8

Axially loaded members, see also Columns

318—Building Code Requirements for Structural Concrete, Ch. 10, 22

349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 10, 18.11

350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 10, 18.11

441R—High-Strength Concrete Columns, Ch. 2, Ch. 3

363R—Report on High-Strength Concrete, 6.2

Backfill, see also Fills

229R—Controlled Low-Strength Materials, Ch. 2

346—Specification for Cast-in-Place Concrete Pipe, 3.1.1.4, 3.2

Bacterial erosion, see also Chemical attack

350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 4

210R—Erosion of Concrete in Hydraulic Structures, 7.2, 7.3

Bar deformations, see also Reinforcement – steel

408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

Bars

440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars

440.5—Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars

ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete

423.8R—Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems, 4.6

ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, 7.1, 7.2

Barges, see also Offshore structures

357.2R—Report on Floating and Float-In Concrete Structures

Barrier systems, see Protective coatings

Base, see also Pavements

229R—Controlled Low-Strength Materials, 2.5

325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.1
Base of equipment and machinery

351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery

Base of structure, see Foundations

Batching, see also Mixture proportioning

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 3, 12.2
325.10R—Report on Roller-Compacted Concrete Pavements, Ch. 4, 7.3
363R—Report on High-Strength Concrete, Ch. 4
506.5R—Guide for Specifying Underground Shotcrete, Ch. 12
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, Ch. 6

117—Specifications for Tolerances for Concrete Construction and Materials, 2.4
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, 11.5
207.1R—Guide to Mass Concrete, 4.1
212.3R—Report on Chemical Admixtures for Concrete, 3.7, 4.9, 5.10, 6.9, 8.8, 9.5, 10.8, 11.9, 15.8
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 7.6
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 4.2
233R—Slag Cement in Concrete and Mortar, 2.3
302.1R—Guide for Concrete Floor and Slab Construction, 7.1
304.4R—Placing Concrete with Belt Conveyors, 2.4, 2.6
305R—Guide to Hot Weather Concreting, 3.3
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
330.1—Specification for Unreinforced Concrete Parking Lots, 3.5
506R—Guide to Shotcrete, 7.2
506.1R—Guide to Fiber-Reinforced Shotcrete, 5.2
506.2—Specification for Shotcrete, 3.2
522.1—Specification for Pervious Concrete Pavement, 3.4
523.1R—Guide for Cast-in-place Low-Density Cellular Concrete, 5.2
524R—Guide to Portland Cement-Based Plaster, 10.3
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, 8.1

Beam-column frame

374.1—Acceptance Criteria for Moment Frames Based on Structural Testing

Beam-column joints, see also Column-slab connections, Joints

352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures

550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures

Beams

352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary
445R—Recent Approaches to Shear Design of Structural Concrete
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete

209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Ch. 3, 4.3 through 4.5, 4.8
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, Ch. 2
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 8
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 10, 14.7
435R—Control of Deflection in Concrete Structures, Ch. 3, A4.2
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 5
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, Ch. 4
224R—Control of Cracking in Concrete Structures, 4.7
318—Building Code Requirements for Structural Concrete, 24.3
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 10.5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 10.6, 14.7
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, 4.2, 4.3
363R—Report on High-Strength Concrete, 6.3
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 2.2
530—Building Code Requirements for Masonry Structures, 1.13

Bearings

318—Building Code Requirements for Structural Concrete, 22.8
341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems, 6.5
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.20, 11.2
350—Code Requirements for Environmental Engineering Concrete Structures, 16.6
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.9
Belt conveyor, see also placing concrete
304.4R—Placing Concrete with Belt Conveyors, 2.5

Bending moment, see also Ultimate strength
441R—High-Strength Concrete Columns, Ch. 3

Bending of reinforcing steel, see also Fabrication
439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availabilities
530.1—Specification for Masonry Structures
301—Specifications for Structural Concrete, Sec. 3
307—Code Requirements for Reinforced Concrete Chimneys, 5.7
318—Building Code Requirements for Structural Concrete, 26.3
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.7, 9.8
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 7.3
350—Code Requirements for Environmental Engineering Concrete Structures, 7.2, 7.3
530—Building Code Requirements for Masonry Structures, 2.3

Bibliography
363R—Report on High-Strength Concrete, 10.3

Binder
548.5R—Guide for Polymer Concrete Overlays, Ch. 2

Bins, see also Silos
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 1.2, R4.3.2

Blast
370R—Report for the Design of Concrete Structures for Blast Effects

Blast-furnace slag, see Slag cement

Bleeding (concrete), see also Finishing
308R—Guide to Curing Concrete
423.9M—Test Method for Bleed Stability of Cementitious Post-Tensioning Tendon Grout
201.2R—Guide to Durable Concrete, 3.5
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results, 3.1
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 3.5
233R—Slag Cement in Concrete and Mortar, 4.3
234R—Guide for the Use of Silica Fume in Concrete, 4.6
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 4.2.5

Blemishes, see Surface defects

Blended cements, see also Pozzolans
225R—Guide to the Selection and Use of Hydraulic Cements, 2.1
234R—Guide for the Use of Silica Fume in Concrete, 1.5

Blisters, see Surface defects

Bolts, see Anchorage

Bond, to concrete or substrates
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
503.5R—Guide for the Selection of Polymer Adhesives with Concrete
548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 6
506.4R—Guide for the Evaluation of Shotcrete, Ch. 3
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.3
446.4R—Report on Dynamic Fracture of Concrete, B.4
555R—Removal and Reuse of Hardened Concrete, 4.7

Bond of reinforcement to concrete, see also Anchorage of reinforcement
408R—Bond and Development of Straight Reinforcing Bars in Tension
408.2R—Bond under Cyclic Loads
408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension
437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary
440.3R—Guide to Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.12
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 1.5
325.10R—Report on Roller-Compacted Concrete Pavements, 5.7
Bonded tendon

222.2R—Report on Corrosion of Prestressing Steels, 7.3
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 6.5
318—Building Code Requirements for Structural Concrete, 18.12, 19.1, 25.8
350—Code Requirements for Environmental Engineering Concrete Structures, 18.9, 18.18
530—Building Code Requirements for Masonry Structures, 4.10
530.1—Specification for Masonry Structures, 2.4, 3.6

Bonding, see also Adhesives, Protective systems

503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
506.5R—Guide for Specifying Underground Shotcrete, 16.2
524R—Guide to Portland Cement-Based Plaster, 4.8, 9.5, 9.6, 9.7
555R—Removal and Reuse of Hardened Concrete, 4.7

Box girders

343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.21

Brackets, see also Corbels

318—Building Code Requirements for Structural Concrete, 16.5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 11.9
350—Code Requirements for Environmental Engineering Concrete Structures, 11.9

Bracing, see also Stability

Bridge deck

345R—Guide for Concrete Highway Bridge Deck Construction
345.2R—Guide for Widening Highway Bridges
548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays
548.5R—Guide for Polymer Concrete Overlays
345.1R—Guide for Maintenance of Concrete Bridge Members, Ch. 3, Ch. 4
549.4R—Guide to Design and Construction of Externally Bonded Fabric-Reinforced Cemmentitious Matrix (FRCM) Systems for Repair and Strengthening Concrete and Masonry Structures, 16.2

Bridge repair, see Repair

Bridges (structures)

341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges
343R—Analysis and Design of Reinforced Concrete Bridge Structures
345.1R—Guide for Maintenance of Concrete Bridge Members
345.2R—Guide for Widening Highway Bridges
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks
548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 11
224.3R—Joints in Concrete Construction, Ch. 4
229R—Controlled Low-Strength Materials, 2.7
308R—Guide to Curing Concrete, 3.2
347R—Guide to Formwork for Concrete, 8.2
363R—Report on High-Strength Concrete, 8.3

Bracing

364.7T—Evaluation and Minimization of Bruising (Microcracking) in Concrete Repair

Bubblers, see Aeration

Bug holes, see Surface defects

Building code—Masonry

530—Building Code Requirements for Masonry Structures

Building code—Structural concrete

318—Building Code Requirements for Structural Concrete
349—Code Requirements for Nuclear Safety-Related Concrete Structures
Bulk density, see Properties of concrete

Bundled bars
318—Building Code Requirements for Structural Concrete, 25.6
350—Code Requirements for Environmental Engineering Concrete Structures, 12.4

Calcium-aluminate cements
225R—Guide to the Selection and Use of Hydraulic Cements, Ch. 2, Ch. 3, App. 6.10

Calibration, see Testing

Camber, see also Deflection
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Ch. 4

Canal lining
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 4

Cantilevers
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 5.7

Carbon fibers, see also Fibers
440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, App. A
549.2R—Thin Reinforced Cementitious Products, 4.4

Carbonation
201.2R—Guide to Durable Concrete, 6.6
555R—Removal and Reuse of Hardened Concrete, 5.4

Casing (steel)
336.3R—Report on Design and Construction of Drilled Piers, Ch. 5, 4.7
336.1—Specification for the Construction of Drilled Piers, 2.2, 3.3, 3.6
543R—Design, Manufacture, and Installation of Concrete Piles, 3.3

Cast-in-place anchors, see also Anchorage
318—Building Code Requirements for Structural Concrete, Ch. 17

Cast-in-place concrete
303R—Guide to Cast-in-Place Architectural Concrete Practice
303.1—Standard Specification for Cast-in-Place Architectural Concrete
332.1R—Guide to Residential Concrete Construction
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete

117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 4, Sec. 7, Sec. 11, Sec. 14
362.1R—Guide for the Design of Durable Parking Structures, Ch. 2

Cast-in-place pipe
346—Specification for Cast-in-Place Concrete Pipe

Cathodic protection
222.2R—Report on Corrosion of Prestressing Steels, App. B
222R—Protection of Metals in Concrete Against Corrosion, 3.4.4
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 5.5
345.1R—Guide for Maintenance of Concrete Bridge Members, 8.3
546R—Guide to Concrete Repair, 6.7

Cavitation, see also Erosion
210R—Erosion of Concrete in Hydraulic Structures, Ch. 2, Part 2
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.8, 3.6

Cellular concrete, see also Low-density concrete
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units
523.3R—Guide for Cellular Concretes above 50 lb/ft 3 (800 kg/m 3)

Cement, see also Cementitious materials, Hydraulic cement
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials
225R—Guide to the Selection and Use of Hydraulic Cements
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
346—Specification for Cast-in-Place Concrete Pipe
524R—Guide to Portland Cement-Based Plaster
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, Ch. 5
207.1R—Guide to Mass Concrete, 2.2
212.3R—Report on Chemical Admixtures for Concrete, 5.2.4
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.4
221.1R—Report on Alkali-Aggregate Reactivity, 5.5, 9.3
223R—Guide for the Use of Shrinkage-Compensating Concrete, 4.1
229R—Controlled Low-Strength Materials, 3.2
230.1R—Report on Soil Cement, 3.2, 7.3
234R—Guide for the Use of Silica Fume in Concrete, 1.5, 7.4, 8.2
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete, 4.2, 4.6
302.1R—Guide for Concrete Floor and Slab Construction, 5.3
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 2.3
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 2.3
305R—Guide to Hot Weather Concreting, 2.5
307—Code Requirements for Reinforced Concrete Chimneys, 2.2
308R—Guide to Curing Concrete, 1.3
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 2.2
318—Building Code Requirements for Structural Concrete, 26.4
325.11R—Accelerated Techniques for Concrete Paving, 4.2
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 3.2
350—Code Requirements for Environmental Engineering Concrete Structures, 3.2
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.5
363R—Report on High-Strength Concrete, 2.2, 3.5
506R—Guide to Shotcrete, 2.3
506.2—Specification for Shotcrete, 2.1
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³), 2.2
530—Building Code Requirements for Masonry Structures, 1.8, 2.2
530.1—Specification for Masonry Structures, 2.1, 2.2
533R—Guide for Precast Concrete Wall Panels, 4.2

**Cement storage**

225R—Guide to the Selection and Use of Hydraulic Cements, Ch. 7

**Cementitious materials, see also Cement, Silica fume, Slag cement**

233R—Slag Cement in Concrete and Mortar
234R—Guide for the Use of Silica Fume in Concrete

207.4R—Cooling and Insulating Systems for Mass Concrete, 2.5

211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, 4.4, 4.5, 4.6
230.1R—Report on Soil Cement, 4.8
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 3.4
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 2.4, 2.8.3
304.2R—Placing Concrete by Pumping Methods, 4.5
305R—Guide to Hot Weather Concreting, 2.6
325.10R—Report on Roller-Compacted Concrete Pavements, 3.3
325.11R—Accelerated Techniques for Concrete Paving, 4.3
350—Code Requirements for Environmental Engineering Concrete Structures, 3.1
357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, 4.2
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.2
546R—Guide to Concrete Repair, 4.2

**Chemical admixtures, see admixtures**

**Chemical analysis**

225R—Guide to the Selection and Use of Hydraulic Cements, Ch. 8
207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, 4.3
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 1.3

**Chemical attack**

201.2R—Guide to Durable Concrete, Ch. 6
210R—Erosion of Concrete in Hydraulic Structures, Ch. 4, Ch. 7
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 5

225R—Guide to the Selection and Use of Hydraulic Cements, 6.10
234R—Guide for the Use of Silica Fume in Concrete, 5.3
546.2R—Guide to Underwater Repair of Concrete, 2.3

**Chemicals**

350—Code Requirements for Environmental Engineering Concrete Structures, 4.5

**Chimneys, see also Silos**

307—Code Requirements for Reinforced Concrete Chimneys

234R—Guide for the Use of Silica Fume in Concrete, 5.3
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 13
**Chloride admixtures**  
222R—Protection of Metals in Concrete Against Corrosion, 2.2.4

**Circular concrete structures, see Water tanks**

**Circular wire**  
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures

**Clay brick**  
530—Building Code Requirements for Masonry Structures  
530.1—Specification for Masonry Structures

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, 4.3

**Clay tile**  
530—Building Code Requirements for Masonry Structures  
530.1—Specification for Masonry Structures

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, 4.3

**Cleaning**  
330R—Guide for the Design and Construction of Concrete Parking Lots, 7.7

345.1R—Guide for Maintenance of Concrete Bridge Members, 4.3

362.2R—Guide for Structural Maintenance of Parking Structures, 4.1

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 5.11

503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.3.10

530.1—Specification for Masonry Structures, 3.8

533R—Guide for Precast Concrete Wall Panels, 6.5

548.5R—Guide for Polymer Concrete Overlays, 8.6

**Coarse aggregates, see also Aggregates**  
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete

304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications

304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing

548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

211.3R—Guide for Selecting Proportions for No-Slump Concrete, App. A, Ch. 4, 3.5

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 2.2, 9.4

**Coatings, see also Protective coatings**  
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures

364.4T—Determining the Load Capacity of a Structure When As-Built Drawings are Unavailable

350.2R—Concrete Structures for Containment of Hazardous Materials, Ch. 5

347R—Guide to Formwork for Concrete, 6.4

350—Code Requirements for Environmental Engineering Concrete Structures, 4.7

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.12, 4.13

376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.15, 6.8, 9.8, 11.9

546R—Guide to Concrete Repair, 4.5

549R—Report on Ferro cement, 3.6

549.4R—Guide to Design and Construction of Externally Bonded Fabric-Reinforced Cementitious Matrix (FRCM) Systems for Repair and Strengthening Concrete and Masonry Structures, 7.6.3

**Code**  
318—Building Code Requirements for Structural Concrete  
332—Residential Code Requirements for Structural Concrete

349—Code Requirements for Nuclear Safety-Related Concrete Structures

350—Code Requirements for Environmental Engineering Concrete Structures

530—Building Code Requirements for Masonry Structures  
530.1—Specification for Masonry Structures

341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems, Ch. 3

423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, Ch. 3

439.3R—Types of Mechanical Splices for Reinforcing Bars, Ch. 2

**Coefficient of variation**  
214R—Guide to Evaluation of Strength Test Results of Concrete

228.1R—In-Place Methods to Estimate Concrete Strength, 2.3, 2.4, 2.6, 3.2, 4.2, 6.2

**Cold joints, see Surface defects**

**Cold storage rooms**  
302.1R—Guide for Concrete Floor and Slab Construction, 9.9

**Cold weather concreting**  
306R—Guide to Cold Weather Concreting

306.1—Standard Specification for Cold Weather Concreting

301—Specifications for Structural Concrete, 4.2.2.8, 5.3.2
302.1R—Guide for Concrete Floor and Slab Construction, 8.17
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 5.5
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 7.2
308R—Guide to Curing Concrete, 1.4, 2.6
308.1—Specification for Curing Concrete, 3.5
318—Building Code Requirements for Structural Concrete, 26.5
330.1—Specification for Unreinforced Concrete Parking Lots, 3.12
332—Residential Code Requirements for Structural Concrete, 5.4
332.1R—Guide to Residential Concrete Construction, 6.6
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.12
350—Code Requirements for Environmental Engineering Concrete Structures, 5.11
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.4
506R—Guide to Shotcrete, 8.10
506.2—Specification for Shotcrete, 3.10
506.5R—Guide for Specifying Underground Shotcrete, 11.4
522R—Report on Pervious Concrete, 7.6, 10.1
522.1—Specification for Pervious Concrete Pavement, 3.11
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 5.7
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 7.5

Color, see also Surface defects
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces
310R—Guide to Decorative Concrete

212.3R—Report on Chemical Admixtures for Concrete, 16.2
233R—Slag Cement in Concrete and Mortar, 5.6
234R—Guide for the Use of Silica Fume in Concrete, 2.1, 4.7
308R—Guide to Curing Concrete, 3.4.8
524R—Guide to Portland Cement-Based Plaster, 12.2

Columns
343R—Analysis and Design of Reinforced Concrete Bridge Structures
352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures

369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary
441R—High-Strength Concrete Columns

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, App. A through C, 2.5, 2.6, 3.4, 3.6, 4.4, 4.7
224.4R—Guide to Design Detailing to Mitigate Cracking, Ch. 6
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 10
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 5
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, Ch. 5
SP-17—The Reinforced Concrete Design Manual, Ch. 3, Ch. 4

213R—Guide for Structural Lightweight-Aggregate Concrete, 5.8
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 4.7
318—Building Code Requirements for Structural Concrete, 10.2, 15.2, 13.2, 16.3
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges, 4.1
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.8, 11.11, 12.17
350—Code Requirements for Environmental Engineering Concrete Structures, 7.8, 8.8, 10.15, 11.11, 12.17, 15.3, 15.8
363R—Report on High-Strength Concrete, 6.2, 6.4
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.7
530—Building Code Requirements for Masonry Structures, 2.1

Column-slab connection, see also Slab-column connection
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures
421.1R—Guide to Shear Reinforcement for Slabs, Ch. 7

Compacted fill
229R—Controlled Low-Strength Materials, Ch. 1

Compacting, see also Consolidation
207.5R—Report on Roller-Compacted Mass Concrete

Compaction, see also Consolidation
207.5R—Report on Roller-Compacted Mass Concrete, 6.5
Components, nuclear reactors
359—Code for Concrete Containments

Composite compression members
318—Building Code Requirements for Structural Concrete, 4.12
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 10.16
350—Code Requirements for Environmental Engineering Concrete Structures, 10.16

Composite construction
318—Building Code Requirements for Structural Concrete, 24.2.5
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 2.5, 2.6

Composite materials
548.1R—Guide for the Use of Polymers in Concrete, 3.1

Compression field theory
445R—Recent Approaches to Shear Design of Structural Concrete, Ch. 2

Compression tests
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results

Compressive strength, see also Strength
207.5R—Report on Roller-Compacted Mass Concrete
213R—Guide for Structural Lightweight-Aggregate Concrete
214R—Guide to Evaluation of Strength Test Results of Concrete
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results
228.1R—In-Place Methods to Estimate Concrete Strength
228.2R—Nondestructive Test Methods for Evaluation of Concrete in Structures
301—Specifications for Structural Concrete
349—Code Requirements for Nuclear Safety-Related Concrete Structures
437R—Strength Evaluation of Existing Concrete Buildings
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete
233R—Slag Cement in Concrete and Mortar, Ch. 5
307—Code Requirements for Reinforced Concrete Chimneys, Ch. 3
506.4R—Guide for the Evaluation of Shotcrete, Ch. 2
207.1R—Guide to Mass Concrete, 3.2

Concrete block
530—Building Code Requirements for Masonry Structures
530.1—Specification for Masonry Structures

Concrete brick
530—Building Code Requirements for Masonry Structures
530.1—Specification for Masonry Structures

Concrete construction, see Construction

Concrete design, see Design factors

Concrete durability, see Durability

Concrete equipment, see Equipment

Concrete parking lots, see Parking lots

Concrete paving
325.11R—Accelerated Techniques for Concrete Paving
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads

Concrete slabs, see Slabs

Conduits, embedded
229R—Controlled Low-Strength Materials, 2.6
Connections, see also Beam-column joints
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
439.3R—Types of Mechanical Splices for Reinforcing Bars

Consistency tests, see also Mixture proportioning
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 6.4
229R—Controlled Low-Strength Materials, 7.3
325.10R—Report on Roller-Compacted Concrete Pavements, 4.2
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.1
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 4.2

Consolidation
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309R—Guide for Consolidation of Concrete
309.1R—Report on Behavior of Fresh Concrete During Vibration
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces

Connections, see also Beam-column joints
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
439.3R—Types of Mechanical Splices for Reinforcing Bars

Consistency tests, see also Mixture proportioning
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 6.4
229R—Controlled Low-Strength Materials, 7.3
325.10R—Report on Roller-Compacted Concrete Pavements, 4.2
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.1
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 4.2

Consolidation
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309R—Guide for Consolidation of Concrete
309.1R—Report on Behavior of Fresh Concrete During Vibration
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces

Consistency tests, see also Mixture proportioning
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 6.4
229R—Controlled Low-Strength Materials, 7.3
325.10R—Report on Roller-Compacted Concrete Pavements, 4.2
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.1
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 4.2

Consolidation
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309R—Guide for Consolidation of Concrete
309.1R—Report on Behavior of Fresh Concrete During Vibration
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces

Consistency tests, see also Mixture proportioning
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 6.4
229R—Controlled Low-Strength Materials, 7.3
325.10R—Report on Roller-Compacted Concrete Pavements, 4.2
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.1
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 4.2

Consolidation
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309R—Guide for Consolidation of Concrete
309.1R—Report on Behavior of Fresh Concrete During Vibration
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces

Consistency tests, see also Mixture proportioning
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 6.4
229R—Controlled Low-Strength Materials, 7.3
325.10R—Report on Roller-Compacted Concrete Pavements, 4.2
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.1
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 4.2

Consolidation
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309R—Guide for Consolidation of Concrete
309.1R—Report on Behavior of Fresh Concrete During Vibration
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces
530.1—Specification for Masonry Structures
ITG-7—Specification for Tolerances for Precast Concrete

222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, Ch. 4

307—Code Requirements for Reinforced Concrete Chimneys, Ch. 3

314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 16

325.11R—Accelerated Techniques for Concrete Paving, Ch. 5

336.3R—Report Design and Construction of Drilled Piers, Ch. 6

345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 4

345.2R—Guide for Widening Highway Bridges, Ch. 3

347.3R—Guide to Formed Concrete Surfaces, Ch. 6

350—Code Requirements for Environmental Engineering Concrete Structures, Part 3, 19.5, G.4

351.3R—Foundations for Dynamic Equipment, Ch. 5

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, Ch. 6

371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, Ch. 4

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, Ch. 5

522R—Report on Pervious Concrete, Ch. 7

549R—Report on Ferrocement, Ch. 3

551.1R—Guide to Tilt-Up Concrete Construction, Ch. 6

341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems, 7.8

548.3R—Report on Polymer-Modified Concrete, 4.1.5, 4.3.8

549.1R—Guide for the Design, Construction, and Repair of Ferrocement, 5.2

Construction joints, see also Joints, Connections

224.3R—Joints in Concrete Construction

325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, Ch. 4

318—Building Code Requirements for Structural Concrete, 26.5

325.10R—Report on Roller-Compacted Concrete Pavements, 7.6

346—Specification for Cast-in-Place Concrete Pipe, 3.2

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 6.4

350—Code Requirements for Environmental Engineering Concrete Structures, 6.4

351.2R—Report on Foundations for Static Equipment, 6.4

351.3R—Foundations for Dynamic Equipment, 5.4

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.3

376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 11.7

423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 5.1

Construction loads, see also Loads

347.2R—Guide for Shoring/Reshoring of Concrete Multistory Buildings, Ch. 3

334.3R—Construction of Concrete Shells Using Inflated Forms, 3.15

551.1R—Guide to Tilt-Up Concrete Construction, 4.1

Construction materials, see Materials

Construction specification, see also Specifications

117—Specifications for Tolerances for Concrete Construction and Materials

301—Specifications for Structural Concrete

303.1—Standard Specification for Cast-in-Place Architectural Concrete

306.1—Standard Specification for Cold Weather Concreting

308.1—Specification for Curing Concrete

330.1—Specification for Unreinforced Concrete Parking Lots

336.1—Specification for the Construction of Drilled Piers

346—Specification for Cast-in-Place Concrete Pipe

423.7—Specification for Unbonded Single-Strand Tendon Materials

503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive

503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate

503.4—Standard Specification for Repairing Concrete with Epoxy Mortars

506.2—Specification for Shotcrete

530.1—Specification for Masonry Structures

548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays

548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

Containment

350.2R—Concrete Structures for Containment of Hazardous Materials

359—Code for Concrete Containments

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 4.5.3

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.1
Contract documents, see Specifications

Contraction joints, see also Joints, movement
  224.3R—Joints in Concrete Construction
  207.5R—Report on Roller-Compacted Mass Concrete, 5.6
  216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, 2.2.7, 3.3.3, 4.6
  318—Building Code Requirements for Structural Concrete, 14.3
  325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 4.4
  360R—Guide to Design of Slabs-on-Ground, 13.14
  544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 7.7

Contractor
  533.1R—Design Responsibility for Architectural Precast-Concrete Projects
  301—Specifications for Structural Concrete, 1.6.3
  311.4R—Guide for Concrete Inspection, 2.5
  440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 6.1

Controlled density fill, see Controlled low-strength materials

Controlled low-strength materials
  229R—Controlled Low-Strength Materials
  232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 6.2
  232.2R—Use of Fly Ash in Concrete, 8.2

Conveying, see also Placing
  304.4R—Placing Concrete with Belt Conveyors
  304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 10
  207.5R—Report on Roller-Compacted Mass Concrete, 5.4
  301—Specifications for Structural Concrete, 5.1, 6.1, 7.1, 9.1
  318—Building Code Requirements for Structural Concrete, 26.5
  349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.9
  350—Code Requirements for Environmental Engineering Concrete Structures, 5.8

Cooling
  207.4R—Cooling and Insulating Systems for Mass Concrete, Ch. 2, Ch. 3
  207.1R—Guide to Mass Concrete, 4.7
  305R—Guide to Hot Weather Concreting, 3.2

Cooling system
  207.4R—Cooling and Insulating Systems for Mass Concrete

Cooling tower
  117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 13

Corbels, shear design, see also Shear strength
  445R—Recent Approaches to Shear Design of Structural Concrete, Ch. 6
  318—Building Code Requirements for Structural Concrete, 16.5
  349—Code Requirements for Nuclear Safety-Related Concrete Structures, 11.9
  350—Code Requirements for Environmental Engineering Concrete Structures, 11.9
  530—Building Code Requirements for Masonry Structures, 1.12

Cores, concrete, see also Testing
  214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results
  224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 2.2
  349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures, 3.5
  364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation, 5.5
  437R—Strength Evaluation of Existing Concrete Buildings, 3.1
  506.4R—Guide for the Evaluation of Shotcrete, 2.2

Cores, steel, see also Composite construction
  543R—Design, Manufacture, and Installation of Concrete Piles, 3.4, 5.4

Corrosion, see also Durability
  222R—Protection of Metals in Concrete Against Corrosion
  222.2R—Report on Corrosion of Prestressing Steels
  222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures
  364.4T—Determining the Load Capacity of a Structure When As-Built Drawings are Unavailable
  364.6T—Concrete Removal in Repairs Involving Corroded Reinforcing Steel
  423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons
423.8R—Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems

201.2R—Guide to Durable Concrete, Ch. 7

225R—Guide to the Selection and Use of Hydraulic Cements, 6.8

233R—Slag Cement in Concrete and Mortar, 5.13

234R—Guide for the Use of Silica Fume in Concrete, 5.3

318—Building Code Requirements for Structural Concrete, 20.6

343R—Analysis and Design of Reinforced Concrete Bridge Structures, 6.2.3

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 4.4

350—Code Requirements for Environmental Engineering Concrete Structures, 4.4, 18.16

423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 2.3

544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 4.5

546.2R—Guide to Underwater Repair of Concrete, 2.4

546.3R—Guide to Materials Selection Concrete Repair, A.6

555R—Removal and Reuse of Hardened Concrete, 5.4

ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1, 3.7

Couplers, post-tensioning

550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Ch. 5

318—Building Code Requirements for Structural Concrete, 25.8

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 18.21

350—Code Requirements for Environmental Engineering Concrete Structures, 18.21

423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 6.3

423.7—Specification for Unbonded Single-Strand Tendon Materials, 5.4


440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.3

530—Building Code Requirements for Masonry Structures, 4.8

Coupling sleeve, see Connections, mechanical

Cover, see also Durability

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, App. A, 2.3, 2.4

306R—Guide to Cold Weather Concreting, 7.6

332—Residential Code Requirements for Structural Concrete, 4.3

345R—Guide for Concrete Highway Bridge Deck Construction, 2.4

350.2R—Concrete Structures for Containment of Hazardous Materials, 2.3

362.1R—Guide for the Design of Durable Parking Structures, 4.2

423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 4.4

423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 3.2

441R—High-Strength Concrete Columns, 2.1

549R—Report on Ferrocement, 5.7

Crack control, see also Durability

224R—Control of Cracking in Concrete Structures

224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, Ch. 1

224.2R—Cracking of Concrete Members in Direct Tension, Ch. 5

343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.11

343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures, 6.8

523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 7.7

ITG-6R—Design Guide for the Use of ASTM A1035/ A1035M Grade 100 (690) Steel Bars for Structural Concrete, 4.9

Cracking, see also Cracks

207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete

222.2R—Report on Corrosion of Prestressing Steels

223R—Guide for the Use of Shrinkage-Compensating Concrete

224R—Control of Cracking in Concrete Structures

224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures

343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures

364.5T—Importance of Modulus of Elasticity of Repair Materials

364.7T—Evaluation and Minimization of Bruising (Microcracking) in Concrete Repair

364.9T—Cracks in a Repair

503.7—Specification for Crack Repair by Epoxy Injection

231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation, Ch. 3

349.1R—Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures, Ch. 3

503.5R—Guide for the Selection of Polymer Adhesives with Concrete, Ch. 7
201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.1
201.2R—Guide to Durable Concrete, 3.6
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 3.4
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Test Results, 3.4
221.1R—Report on Alkali-Aggregate Reactivity, 2.2
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 2.3
225R—Guide to the Selection and Use of Hydraulic Cements, 6.1
302.1R—Guide for Concrete Floor and Slab Construction, 9.6, 11.2
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 3.5
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.13
345R—Guide for Concrete Highway Bridge Deck Construction, 1.3

Cracks, see also Crack control, Cracking
224R—Control of Cracking in Concrete Structures
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures
224.2R—Cracking of Concrete Members in Direct Tension
355.4-10—Acceptance Criteria for Qualification of Post-Installed Adhesive Anchors in Concrete

446.3R—Finite Element Analysis of Fracture in Concrete Structures, Ch. 2, Ch. 3
330R—Guide for the Design and Construction of Concrete Parking Lots, 7.3
345.1R—Guide for Maintenance of Concrete Bridge Members, 7.3, 7.4
346—Specification for Cast-in-Place Concrete Pipe, 3.3
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, 8.6, A3.2
437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary, 5.7
440.4R—Prestressing Concrete Structures with FRP Tendons, 4.3
506.1R—Guide to Fiber-Reinforced Shotcrete, 7.6
524R—Guide to Portland Cement-Based Plaster, 15.2
546.3R—Guide to Materials for Concrete Repair, 3.2
549.4R—Guide to Design and Construction of Externally Bonded Fabric-Reinforced Cementitious Matrix (FRCM) Systems for Repair and Strengthening Concrete and Masonry Structures, 3.2, 3.3

Creep, see also Deflections
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures
209.2R—Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete
364.5T—Importance of Modulus of Elasticity of Repair Materials
209.1R—Report on Factors Affecting Shrinkage and Creep of Hardened Concrete, Ch. 3
224R—Control of Cracking in Concrete Structures, Ch. 7
207.1R—Guide to Mass Concrete, 3.4
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 3.4
207.5R—Report on Roller-Compacted Mass Concrete, 4.5
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.8, 5.7
225R—Guide to the Selection and Use of Hydraulic Cements, 6.6
233R—Slag Cement in Concrete and Mortar, 5.3
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 5.4
363R—Report on High-Strength Concrete, 5.14
364.3R—Guide for Cementitious Repair Material Data Sheet, 5.13
435R—Control of Deflection in Concrete Structures, 2.6
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 8.4
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.4
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.8
440.4R—Prestressing Concrete Structures with FRP Tendons, 3.8
530—Building Code Requirements for Masonry Structures, 1.8.6
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.6
544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 3.1
549R—Report on Ferrocement, 4.8
555R—Removal and Reuse of Hardened Concrete, 5.4

Crosstie, see Forming

Culverts
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 10
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 7.3
Curing

308—Guide to Curing Concrete
308.1—Specification for Curing Concrete
503.5R—Guide for the Selection of Polymer Adhesives with Concrete

302.1R—Guide for Concrete Floor and Slab Construction, Ch. 9, 5.6
303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 8
305R—Guide to Hot Weather Concreting, Ch. 4
306R—Guide to Cold Weather Concreting, Ch. 8
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 11
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, Ch. 8
506.5R—Guide for Specifying Underground Shotcrete, Ch. 19
524R—Guide to Portland Cement-Based Plaster, Ch. 13
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, Ch. 8
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 10
ITG-4.2—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 14, 17.10

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, 11.11
207.1R—Guide to Mass Concrete, 4.4
207.5R—Report on Roller-Compacted Mass Concrete, 6.9
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results, 3.3
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 4.4
223R—Guide for the Use of Shrinkage-Compensating Concrete, 7.3
230.1R—Report on Soil Cement, 7.6
231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation, 5.4
233R—Slag Cement in Concrete and Mortar, 5.5
235R—Guide for the Use of Silica Fume in Concrete, 9.6, 9.7
237R—Self-Consolidating Concrete, 6.7
301—Specifications for Structural Concrete, 5.3, 8.3, 10.3
302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, 6.9, 9.7
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 4.10
305.1—Specification for Hot Weather Concreting, 3.7
306.1—Standard Specification for Cold Weather Concreting, 3.3

307—Code Requirements for Reinforced Concrete Chimneys, 3.7
311.6—Specification for Ready Mixed Concrete Testing Services, 2.5
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.7
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 16.6
318—Building Code Requirements for Structural Concrete, 26.5
325.10R—Report on Roller-Compacted Concrete Pavements, 7.7
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.6
330.1—Specification for Unreinforced Concrete Parking Lots, 3.11
332—Residential Code Requirements for Structural Concrete, 8.7
332.1R—Guide to Residential Concrete Construction, 4.6, 5.6
334.1R—Concrete Shell Structures Practice, 7.3
346—Specification for Cast-in-Place Concrete Pipe, 3.2
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.11
350—Code Requirements for Environmental Engineering Concrete Structures, 5.10, H.7
350.2R—Concrete Structures for Containment of Hazardous Materials, 4.2
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, A3.3
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.5
360R—Guide to Design of Slabs-on-Ground, 13.11
362.1R—Guide for the Design of Durable Parking Structures, 4.8
363R—Report on High-Strength Concrete, 4.6
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete, 4.5
364.3R—Guide for Cementitious Repair Material Data Sheet, 5.2
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 5.4
506R—Guide to Shotcrete, 2.9, 8.8
506.2—Specification for Shotcrete, 2.6, 3.8
522R—Report on Pervious Concrete, 7.5
522.1—Specification for Pervious Concrete Pavement, 3.10
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 5.6
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 5.1
533R—Guide for Precast Concrete Wall Panels, 4.9, 5.7
543R—Design, Manufacture, and Installation of Concrete Piles, 4.5
546.3R—Guide to Materials Selection for Concrete Repair, A.2
Curing compounds
308R—Guide to Curing Concrete

330.1—Specification for Unreinforced Concrete Parking Lots, 2.3, 3.11
506R—Guide to Shotcrete, 2.9

Curling, see also Slabs
360R—Guide to Design of Slabs-on-Ground, Ch. 13

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.2
302.1R—Guide for Concrete Floor and Slab Construction, 11.11

Currents, see also Electrical properties
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.18

Curvature friction
318—Building Code Requirements for Structural Concrete, 20.3

Cyclic loads, see also Fatigue
408.2R—Bond under Cyclic Loads

Cylinders, concrete, see also Testing
228.1R—In-Place Methods to Estimate Concrete Strength, 2.8

Dampproofing, see also Admixtures, Protective systems, Barrier systems
212.3R—Report on Chemical Admixtures for Concrete, Ch. 15

Dams, see also Mass concrete
207.1R—Guide to Mass Concrete

207.5R—Report on Roller-Compacted Mass Concrete, Ch. 5, Ch. 6
309.5R—Compaction of Roller-Compacted Concrete, 5.3

Database, see also Materials property database
408R—Bond and Development of Straight Reinforcing Bars in Tension, Ch. 5

Decks, bridge
345R—Guide for Concrete Highway Bridge Deck Construction
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks

548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks
548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks

Deep beams, see Deep flexural members

Deep flexural members
318—Building Code Requirements for Structural Concrete, 9.9
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 10.7, 11.8
350—Code Requirements for Environmental Engineering Concrete Structures, 10.7, 11.8

Decorative concrete
310R—Guide to Decorative Concrete

Defects, see Surface defects

Definitions, see Terminology, Notation

Deflection, see also Creep
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures
435R—Control of Deflection in Concrete Structures
435.8R—Observed Deflections of Reinforced Concrete Slab Systems, and Causes of Large Deflections

437R—Strength Evaluation of Existing Concrete Buildings, Ch. 5
551.2R—Design Guide for Tilt-Up Concrete Panels, Ch. 6
SP-17—The Reinforced Concrete Design Manual, Ch. 7

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.3
213R—Guide for Structural Lightweight-Aggregate Concrete, 5.7
307—Code Requirements for Reinforced Concrete Chimneys, 4.5
318—Building Code Requirements for Structural Concrete, 7.3
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 8.5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 9.5
350—Code Requirements for Environmental Engineering Concrete Structures, 9.5
351.2R—Report on Foundations for Static Equipment, 4.3
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.9
440.4R—Prestressing Concrete Structures with FRP Tendons, 3.10, 4.2
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 4.4
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 7.4
530—Building Code Requirements for Masonry Structures, 1.10

Deformation
343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures

Deformed bars, see also Reinforcement – steel
408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 12
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 12
318—Building Code Requirements for Structural Concrete, 8.6, 8.7

Degradation of concrete, see also Deterioration
349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures, Ch. 4

Deicing salt
233R—Slag Cement in Concrete and Mortar, 5.11

Delamination, see Surface defects
201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.5
440.2R—Guide for the Design and Construction ofExternally Bonded FRP Systems for Strengthening Concrete Structures, 13.1
524R—Guide to Portland Cement-Based Plaster, 15.4

Demolition
364.8T—Use of Hydrodemolition for Concrete Removal in Unbonded Post-Tensioned Systems
555R—Removal and Reuse of Hardened Concrete, Ch. 3, 2.2
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 6.9

Density
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, Ch. 7
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.4, 4.5
230.1R—Report on Soil Cement, 5.2
234R—Guide for the Use of Silica Fume in Concrete, 2.3
309R—Guide for Consolidation of Concrete, 17.2
309.5R—Compaction of Roller-Compacted Concrete, 2.2, 6.3, 6.4

364.3R—Guide for Cementitious Repair Material Data Sheet, 5.1
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.2
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 3.1, 3.2, 4.3

Depositing concrete, see Placing

Design
314R—Guide to Simplified Design for Reinforced Concrete Buildings
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³), Ch. 6

Design examples
355.3R—Guide for Design of Anchorage of Concrete: Examples using ACI 318 Appendix D
349.2R—Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples
SP-17—ACI Design Handbook

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 15
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, App. C

Design factors
318—Building Code Requirements for Structural Concrete
330R—Guide for the Design and Construction of Concrete Parking Lots
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats
343R—Analysis and Design of Reinforced Concrete Bridge Structures
345.2R—Guide for Widening Highway Bridges
349—Code Requirements for Nuclear Safety-Related Concrete Structures
349.1R—Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures
350.3—Seismic Design of Liquid-Containing Concrete Structures
350.4R—Design Considerations for Environmental Engineering Concrete Structures
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures
357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures
360R—Guide to Design of Slabs-on-Ground
362.1R—Guide for the Design of Durable Parking Structures
370R—Report for the Design of Concrete Structures for Blast Effects
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
435R—Control of Deflection in Concrete Structures
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
445R—Recent Approaches to Shear Design of Structural Concrete
530—Building Code Requirements for Masonry Structures
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures
551.2R—Design Guide for Tilt-Up Concrete Panels
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Wall Satisfying ACI ITG-5.1
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete
SP-17—ACI Design Handbook
207.5R—Report on Roller-Compacted Mass Concrete, Ch. 5
210R—Erosion of Concrete in Hydraulic Structures, Ch. 5
213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 5
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, Ch. 2
307—Code Requirements for Reinforced Concrete Chimneys, Ch. 4
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, Ch. 4
325.10R—Report on Roller-Compacted Concrete Pavements, Ch. 6
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, Ch. 3
341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems, Ch. 7
347R—Guide to Formwork for Concrete, Ch. 4
351.2R—Report on Foundations for Static Equipment, Ch. 4, Ch. 5
351.3R—Foundations for Dynamic Equipment, Ch. 3
352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures, Ch. 3
357.2R—Report on Floating and Float-In Concrete Structures, Ch. 5
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, Ch. 5
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, Ch. 8
408R—Bond and Development of Straight Reinforcing Bars in Tension, Ch. 4
421.1R—Guide to Shear Reinforcement for Slabs, Ch. 4
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, Ch. 2, Ch. 3
439.3R—Types of Mechanical Splices for Reinforcing Bars, Ch. 2
440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 3
506.1R—Guide to Fiber-Reinforced Shotcrete, Ch. 8
522R—Report on Pervious Concrete, Ch. 6
524R—Guide to Portland Cement-Based Plaster, Ch. 5
ITG-5.1—Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing, Ch. 3
222R—Protection of Metals in Concrete Against Corrosion, 3.2
309R—Guide for Consolidation of Concrete, 8.1
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 2.1
533R—Guide for Precast Concrete Wall Panels, 2.2
544.1R—Report on Fiber-Reinforced Concrete, 2.5
549R—Report on Precast Concrete, 5.2
549.1R—Guide for the Design, Construction, and Repair of Precast Concrete, 4.1

Detailing
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications
224.4R—Guide to Design Detailing to Mitigate Cracking, Ch. 3
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, Ch. 9
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, Ch. 11
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 13.2

Detailing of reinforcement
439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availability
SP-66—ACI Detailing Manual
303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 7
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 7

222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 2.4
309R—Guide for Consolidation of Concrete, 8.1
318—Building Code Requirements for Structural Concrete, 10.7
530—Building Code Requirements for Masonry Structures, 1.16

Deterioration
222.2R—Report on Corrosion of Prestressing Steels, Ch. 4
345.1R—Guide for Maintenance of Concrete Bridge Members, Ch. 2
362.1R—Guide for the Design of Durable Parking Structures, Ch. 3

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 4.5
524R—Guide to Portland Cement-Based Plaster, 15.6

Development length, see also Reinforcement—steel
408R—Bond and Development of Straight Reinforcing Bars in Tension
408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 12
440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 6
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 7, 8.5

213R—Guide for Structural Lightweight-Aggregate Concrete, 5.6
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 11.2

Dimensions, see Tolerances

Discoloration, see Surface defects

Documentation
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation, Ch. 3

Dowel, bar connectors
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 4.1

439.3R—Types of Mechanical Splices for Reinforcing Bars, 3.4

Drainage
345.1R—Guide for Maintenance of Concrete Bridge Members, Ch. 4
350.2R—Concrete Structures for Containment of Hazardous Materials, Ch. 7
207.5R—Report on Roller-Compacted Mass Concrete, 6.10
302.1R—Guide for Concrete Floor and Slab Construction, 11.10
332.1R—Guide to Residential Concrete Construction, 3.13
345.5R—Guide for Concrete Highway Bridge Deck Construction, 2.2
362.1R—Guide for the Design of Durable Parking Structures, 3.2, 4.4

Drawings
364.4T—Determining the Load Capacity of a Structure When As-Built Drawings are Unavailable

318—Building Code Requirements for Structural Concrete, Ch. 26

307—Code Requirements for Reinforced Concrete Chimneys, 1.2
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 1.4
332—Residential Code Requirements for Structural Concrete, 1.4
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 1.2
350—Code Requirements for Environmental Engineering Concrete Structures, 1.2
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 1.3
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 14.2
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 12.2
533.1R—Design Responsibility for Architectural Precast-Concrete Projects, 2.4
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1, 1.3

Drift ratio, see also Deflection
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
421.2R—Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates, 2.2
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, 5.4

**Drilled piers**
336.1—Specification for the Construction of Drilled Piers
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats
336.3R—Report on Design and Construction of Drilled Piers

117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 3

228.2R—Nondestructive Test Methods for Evaluation of Concrete in Structures, 2.3

**Drying**
302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, Ch. 2, Ch. 6

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 2.1

**Drying shrinkage**
224R—Control of Cracking in Concrete Structures

360R—Guide to Design of Slabs-on-Ground, Ch. 13

207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 4.2

213R—Guide for Structural Lightweight-Aggregate Concrete, 4.9

224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 1.3

234R—Guide for the Use of Silica Fume in Concrete, 10.4

523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 3.4

523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 3.2

**Ductility**

421.2R—Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates, Ch. 4

439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availability, 3.2.1

440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 7.6

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 12.3

441R—High-Strength Concrete Columns, 3.2

550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, 3.2

**Ducts, as in Conduits**
350—Code Requirements for Environmental Engineering Concrete Structures, 6.3
549.2R—Thin Reinforced Cementitious Products, 5.4

**Ducts, for post-tensioning**
222.2R—Report on Corrosion of Prestressing Steels, 6.4
318—Building Code Requirements for Structural Concrete, 18.17
350—Code Requirements for Environmental Engineering Concrete Structures, 20.8
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.11, 6.7
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.11
423.8R—Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems, 4.4

**Durability, see also Corrosion, cracks**
201.1R—Guide for Conducting a Visual Inspection of Concrete in Service
201.2R—Guide to Durable Concrete
221.1R—Report on Alkali-Aggregate Reactivity
301—Specifications for Structural Concrete
364.9T—Cracks in a Repair

350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 4
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, Ch. 2
357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, Ch. 5
362.1R—Guide for the Design of Durable Parking Structures, Ch. 3

440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 11, 5.4
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, Ch. 4
440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement, Ch. 9
440.8—Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures, Ch. 8
544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, Ch. 4, Ch. 5

207.1R—Guide to Mass Concrete, 3.9
207.5R—Report on Roller-Compacted Mass Concrete, 4.10

213R—Guide for Structural Lightweight-Aggregate Concrete, 4.14
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 2.1

234R—Guide for the Use of Silica Fume in Concrete, 5.3
237R—Self-Consolidating Concrete, 3.3
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 1.6
309.5R—Compaction of Roller-Compacted Concrete, 3.4
318—Building Code Requirements for Structural Concrete, 4.8
325.10R—Report on Roller-Compacted Concrete Pavements, 5.8
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
330R—Guide for the Design and Construction of Concrete Parking Lots, 4.3
350.2R—Concrete Structures for Containment of Hazardous Materials, 2.4
365.1R—Service-Life Prediction, 7.2
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.5
522R—Report on Pervious Concrete, 4.6
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 3.6, 3.7
549R—Report on Ferrocement, 4.9, 5.10

**Dusting, see also Curing**

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.9
302.1R—Guide for Concrete Floor and Slab Construction, 11.4

**Dynamic equipment, see Equipment foundations**

**Dynamic fracture**

446.4R—Report on Dynamic Fracture of Concrete

**Dynamic load effects, see also Fatigue**

350.3—Seismic Design of Liquid-Containing Concrete Structures
408.2R—Bond under Cyclic Loads
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.9

**Dynamic properties of concrete**

446.4R—Report on Dynamic Fracture of Concrete

207.5R—Report on Roller-Compacted Mass Concrete, 4.4
350.3—Seismic Design of Liquid-Containing Concrete Structures, 3.1

**Early age**

231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation

**Earthquake requirements and loading, see also Seismic**

350.3—Seismic Design of Liquid-Containing Concrete Structures
Empirical design

530—Building Code Requirements for Masonry Structures, Ch. 5

Energy dissipation

374.1—Acceptance Criteria for Moment Frames Based on Structural Testing, 9.0

Engineered demolition, see Demolition

Environmental considerations, see also Chemical attack, Marine concrete, and Hot and Cold weather concreting

222R—Protection of Metals in Concrete Against Corrosion

350.4R—Design Considerations for Environmental Engineering Concrete Structures

207.5R—Report on Roller-Compacted Mass Concrete, 6.9

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 4.6

222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 2.2

233R—Slag Cement in Concrete and Mortar, 1.4

305R—Guide to Hot Weather Concreting, 4.4

308R—Guide to Curing Concrete, 1.4, 2.6, 2.7, 4.2, 4.4

313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.7


Environmental engineering, see also Water tanks

350—Code Requirements for Environmental Engineering Concrete Structures

350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures

350.2R—Concrete Structures for Containment of Hazardous Materials

350.4R—Design Considerations for Environmental Engineering Concrete Structures

Epoxy, see also Adhesives or Polymer adhesives

351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery

364.3T—Treatment of Exposed Epoxy-Coated Reinforcement in Repair

503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive

503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate

503.4—Standard Specification for Repairing Concrete with Epoxy Mortars

503.5R—Guide for the Selection of Polymer Adhesives with Concrete

503.7—Specification for Crack Repair by Epoxy Injection

548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks

548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks

548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes

548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

224R—Control of Cracking in Concrete Structures, 6.3

224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 3.2

546.2R—Guide to Underwater Repair of Concrete, 6.6, 6.7

548.3R—Report on Polymer-Modified Concrete, 4.2

548.5R—Guide for Polymer Concrete Overlays, 2.3

Epoxy resin

311.1R—ACI Manual of Concrete Inspection

548.3R—Report on Polymer-Modified Concrete, Ch. 4

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.20

440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 4.2

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.1

Equipment

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete

304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing

345R—Guide for Concrete Highway Bridge Deck Construction

304.2R—Placing Concrete by Pumping Methods, Ch. 2

304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, Ch. 3

309R—Guide for Consolidation of Concrete, Ch. 5

506R—Guide to Shotcrete, Ch. 3
506.5R—Guide for Specifying Underground Shotcrete, Ch. 13, Ch. 14
555R—Removal and Reuse of Hardened Concrete, Ch. 3
318—Building Code Requirements for Structural Concrete, 26.5
325.11R—Accelerated Techniques for Concrete Paving, 3.5
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.4
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.7
350—Code Requirements for Environmental Engineering Concrete Structures, 5.6
351.2R—Report on Foundations for Static Equipment, 6.5
351.3R—Foundations for Dynamic Equipment, 5.5
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 6.3
543R—Design, Manufacture, and Installation of Concrete Piles, 5.1
548.5R—Guide for Polymer Concrete Overlays, 8.8

**Equipment foundations**

351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery
351.2R—Report on Foundations for Static Equipment
351.3R—Foundations for Dynamic Equipment

**Erection tolerances, see also Tolerances**

ITG-7—Specification for Tolerances for Precast Concrete
533R—Guide for Precast Concrete Wall Panels, Ch. 3
530.1—Specification for Masonry Structures, 3.3

**Erosion, see also Abrasion**

210R—Erosion of Concrete in Hydraulic Structures
345.1R—Guide for Maintenance of Concrete Bridge Members, Ch. 2
229R—Controlled Low-Strength Materials, 2.7
350—Code Requirements for Environmental Engineering Concrete Structures, 4.6
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.8

**Evaluation, see also Acceptance or Testing**

207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions
210R—Erosion of Concrete in Hydraulic Structures
214R—Guide to Evaluation of Strength Test Results of Concrete
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges
349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation
437R—Strength Evaluation of Existing Concrete Buildings
548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
222.2R—Report on Corrosion of Prestressing Steels, Ch. 6
308R—Guide to Curing Concrete, Ch. 4
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 20, 3.1, 5.5, 16.10
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete, Ch. 6
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, Ch. 5
506.4R—Guide for the Evaluation of Shotcrete, Ch. 3
524R—Guide to Portland Cement-Based Plaster, Ch. 14
546.2R—Guide to Underwater Repair of Concrete, Ch. 3
209.2R—Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete, 3.5
222R—Protection of Metals in Concrete Against Corrosion, 4.2
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 5.2
301—Specifications for Structural Concrete, 1.6
308R—Guide to Curing Concrete, 2.8
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 16.5
318—Building Code Requirements for Structural Concrete, 26.12, 27.2
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.6, 20.1
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 4.4
365.1R—Service-Life Prediction, 3.2
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 6.2
503.7—Specification for Crack Repair by Epoxy Injection, 3.1
506.2—Specification for Shotcrete, 3.1
546R—Guide to Concrete Repair, 1.2, 3.4, 4.2, 5.6
549.4R—Guide to Design and Construction of Externally Bonded Fabric-Reinforced Cementitious Matrix (FRCM) Systems for Repair and Strengthening Concrete and Masonry Structures, 8.2
555R—Removal and Reuse of Hardened Concrete, 2.2
Examination, see also Testing  
506.2—Specification for Shotcrete, 3.1

Excavation  
336.1—Specification for the Construction of Drilled Piers, 3.2

Existing structures, see Repair

Expansion, see Alkali-aggregate reactivity or Alkali-silica reactivity

Expansion anchors, see also Anchorage to concrete  
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete

Expansion joints, see also Joints  
224.3R—Joints in Concrete Construction
 
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 4.4

Expansive cement, see also Cement  
223R—Guide for the Use of Shrinkage-Compensating Concrete
 
225R—Guide to the Selection and Use of Hydraulic Cements, 2.2

Exposed aggregate, see also Architectural concrete  
303.1—Standard Specification for Cast-in-Place Architectural Concrete, Ch. 5
 
301—Specifications for Structural Concrete, 6.3
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 1.11

External reinforcement, see Repair

Fabrication, see also Bending of reinforcing steel  
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, Ch. 5
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Ch. 6
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 13.9
440.5—Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars, 2.2
549R—Report on Ferrocement, 3.7

Factor of safety  
360R—Guide to Design of Slabs-on-Ground, 4.9

Failures  
408.2R—Bond under Cyclic Loads

Falsework, see also Formwork  
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 5

Fasteners, see Anchorage to concrete

Fatigue, see also Dynamic load effects  
343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures
408.2R—Bond under Cyclic Loads
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, App. C
210R—Erosion of Concrete in Hydraulic Structures, 5.4
213R—Guide for Structural Lightweight-Aggregate Concrete, 5.12
325.10R—Report on Roller-Compacted Concrete Pavements, 5.6
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, 8.5
363R—Report on High-Strength Concrete, 5.7
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 6.4, 7.4
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.4
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.7
440.4R—Prestressing Concrete Structures with FRP Tendons, 4.4
549R—Report on Ferrocement, 4.5

Ferrocement  
549R—Report on Ferrocement
549.1R—Guide for the Design, Construction, and Repair of Ferrocement
549.2R—Thin Reinforced Cementitious Products

Fiber-reinforced concrete, see also Fibers  
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures
440.4R—Prestressing Concrete Structures with FRP Tendons
506.1R—Guide to Fiber-Reinforced Shotcrete
544.2R—Measurement of Properties of Fiber-Reinforced Concrete
Fiber-reinforced polymer (FRP) reinforcement

- 440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures
- 440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars
- 440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
- 440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures
- 440.4R—Prestressing Concrete Structures with FRP Tendons
- 440.5—Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars
- 440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement
- 440.8—Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures
- 549.2R—Thin Reinforced Cementitious Products, 4.3

Fibers
- 440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars
- 440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
- 440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures
- 440.4R—Prestressing Concrete Structures with FRP Tendons

Field-cured specimens, see also Testing

- 306R—Guide to Cold Weather Concreting, 6.2

Field tests, see also Testing

- 311.4R—Guide for Concrete Inspection, App. I
- 311.5—Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete, Ch. 2
- 311.6—Specification for Ready Mixed Concrete Testing Services, Sec. 2

Fills, see also Controlled low-strength materials

- 229R—Controlled Low-Strength Materials, Ch. 2
- 523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, Ch. 7

Fine aggregates, see also Aggregates

- 304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 2.2

Finishes

- 216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, Ch. 5
- 303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 9
- 524R—Guide to Portland Cement-Based Plaster, Ch. 12
301—Specifications for Structural Concrete, 5.3, 6.3, 7.3
318—Building Code Requirements for Structural Concrete, 8.3, 9.3, 20.6
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 6.9
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.12
350—Code Requirements for Environmental Engineering Concrete Structures, 8.12
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 4.1.5, App. 4
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 5.5, 5.6
533R—Guide for Precast Concrete Wall Panels, 5.6

Finishing
117—Specifications for Tolerances for Concrete Construction and Materials
230.1R—Report on Soil Cement
223R—Guide for the Use of Shrinkage-Compensating Concrete, Ch. 7
237R—Self-Consolidating Concrete, Ch. 6
302.1R—Guide for Concrete Floor and Slab Construction, Ch. 8, 2.5
303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 10
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 13, 17.9
234R—Guide for the Use of Silica Fume in Concrete, 9.5
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 6.3, 7.10
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 4.9
305R—Guide to Hot Weather Concreting, 4.3
305.1—Specification for Hot Weather Concreting, 3.5
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.6
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.5
330.1—Specification for Unreinforced Concrete Parking Lots, 3.6, 3.7
332.1R—Guide to Residential Concrete Construction, 5.4
345R—Guide for Concrete Highway Bridge Deck Construction, 10.2 through 10.4
346—Specification for Cast-in-Place Concrete Pipe, 3.2
362.1R—Guide for the Design of Durable Parking Structures, 4.7
506R—Guide to Shotcrete, 8.6
506.2—Specification for Shotcrete, 3.7
522.1—Specification for Pervious Concrete Pavement, 3.5, 3.6
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 5.5
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³), 4.3
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 7.4

Finishing equipment, see Equipment

Finite element analysis
446.3R—Finite Element Analysis of Fracture in Concrete Structures
224.2R—Cracking of Concrete Members in Direct Tension, 4.2

Fire resistance and protection
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, Ch. 8
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.19
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 2.4
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 12.2
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 1.3, 9.2
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 3.9
549R—Report on Ferrocement, 4.10

Fixed offshore structures
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures

Flat plate, see also Slabs
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
421.1R—Guide to Shear Reinforcement for Slabs
421.2R—Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates
435.8R—Observed Deflections of Reinforced Concrete Slab Systems, and Causes of Large Deflections
318—Building Code Requirements for Structural Concrete, Ch. 8
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.3

Flat slab, see also Slabs
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.3

**Flexure**

318—Building Code Requirements for Structural Concrete, Ch. 8
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 10
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, Ch. 8
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 10
SP-17—The Reinforced Concrete Design Manual, Ch. 1

314R—Guide to Simplified Design for Reinforced Concrete Buildings, 5.11, 9.8, 10.5, 12.5

**Flexural member**

318—Building Code Requirements for Structural Concrete

349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 17, 7.11, 8.4, 10.4, 10.5, 10.7, 11.8, 18.4, 18.8, 21.3
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 17, App. B, 7.11, 8.4, 10.4, 10.5, 18.4, 21.3
435R—Control of Deflection in Concrete Structures, Ch. 2, Ch. 3
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 10

209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 3.5
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 8.4, 8.6, 13.4

**Flexural reinforcement, see Reinforcement – steel or Reinforcement – FRP**

**Flexural strength**

550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 10
441R—High-Strength Concrete Columns, Ch. 3

230.1R—Report on Soil Cement, 5.4
307—Code Requirements for Reinforced Concrete Chimneys, 5.5
325.10R—Report on Roller-Compacted Concrete Pavements, 5.3
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2

350—Code Requirements for Environmental Engineering Concrete Structures, 18.7
364.3R—Guide for Cementitious Repair Material Data Sheet, 5.4
506.1R—Guide to Fiber-Reinforced Shotcrete, 6.3.1.2, 7.1
506.5R—Guide for Specifying Underground Shotcrete, 8.7
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.4
549R—Report on Ferrocement, 4.2.3
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, 4.2
549.4R—Guide to Design and Construction of Externally Bonded Fabric-Reinforced Cementitious Matrix (FRCM) Systems for Repair and Strengthening Concrete and Masonry Structures, 16.1, 16.2, 16.6
555R—Removal and Reuse of Hardened Concrete, 5.4
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Prestressed Concrete Tensile Beam Satisfying ACI ITG-5.1, 6.6
ITG-6R—Design Guide for the Use of ASTM A1035/ A1035M Grade 100 (690) Steel Bars for Structural Concrete, 4.2

**Floating structures**

357.2R—Report on Floating and Float-In Concrete Structures

**Floors, see also Slabs**

302.1R—Guide for Concrete Floor and Slab Construction
302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units

201.2R—Guide to Durable Concrete, Ch. 8
309R—Guide for Consolidation of Concrete, Ch. 10, 13.5
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 6
435R—Control of Deflection in Concrete Structures, Ch. 4

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, 2.2, 2.4
301—Specifications for Structural Concrete, 2.2, 2.3, 4.1, 4.2, 5.3, 7.2
308R—Guide to Curing Concrete, 3.4
318—Building Code Requirements for Structural Concrete, 6.3, 6.6, 26.5, 26.13, 7.3, 8.3, 9.3
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.12, 10.15
350—Code Requirements for Environmental Engineering Concrete Structures, 8.12, 10.15
362.1R—Guide for the Design of Durable Parking Structures, 3.6, 4.4
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 4.2.1, 4.3.1.1, 5.3.1, 5.3.1.2, 5.3.1.3, 5.3.2.3, 5.3.2.4, 7.8
Flowability, see Rheology or Workability

Flowable fill
229R—Controlled Low-Strength Materials, 2.3

Fly ash, see also Cementitious materials
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials
232.2R—Use of Fly Ash in Concrete
232.3R—Report on High-Volume Fly Ash Concrete for Structural Applications
229R—Controlled Low-Strength Materials, 3.3, 3.9
234R—Guide for the Use of Silica Fume in Concrete, 3.8

Foams, see Cellular concrete, Controlled low-strength materials, Low-density concrete

Folded plates, see also Shells
334.1R—Concrete Shell Structures Practice
318.2—Code Requirements for Thin Shells and Commentary
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 19
347R—Guide to Formwork for Concrete, 8.4

Footings, see also Foundations
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 14
318—Building Code Requirements for Structural Concrete, Ch. 13, 14.4
332—Residential Code Requirements for Structural Concrete, Ch. 6, 1.3
332.1R—Guide to Residential Concrete Construction, Ch. 3
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 15
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 15, 11.12
ITG-6R—Design Guide for the Use of ASTM A1035/ A1035M Grade 100 (690) Steel Bars for Structural Concrete, Ch. 8
SP-17—The Reinforced Concrete Design Manual, Ch. 5
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges, 4.4
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.2

Forms, see Formwork

Forms – inflated
334.3R—Construction of Concrete Shells Using Inflated Forms

Formwork, see also Construction
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces
347R—Guide to Formwork for Concrete
347.2R—Guide for Shoring/Reshoring of Concrete Mutistory Buildings
347.3R—Guide to Formed Concrete Surfaces
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
SP-4—Formwork for Concrete
301—Specifications for Structural Concrete, Sec. 2
303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 4
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, Ch. 4
309R—Guide for Consolidation of Concrete, Ch. 6, 5.2
318—Building Code Requirements for Structural Concrete, Ch. 26
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 6
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 9
551.1R—Guide to Tilt-Up Concrete Construction, Ch. 5
207.1R—Guide to Mass Concrete, 4.5
207.5R—Report on Roller-Compacted Mass Concrete, 6.8
223R—Guide for the Use of Shrinkage-Compensating Concrete, 5.9
302.1R—Guide for Concrete Floor and Slab Construction, 4.2
303.1—Standard Specification for Cast-in-Place Architectural Concrete, 4.2
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 4.4
306R—Guide to Cold Weather Concreting, 5.4, 6.9
307—Code Requirements for Reinforced Concrete Chimneys, 3.4
308R—Guide to Curing Concrete, 3.4.2
309.1R—Report on Behavior of Fresh Concrete During Vibration, 4.4.3
311.4R—Guide for Concrete Inspection, 3.7
Foundations, see also Drilled piers

314R—Guide to Simplified Design for Reinforced Concrete Buildings
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery
351.2R—Report on Foundations for Static Equipment
351.3R—Foundations for Dynamic Equipment

117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 3
318—Building Code Requirements for Structural Concrete, Ch. 13, 18.13
334.3R—Construction of Concrete Shells Using Inflated Forms, Ch. 2
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 15
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, Ch. 10
551.1R—Guide to Tilt-Up Concrete Construction, Ch. 3, 7.2
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, Ch. 9

228.2R—Nondestructive Test Methods for Evaluation of Concrete in Structures, 2.3
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 4.8, 7.6
341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems, 6.4
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 11.3
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 5.4
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 4.1.3.2, 4.1.7, 5.1.1.1, 5.2.1, 5.2.1.1.2, 5.2.1.3.2, 5.2.1.3.3, 5.2.1.4, 6.2, 6.3, 6.4, 6.44, 6.5
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.2
375—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 8.3
530—Building Code Requirements for Masonry Structures, 5.6.3

Fracture mechanics

446.1R—Fracture Mechanics of Concrete: Concepts, Models, and Determination of Material Properties
446.4R—Report on Dynamic Fracture of Concrete

224R—Control of Cracking in Concrete Structures, 2.3
446.3R—Finite Element Analysis of Fracture in Concrete Structures, 2.2
Frames
314R—Guide to Simplified Design for Reinforced Concrete Buildings
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
349.1R—Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures, Ch. 3
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Ch. 3, 5.2
318—Building Code Requirements for Structural Concrete, 18.3, 18.4, 18.6 through 18.8
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 10.11, 10.12, 10.13
530—Building Code Requirements for Masonry Structures, 1.14
Freeboard
350.3—Seismic Design of Liquid-Containing Concrete Structures, Ch. 7
Freezing, see also Cold weather
306R—Guide to Cold Weather Concreting, 5.1
306.1—Standard Specification for Cold Weather Concreting, 3.4
308R—Guide to Curing Concrete, 2.4
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.6, B.5
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.14
Freezing-and-thawing resistance, see also Durability
201.2R—Guide to Durable Concrete, Ch. 4
306R—Guide to Cold Weather Concreting, Ch. 5 through Ch. 7, 2.6
548.3R—Report on Polymer-Modified Concrete, Ch. 3, 3.6.1, 4.3
225R—Guide to the Selection and Use of Hydraulic Cements, 6.9
233R—Slag Cement in Concrete and Mortar, 5.11
318—Building Code Requirements for Structural Concrete, 19.3
325.10R—Report on Roller-Compacted Concrete Pavements, 9.2, 9.6
330R—Guide for the Design and Construction of Concrete Parking Lots, 7.2
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 4.2
350—Code Requirements for Environmental Engineering Concrete Structures, 4.2
363R—Report on High-Strength Concrete, 5.12
364.3R—Guide for Cementitious Repair Material Data Sheet, 5.11
522R—Report on Pervious Concrete, 9.4
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 3.11
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 7.1.10
544.1R—Report on Fiber-Reinforced Concrete, 3.5
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.7
544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 4.2
546.2R—Guide to Underwater Repair of Concrete, 2.6
555R—Removal and Reuse of Hardened Concrete, 5.4
Fresh concrete, see also Rheology
212.3R—Report on Chemical Admixtures for Concrete
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete
308R—Guide to Curing Concrete
309R—Guide for Consolidation of Concrete
309.1R—Report on Behavior of Fresh Concrete During Vibration
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, Ch. 3, Ch. 4
233R—Slag Cement in Concrete and Mortar, Ch. 4
234R—Guide for the Use of Silica Fume in Concrete, Ch. 4
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 5
232.2R—Use of Fly Ash in Concrete, 3.1
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 7.7
306R—Guide to Cold Weather Concreting, 4.1
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 2.4
Friction, see Skid resistance or Shear friction
Galleries in dams, see also Roller-compacted concrete or Mass concrete
207.5R—Report on Roller-Compacted Mass Concrete, 5.7
Girder
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 8
Glass fibers, see also Fibers
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars
440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement
549.3R—Report on Glass Fiber-Reinforced Concrete Premix
544.1R—Report on Fiber-Reinforced Concrete, Ch. 3
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 4.3
506.1R—Guide to Fiber-Reinforced Shotcrete, 3.2
549.2R—Thin Reinforced Cementitious Products, 4.2

Glass units
530—Building Code Requirements for Masonry Structures, Ch. 7
530.1—Specification for Masonry Structures, 2.3

Grout
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery
423.8R—Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems
423.9M—Test Method for Bleed Stability of Cementitious Post-Tensioned Tendon Grout
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, Ch. 2 through Ch. 4, 5.1, 5.4

207.1R—Guide to Mass Concrete, 4.9
222.2R—Report on Corrosion of Prestressing Steels, 5.3
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 3.8
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 6.1
232.2R—Use of Fly Ash in Concrete, 8.1
233R—Slag Cement in Concrete and Mortar, 6.4
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete, 3.3.3, 5.2, 5.5
301—Specifications for Structural Concrete, 5.3.7, 9.2.2
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 7.3, 7.6, 7.8
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 5.11
318—Building Code Requirements for Structural Concrete, 26.10
336.1—Specification for the Construction of Drilled Piers, 2.5
351.2R—Report on Foundations for Static Equipment, 6.6
351.3R—Foundations for Dynamic Equipment, 5.6
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.12, 6.7
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 3.3.2, 3.3.3, 4.2.2
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.7
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.12
530—Building Code Requirements for Masonry Structures, 1.8.2.4
530.1—Specification for Masonry Structures, 2.2, 3.5

543R—Design, Manufacture, and Installation of Concrete Piles, 3.5
546.2R—Guide to Underwater Repair of Concrete, 6.4
548.3R—Report on Polymer-Modified Concrete, 4.3.7, 4.4.7.1
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1, 3.5, 5.8, 6.8

Guideways
343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures

Handling concrete, see also Placing
301—Specifications for Structural Concrete, Sec. 5
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, Ch. 7
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³), Ch. 3
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 10, 17.6

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 3.3
233R—Slag Cement in Concrete and Mortar, 2.2
234R—Guide for the Use of Silica Fume in Concrete, 9.1
303.1—Standard Specification for Cast-in-Place Architectural Concrete, 1.7
330.1—Specification for Unreinforced Concrete Parking Lots, 1.5
350—Code Requirements for Environmental Engineering Concrete Structures, 16.9
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.1.4
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.1.4
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate, 1.7
503.4—Standard Specification for Repairing Concrete with Epoxy Mortars, 2.1.4
506.2—Specification for Shotcrete, 2.10
506.5R—Guide for Specifying Underground Shotcrete, 12.1
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 5.1
530.1—Specification for Masonry Structures, 1.7
533R—Guide for Precast Concrete Wall Panels, 6.2
543R—Design, Manufacture, and Installation of Concrete Piles, 4.7

Hardened concrete
209.2R—Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete
548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
555R—Removal and Reuse of Hardened Concrete
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, Ch. 2
233R—Slag Cement in Concrete and Mortar, Ch. 5
503.5R—Guide for the Selection of Polymer Adhesives with Concrete, Ch. 5
548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes, Ch. 3
212.3R—Report on Chemical Admixtures for Concrete, 4.7, 5.7, 6.8, 7.7, 8.6, 9.9, 10.6, 11.7, 12.7, 13.7, 15.6,
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 1.3
232.2R—Use of Fly Ash in Concrete, 3.2

Haunches, see Brackets

Hazardous material
350.2R—Concrete Structures for Containment of Hazardous Materials

Health hazards, see Safety

Heat generation, see Heat of hydration

Heat of hydration, see also Curing
231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation
211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, App. 5, Ch. 4
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 4.1
207.4R—Cooling and Insulating Systems for Mass Concrete, 2.6
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.18
233R—Slag Cement in Concrete and Mortar, 1.9
234R—Guide for the Use of Silica Fume in Concrete, 3.10, 10.10
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 1.7
308R—Guide to Curing Concrete, 1.3
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 4.5.5.1
363R—Report on High-Strength Concrete, 5.10

Heavyweight concrete, see also High-density concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials
363R—Report on High-Strength Concrete
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete
441R—High-Strength Concrete Columns
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications
213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 6
234R—Guide for the Use of Silica Fume in Concrete, Ch. 5
311.5—Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete, 2.5
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, 8.4
**High temperature, see also Fire resistance**  
225R—Guide to the Selection and Use of Hydraulic Cements, 6.11

**High-volume fly ash concrete**  
232.2R—Use of Fly Ash in Concrete, 6.6

**Highway bridge decks, see Bridge deck**

**Highway bridges, see Bridges (structures)**

**Historic structures**  
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation, 3.2.2

**Honeycombing, see Surface defects**

**Hooked reinforcement**  
318—Building Code Requirements for Structural Concrete, 25.3, 25.4  
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 7.1, 12.5  
350—Code Requirements for Environmental Engineering Concrete Structures, 7.1

**Hot weather concreting**  
210R—Erosion of Concrete in Hydraulic Structures  
305R—Guide to Hot Weather Concreting  
305.1—Specification for Hot Weather Concreting  
301—Specifications for Structural Concrete, 4.2.2.8, 5.3.2, 8.3.2.3  
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 5.9, 7.3  
308R—Guide to Curing Concrete, 1.4, 2.5, 2.7  
308.1—Specification for Curing Concrete, 3.6  
318—Building Code Requirements for Structural Concrete, 26.5  
330.1—Specification for Unreinforced Concrete Parking Lots, 3.12  
332—Residential Code Requirements for Structural Concrete, 5.5  
332.1R—Guide to Residential Concrete Construction, 6.5  
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.13  
350—Code Requirements for Environmental Engineering Concrete Structures, 5.12  
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.4  
506R—Guide to Shotcrete, 8.9  
506.2—Specification for Shotcrete, 3.9  
506.5R—Guide for Specifying Underground Shotcrete, 11.5

522R—Report on Pervious Concrete, 7.7  
522.1—Specification for Pervious Concrete Pavement, 3.11  
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 5.8

**Houses, see Residential concrete**

**Hydration, see Heat of hydration**

**Hydraulic cement grout, see also Grout**  
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery

**Hydraulic cements, see also Cement**  
225R—Guide to the Selection and Use of Hydraulic Cements

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, Ch. 5  
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 2.2

**Hydraulic design**  
522R—Report on Pervious Concrete, App. A

**Hydraulic structures, see also Erosion**  
210R—Erosion of Concrete in Hydraulic Structures  
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 11.4

**Hydrodemolition**  
364.8T—Use of Hydrodemolition for Concrete Removal in Unbonded Post-Tensioned Systems

**Hydrogen**  
222.2R—Report on Corrosion of Prestressing Steels, Ch. 5  
234R—Guide for the Use of Silica Fume in Concrete, 4.10

**Hydrostatic**  
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures

350—Code Requirements for Environmental Engineering Concrete Structures, H.6

**Impact, see also Loads**  
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases  
506.1R—Guide to Fiber-Reinforced Shotcrete, 7.7  
549R—Report on Ferrocement, 4.6
Implosion
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 4.5.1
549R—Report on Ferrocement, 4.6

Inflated forms, see Forms – inflated

In-place testing, see Testing

Inspection, see also Testing
201.1R—Guide for Conducting a Visual Inspection of Concrete in Service
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
311.1R—ACI Manual of Concrete Inspection
311.4R—Guide for Concrete Inspection
311.5—Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete
311.7 Inspection Services Specification for Cast-In-Place Concrete Construction
314R—Guide to Simplified Design for Reinforced Concrete Buildings
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
533.1R—Design Responsibility for Architectural Precast-Concrete Projects

207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, Ch. 2
210R—Erosion of Concrete in Hydraulic Structures, Part 3
304.4R—Placing Concrete with Belt Conveyors, Ch. 5
305R—Guide to Hot Weather Concreting, Ch. 5
309R—Guide for Consolidation of Concrete, Ch. 16
325.10R—Report on Roller-Compacted Concrete Pavements, Ch. 8
336.3R—Report on Design and Construction of Drilled Piers, Ch. 6
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 3
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation, Ch. 2
506.5R—Guide for Specifying Underground Shotcrete, Ch. 11
522R—Report on Pervious Concrete, Ch. 8
546.2R—Guide to Underwater Repair of Concrete, Ch. 3, Ch. 7
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Ch. 6

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 5.2
228.2R—Nondestructive Test Methods for Evaluation of Concrete in Structures, 2.1
301—Specifications for Structural Concrete, 1.6, 9.3.1
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 16.8
318—Building Code Requirements for Structural Concrete, 26.13
330.1—Specification for Unreinforced Parking Lots, 1.6
332—Residential Code Requirements for Structural Concrete, 1.5
336.1—Specification for the Construction of Drilled Piers, 3.7.6
347R—Guide to Formwork for Concrete, 5.6
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 1.3
350—Code Requirements for Environmental Engineering Concrete Structures, 1.3
350.2R—Concrete Structures for Containment of Hazardous Materials, 4.3, 5.4
360R—Guide to Design of Slabs-on-Ground, 3.7
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 5.5
440.1R—Guide for the Design and Construction of Concrete with FRP Bars, 6.3
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 7.1, 8.2
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 6.1, 7.2
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.3.7
506R—Guide to Shotcrete, 9.7
524R—Guide to Portland Cement-Based Plaster, 11.1
530.1—Specification for Masonry Structures, 3.1

Installation, see also Placing
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 6
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, Ch. 5
530.1—Specification for Masonry Structures, Ch. 3
533R—Guide for Precast Concrete Wall Panels, Ch. 6

Instrumentation, see also Testing
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 1.2

Insulating concretes
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
308R—Guide to Curing Concrete, 3.4.7
533R—Guide for Precast Concrete Wall Panels, 4.6

Insulation
207.4R—Cooling and Insulating Systems for Mass Concrete

229R—Controlled Low-Strength Materials, 4.3.4
306R—Guide to Cold Weather Concreting, 7.2, 7.3, 7.8
Iron
233R—Slag Cement in Concrete and Mortar, 1.5

ISO, see also Quality assurance
121R—Guide for Concrete Construction Quality Systems in Conformance with ISO 9001

Isolation joints
224R—Control of Cracking in Concrete Structures
224.3R—Joints in Concrete Construction, 3.4
301—Specifications for Structural Concrete, 10.3
302.1R—Guide for Concrete Floor and Slab Construction, 3.2, 5.1
318—Building Code Requirements for Structural Concrete, 14.3
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 4.4
330.1—Specification for Unreinforced Concrete Parking Lots, 2.4, 3.13
530—Building Code Requirements for Masonry Structures, 1.18.3.1, B.2.1

Joints, see also Isolation joints
224.3R—Joints in Concrete Construction
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads
530—Building Code Requirements for Masonry Structures
530.1—Specification for Masonry Structures
350.2R—Concrete Structures for Containment of Hazardous Materials, Ch. 3
350.4R—Design Considerations for Environmental Engineering Concrete Structures, Ch. 5
360R—Guide to Design of Slabs-on-Ground, Ch. 5
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 8
207.5R—Report on Roller-Compacted Mass Concrete, 6.6
301—Specifications for Structural Concrete, 5.3
302.1R—Guide for Concrete Floor and Slab Construction, 3.2
303R—Guide to Cast-in-Place Architectural Concrete Practice, 3.4
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 6.2, 7.9
318—Building Code Requirements for Structural Concrete, 14.3, 26.5
325.10R—Report on Roller-Compacted Concrete Pavements, 7.6
330R—Guide for the Design and Construction of Concrete Parking Lots, 3.7, 3.9, 5.7, 7.3, C.1
330.1—Specification for Unreinforced Concrete Parking Lots, 3.13
332—Residential Code Requirements for Structural Concrete, 8.5
332.1R—Guide to Residential Concrete Construction, 5.5
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges, 4.3
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.20
345.1R—Guide for Maintenance of Concrete Bridge Members, 3.3, 7.2, 7.5
350—Code Requirements for Environmental Engineering Concrete Structures, 4.8, H.5
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.2
506.1R—Guide to Shotcrete, 5.7
506.2—Specification for Shotcrete, 3.4
522.1—Specification for Pervious Concrete Pavement, 3.12
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks, 3.7
548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks, 3.7
548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks, 3.7
551.1R—Guide to Tilt-Up Concrete, 4.3, 8.3

Joints, connection
349—Code Requirements for Nuclear Safety-Related Concrete Structures
352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
352.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, Ch. 4
350.2R—Concrete Structures for Containment of Hazardous Materials, Ch. 3
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Ch. 5
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 6.2, 7.9
318—Building Code Requirements for Structural Concrete, 26.5
325.10R—Report on Roller-Compacted Concrete Pavements, 7.6
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.20
350—Code Requirements for Environmental Engineering Concrete Structures, 6.4, 21.5
506R—Guide to Shotcrete, 5.7
506.2—Specification for Shotcrete, 3.4
530.1—Specification for Masonry Structures, 1.4, 2.4
Joints, junctions
318—Building Code Requirements for Structural Concrete
349—Code Requirements for Nuclear Safety-Related Concrete Structures
350—Code Requirements for Environmental Engineering Concrete Structures
352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
530—Building Code Requirements for Masonry Structures

Joints, movement
224.3R—Joints in Concrete Construction

325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, Ch. 4

207.5R—Report on Roller-Compacted Mass Concrete, 6.6
302.1R—Guide for Concrete Floor and Slab Construction, 3.2.5
318—Building Code Requirements for Structural Concrete, 14.3
325.11R—Accelerated Techniques for Concrete Paving, 5.3
330R—Guide for the Design and Construction of Concrete Parking Lots, 3.7
330.1—Specification for Unreinforced Concrete Parking Lots, 3.13
350—Code Requirements for Environmental Engineering Concrete Structures, 6.5
350.4R—Design Considerations for Environmental Engineering Concrete Structures, 5.3
530—Building Code Requirements for Masonry Structures, 7.5

Joists
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 8

318—Building Code Requirements for Structural Concrete, 8.8
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.11
350—Code Requirements for Environmental Engineering Concrete Structures, 8.11

Lap splices, see Reinforcement

Lateral alignment, see Tolerances

Lateral-force-resisting system, see also Moment frame
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing

318—Building Code Requirements for Structural Concrete, Ch. 18, 21.2
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 21
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 21
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 4.14
421.2R—Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates, 2.1
530—Building Code Requirements for Masonry Structures, 1.14

Latex, see also Adhesives
503.5R—Guide for the Selection of Polymer Adhesives with Concrete
548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays
548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

548.3R—Report on Polymer-Modified Concrete, Ch. 2, 5.2.1, 6.2.4
224R—Control of Cracking in Concrete Structures, 6.3

Latex-modified concrete, see also Overlays
548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays

548.3R—Report on Polymer-Modified Concrete, Ch. 2, 5.1
224R—Control of Cracking in Concrete Structures, 6.3

Lath
524R—Guide to Portland Cement-Based Plaster, Ch. 6, Ch. 8

Layer coefficients for pavements, see also Roller-compacted concrete
230.1R—Report on Soil Cement, 5.7

Layers, lines; see Surface defects

Leakage, see also Watertightness
350.2R—Concrete Structures for Containment of Hazardous Materials, Ch. 7

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.14

Level alignment, see Tolerances
Lightweight aggregate, see also Aggregates

211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete, Ch. 2

213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 2

Lightweight-aggregate concrete, see also Low-density concrete

211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete

213R—Guide for Structural Lightweight-Aggregate Concrete

435R—Control of Deflection in Concrete Structures

523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)

301—Specifications for Structural Concrete, Sec. 7

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 12

309R—Guide for Consolidation of Concrete, Ch. 13

302.1R—Guide for Concrete Floor and Slab Construction, 8.11

304.2R—Placing Concrete by Pumping Methods, 4.3

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.6

350—Code Requirements for Environmental Engineering Concrete Structures, 11.2

Lining

350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures

224.3R—Joints in Concrete Construction, Ch. 7

350.2R—Concrete Structures for Containment of Hazardous Materials, Ch. 5

230.1R—Report on Soil Cement, 3.5

315—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.8

350—Code Requirements for Environmental Engineering Concrete Structures, 4.7

376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.13, 9.8

549.2R—Thin Reinforced Cementitious Products, 5.5

Liquid tightness, see Watertightness or Leakage

Load tests, see also Testing

437.1R—Load Tests of Concrete Structures: Methods, Magnitude, Protocols, and Acceptance Criteria

318—Building Code Requirements for Structural Concrete, 27.4

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 20.3, 20.4

350—Code Requirements for Environmental Engineering Concrete Structures, 20.3

437R—Strength Evaluation of Existing Concrete Buildings, 5.2

Loads

343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures

364.4T—Determining the Load Capacity of a Structure When As-Built Drawings are Unavailable

364.5T—Importance of Modulus of Elasticity of Repair Materials

408.2R—Bond under Cyclic Loads

437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary

307—Code Requirements for Reinforced Concrete Chimneys, Ch. 4

314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 4, 8.2, 9.2, 10.2, 12.2

318—Building Code Requirements for Structural Concrete, Ch. 27, 4.4, 5.2,

336.3R—Report Design and Construction of Drilled Piers, Ch. 4

343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 5, Ch. 8

349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 8

350.3—Seismic Design of Liquid-Containing Concrete Structures, Ch. 4, Ch. 5

350.4R—Design Considerations for Environmental Engineering Concrete Structures, Ch. 2

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, Ch. 3, App. A

357.2R—Report on Floating and Float-In Concrete Structures, Ch. 4

357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, Ch. 7

360R—Guide to Design of Slabs-on-Ground, Ch. 4

370R—Report for the Design of Concrete Structures for Blast Effects, Ch. 5

371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, Ch. 5, 5.1.2, 6.3, 6.4, 6.5, 7.4.3.1, 7.8.1.1, 7.8.3.1, App. 5

376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, Ch. 5, Ch. 7

437R—Strength Evaluation of Existing Concrete Buildings, Ch. 4

551.2R—Design Guide for Tilt-Up Concrete Panels, Ch. 4

ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 4

224R—Control of Cracking in Concrete Structures, 5.2
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 4.4, 7.3
325.10R—Report on Roller-Compacted Concrete Pavements, 9.7
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats, 1.4
347R—Guide to Formwork for Concrete, 4.2
350—Code Requirements for Environmental Engineering Concrete Structures, 8.2, 8.9, 15.2, 18.11, 20.3
351.2R—Report on Foundations for Static Equipment, 4.1
351.3R—Foundations for Dynamic Equipment, 3.2
365.1R—Service-Life Prediction, 2.3
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary, 3.3
435R—Control of Deflection in Concrete Structures, 4.6
530—Building Code Requirements for Masonry Structures, 1.7
543R—Design, Manufacture, and Installation of Concrete Piles, 2.2
549R—Report on Ferrocement, 4.2 through 4.5

Low-density concrete, see also Lightweight aggregate concrete or Cellular concrete
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units
309R—Guide for Consolidation of Concrete, Ch. 13

Low-density materials
229R—Controlled Low-Strength Materials, Ch. 8

Low-strength concrete
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, 8.3

Low-strength materials, see Controlled low-strength materials

Machinery foundations, see Foundations and Footings

Maintenance
345.1R—Guide for Maintenance of Concrete Bridge Members
362.2R—Guide for Structural Maintenance of Parking Structures
330R—Guide for the Design and Construction of Concrete Parking Lots, Ch. 7
357.2R—Report on Floating and Float-In Concrete Structures, Ch. 8
362.1R—Guide for the Design of Durable Parking Structures, Ch. 5

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 8
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, Ch. 7
548.5R—Guide for Polymer Concrete Overlays, Ch. 7
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, Ch. 6
304.4R—Placing Concrete with Belt Conveyors, 4.5
345R—Guide for Concrete Highway Bridge Deck Construction, 12.3
365.1R—Service-Life Prediction, 3.4

Manufacturing
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 4.8
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 3.2
548.3R—Report on Polymer-Modified Concrete, 4.4.2

Marine concrete, see also Underwater repair
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures
357.2R—Report on Floating and Float-In Report on Barge-Like Concrete Structures
357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures
546.2R—Guide to Underwater Repair of Concrete
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 8
201.2R—Guide to Durable Concrete, 6.4

Masonry
440.8—Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures
530—Building Code Requirements for Masonry Structures
530.1—Specification for Masonry Structures
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, Ch. 3, Ch. 4
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 10
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 5.1
232.2R—Use of Fly Ash in Concrete, 7.1
524R—Guide to Portland Cement-Based Plaster, 9.3, 9.4
Masonry cements, see also Cement
530—Building Code Requirements for Masonry Structures

Masonry mortars, see also Grout
530—Building Code Requirements for Masonry Structures

Masonry units, see Masonry

Masonry walls
122R—Guide to Thermal Properties of Concrete and Masonry Systems, Ch. 3, Ch. 4
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, Ch. 3, Ch. 4

530—Building Code Requirements for Masonry Structures, 1.9, 2.1, 5.3, 5.6 through 5.8

Mass concrete, see also Roller-compacted concrete
207.1R—Guide to Mass Concrete
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete
207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions
207.4R—Cooling and Insulating Systems for Mass Concrete
207.5R—Report on Roller-Compacted Mass Concrete

117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 8
211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, App. 5
224R—Control of Cracking in Concrete Structures, Ch. 7
301—Specifications for Structural Concrete, Sec. 8
309R—Guide for Consolidation of Concrete, Ch. 9

232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 5.4
232.2R—Use of Fly Ash in Concrete, 6.3
233R—Slag Cement in Concrete and Mortar, 5.7
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 5.6
308R—Guide to Curing Concrete, 3.3
347R—Guide to Formwork for Concrete, 8.5
555R—Removal and Reuse of Hardened Concrete, 2.4

Material response
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Ch. 2

Materials, see also Material response
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database
301—Specifications for Structural Concrete
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
364.3R—Guide for Cementitious Repair Material Data Sheet
439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availability
503.5R—Guide for the Selection of Polymer Adhesives with Concrete
546.3R—Guide to Materials Selection for Concrete Repair
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications

207.1R—Guide to Mass Concrete, Ch. 2
207.5R—Report on Roller-Compacted Mass Concrete, Ch. 3
211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, Ch. 4
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, Ch. 4
213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 2
224.3R—Joists in Concrete Construction, Ch. 2
229R—Controlled Low-Strength Materials, Ch. 3
303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 6
306R—Guide to Cold Weather Concreting, Ch. 7
306.1—Standard Specification for Cold Weather Concreting, Ch. 2
307—Code Requirements for Reinforced Concrete Chimneys, Ch. 2
308R—Guide to Curing Concrete, Ch. 2
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, Ch. 2
318—Building Code Requirements for Structural Concrete, Ch. 26
325.11R—Accelerated Techniques for Concrete Paving, Ch. 4
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, Ch. 2
330R—Guide for the Design and Construction of Concrete Parking Lots, Ch. 4
332—Residential Code Requirements for Structural Concrete, Ch. 3
343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 3
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 7
347R—Guide to Formwork for Concrete, Ch. 6
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 3
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 3
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, Ch. 3
362.1R—Guide for the Design of Durable Parking Structures, Ch. 3
363R—Report on High-Strength Concrete, Ch. 2
Materials handling

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 2

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 5

506.5R—Guide for Specifying Underground Shotcrete, Ch. 6

548.1R—Guide for the Use of Polymers in Concrete, Ch. 5

423.7—Specification for Unbonded Single-Strand Tendon Materials, Ch. 5

Materials property database

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database

Mats, see also Foundations and Footings

336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats

318—Building Code Requirements for Structural Concrete, 13.3

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 15.10

350—Code Requirements for Environmental Engineering Concrete Structures, 15.10

Measuring, see also Mixture proportioning

231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation

304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 3

345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 8

Mechanical properties, see Properties of concrete

Mechanical splices, see Couplers

Membranes, see also Protective coatings

350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures

362.1R—Guide for the Design of Durable Parking Structures, 4.11

Metal fibers

544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete

544.4R—Design Considerations for Steel Fiber-Reinforced Concrete
544.1R—Report on Fiber-Reinforced Concrete, Ch. 2

506.1R—Guide to Fiber-Reinforced Shotcrete, 3.2

Metals, see Corrosion

Microstructure
231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation

Mineral admixtures, see also Admixtures
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, Ch. 8

225R—Guide to the Selection and Use of Hydraulic Cements, 4.3
363R—Report on High-Strength Concrete, 2.4

Mitigation
231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation

Mixers, see also Equipment
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 4

304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 3.2
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 3.2

Mixing
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 4

304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, Ch. 3

318—Building Code Requirements for Structural Concrete, Ch. 26
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 5
506.5R—Guide for Specifying Underground Shotcrete, Ch. 12
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³), Ch. 3
524R—Guide to Portland Cement-Based Plaster, Ch. 10

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, 4.5
207.1R—Guide to Mass Concrete, 4.2
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.3

213R—Guide for Structural Lightweight-Aggregate Concrete, 3.5
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 4.1
229R—Controlled Low-Strength Materials, 6.2
230.1R—Report on Soil Cement, 7.2, 8.5

238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete, 4.7, 5.2.2.4
301—Specifications for Structural Concrete, 4.3.1, 7.2.4
302.1R—Guide for Concrete Floor and Slab Construction, 7.2
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 3.2
305R—Guide to Hot Weather Concreting, 3.3
306R—Guide to Cold Weather Concreting, 3.2, 3.3
325.10R—Report on Roller-Compacted Concrete Pavements, 7.3
330.1—Specification for Unreinforced Concrete Parking Lots, 3.5
345R—Guide for Concrete Highway Bridge Deck Construction, 8.4 through 8.6
346—Specification for Cast-in-Place Concrete Pipe, 1.5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 5.8
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.3
363R—Report on High-Strength Concrete, 4.3
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.3.8
506R—Guide to Shotcrete, 7.3
506.1R—Guide to Fiber-Reinforced Shotcrete, 5.2
506.2—Specification for Shotcrete, 3.2
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 5.3
530.1—Specification for Masonry Structures, 2.6
533R—Guide for Precast Concrete Wall Panels, 5.3
543R—Design, Manufacture, and Installation of Concrete Piles, 4.5
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 6.2

Mixture proportioning, see also Batching
211.5R—Guide for Submittal of Concrete Proportions
211.6T—TechNote: Aggregate Suspension Mixture Proportioning Method

212.3R—Report on Chemical Admixtures for Concrete
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)

207.5R—Report on Roller-Compacted Mass Concrete, Ch. 3, 6.3
211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, Ch. 6
211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete, Ch. 3
211.3R—Guide for Selecting Proportions for No-Slump Concrete, App. 3 through 6, Ch. 4
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, Ch. 4, Ch. 6 through 8
223R—Guide for the Use of Shrinkage-Compensating Concrete, Ch. 6
229R—Controlled Low-Strength Materials, Ch. 5
<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>230.1R</td>
<td>Report on Soil Cement, Ch. 6</td>
</tr>
<tr>
<td>232.2R</td>
<td>Use of Fly Ash in Concrete, Ch. 4</td>
</tr>
<tr>
<td>233R</td>
<td>Slag Cement in Concrete and Mortar, Ch. 3</td>
</tr>
<tr>
<td>234R</td>
<td>Guide for the Use of Silica Fume in Concrete, Ch. 8</td>
</tr>
<tr>
<td>237R</td>
<td>Self-Consolidating Concrete, Ch. 4</td>
</tr>
<tr>
<td>301</td>
<td>Specifications for Structural Concrete, Sec. 4</td>
</tr>
<tr>
<td>303R</td>
<td>Guide to Cast-in-Place Architectural Concrete Practice, Ch. 6</td>
</tr>
<tr>
<td>304.2R</td>
<td>Placing Concrete by Pumping Methods, Ch. 4</td>
</tr>
<tr>
<td>304.3R</td>
<td>Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, Ch. 2</td>
</tr>
<tr>
<td>304.6R</td>
<td>Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, Ch. 4</td>
</tr>
<tr>
<td>309R</td>
<td>Guide for Consolidation of Concrete, Ch. 2</td>
</tr>
<tr>
<td>363R</td>
<td>Report on High-Strength Concrete, Ch. 3</td>
</tr>
<tr>
<td>506.1R</td>
<td>Guide to Fiber-Reinforced Shotcrete, Ch. 4, 5.2</td>
</tr>
<tr>
<td>506.5R</td>
<td>Guide for Specifying Underground Shotcrete, Ch. 7</td>
</tr>
<tr>
<td>522R</td>
<td>Report on Pervious Concrete, Ch. 5</td>
</tr>
<tr>
<td>524R</td>
<td>Guide to Portland Cement-Based Plaster, Ch. 10</td>
</tr>
<tr>
<td>544.3R</td>
<td>Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, Ch. 4, Ch. 6</td>
</tr>
<tr>
<td>ITG-4.1</td>
<td>Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 3</td>
</tr>
<tr>
<td>ITG-4.2R</td>
<td>Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 6, 17.2</td>
</tr>
<tr>
<td>126.3R</td>
<td>Guide to a Recommended Format for Concrete in a Materials Property Database, 4.4</td>
</tr>
<tr>
<td>207.1R</td>
<td>Guide to Mass Concrete, 2.7</td>
</tr>
<tr>
<td>212.3R</td>
<td>Report on Chemical Admixtures for Concrete, 3.7, 4.5, 5.5, 6.6, 7.5, 8.4, 9.4, 10.4, 11.5, 12.5, 13.5, 15.5</td>
</tr>
<tr>
<td>213R</td>
<td>Guide for Structural Lightweight-Aggregate Concrete, 3.2, 3.4</td>
</tr>
<tr>
<td>221R</td>
<td>Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 3.2</td>
</tr>
<tr>
<td>222.3R</td>
<td>Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 3.1, 3.2</td>
</tr>
<tr>
<td>232.1R</td>
<td>Use of Raw or Processed Natural Pozzolans in Concrete, 2.1</td>
</tr>
<tr>
<td>302.1R</td>
<td>Guide for Concrete Floor and Slab Construction, 6.2, 6.3</td>
</tr>
<tr>
<td>304R</td>
<td>Guide for Measuring, Mixing, Transporting, and Placing Concrete, 7.3, 8.3, 9.4</td>
</tr>
<tr>
<td>304.1R</td>
<td>Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 2.8, 5.1</td>
</tr>
<tr>
<td>304.4R</td>
<td>Placing Concrete with Belt Conveyors, 2.6</td>
</tr>
<tr>
<td>305R</td>
<td>Guide to Hot Weather Concreting, 2.9</td>
</tr>
<tr>
<td>305.1</td>
<td>Specification for Hot Weather Concreting, 2.2, 3.3</td>
</tr>
<tr>
<td>309.1R</td>
<td>Report on Behavior of Fresh Concrete During Vibration, 3.2.1</td>
</tr>
<tr>
<td>314R</td>
<td>Guide to Simplified Design for Reinforced Concrete Buildings, 16.2</td>
</tr>
<tr>
<td>318</td>
<td>Building Code Requirements for Structural Concrete, 26.4</td>
</tr>
<tr>
<td>325.10R</td>
<td>Report on Roller-Compacted Concrete Pavements, 4.2, 4.3</td>
</tr>
<tr>
<td>325.11R</td>
<td>Accelerated Techniques for Concrete Paving, 4.1</td>
</tr>
<tr>
<td>325.12R</td>
<td>Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2</td>
</tr>
<tr>
<td>332.1R</td>
<td>Guide to Residential Concrete Construction, 2.3</td>
</tr>
<tr>
<td>349</td>
<td>Code Requirements for Nuclear Safety-Related Concrete Structures, 5.2 through 5.4</td>
</tr>
<tr>
<td>350</td>
<td>Code Requirements for Environmental Engineering Concrete Structures, 5.2, 5.3</td>
</tr>
<tr>
<td>350.2R</td>
<td>Concrete Structures for Containment of Hazardous Materials, 2.5</td>
</tr>
<tr>
<td>506R</td>
<td>Guide to Shotcrete, 6.3</td>
</tr>
<tr>
<td>506.2</td>
<td>Specification for Shotcrete, 2.7</td>
</tr>
<tr>
<td>523.1R</td>
<td>Guide for Cast-in-Place Low-Density Cellular Concrete, 4.1</td>
</tr>
<tr>
<td>533R</td>
<td>Guide for Precast Concrete Wall Panels, 5.3</td>
</tr>
<tr>
<td>548.1R</td>
<td>Guide for the Use of Polymers in Concrete, 5.4</td>
</tr>
<tr>
<td>548.3R</td>
<td>Report Polymer-Modified Concrete, 4.1, 4.3.4, 4.4.4</td>
</tr>
<tr>
<td>549.1R</td>
<td>Guide for the Design, Construction, and Repair of Ferrocement, 3.1, 3.15</td>
</tr>
<tr>
<td>549R</td>
<td>Report on Ferrocement, 3.5</td>
</tr>
<tr>
<td>555R</td>
<td>Removal and Reuse of Hardened Concrete, 5.5</td>
</tr>
</tbody>
</table>

**Modeling, see also Finite element analysis**

- 209.2R - Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete
- 446.1R - Fracture Mechanics of Concrete: Concepts, Models, and Determination of Material Properties
- 446.4R - Report on Dynamic Fracture of Concrete

- 334.1R - Concrete Shell Structures Practice, Ch. 8
- 341.2R - Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems, Ch. 6

**Modified Compression Field Theory, see also Shear strength**

- 445R - Recent Approaches to Shear Design of Structural Concrete, 2.4, 2.6

**Modulus of elasticity, see also Properties of concrete**

- 523.3R - Guide for Cellular Concretes above 50 lb/ft$^3$ (800 kg/m$^3$)
- 207.1R - Guide to Mass Concrete, 3.3
- 207.2R - Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 3.6
- 213R - Guide for Structural Lightweight-Aggregate Concrete, 4.6, 5.3
Moment frame, see also Lateral-force resisting system

374.1—Acceptance Criteria for Moment Frames Based on Structural Testing

369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary, Ch. 4

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 21.3

Monolithic joints, see Beam-column joints

Mortars, see also Masonry mortars

503.4—Standard Specification for Repairing Concrete with Epoxy Mortars

548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks

234R—Guide for the Use of Silica Fume in Concrete, Ch. 3

548.3R—Report on Polymer-Modified Concrete, Ch. 4, 4.1.3.2, 4.1.3.3, 4.2.3.2, 4.4.5, 4.4.6, 4.4.7.3

232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 6.1

232.2R—Use of Fly Ash in Concrete, 8.1

233R—Slag Cement in Concrete and Mortar, 6.4

Natural pozzolans, see Pozzolans

210R—Erosion of Concrete in Hydraulic Structures, 3.3

Nondestructive evaluation (NDE), see also Testing or Evaluation

228.2R—Nondestructive Test Methods for Evaluation of Concrete in Structures

555R—Removal and Reuse of Hardened Concrete

325.11R—Accelerated Techniques for Concrete Paving, Ch. 6

440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 5

207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, 3.9

423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 5.4

437R—Strength Evaluation of Existing Concrete Buildings, 2.2, 3.1

506.4R—Guide for the Evaluation of Shotcrete, 2.3

546.2R—Guide to Underwater Repair of Concrete, 3.4

No-slump concrete, see also Slump

211.3R—Guide for Selecting Proportions for No-Slump Concrete
Notation, see also Terminology
318—Building Code Requirements for Structural Concrete, Ch. 2
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, 1.5

Nozzlemen, see also Shotcrete
506.5R—Guide for Specifying Underground Shotcrete
506R—Guide to Shotcrete, 9.5
506.2—Specification for Shotcrete, 1.6.1

Nuclear radiation shielding
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, Ch. 1

Nuclear safety-related structures
349—Code Requirements for Nuclear Safety-Related Concrete Structures
349.1R—Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures
349.2R—Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples
349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures
359—Code for Concrete Containments
229R—Controlled Low-Strength Materials, 2.9

Offsets, see Tolerances

Offshore structures
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures

One-way slabs, see Slabs
224.4R—Guide to Design Detailing to Mitigate Cracking, Ch. 5

ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, 6.1, 6.2

Openings, see also Tolerances
307—Code Requirements for Reinforced Concrete Chimneys, Ch. 4, 3.8, 3.8.2, 4.1.3, 5.5.3, 5.5.4
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 6.10
318—Building Code Requirements for Structural Concrete, 8.5
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.9
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 13.4

352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, 4.4
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 5.3
551.1R—Guide to Tilt-Up Concrete Construction, 4.3

Ordering
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 6
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 9, 17.5

Oscillation
350.3—Seismic Design of Liquid-Containing Concrete Structures, Ch. 7

Outlets
207.5R—Report on Roller-Compacted Mass Concrete, 5.10

Overlays, see also Latex-modified concrete
325.13—Concrete Overlays for Pavement Rehabilitation
548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays
548.5R—Guide for Polymer Concrete Overlays
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks
548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks
224R—Control of Cracking in Concrete Structures, Ch. 6
310R—Guide to Decorative Concrete, Ch. 8
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 13
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 3.12
330R—Guide for the Design and Construction of Concrete Parking Lots, 7.6
548.3R—Report on Polymer-Modified Concrete, 4.3, 4.3.4
548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks, 2.6, 3.4

Paints, see also Coatings
308R—Guide to Curing Concrete, 3.4
551.1R—Guide to Tilt-Up Concrete Construction, 8.4

Panels, see also Walls
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels
533R—Guide for Precast Concrete Wall Panels
533.1R—Design Responsibility for Architectural Precast-Concrete Projects
551.2R—Design Guide for Tilt-Up Concrete Panels
Parking lots, see also Slabs-on-ground

- 330R—Guide for the Design and Construction of Concrete Parking Lots
- 330.1—Specification for Unreinforced Concrete Parking Lots
- 522R—Report on Pervious Concrete
- 224.3R—Joints in Concrete Construction, 6.6

Paving structures

- 362.1R—Guide for the Design of Durable Parking Structures
- 362.2R—Guide for Structural Maintenance of Parking Structures
- 548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks
- 548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks

Patterning

- 310R—Guide to Decorative Concrete, Ch. 7

Pavements

- 229R—Controlled Low-Strength Materials
- 325.10R—Report on Roller-Compacted Concrete Pavements
- 325.11R—Accelerated Techniques for Concrete Paving
- 325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads
- 330R—Guide for the Design and Construction of Concrete Parking Lots
- 522.1—Specification for Pervious Concrete Pavement
- 544.1R—Report on Fiber-Reinforced Concrete
- 117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 12
- 309R—Guide for Consolidation of Concrete, Ch. 11
- 201.2R—Guide to Durable Concrete, 8.5, 8.6
- 230.1R—Report on Soil Cement, 3.2
- 232.2R—Use of Fly Ash in Concrete, 6.2
- 308R—Guide to Curing Concrete, 3.1
- 309.5R—Compaction of Roller-Compacted Concrete, 5.4
- 330.1—Specification for Unreinforced Concrete Parking Lots, 3.6, 3.7
- 440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 6.7
- 555R—Removal and Reuse of Hardened Concrete, 4.6

Performance-based requirements

Permeability, see also Properties of concrete

- 506.4R—Guide for the Evaluation of Shotcrete, Ch. 5
- 207.1R—Guide to Mass Concrete, 3.6
- 207.5R—Report on Roller-Compacted Mass Concrete, 4.9
- 230.1R—Report on Soil Cement, 5.5
- 233R—Slag Cement in Concrete and Mortar, 5.8
- 523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 3.10
- 544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 3.3
- 555R—Removal and Reuse of Hardened Concrete, 5.4

Pervious concrete

- 522R—Report on Pervious Concrete
- 522.1—Specification for Pervious Concrete Pavement

Petrographic examination

- 201.2R—Guide to Durable Concrete
- 207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions
- 221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete
- 221.1R—Report on Alkali-Aggregate Reactivity
- 349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures
- 437R—Strength Evaluation of Existing Concrete Buildings
- 555R—Removal and Reuse of Hardened Concrete

Photographs

- 303R—Guide to Cast-in-Place Architectural Concrete Practice, App. A

Physical properties, see also Modulus of elasticity

- 364.3R—Guide for Cementitious Repair Material Data Sheet
- 213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 4
- 225R—Guide to the Selection and Use of Hydraulic Cements, Ch. 5
- 233R—Slag Cement in Concrete and Mortar, Ch. 3
- 234R—Guide for the Use of Silica Fume in Concrete, Ch. 2
- 440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement, Ch. 7
- 232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 1.6
- 232.2R—Use of Fly Ash in Concrete, 2.5
- 308R—Guide to Curing Concrete, 4.7
- 440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 3.1
- 440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.2

Piers, see also Drilled piers

- 343R—Analysis and Design of Reinforced Concrete Bridge Structures, 11.6
Piles, see also Drilled piers
  543R—Design, Manufacture, and Installation of Concrete Piles
  117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 3
  440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 8

304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 5.11
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 14.8, 14.9
351.2R—Report on Foundations for Static Equipment, 5.6

Pipe bedding
229R—Controlled Low-Strength Materials, 2.6

Pipe diameter, see Tolerances

Pipes
346—Specification for Cast-in-Place Concrete Pipe
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 14

224.3R—Joints in Concrete Construction, 7.4
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 5.2
232.2R—Use of Fly Ash in Concrete, 7.2
350—Code Requirements for Environmental Engineering Concrete Structures, 6.3
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 7.6, 7.7

Placeability, see Workability

Placing concrete
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications
304.2R—Placing Concrete by Pumping Methods
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
304.4R—Placing Concrete with Belt Conveyors
309R—Guide for Consolidation of Concrete
506.1R—Guide to Fiber-Reinforced Shotcrete

237R—Self-Consolidating Concrete, Ch. 6, 6.5
301—Specifications for Structural Concrete, Sec. 5, 8.3, 9.3, 10.3
302.1R—Guide for Concrete Floor and Slab Construction, Ch. 8
303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 7
305R—Guide to Hot Weather Concreting, Ch. 4

309.5R—Compaction of Roller-Compacted Concrete, Ch. 5
332—Residential Code Requirements for Structural Concrete, Ch. 5
345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 9
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 5
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, Ch. 7
506.5R—Guide for Specifying Underground Shotcrete, Ch. 13
523.3R—Guide for Cellular Concrete above 50 lb/ft^3 (800 kg/m^3)
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 9
ITG-4.2—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 13, 8.3, 17.9

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, 11.8
201.2R—Guide to Durable Concrete, 3.4
207.1R—Guide to Mass Concrete, 4.3
207.4R—Cooling and Insulating Systems for Mass Concrete, 2.8
207.5R—Report on Roller-Compacted Mass Concrete, 6.4
213R—Guide for Structural Lightweight-Aggregate Concrete, 3.6
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 4.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 7.1
229R—Controlled Low-Strength Materials, 6.4
234R—Guide for the Use of Silica Fume in Concrete, 9.4
306R—Guide to Cold Weather Concreting, 3.1, 7.6
307—Code Requirements for Reinforced Concrete Chimneys, 3.6
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 2.5
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.6
318—Building Code Requirements for Structural Concrete, 26.5
325.10R—Report on Roller-Compacted Concrete Pavements, 7.4
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.5
330.1—Specification for Unreinforced Concrete Parking Lots, 3.6, 3.7
332.1R—Guide to Residential Concrete Construction, 3.11, 5.4, 6.3
334.1R—Concrete Shell Structures Practice, 7.2
336.3R—Report on Design and Construction of Drilled Piers, 6.5
346—Specification for Cast-in-Place Concrete Pipe, 3.2
Placing drawings

Placing equipment, see also Equipment
  304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 4.2, 8.5, 9.2, 11.4

Plain concrete
  330.1—Specification for Unreinforced Concrete Parking Lots

  318—Building Code Requirements for Structural Concrete, Ch. 14

  446.3R—Finite Element Analysis of Fracture in Concrete Structures, 4.2

Plans, see Specifications

Plastering
  524R—Guide to Portland Cement-Based Plaster

  308R—Guide to Curing Concrete, 3.4

Plastic concrete, see also Rheology, Consolidation, Placing, or Admixtures
  503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

  503.5R—Guide for the Selection of Polymer Adhesives with Concrete, Ch. 6

  224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 1.2

  533R—Guide for Precast Concrete Wall Panels, 7.6

Plastic properties, see Properties

Plastic shotcrete
  506.4R—Guide for the Evaluation of Shotcrete, Ch. 6

Plastic shrinkage, see also Cracks
  305R—Guide to Hot Weather Concreting, Ch. 2

  224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 1.2

  232.3R—Report on High-Volume Fly Ash Concrete for Structural Applications, 3.5

  234R—Guide for the Use of Silica Fume in Concrete, 4.6

  308R—Guide to Curing Concrete, 3.1

Plastics in concrete, see also Polymer concrete
  503.5R—Guide for the Selection of Polymer Adhesives with Concrete

  548.3R—Report on Polymer-Modified Concrete

Pneumatic
  350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures

Pneumatically applied concrete, see Shotcrete

Poisson’s ratio, see also Properties of concrete
  213R—Guide for Structural Lightweight-Aggregate Concrete, 4.7

  228.2R—Nondestructive Test Methods for Evaluation of Concrete in Structures, 2.2

  363R—Report on High-Strength Concrete, 5.4

Polymer adhesives, see also Adhesive or Epoxy adhesive
  440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete

  503.5R—Guide for the Selection of Polymer Adhesives with Concrete

Polymer concrete
  440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures

  440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures

  440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete

  440.4R—Prestressing Concrete Structures with FRP Tendons

  548.1R—Guide for the Use of Polymers in Concrete

  548.3R—Report on Polymer-Modified Concrete

  548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays

  548.5R—Guide for Polymer Concrete Overlays

  548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks
224R—Control of Cracking in Concrete Structures, 5.5
546R—Guide to Concrete Repair, 4.2, 6.4

**Polymer-impregnated concrete**
548.1R—Guide for the Use of Polymers in Concrete, Ch. 3
224R—Control of Cracking in Concrete Structures, 6.4
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 3.11

**Polymer-portland cement concrete, see Polymer concrete**

**Polymer reinforcement, see Fiber-reinforced polymer**

**Polymerization**
548.1R—Guide for the Use of Polymers in Concrete, 3.5
548.3R—Report on Polymer-Modified Concrete, 1.1, 4.2.2.1, 4.3.2.2

**Popouts, see also Surface defects**
201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.18
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 2.1
302.1R—Guide for Concrete Floor and Slab Construction, 11.6

**Portland cement, see Cement**

**Post-tensioning, see also Prestressed concrete**
222.2R—Report on Corrosion of Prestressing Steels
364.8T—Use of Hydrodemolition for Concrete Removal in Unbonded Post-Tensioned Systems
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons
423.7—Specification for Unbonded Single-Strand Tendon Materials
423.9M—Test Method for Bleed Stability of Cementitious Post-Tensioning Tendon Grout
ITG-5.1—Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1
360R—Guide to Design of Slabs-on-Ground, Ch. 9
223R—Guide for the Use of Shrinkage-Compensating Concrete, 5.5, 5.6
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 6.3, 6.7, 6.13

318—Building Code Requirements for Structural Concrete, 25.8, 25.9
347.2R—Guide for Shoring/Reshoring of Concrete Multistory Buildings, 5.2
350—Code Requirements for Environmental Engineering Concrete Structures, 18.13, 18.17, 18.21, 18.22
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 11.4
546R—Guide to Concrete Repair Guide, 7.4
555R—Removal and Reuse of Hardened Concrete, 2.4

**Pouring, see Placing concrete**

**Pozzolans, see also Cementitious materials**
234R—Guide for the Use of Silica Fume in Concrete
207.1R—Guide to Mass Concrete, 2.3
221.1R—Report on Alkali-Aggregate Reactivity, 9.4
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 2.4
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³), 5.2

223.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
533R—Guide for Precast Concrete Wall Panels
533.1R—Design Responsibility for Architectural Precast-Concrete Projects
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures
551.2R—Design Guide for Tilt-Up Concrete Panels
ITG-5.1—Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1
ITG-7—Specification for Tolerances for Precast Concrete
232.2R—Use of Fly Ash in Concrete, Ch. 7
309R—Guide for Consolidation of Concrete, Ch. 12
318—Building Code Requirements for Structural Concrete, 18.9, 26.9
343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 9, Ch. 12
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 16
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 16
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 4.3
Preconstruction planning
551.1R—Guide to Tilt-Up Concrete Construction, Ch. 2
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 5
ITG-4.2—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 8, 17.4

Prediction, see also Service life
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures
209.2R—Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete, Ch. 3
365.1R—Service-Life Prediction, 4.4

Preformed foam, see also Cellular concrete
229R—Controlled Low-Strength Materials, Ch. 8

Preparation, see Surface preparation

Preplaced aggregate concrete, see also Aggregates, preplaced
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, Ch. 5
347R—Guide to Formwork for Concrete, 9.1
546.2R—Guide to Underwater Repair of Concrete, 6.2

Pressures, see also Loads
350.3—Seismic Design of Liquid-Containing Concrete Structures, Ch. 8, 4.1

304.2R—Placing Concrete by Pumping Methods, 3.2
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats, 1.5

Prestressed concrete, see also Post-tensioning
222.2R—Report on Corrosion of Prestressing Steels
232.2R—Use of Fly Ash in Concrete
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons
423.7—Specification for Unbonded Single-Strand Tendon Materials
ITG-7—Specification for Tolerances for Precast Concrete

209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Ch. 4
301—Specifications for Structural Concrete, Sec. 9
318—Building Code Requirements for Structural Concrete, Ch. 24
343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 9
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 18
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 18, App. B, App. G
421.1R—Guide to Shear Reinforcement for Slabs, Ch. 5
435R—Control of Deflection in Concrete Structures, Ch. 3
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 7
440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 7

213R—Guide for Structural Lightweight-Aggregate Concrete, 5.9
224R—Control of Cracking in Concrete Structures, 4.6
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 5.3
334.1R—Concrete Shell Structures Practice, 4.4
347R—Guide to Formwork for Concrete, 9.5
362.2R—Guide for Structural Maintenance of Parking Structures, 4.5
533R—Guide for Precast Concrete Wall Panels, 7.4
555R—Removal and Reuse of Hardened Concrete, 2.4

Prestressed masonry
530—Building Code Requirements for Masonry Structures, Ch. 4

530.1—Specification for Masonry Structures, 2.4, 3.6

Prestressing steel
222R—Protection of Metals in Concrete Against Corrosion
222.2R—Report on Corrosion of Prestressing Steels
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons
301—Specifications for Structural Concrete, Sec. 9
318—Building Code Requirements for Structural Concrete, Ch. 24
343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 9
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 18, 12.9
439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availability, Ch. 6
530—Building Code Requirements for Masonry Structures, Ch. 4

349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures, 4.4
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.10
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 4.9
423.7—Specification for Unbonded Single-Strand Tendon Materials, 8.1

Pretensioned
222.2R—Report on Corrosion of Prestressing Steels, 5.3, 6.3
555R—Removal and Reuse of Hardened Concrete, 2.4

Problems, see Repair

Production
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete

232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, Ch. 4
237R—Self-Consolidating Concrete, Ch. 5
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, Ch. 5, Ch. 6, 4.2
305R—Guide to Hot Weather Concrete, Ch. 3
332—Code Requirements for Residential Concrete, Ch. 5
555R—Removal and Reuse of Hardened Concrete, Ch. 5
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 7
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 11, 17.7

213R—Guide for Structural Lightweight-Aggregate Concrete, 2.2
305.1—Specification for Hot Weather Concreting, 3.4
309R—Guide for Consolidation of Concrete, 12.4

Properties of concrete
122R—Guide to Thermal Properties of Concrete and Masonry Systems
126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database

214R—Guide to Evaluation of Strength Test Results of Concrete
233R—Slag Cement in Concrete and Mortar
234R—Guide for the Use of Silica Fume in Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
546.3R—Guide to Materials Selection for Concrete Repair
555R—Removal and Reuse of Hardened Concrete

207.1R—Guide to Mass Concrete, Ch. 3
207.5R—Report on Roller-Compacted Mass Concrete, Ch. 4
212.3R—Report on Chemical Admixtures for Concrete
213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 4
229R—Controlled Low-Strength Materials, Ch. 4
237R—Self-Consolidating Concrete, Ch. 2, Ch. 3
363R—Report on High-Strength Concrete, Ch. 5
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 5
440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement, Ch. 8
522R—Report on Pervious Concrete, Ch. 4
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, Ch. 3, 4.4
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 4

232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 2.2, 2.3
302.1R—Guide for Concrete Floor and Slab Construction, 6.1
302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, 6.7, 9.5
308R—Guide to Curing Concrete, 1.6
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
345R—Guide for Concrete Highway Bridge Deck Construction, 7.3
350—Code Requirements for Environmental Engineering Concrete Structures, 20.2
408R—Bond and Development of Straight Reinforcing Bars in Tension, 2.3, 6.2
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 7.1
548.3R—Report on Polymer-Modified Concrete, 3.1, 4.1.3, 4.2.2, 4.2.3, 4.4.5, 4.4.6

Proportioning, see Mixture proportioning

Protection during concrete construction
423.7—Specification for Unbonded Single-Strand Tendon Materials

222R—Protection of Metals in Concrete Against Corrosion, Ch. 3
222.2R—Report on Corrosion of Prestressing Steels, Ch. 4
Protection of slope
230.1R—Report on Soil Cement, 3.3

Protective coatings, see also Protective systems
222.2R—Report on Corrosion of Prestressing Steels
345.1R—Guide for Maintenance of Concrete Bridge Members, Ch. 5

222R—Protection of Metals in Concrete Against Corrosion, 3.3, 5.4

222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 5.3
423.7—Specification for Unbonded Single-Strand Tendon Materials, 5.2
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, 6.3

Protective systems
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, Ch. 5
546R—Guide to Concrete Repair, Ch. 6

201.2R—Guide to Durable Concrete, 7.5.5
222.2R—Report on Corrosion of Prestressing Steels, 5.3
332.1R—Guide to Residential Concrete Construction, 3.12, 4.6, 4.7
362.1R—Guide for the Design of Durable Parking Structures, 4.11
362.2R—Guide for Structural Maintenance of Parking Structures, 3.2

Pullout, see Anchorage to concrete

Pulverization
230.1R—Report on Soil Cement, 7.2.1.3, 8.2

Pumpability, see also Workability
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 3.4

Pumped concrete, see also Placing concrete
304.2R—Placing Concrete by Pumping Methods

Pumping
304.2R—Placing Concrete by Pumping Methods
213R—Guide for Structural Lightweight-Aggregate Concrete, 3.7
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 3.2

Punching shear, see Shear reinforcement

Quality assurance, see also Quality control
121R—Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, Ch. 5
232.2R—Use of Fly Ash in Concrete, Ch. 5
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, Ch. 6, 5.1
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, Ch. 6
311.4R—Guide for Concrete Inspection, App. 1
318—Building Code Requirements for Structural Concrete, Ch. 26
506.5R—Guide for Specifying Underground Shotcrete, Ch. 9

212.3R—Report on Chemical Admixtures for Concrete, 4.8, 5.9, 7.8, 8.7, 9.10, 10.7, 11.8, 12.8, 13.8, 15.7
301—Specifications for Structural Concrete, 1.6
303.1—Standard Specification for Cast-In-Place Architectural Concrete, 1.6
308.1—Specification for Curing Concrete, 1.5
330R—Guide for the Design and Construction of Concrete Parking Lots, 6.3
330.1—Specification for Unreinforced Concrete Parking Lots, 1.7
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 1.5
363R—Report on High-Strength Concrete, 4.7
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.1.3
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.1.3
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate, 1.6
503.4—Standard Specification for Repairing Concrete with Epoxy Mortars, 2.1.3
503.7—Specification for Crack Repair by Epoxy Injection, 1.5
506.2—Specification for Shotcrete, 1.6
530—Building Code Requirements for Masonry Structures, 1.19
530.1—Specification for Masonry Structures, 1.6

Quality control, see also Quality assurance, Inspection

121R—Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
214R—Guide to Evaluation of Strength Test Results of Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete
1TG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications

207.5R—Report on Roller-Compacted Mass Concrete, Ch. 7
225R—Guide to the Selection and Use of Hydraulic Cements, Ch. 8

230.1R—Report on Soil Cement, Ch. 8
232.2R—Use of Fly Ash in Concrete, Ch. 5, App.
302.1R—Guide for Concrete Floor and Slab Construction, Ch. 10
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, Ch. 6
309R—Guide for Consolidation of Concrete, Ch. 16
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 5
355.4-10—Acceptance Criteria for Qualification of Post-Installed Adhesive Anchors in Concrete, Ch. 13
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, Ch. 7
506R—Guide to Shotcrete, Ch. 9
522R—Report on Pervious Concrete, Ch. 8

213R—Guide for Structural Lightweight-Aggregate Concrete, 3.8
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 4.5
234R—Guide for the Use of Silica Fume in Concrete, 2.9
301—Specifications for Structural Concrete, 4.1.3, 7.3.3, 9.1.3
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 7.11, 11.7
304.1R—Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, 6.2
304.2R—Placing Concrete by Pumping Methods, 6.2
325.13R—Concrete Overlays for Pavement Rehabilitation, 2.6
330R—Guide for the Design and Construction of Concrete Parking Lots, 6.3
351.2R—Report on Foundations for Static Equipment, 6.8
351.3R—Foundations for Dynamic Equipment, 5.8
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.3
362.1R—Guide for the Design of Durable Parking Structures, 4.14
363R—Report on High-Strength Concrete, 4.8, 7.6
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 6.3
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate, 1.6
506.5R—Guide for Specifying Underground Shotcrete, 12.2
522.1—Specification for Pervious Concrete Pavement, 1.6
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 6.2
530.1—Specification for Masonry Structures, 3.7
548.1R—Guide for the Use of Polymers in Concrete, 5.6
548.5R—Guide for Polymer Concrete Overlays, 6.1

Radiation shielding

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
Radioactive waste, see Hazardous material

Rails, see Guideway

Rate of hydration, see also Heat of hydration

305R—Guide to Hot Weather Concreting, 2.5

Reactions, see also Alkali-aggregate reactivity

225R—Guide to the Selection and Use of Hydraulic Cements, 6.12

Ready mixed concrete, see also Mixing or Mixture proportioning

311.5—Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete

Rebound, see also Shotcrete

506.1R—Guide to Fiber-Reinforced Shotcrete, 7.5

Recycle, reuse

555R—Removal and Reuse of Hardened Concrete

Reinforced concrete, see also Reinforcement – steel or Reinforcement – fiber-reinforced polymer (FRP)

Reinforced masonry

530—Building Code Requirements for Masonry Structures, 2.3

Reinforced slabs, see Slabs

Reinforcement corrosion, see also Corrosion

222R—Protection of Metals in Concrete Against Corrosion

Reinforcement – fiber-reinforced polymer (FRP)

364.1T—Increasing Shear Capacity Within Existing Reinforced Concrete Structures

364.1R—Guide for the Design and Construction of Concrete Structures Reinforced with FRP Bars

Reinforcement – steel

222R—Protection of Metals in Concrete Against Corrosion

222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures
364.2T—Increasing Shear Capacity Within Existing Reinforced Concrete Structures

364.4T—Determining the Load Capacity of a Structure When As-Built Drawings are Unavailable

364.6T—Concrete Removal in Repairs Involving Corroded Reinforcing Steel

408R—Bond and Development of Straight Reinforcing Bars in Tension

408.2R—Bond under Cyclic Loads

408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

421.1R—Guide to Shear Reinforcement for Slabs

423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons

439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availabilitys

ITG-7—Specification for Tolerances for Precast Concrete

301—Specifications for Structural Concrete, Sec. 3

303R—Guide to Cast-in-Place Architectural Concrete Practice, Ch. 5

303.1—Standard Specification for Cast-in-Place Architectural Concrete, Ch. 3

309R—Guide for Consolidation of Concrete, Ch. 18

318—Building Code Requirements for Structural Concrete, 20.2, 25.4, 26.6

343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 13, 3.2

345R—Guide for Concrete Highway Bridge Deck Construction, Ch. 6

349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 7

350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 7, Ch.12, App. F, 3.5, 10.5, 10.6, 10.9, H.4

352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures, Ch. 4

352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, Ch. 5

360R—Guide to Design of Slabs-on-Ground, Ch. 7, 8.3

423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, Ch. 4

441R—High-Strength Concrete Columns, Ch. 2

506.5R—Guide for Specifying Underground Shotcrete, Ch. 17, 5.3

117—Specifications for Tolerances for Concrete Construction and Materials, 2.1, 2.2

201.2R—Guide to Durable Concrete, 7.5

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, 2.3, 2.4.2.2(a), 2.4.2.2(c)

224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 3.5

302.1R—Guide for Concrete Floor and Slab Construction, 5.9

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 5.3

307—Code Requirements for Reinforced Concrete Chimneys, 2.4

313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.4, 4.3, 6.9

330R—Guide for the Design and Construction of Concrete Parking Lots, 3.8

332—Residential Code Requirements for Structural Concrete, 3.2, 8.6

332.1R—Guide to Residential Concrete Construction, 3.10, 4.3

334.1R—Concrete Shell Structures Practice, 4.3

336.1—Specification for the Construction of Drilled Piers, 2.3, 3.4

336.3R—Report on Design and Construction of Drilled Piers, 5.2

349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures, 4.3

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.10, 2.13, 2.14, 6.6

371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 5.2.2.2, 5.3, 7.8.2.2

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.8

435R—Control of Deflection in Concrete Structures, 3.3

437R—Strength Evaluation of Existing Concrete Buildings, 3.2

506R—Guide to Shotcrete, 2.8

506.2—Specification for Shotcrete, 2.3

523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 2.8, 4.5

524R—Guide to Portland Cement-Based Plaster, 7.2

530—Building Code Requirements for Masonry Structures, 1.16

530.1—Specification for Masonry Structures, 2.4

533R—Guide for Precast Concrete Wall Panels, 4.7

543R—Design, Manufacture, and Installation of Concrete Piles, 3.2, 4.3, 5.4

546R—Guide to Concrete Repair, 4.5, 4.6

549.1R—Guide for the Design, Construction, and Repair of Ferrocement, 3.1, 3.2

549R—Report on Ferrocement, 3.3

ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1, 3.3

Reinforcing bars, see Reinforcement — steel and Reinforcement — fiber-reinforced polymer (FRP)

Reinforcing steel, see Reinforcement — steel

Relative alignment, see Tolerances

Removal of concrete, see also Demolition

555R—Removal and Reuse of Hardened Concrete
Removal of forms, see also Formwork
306R—Guide to Cold Weather Concreting, 6.9
308R—Guide to Curing Concrete, 3.3
318—Building Code Requirements for Structural Concrete, 26.11
345R—Guide for Concrete Highway Bridge Deck Construction, 5.4
347R—Guide to Formwork for Concrete, 5.2, 6.2, 7.2, 7.3
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 6.2
350—Code Requirements for Environmental Engineering Concrete Structures, 6.2
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 5.6

Repair
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation
364.3R—Guide for Cementitious Repair Material Data Sheet
364.3T—Treatment of Exposed Epoxy-Coated Reinforcement in Repair
364.5T—Importance of Modulus of Elasticity of Repair Materials
364.6T—Concrete Removal in Repairs Involving Corroded Reinforcing Steel
364.7T—The Evaluation and Minimization of Bruising (Microcracking) in Concrete Repair
364.8T—Use of Hydrodemolition for Concrete Removal in Unbonded Post-Tensioned Systems
364.9T—Cracks in a Repair
503.4—Standard Specification for Repairing Concrete with Epoxy Mortars
503.5R—Guide for the Selection of Polymer Adhesives with Concrete
503.7—Specification for Crack Repair by Epoxy Injection
546R—Guide to Concrete Repair
546.2R—Guide to Underwater Repair of Concrete
546.3R—Guide to Materials Selection for Concrete Repair

548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes, Ch. 4
345.2R—Guide for Widening Highway Bridges, 3.2
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.5
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 5.5
546R—Guide to Concrete Repair, 2.2
546.2R—Guide to Underwater Repair of Concrete, 4.1

Required strength
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, 2.2
307—Code Requirements for Reinforced Concrete Chimneys, 5.3
318—Building Code Requirements for Structural Concrete, 5.3
<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>349</td>
<td>Code Requirements for Nuclear Safety-Related Concrete Structures, 9.2</td>
</tr>
<tr>
<td>350</td>
<td>Code Requirements for Environmental Engineering Concrete Structures, 9.2</td>
</tr>
<tr>
<td>363R</td>
<td>Report on High-Strength Concrete, 3.2</td>
</tr>
<tr>
<td>421.1R</td>
<td>Guide to Shear Reinforcement for Slabs, 4.1</td>
</tr>
<tr>
<td>Reservoir, see Water tanks</td>
<td></td>
</tr>
<tr>
<td>Reshoring, see Formwork</td>
<td></td>
</tr>
<tr>
<td>Residential concrete, see also Slab-on-ground</td>
<td></td>
</tr>
<tr>
<td>332</td>
<td>Residential Code Requirements for Structural Concrete</td>
</tr>
<tr>
<td>332.1R</td>
<td>Guide to Residential Concrete Construction</td>
</tr>
<tr>
<td>Response, see Material response, Structural response</td>
<td></td>
</tr>
<tr>
<td>Responsibility</td>
<td></td>
</tr>
<tr>
<td>533.1R</td>
<td>Design Responsibility for Architectural Precast-Concrete Projects</td>
</tr>
<tr>
<td>121R</td>
<td>Guide for Concrete Construction Quality Systems in Conformance with ISO 9001, Sec. 5</td>
</tr>
<tr>
<td>311.4R</td>
<td>Guide for Concrete Inspection, Ch. 2</td>
</tr>
<tr>
<td>Restoration, see Repair</td>
<td></td>
</tr>
<tr>
<td>Restraint, see also Cracking or Shrinkage-compensating concrete</td>
<td></td>
</tr>
<tr>
<td>207.2R</td>
<td>Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, Ch. 5</td>
</tr>
<tr>
<td>223R</td>
<td>Guide for the Use of Shrinkage-Compensating Concrete, 5.2</td>
</tr>
<tr>
<td>Resurfacing, see also Overlays</td>
<td></td>
</tr>
<tr>
<td>330R</td>
<td>Guide for the Design and Construction of Concrete Parking Lots, 7.6</td>
</tr>
<tr>
<td>Retarding admixtures, see Admixtures</td>
<td></td>
</tr>
<tr>
<td>Retempering, see also Setting time</td>
<td></td>
</tr>
<tr>
<td>305R</td>
<td>Guide to Hot Weather Concreting, 3.6</td>
</tr>
<tr>
<td>Retrofit</td>
<td></td>
</tr>
<tr>
<td>341.3R</td>
<td>Seismic Evaluation and Retrofit Techniques for Concrete Bridges</td>
</tr>
<tr>
<td>369R</td>
<td>Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary</td>
</tr>
<tr>
<td>440R</td>
<td>Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 8</td>
</tr>
<tr>
<td>Rheology</td>
<td></td>
</tr>
<tr>
<td>238.1R</td>
<td>Report on Measurements of Workability and Rheology of Fresh Concrete</td>
</tr>
<tr>
<td>309R</td>
<td>Guide for Consolidation of Concrete, Ch. 2</td>
</tr>
<tr>
<td>309.1R</td>
<td>Report on Behavior of Fresh Concrete During Vibration, Ch. 3</td>
</tr>
<tr>
<td>234R</td>
<td>Guide for the Use of Silica Fume in Concrete, 10.7</td>
</tr>
<tr>
<td>544.5R</td>
<td>Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 3.4</td>
</tr>
<tr>
<td>Roller-compacted concrete, see also Mass concrete</td>
<td></td>
</tr>
<tr>
<td>207.5R</td>
<td>Report on Roller-Compacted Mass Concrete</td>
</tr>
<tr>
<td>325.10R</td>
<td>Report on Roller-Compacted Concrete Pavements</td>
</tr>
<tr>
<td>232.2R</td>
<td>Use of Fly Ash in Concrete, 6.4</td>
</tr>
<tr>
<td>309R</td>
<td>Guide for Consolidation of Concrete, 9.5</td>
</tr>
<tr>
<td>Roofs, see also Slabs</td>
<td></td>
</tr>
<tr>
<td>523.2R</td>
<td>Guide for Precast Cellular Concrete Floor, Roof, and Wall Units</td>
</tr>
<tr>
<td>318</td>
<td>Building Code Requirements for Structural Concrete, Ch. 6, 4.4, 5.3, 18.12, 24.2</td>
</tr>
<tr>
<td>372R</td>
<td>Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.4</td>
</tr>
<tr>
<td>376</td>
<td>Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 6.4, 8.5</td>
</tr>
<tr>
<td>523.4R</td>
<td>Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 5.3, 6.3</td>
</tr>
<tr>
<td>549R</td>
<td>Report on Ferrocement, 6.5</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>364.3R</td>
<td>Guide for Cementitious Repair Material Data Sheet, Ch. 7</td>
</tr>
<tr>
<td>506.5R</td>
<td>Guide for Specifying Underground Shotcrete, Ch. 15</td>
</tr>
<tr>
<td>548.1R</td>
<td>Guide for the Use of Polymers in Concrete, Ch. 6</td>
</tr>
<tr>
<td>304.2R</td>
<td>Placing Concrete by Pumping Methods, 2.7</td>
</tr>
<tr>
<td>318</td>
<td>Building Code Requirements for Structural Concrete, 27.4</td>
</tr>
<tr>
<td>336.3R</td>
<td>Report on Design and Construction of Drilled Piers, 5.5</td>
</tr>
<tr>
<td>347R</td>
<td>Guide to Formwork for Concrete, 4.4, 5.1</td>
</tr>
<tr>
<td>349</td>
<td>Code Requirements for Nuclear Safety-Related Concrete Structures, 20.7</td>
</tr>
<tr>
<td>350</td>
<td>Code Requirements for Environmental Engineering Concrete Structures, 20.7</td>
</tr>
</tbody>
</table>
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 6.6
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 1.3, 5.3
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.3.11
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.3.6
503.4—Standard Specification for Repairing Concrete with Epoxy Mortars, 2.3.6
503.5R—Guide for the Selection of Polymer Adhesives with Concrete, 1.2
503.7—Specification for Crack Repair by Epoxy Injection, 1.7
548.3R—Report on Polymer-Modified Concrete, 4.3.6
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks, 1.7
548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks, 1.7

Safety-related structures
349.3R—Evaluation of Existing Nuclear Safety-Related Concrete Structures

Salt attack
201.2R—Guide to Durable Concrete, 6.3

Sampling, see also Testing
207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, Ch. 4
225R—Guide to the Selection and Use of Hydraulic Cements, Ch. 8
228.1R—In-Place Methods to Estimate Concrete Strength, Ch. 5
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation, Ch. 5, 2.7, 7.5
437R—Strength Evaluation of Existing Concrete Buildings, Ch. 3
440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement, Ch. 11
440.8—Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures, Ch. 9
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 11
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 15, Ch. 16, 17.11, 17.12
212.3R—Report on Chemical Admixtures for Concrete, 3.4
229R—Controlled Low-Strength Materials, 7.2
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 3.5
232.2R—Use of Fly Ash in Concrete, 5.5
311.6—Specification for Ready Mixed Concrete Testing Services, 2.1, 2.2
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.3
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete, 5.3
506.4R—Guide for the Evaluation of Shotcrete, 7.2

Sanitary engineering structures, see Water tanks

Scaling, see also Curing
201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.19
302.1R—Guide for Concrete Floor and Slab Construction, 11.5
364.3R—Guide for Cementitious Repair Material Data Sheet, 5.12
345R—Guide for Concrete Highway Bridge Deck Construction, 1.5
503.7—Specification for Crack Repair by Epoxy Injection, 2.1, 3.3
544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 4.4
546.2R—Guide to Underwater Repair of Concrete, 2.7

Scour
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 5.3

Sealants, see also Joints
345.1R—Guide for Maintenance of Concrete Bridge Members, Ch. 5
224.1R—Causes, Evaluation, and Repair of Cracks in Concrete Structures, 3.3
224.3R—Joints in Concrete Construction, 2.2, 2.6, 2.7
302.1R—Guide for Concrete Floor and Slab Construction, 5.8
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 4.7
330R—Guide for the Design and Construction of Concrete Parking Lots, 7.2
350.2R—Concrete Structures for Containment of Hazardous Materials, 3.2
362.1R—Guide for the Design of Durable Parking Structures, 4.9
362.2R—Guide for Structural Maintenance of Parking Structures, 3.2

Secondary containment, see Containment

Seepage control, see also Watertightness
207.5R—Report on Roller-Compacted Mass Concrete, 5.8

Segregation, see also Consolidation
234R—Guide for the Use of Silica Fume in Concrete, 4.5
Seismic, see also Earthquake requirements and loading

341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems
341.3R—Seismic Evaluation and Retrofit Techniques for Concrete Bridges
350.3—Seismic Design of Liquid-Containing Concrete Structures
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
408.2R—Bond under Cyclic Loads
421.2R—Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications

314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 11
318—Building Code Requirements for Structural Concrete, Ch. 18
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 21
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 21
421.1R—Guide to Shear Reinforcement for Slabs, Ch. 7
SP-17—The Reinforced Concrete Design Manual, Ch. 6

213R—Guide for Structural Lightweight-Aggregate Concrete, 5.14
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, 9.5, 9.6
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 6.6
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 2.5
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 9.2
530—Building Code Requirements for Masonry Structures, 1.18
551.2R—Design Guide for Tilt-Up Concrete Panels, 8.4
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, 10.1

Selection of cements, see also Cement

225R—Guide to the Selection and Use of Hydraulic Cements

Self-consolidating concrete

237R—Self-Consolidating Concrete

212.3R—Report on Chemical Admixtures for Concrete, Ch. 8
309R—Guide for Consolidation of Concrete, Ch. 15
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete, 5.3, 5.4

Serviceability

350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 9
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, Ch. 9
440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 4
318—Building Code Requirements for Structural Concrete, 24.5
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 8.2
347.2R—Guide for Shoring/Reshoring of Concrete Multistory Buildings, 4.4
352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures, 3.4
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 4.3
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 5.1.4, 5.2.1.6.3
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.1
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.8
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 6.2
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 8.3
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 10.2
533R—Guide for Precast Concrete Wall Panels, 2.5
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, 4.4

Service life

365.1R—Service-Life Prediction

Settlement, see also Deformation

224R—Control of Cracking in Concrete Structures, 8.4
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 5.4.4
Setting time, see also Fresh concrete, Curing
212.3R—Report on Chemical Admixtures for Concrete, Ch. 6
233R—Slag Cement in Concrete and Mortar, 4.2
234R—Guide for the Use of Silica Fume in Concrete, 4.4
308R—Guide to Curing Concrete, R1.4, 2.9, 3.1, 3.2, 3.3
309.1R—Report on Behavior of Fresh Concrete During Vibration, 3.1

Sewage treatment, see also Sanitary engineering structures

Shear design, see Shear strength

Shear friction, see also Shear strength
445R—Recent Approaches to Shear Design of Structural Concrete, Ch. 5

Shear reinforcement, see also Shear strength
421.1R—Guide to Shear Reinforcement for Slabs
421.2R—Guide to Seismic Design of Punching Shear Reinforcement in Flat Plates

Shear strength
318—Building Code Requirements for Structural Concrete
364.2T—Increasing Shear Capacity Within Existing Reinforced Concrete Structures
355.3R—Guide for Design of Anchorage of Concrete: Examples using ACI 318 Appendix D
421.1R—Guide to Shear Reinforcement for Slabs
445R—Recent Approaches to Shear Design of Structural Concrete

Shear studs, see Shear reinforcement

Shear transfer
350.3—Seismic Design of Liquid-Containing Concrete Structures, 5.2
445R—Recent Approaches to Shear Design of Structural Concrete, 4.3

Shearheads, see Shear reinforcement

Shear walls, see also Walls
318—Building Code Requirements for Structural Concrete, Ch. 11
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 11, Ch. 14

Sheathing for unbonded post-tensioning, see also Prestressed concrete or Post-tensioning
301—Specifications for Structural Concrete, 9.2.1
318—Building Code Requirements for Structural Concrete, 20.6

ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 6
SP-17—The Reinforced Concrete Design Manual, Ch. 2
207.1R—Guide to Mass Concrete, 3.8
207.5R—Report on Roller-Compacted Mass Concrete, 4.2
213R—Guide for Structural Lightweight-Aggregate Concrete, 5.5
314R—Guide to Simplified Design for Reinforced Concrete Buildings, 5.13, 7.4, 9.5, 10.6, 12.6
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 7.3, 9.4
343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures, 7.3
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, 4.3
506.1R—Guide to Fiber-Reinforced Shotcrete, 7.3
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 7.5, 7.6
530—Building Code Requirements for Masonry Structures, 2.2.5, 2.3.6, 4.6
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 3.3, 3.4
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1, 6.5
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 4.2.2
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 4.2
423.7—Specification for Unbonded Single-Strand Tendon Materials, 5.2, 5.3

Shells
318.2—Code Requirements for Thin Shells and Commentary
334.1R—Concrete Shell Structures Practice
334.3R—Construction of Concrete Shells Using Inflated Forms

349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 19
349.1R—Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures, Ch. 4
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 19

307—Code Requirements for Reinforced Concrete Chimneys, 5.5
308R—Guide to Curing Concrete, 3.4.6
347R—Guide to Formwork for Concrete, 8.4

Short duration, see Impact

Shotcrete
506R—Guide to Shotcrete
506.1R—Guide to Fiber-Reinforced Shotcrete
506.2—Specification for Shotcrete
506.5R—Guide for Specifying Underground Shotcrete

334.3R—Construction of Concrete Shells Using Inflated Forms, Ch. 4

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.2, 5.2
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 6.7, 11.3
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 3.5

Shrinkage, see also Creep
209.2R—Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete
223R—Guide for the Use of Shrinkage-Compensating Concrete

209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Ch. 4, 2.3, 2.4, 2.8, 3.7
209.1R—Report on Factors Affecting Shrinkage and Creep of Hardened Concrete, Ch. 2
212.3R—Report on Chemical Admixtures for Concrete, Ch. 12

224R—Control of Cracking in Concrete Structures, Ch. 3, 8.3, 8.6
305R—Guide to Hot Weather Concreting, Ch. 1, Ch. 2, Ch. 4
360R—Guide to Design of Slabs-on-Ground, Ch. 13
435R—Control of Deflection in Concrete Structures, Ch. 2
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, Ch. 10

213R—Guide for Structural Lightweight-Aggregate Concrete, 4.9, 5.7
230.1R—Report on Soil Cement, 5.6
231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation, 3.2, 3.3, 3.5, 4.2, 5.3
233R—Slag Cement in Concrete and Mortar, 5.4
234R—Guide for the Use of Silica Fume in Concrete, 3.6
318—Building Code Requirements for Structural Concrete, 24.4
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 3.2, 5.4, 13.5
350—Code Requirements for Environmental Engineering Concrete Structures, 7.12
363R—Report on High-Strength Concrete, 5.13
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 3.2
530—Building Code Requirements for Masonry Structures, 1.8
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.6
544.5R—Report on the Physical Properties and Durability of Fiber-Reinforced Concrete, 3.2
549R—Report on Ferrocement, 4.8
555R—Removal and Reuse of Hardened Concrete, 5.4

Shrinkage-compensating concrete, see also Expansive cement
223R—Guide for the Use of Shrinkage-Compensating Concrete

301—Specifications for Structural Concrete, Sec. 10
360R—Guide to Design of Slabs-on-Ground, Ch. 8, App. 5

Sidewalks, see also Slabs-on-ground
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 12

224.3R—Joints in Concrete Construction, 4.2
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 2.2

Silica fume
234R—Guide for the Use of Silica Fume in Concrete

201.2R—Guide to Durable Concrete, 5.4
211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, 3.6, 4.4
221.1R—Report on Alkali-Aggregate Reactivity, 5.6.4
301—Specifications for Structural Concrete, 4.2
Silos, see also Bins
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials

Single-strand tendons, see also Prestressed concrete
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons
423.7—Specification for Unbonded Single-Strand Tendon Materials

Siphons, see Tolerances

Site investigation, see Inspection

Skid resistance
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate

Slab-column connection, see also Column-slab connection
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures

Slab-on-ground
301—Specifications for Structural Concrete
302.1R—Guide for Concrete Floor and Slab Construction
330R—Guide for the Design and Construction of Concrete Parking Lots
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
360R—Guide to Design of Slabs-on-Ground
421.1R—Guide to Shear Reinforcement for Slabs
435.8R—Observed Deflections of Reinforced Concrete Slab Systems, and Causes of Large Deflections

309R—Guide for Consolidation of Concrete, Ch. 10
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 7, Ch. 9
318—Building Code Requirements for Structural Concrete, Ch. 8, 22.6, 24.3,
332.1R—Guide to Residential Concrete Construction, Ch. 5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 13, 10.6, 11.11
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 13, App. H, 10.14, 11.12, 18.12
435R—Control of Deflection in Concrete Structures, Ch. 4
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, Ch. 4
546R—Guide to Concrete Repair, Ch. 4

209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 4.2
223R—Guide for the Use of Shrinkage-Compensating Concrete, 5.3, 5.4, 5.6
232.2R—Use of Fly Ash in Concrete, 7.4
308R—Guide to Curing Concrete, 3.1
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 10.4
363R—Report on High-Strength Concrete, 6.3
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.2, 3.3
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 3.1

Slabs-on-ground
302.1R—Guide for Concrete Floor and Slab Construction
360R—Guide to Design of Slabs-on-Ground

224.3R—Joints in Concrete Construction, Ch. 5
332—Residential Code Requirements for Structural Concrete, Ch. 8
350—Code Requirements for Environmental Engineering Concrete Structures, App. H
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, App. A
551.1R—Guide to Tilt-Up Concrete Construction, Ch. 4, 7.3

Slabs
117—Specifications for Tolerances for Concrete Construction and Materials
223R—Guide for the Use of Shrinkage-Compensating Concrete, 5.4
308R—Guide to Curing Concrete, 3.1
332.1R—Guide to Residential Concrete Construction, 5.1

Slag cement
233R—Slag Cement in Concrete and Mortar

221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, Ch. 1, 5.7

207.1R—Guide to Mass Concrete, 2.3
221.1R—Report on Alkali-Aggregate Reactivity, 5.7
225R—Guide to the Selection and Use of Hydraulic Cements, 4.4
234R—Guide for the Use of Silica Fume in Concrete, 3.8
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 2.4
363R—Report on High-Strength Concrete, 2.4

Sleeves
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 6.3
439.3R—Types of Mechanical Splices for Reinforcing Bars, 1.3, 3.2
530—Building Code Requirements for Masonry Structures, 1.18

Slipform, pavement, see Pavements

Slipform, vertical
117—Specifications for Tolerances for Concrete Construction and Materials, Sec. 7

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 5.4.2.5
308R—Guide to Curing Concrete, 3.4.2

Slope protection
230.1R—Report on Soil Cement, 3.3

Slump, see also Properties of concrete
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 3.2
232.2R—Use of Fly Ash in Concrete, 7.4
232.3R—Report on High-Volume Fly Ash Concrete for Structural Applications, 3.2
233R—Slag Cement in Concrete and Mortar, 4.4
234R—Guide for the Use of Silica Fume in Concrete, 4.3
304.2R—Placing Concrete by Pumping Methods, 4.4
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 5.3, 7.5
305R—Guide to Hot Weather Concreting, 3.5
306R—Guide to Cold Weather Concreting, 2.7
311.6—Specification for Ready Mixed Concrete Testing Services, 2.3.1, 3.3.8
346—Specification for Cast-in-Place Concrete Pipe, 2.1
506.5R—Guide for Specifying Underground Shotcrete, 8.4

Slurry, see also Grout
548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks

336.1—Specification for the Construction of Drilled Piers, 2.6, 3.7
336.3R—Report on Design and Construction of Drilled Piers, 5.4

Soil cement
230.1R—Report on Soil Cement
232.2R—Use of Fly Ash in Concrete, 8.3

Soil cement slurry
229R—Controlled Low-Strength Materials

Soil exploration
336.3R—Report on Design and Construction of Drilled Piers, 3.3, 3.4, 6.3, 6.4, 6.6

Soil mechanics
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats
360R—Guide to Design of Slabs-on-Ground, Ch. 3

Soil properties
302.1R—Guide for Concrete Floor and Slab Construction, 4.1
336.3R—Report on Design and Construction of Drilled Piers, 3.4

Soil stabilization
230.1R—Report on Soil Cement, 2.2
346—Specification for Cast-in-Place Concrete Pipe, 3.1

Soil support
360R—Guide to Design of Slabs-on-Ground, Ch. 3

Soil test
230.1R—Report on Soil Cement, Ch. 8
336.1—Specification for the Construction of Drilled Piers, 1.6
360R—Guide to Design of Slabs-on-Ground, 3.3

Soils
230.1R—Report on Soil Cement, Ch. 4
360R—Guide to Design of Slabs-on-Ground, Ch. 3
Spacing, see Detailing of reinforcement

Spalling, see also Surface defects
- 201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.20
- 345R—Guide for Concrete Highway Bridge Deck Construction, 1.4
- 506.1R—Guide to Fiber-Reinforced Shotcrete, 10.5

Span length
- 349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.9
- 350—Code Requirements for Environmental Engineering Concrete Structures, 8.7

Special inspections
- 311.4R—Guide for Concrete Inspection, 3.3

Specifications
- 212.3R—Report on Chemical Admixtures for Concrete
- 301—Specifications for Structural Concrete
- 303.1—Standard Specification for Cast-in-Place Architectural Concrete
- 305.1—Specification for Hot Weather Concreting
- 306.1—Standard Specification for Cold Weather Concreting
- 308R—Guide to Curing Concrete
- 308.1—Specification for Curing Concrete
- 311.6—Specification for Ready Mixed Concrete Testing Services
- 314R—Guide to Simplified Design for Reinforced Concrete Buildings
- 318—Building Code Requirements for Structural Concrete
- 330.1—Specification for Unreinforced Concrete Parking Lots
- 336.1—Specification for the Construction of Drilled Piers
- 346—Specification for Cast-in-Place Concrete Pipe
- 349—Code Requirements for Nuclear Safety-Related Concrete Structures
- 350—Code Requirements for Environmental Engineering Concrete Structures
- 423.7—Specification for Unbonded Single-Strand Tendon Materials
- 440.5—Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars
- 440.6—Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement
- 503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive
- 503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
- 503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate
- 503.4—Standard Specification for Repairing Concrete with Epoxy Mortars
- 503.7—Specification for Crack Repair by Epoxy Injection
- 506.2—Specification for Shotcrete
- 522.1—Specification for Pervious Concrete Pavement
- 530—Building Code Requirements for Masonry Structures
- 530.1—Specification for Masonry Structures
- 548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks
- 548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks
- 548.10—Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks
- ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications
- ITG-7—Specification for Tolerances for Precast Concrete
- 232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, Ch. 3
- 232.2R—Use of Fly Ash in Concrete, Ch. 5
- 234R—Guide for the Use of Silica Fume in Concrete, Ch. 7
- 439.3R—Types of Mechanical Splices for Reinforcing Bars, Ch. 2
- 126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, 11.2
- 213R—Guide for Structural Lightweight-Aggregate Concrete, 5.13
- 233R—Slag Cement in Concrete and Mortar, 1.8
- 303R—Guide to Cast-in-Place Architectural Concrete Practice, 2.5
- 304.4R—Placing Concrete with Belt Conveyors, 2.7
- 306R—Guide to Cold Weather Concreting, 1.2
- 309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 2.1
- 313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 1.4
- 325.11R—Accelerated Techniques for Concrete Paving, 3.4
- 330R—Guide for the Design and Construction of Concrete Parking Lots, 4.6
- 343R—Analysis and Design of Reinforced Concrete Bridge Structures, 3.4
- 371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 1.3
- 440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 14.2
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 12.2
548.3R—Polymer-Modified Concrete, 3.5

**Spillways**

210R—Erosion of Concrete in Hydraulic Structures

207.5R—Report on Roller-Compacted Mass Concrete, 5.9

**Spiral reinforcement, see Detailing of reinforcement**

**Splice length**

408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

318—Building Code Requirements for Structural Concrete, Ch. 25
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 12
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 12

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 6.8, 13.2

**Splices, see also Reinforcement – steel**

408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension

439.3R—Types of Mechanical Splices for Reinforcing Bars

318—Building Code Requirements for Structural Concrete, Ch. 25
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 12
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, Ch. 11
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, Ch. 5
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 7

350—Code Requirements for Environmental Engineering Concrete Structures, 12.14 through 12.19
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 6.8, 13.2
530—Building Code Requirements for Masonry Structures, 1.13
543R—Design, Manufacture, and Installation of Concrete Piles, 3.7

**Splitting strength, see Strength**

**Stability**

225R—Guide to the Selection and Use of Hydraulic Cements
357.2R—Report on Floating and Float-In Concrete Structures
530—Building Code Requirements for Masonry Structures

334.1R—Concrete Shell Structures Practice, Ch. 5
350.4R—Design Considerations for Environmental Engineering Concrete Structures, Ch. 3

207.5R—Report on Roller-Compacted Mass Concrete, 5.4
351.2R—Report on Foundations for Static Equipment, 4.4
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 5.2, 6.2

**Stacking tubes**

313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials

**Static equipment**

350.2R—Concrete Structures for Containment of Hazardous Materials
351.2R—Report on Foundations for Static Equipment

**Statistical analysis**

214R—Guide to Evaluation of Strength Test Results of Concrete

209.2R—Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete, App. B, 3.2
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results, Ch. 6, 7.3
228.1R—In-Place Methods to Estimate Concrete Strength, Ch. 3, 6.2
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete, Ch. 6

121R—Guide for Concrete Construction Quality Systems in Conformance with ISO 9001, 8.4
408R—Bond and Development of Straight Reinforcing Bars in Tension, 4.5

**Steam curing, see also Accelerated curing**

308R—Guide to Curing Concrete, 2.6, 2.7

**Steel bars**

ITG-6R—Design Guide for the Use of ASTM A1035/ A1035M Grade 100 (690) Steel Bars for Structural Concrete

**Steel reinforcement, see Reinforcement – steel**

**Stiffness**

318—Building Code Requirements for Structural Concrete
349—Code Requirements for Nuclear Safety-Related Concrete Structures
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery
530—Building Code Requirements for Masonry Structures
224.2R—Cracking of Concrete Members in Direct Tension, 4.1
350—Code Requirements for Environmental Engineering Concrete Structures, 8.6
351.2R—Report on Foundations for Static Equipment, 4.3
551.2R—Design Guide for Tilt-Up Concrete Panels, 3.2

Stilling basin
210R—Erosion of Concrete in Hydraulic Structures, 3.2

Stirrups, see also Shear reinforcement
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 9.3

Storage
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 2
364.3R—Guide for Cementitious Repair Material Data Sheet, Ch. 6

212.3R—Report on Chemical Admixtures for Concrete, 4.10, 5.11, 6.10, 7.9, 8.9, 9.12, 10.9, 11.10, 12.9, 13.9, 14.7, 15.9, 16.7
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 7.6
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 4.1
222.2R—Use of Fly Ash in Concrete, 6.8
233R—Slag Cement in Concrete and Mortar, 2.1
303.1—Standard Specification for Cast-in-Place Architectural Concrete, 1.7
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, 3.1
318—Building Code Requirements for Structural Concrete, 26.5
330.1—Specification for Unreinforced Concrete Parking Lots, 1.5
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 3.7
350—Code Requirements for Environmental Engineering Concrete Structures, 3.7
363R—Report on High-Strength Concrete, 4.2.1
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 4.4
423.7—Specification for Unbonded Single-Strand Tendon Materials, 13.2
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, 6.1
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 5.2

440.5—Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars, 1.5
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 4.2
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.1.4
503.2—Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.1.4
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate, 1.7.2
503.4—Standard Specification for Repairing Concrete with Epoxy Mortars, 2.1.4
503.7—Specification for Crack Repair by Epoxy Injection, 1.6
506R—Guide to Shotcrete, 2.2
506.2—Specification for Shotcrete, 2.10
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 5.1
533R—Guide for Precast Concrete Wall Panels, 5.8, 6.3
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 3.4
548.8—Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks, 1.6
548.9—Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks, 1.6

Storage tanks, see also Water tanks
350.3—Seismic Design of Liquid-Containing Concrete Structures
549R—Report on Ferrocement, 6.4

Strain, see also Creep or Deflection
363R—Report on High-Strength Concrete
364.5T—Importance of Modulus of Elasticity of Repair Materials
435R—Control of Deflection in Concrete Structures
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 3.7
207.5R—Report on Roller-Compacted Mass Concrete, 4.8
224R—Control of Cracking in Concrete Structures, 7.3

Streaking, see Surface defects

Strength, see also Compressive strength
214R—Guide to Evaluation of Strength Test Results of Concrete
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete
225R—Guide to the Selection and Use of Hydraulic Cements
228.1R—In-Place Methods to Estimate Concrete Strength Convertion, 3.18—Building Code Requirements for Structural Concrete
349—Code Requirements for Nuclear Safety-Related Concrete Structures
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery
352R—Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures
437R—Strength Evaluation of Existing Concrete Buildings
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
549.1R—Guide for the Design, Construction, and Repair of Ferrocement

211.5R—Guide for Submittal of Concrete Proportions, Ch. 5
306R—Guide to Cold Weather Concreting, Ch. 9
325.10R—Report on Roller-Compacted Concrete Pavements, Ch. 5
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 9, Ch. 20, 5.4, 10.17, 16.10, 19.3, D.4
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, Ch. 4

207.1R—Guide to Mass Concrete, 3.2
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 3.2
207.5R—Report on Roller-Compacted Mass Concrete, 4.2
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, 2.2
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.10
233R—Slag Cement in Concrete and Mortar, 5.1
308R—Guide to Curing Concrete, 2.6
309R—Guide for Consolidation of Concrete, 17.1
309.5R—Compaction of Roller-Compacted Concrete, 3.2, 6.5
325.11R—Accelerated Techniques for Concrete Paving, 7.1
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
330R—Guide for the Design and Construction of Concrete Parking Lots, 4.2
346—Specification for Cast-in-Place Concrete Pipe, 2.1
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, 4.5
363R—Report on High-Strength Concrete, 4.9, 5.6
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 4.1.2.2.2

372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.1
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, 6.1
549R—Report on Ferrocement, 4.2, 4.3
555R—Removal and Reuse of Hardened Concrete, 5.4
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1, 4.2

Strength design
318—Building Code Requirements for Structural Concrete
349—Code Requirements for Nuclear Safety-Related Concrete Structures
350—Code Requirements for Environmental Engineering Concrete Structures
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons

213R—Guide for Structural Lightweight-Aggregate Concrete, Ch. 5, 4.13
307—Code Requirements for Reinforced Concrete Chimneys, Ch. 5
343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 7
421.1R—Guide to Shear Reinforcement for Slabs, Ch. 4
530—Building Code Requirements for Masonry Structures, Ch. 3

336.3R—Report Design and Construction of Drilled Piers, 4.3
440.4R—Prestressing Concrete Structures with FRP Tendons, 3.2
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, 4.11

Strength of early-age concrete
347.2R—Guide for Shoring/Reshoring of Concrete Multistory Buildings, Ch. 4

Strength evaluation, see also Testing or Evaluation
437R—Strength Evaluation of Existing Concrete Buildings

318—Building Code Requirements for Structural Concrete, Ch. 27
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 20, 16.10
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 20, 16.10

214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results, 4.2
Strengthening
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures

440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 8, 10.2, 10.3

Stress
224.2R—Cracking of Concrete Members in Direct Tension
318—Building Code Requirements for Structural Concrete
351.2R—Report on Foundations for Static Equipment
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures
363R—Report on High-Strength Concrete
364.5T—Importance of Modulus of Elasticity of Repair Materials
408.2R—Bond under Cyclic Loads
530—Building Code Requirements for Masonry Structures
543R—Design, Manufacture, and Installation of Concrete Piles

307—Code Requirements for Reinforced Concrete Chimneys, Ch. 6

350.3—Seismic Design of Liquid-Containing Concrete Structures, Ch. 6

207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, 3.4
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.5
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 3.3
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 4.3

Stress relaxation
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 5.3, 5.4

Stress-strain relationship, see also Modulus of elasticity
445R—Recent Approaches to Shear Design of Structural Concrete, 2.3

Structural analysis
318—Building Code Requirements for Structural Concrete
341.2R—Report on Seismic Analysis and Design of Seismic-Resistant Concrete Bridge Systems
343R—Analysis and Design of Reinforced Concrete Bridge Structures
350—Code Requirements for Environmental Engineering Concrete Structures
530—Building Code Requirements for Masonry Structures

336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats, Ch. 3

370R—Report for the Design of Concrete Structures for Blast Effects, Ch. 8
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, Ch. 5
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 4.1
550.1R—Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures, 3.3

Structural design, see also Design factors
307—Code Requirements for Reinforced Concrete Chimneys
318—Building Code Requirements for Structural Concrete
330R—Guide for the Design and Construction of Concrete Parking Lots
336.2R—Suggested Analysis and Design Procedures for Combined Footings and Mats
336.3R—Report on Design and Construction of Drilled Piers
341.2R—Report on Analysis and Design of Seismic-Resistant Concrete Bridge Systems
343R—Analysis and Design of Reinforced Concrete Bridge Structures
349—Code Requirements for Nuclear Safety-Related Concrete Structures
349.2R—Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples
350—Code Requirements for Environmental Engineering Concrete Structures
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
350.3—Seismic Design of Liquid-Containing Concrete Structures
352.1R—Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures
357.2R—Report on Floating and Float-In Concrete Structures
360R—Guide to Design of Slabs-on-Ground
362.1R—Guide for the Design of Durable Parking Structures
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
530—Building Code Requirements for Masonry Structures
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete
549.1R—Guide for the Design, Construction, and Repair of Ferrocement
347R—Guide to Formwork for Concrete, Ch. 4
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, Ch. 4
533.1R—Design Responsibility for Architectural Precast-Concrete Projects, 2.2
Structural diaphragms, see also Lateral-force resisting system
318—Building Code Requirements for Structural Concrete, 18.12

Structural drawings, see Detailing of reinforcement

Structural integrity
318—Building Code Requirements for Structural Concrete, Ch. 23

Structural modeling, see Modeling

Structural plain concrete, see Plain concrete

Structural response
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, Ch. 3

Structural system
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 3

Structural walls, see Walls

Strut-and-tie models, see also Shear design
318—Building Code Requirements for Structural Concrete, Ch. 23
445R—Recent Approaches to Shear Design of Structural Concrete, Ch. 6
SP-17—The Reinforced Concrete Design Manual, Ch. 8

Stucco, see also Plastering
308R—Guide to Curing Concrete, 3.4.5

Studs, see also Slab reinforcement
349.2R—Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples, App. A

Styrene-butadiene latex, see also Polymer concrete
548.4—Standard Specification for Latex-Modified Concrete (LMC) Overlays

224R—Control of Cracking in Concrete Structures, 6.3
548.3R—Report on Polymer-Modified Concrete, 4.1

Subbase, see also Pavements
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.1
332—Residential Code Requirements for Structural Concrete, 8.2
360R—Guide to Design of Slabs-on-Ground, 3.3
522.1—Specification for Pervious Concrete Pavement, 2.1, 3.2

Subgrades, see also Pavements

Substructures, see also Bridges
343R—Analysis and Design of Reinforced Concrete Bridge Structures, Ch. 11, 12.4
345.1R—Guide for Maintenance of Concrete Bridge Members, 3.5
345.2R—Guide for Widening Highway Bridges, 3.7

Subsurface conditions, see also Subbase
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 6.2.5, 6.3.3
351.2R—Report on Foundations for Static Equipment, 6.1
351.3R—Foundations for Dynamic Equipment, 5.1

Sulfate attack, see also Durability
201.2R—Guide to Durable Concrete, App. A, 6.2

232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 2.3.2
233R—Slag Cement in Concrete and Mortar, 5.9
234R—Guide for the Use of Silica Fume in Concrete, 10.3

Sulfate exposure, see also Durability
318—Building Code Requirements for Structural Concrete, Ch. 19

349—Code Requirements for Nuclear Safety-Related Concrete Structures, 4.5
350—Code Requirements for Environmental Engineering Concrete Structures, 4.3
Sump construction

350.2R—Concrete Structures for Containment of Hazardous Materials, 4.1

Superstructures, see also Bridges

341.2R—Report on Analysis and Design of Seismic-Resistant Concrete Bridge Systems, 6.2
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 6.5, 10.2, 10.3, 12.2
345.1R—Guide for Maintenance of Concrete Bridge Members, 3.4

Surface defects, see also Abrasion or Chemical attack

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service
309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces
302.1R—Guide for Concrete Floor and Slab Construction, Ch. 11
308R—Guide to Curing Concrete, 3.4.8
309R—Guide for Consolidation of Concrete, 7.7
345R—Guide for Concrete Highway Bridge Deck Construction, 10.7
524R—Guide to Portland Cement-Based Plaster, 15.5
533R—Guide for Precast Concrete Wall Panels, 7.2
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, 6.2

Surface finish

302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, 9.6

Surface preparation, see also Repair or Overlays

364.6T—Concrete Removal in Repairs Involving Corroded Reinforcing Steel
364.7T—The Evaluation and Minimization of Bruising (Microcracking) in Concrete Repair
548.11—Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes
548.13—Specification for Bonding Fresh Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive
347.3R—Guide to Formed Concrete Surfaces, Ch. 7
506.5R—Guide for Specifying Underground Shotcrete, Ch. 16
548.5R—Guide for Polymer Concrete Overlays, Ch. 4
555R—Removal and Reuse of Hardened Concrete, Ch. 4
302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, 9.8
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 5.4
440.8—Specification for Carbon and Glass Fiber-Reinforced Polymer (FRP) Materials Made by Wet Layup for External Strengthening of Concrete and Masonry Structures
503.1—Standard Specification for Bonding Hardened Concrete Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, 2.3
503.3—Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Epoxy and Aggregate, 3.1
506R—Guide to Shotcrete, 5.2
506.2—Specification for Shotcrete, 3.3
506.5R—Guide for Specifying Underground Shotcrete, 16.3
546R—Concrete Repair Guide, 2.3
546.2R—Guide to Underwater Repair of Concrete, 4.2
548.3R—Report on Polymer-Modified Concrete, 4.3.2
551.1R—Guide to Tilt-Up Concrete Construction, 8.1

Surveys, see also Testing, Evaluation

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 7.2
437R—Strength Evaluation of Existing Concrete Buildings, 2.2

Sustainability

231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation

Synthetic fibers, see also Fiber-reinforced concrete

440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
357.3R—Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, Ch. 6
544.1R—Report on Fiber-Reinforced Concrete, Ch. 4
506.1R—Guide to Fiber-Reinforced Shotcrete, 3.2

Tanks, see also Water tanks

350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
350.3—Seismic Design of Liquid-Containing Concrete Structures
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases
549R—Report on Ferrocement, 6.4

American Concrete Institute – Copyrighted © Material – www.concrete.org
T-beams, see also Flexural member
318—Building Code Requirements for Structural Concrete, 6.3
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 8.12

Temperature, see also Cooling or Insulating
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures
305R—Guide to Hot Weather Concreting
306R—Guide to Cold Weather Concreting
306.1—Standard Specification for Cold Weather Concreting
349—Code Requirements for Nuclear Safety-Related Concrete Structures, App. E
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, Ch. 10, A.2
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 8
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 2, 17.8

207.1R—Guide to Mass Concrete, 1.3, 2.8, 4.7
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 4.3, 4.4, 4.5
207.5R—Report on Roller-Compact Mass Concrete, 5.4.2
207.5R—Report on Measurements of Workability and Rheology of Fresh Concrete, 4.8
207.8R—Specifications for Structural Concrete, 5.3.2
201.2R—Guide for Concrete Floor and Slab Construction, 9.9

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 4.6
305.1—Specification for Hot Weather Concreting, 3.2
308R—Guide to Curing Concrete, 1.3, 4.5, 4.7
325.11R—Accelerated Techniques for Concrete Paving, 5.2
332.1R—Guide to Residential Concrete Construction, 6.5, 6.6
350—Code Requirements for Environmental Engineering Concrete Structures, 7.12
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 7.2
435R—Control of Deflection in Concrete Structures, 2.7
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.2, 6.2
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, 5.2
506.5R—Guide for Specifying Underground Shotcrete, 6.2

Temperature effects, analysis and design
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, Ch. 1, Ch. 2
224.3R—Joints in Concrete Construction, App. A
307—Code Requirements for Reinforced Concrete Chimneys, App. A
360R—Guide to Design of Slabs-on-Ground, Ch. 12
551.2R—Design Guide for Tilt-Up Concrete Panels, Ch. 5

Temporary loads, see Construction loads

Tendon, post-tensioning
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons
423.7—Specification for Unbonded Single-Strand Tendon Materials
423.8R—Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems
423.9M—Test Method for Bleed Stability of Cementitious Post-Tensioning Tendon Grout
301—Specifications for Structural Concrete, Sec. 9
530—Building Code Requirements for Masonry Structures, Ch. 4
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 6.4 through 6.7
318—Building Code Requirements for Structural Concrete, 4.12, 18.11
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.17
350—Code Requirements for Environmental Engineering Concrete Structures, 18.13
357—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.7
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.3, 4.7
440.3R—Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, B.3

Tendon tanks, see Water tanks

Tensile strength
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 3.3
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.10, 5.4
224.2R—Cracking of Concrete Members in Direct Tension, 3.2
Tension, see also Tensile strength
364.5T—Importance of Modulus of Elasticity of Repair Materials
408R—Bond and Development of Straight Reinforcing Bars in Tension
408.3R—Guide for Lap Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension
355.3R—Guide for Design of Anchorage of Concrete: Examples using ACI 318 Appendix D

Terminology

Test method, see also Testing
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
364.3R—Guide for Cementitious Repair Material Data Sheet
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing

Test method, see also Testing
214.4R—Guide for Obtaining Cores and Interpreting Compressive Strength Results
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
364.3R—Guide for Cementitious Repair Material Data Sheet
374.1—Acceptance Criteria for Moment Frames Based on Structural Testing
302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, Ch. 3, Ch. 4, 9.2
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, Ch. 6
304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, Ch. 6, App. A
305R—Guide to Hot Weather Concreting, Ch. 5
309R—Guide for Consolidation of Concrete, Ch. 17
311.4R—Guide for Concrete Inspection, App. I, 3.7
311.5—Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete, Ch. 2
318—Building Code Requirements for Structural Concrete, Ch. 27
325.10R—Report on Roller-Compacted Concrete Pavements, Ch. 8, 4.4
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, Ch. 4
355.2—Qualification of Post-Installed Mechanical Anchors in Concrete, Ch. 5, 7, 8, 9, 12, App. A3
355.4-10—Acceptance Criteria for Qualification of Post-Installed Adhesive Anchors in Concrete, Ch. 6 through 9
363.2R—Guide to Quality Control and Assurance of High-Strength Concrete, Ch. 5, Ch. 6
364.1R—Guide for Evaluation of Concrete Structures before Rehabilitation, Ch. 5, 2.7, 7.5
408R—Bond and Development of Straight Reinforcing Bars in Tension, Ch. 6
423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, Ch. 5
423.7—Specification for Unbonded Single-Strand Tendon Materials, Ch. 10
437R—Strength Evaluation of Existing Concrete Buildings, Ch. 3, 5.2
440R—Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, Ch. 5
440.1R—Guide for the Design and Construction of Concrete Reinforced with FRP Bars, Ch. 5
506.5R—Guide for Specifying Underground Shotcrete, Ch. 10, Ch. 11, 8.9
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, Ch. 6
522R—Report on Pervious Concrete, Ch. 8
524R—Guide to Portland Cement-Based Plaster, Ch. 14
549.1R—Guide for the Design, Construction, and Repair of Ferrocement, Ch. 7
ITG-4.1—Specification for High-Strength Concrete in Moderate to High Seismic Applications, Sec. 11
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 15, Ch. 16, 17.11, 17.12
201.2R—Guide to Durable Concrete, 5.4, 6.2
210R—Erosion of Concrete in Hydraulic Structures, 5.6
232.1R—Use of Raw or Processed Natural Pozzolans in Concrete, 3.5

301—Specifications for Structural Concrete, 1.6
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 8.4
304.2R—Placing Concrete by Pumping Methods, 4.9
304.4R—Placing Concrete with Belt Conveyors, 5.2
306R—Guide to Cold Weather Concreting, 6.2, 6.3
307—Code Requirements for Reinforced Concrete Chimneys, 3.3
308R—Guide to Curing Concrete, 2.9
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.3, 5.7
330.1—Specification for Unreinforced Concrete Parking Lots, 1.6
332.1R—Guide to Residential Concrete Construction, 2.6
346—Specification for Cast-in-Place Concrete Pipe, 3.4
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 3.1, 20.3
350—Code Requirements for Environmental Engineering Concrete Structures, 3.1, 20.3
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 2.2
360R—Guide to Design of Slabs-on-Ground, 3.7
363R—Report on High-Strength Concrete, 3.3
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 6.1, 6.4
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 12.2, 12.3
437.2—Code Requirements for Load Testing of Existing Concrete Structures and Commentary, 4.2
439.4R—Report on Steel Reinforcement—Material Properties and U.S. Availabilities, 3.5
506R—Guide to Shotcrete, 9.8
506.4R—Guide for the Evaluation of Shotcrete, 2.2, 2.3, 7.3
533R—Guide for Precast Concrete Wall Panels, 7.6, 7.7
546.2R—Guide to Underwater Repair of Concrete, 3.5
546.3R—Guide to Materials Selection for Concrete Repair, A.1, A.2
555R—Removal and Reuse of Hardened Concrete, 2.2

Texture, see also Pavements
303R—Guide to Cast-in-Place Architectural Concrete Practice, 4.6
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 2.2
330R—Guide for the Design and Construction of Concrete Parking Lots, 5.5
330.1—Specification for Unreinforced Concrete Parking Lots, 3.9
345R—Guide for Concrete Highway Bridge Deck Construction, 1.2, 2.7, 10.6
524R—Guide to Portland Cement-Based Plaster, 12.3

Thermal effects, see also Temperature
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
349.1R—Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures

307—Code Requirements for Reinforced Concrete CHIMNEYS, Ch. 6
349—Code Requirements for Nuclear Safety-Related Concrete Structures, App. E

213R—Guide for Structural Lightweight-Aggregate Concrete, 5.10
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 5.4.4, 8.8
360R—Guide to Design of Slabs-on-Ground, 13.2
364.3R—Guide for Cementitious Repair Material Data Sheet, 5.10
522.1—Specification for Pervious Concrete Pavement, 3.7
530—Building Code Requirements for Masonry Structures, 1.8.3

Thermal properties, see also Properties of concrete
122R—Guide to Thermal Properties of Concrete and Masonry Systems
523.3R—Guide for Cellular Concretes above 50 lb/ft³ (800 kg/m³)
207.1R—Guide to Mass Concrete, 3.7
207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, 3.5
207.5R—Report on Roller-Compacted Mass Concrete, 4.7
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.17, 4.18
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 2.4
231R—Report on Early-Age Cracking: Causes, Measurement, and Mitigation, 3.1, 4.5
363R—Report on High-Strength Concrete, 5.9
440.2R—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, 4.2
523.1R—Guide for Cast-in-Place Low-Density Cellular Concrete, 3.5, 3.8
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 3.3

Thickness, see also Design factors, Deflections
216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, App. A through C, 3.2, 4.2
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, Ch. 3

117—Specifications for Tolerances for Concrete Construction and Materials, 13.3

330R—Guide for the Design and Construction of Concrete Parking Lots, 3.6
345R—Guide for Concrete Highway Bridge Deck Construction, 2.3
350—Code Requirements for Environmental Engineering Concrete Structures, 14.6, H.3
360R—Guide to Design of Slabs-on-Ground, 6.2, 7.2, 8.2
435R—Control of Deflection in Concrete Structures, 4.4
530—Building Code Requirements for Masonry Structures, 5.6

Thin reinforced cement products, see Ferrocement
Thin shells, see Shells

Thixotropy
238.2T—Concrete Thixotropy

Tilt-up construction
551.1R—Guide to Tilt-Up Concrete Construction
551.2R—Design Guide for Tilt-Up Concrete Panels

Ties, see Anchor ties or Forms

Tolerances
117—Specifications for Tolerances for Concrete Construction and Materials
302.1R—Guide for Concrete Floor and Slab Construction

421.1R—Guide to Shear Reinforcement for Slabs, Ch. 6

210R—Erosion of Concrete in Hydraulic Structures, 5.2
230.1R—Report on Soil Cement, 8.7
301—Specifications for Structural Concrete, 1.7
307—Code Requirements for Reinforced Concrete CHIMNEYS, 3.8
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 3.9, 5.4, 6.14
318—Building Code Requirements for Structural Concrete, 26.6
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 3.2
330.1—Specification for Unreinforced Concrete Parking Lots, 3.10
332.1R—Guide to Residential Concrete Construction, 3.6
334.3R—Construction of Concrete Shells Using Inflated Forms, 3.7, 4.18
336.1—Specification for the Construction of Drilled Piers, 3.1
346—Specification for Cast-in-Place Concrete Pipe, 3.2
347R—Guide to Formwork for Concrete, 5.3
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 5.5
351.2R—Report on Foundations for Static Equipment, 6.2
362.1R—Guide for the Design of Durable Parking Structures, 4.3, 4.4
Tracks, see Guideways

Traffic

325.11R—Accelerated Techniques for Concrete Paving, Ch. 7
325.12R—Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, 3.2

Training, see Certification

Transit, see Guideways

Transporting concrete, see also Conveying

304.2R—Placing Concrete by Pumping Methods
304.3R—Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing

229R—Controlled Low-Strength Materials, Ch. 6
237R—Self-Consolidating Concrete, Ch. 6, 6.2
304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, Ch. 4

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, 11.7
207.5R—Report on Roller-Compacted Mass Concrete, 6.4
213R—Guide for Structural Lightweight-Aggregate Concrete, 3.5
222.3R—Guide to Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, 4.1
234R—Guide for the Use of Silica Fume in Concrete, 9.1, 9.3
302.1R—Guide for Concrete Floor and Slab Construction, 7.3
311.6—Specification for Ready Mixed Concrete Testing Services, 2.5.2
325.10R—Report on Roller-Compacted Concrete Pavements, 7.3
330.1—Specification for Unreinforced Concrete Parking Lots, 3.5
345R—Guide for Concrete Highway Bridge Deck Construction, 9.2
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 16.9
363R—Report on High-Strength Concrete, 4.4
543R—Design, Manufacture, and Installation of Concrete Piles, 4.5
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 7.3
ITG-4.2R—Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, 8.2

Tremie concrete, see also Placing concrete

304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete, 8.5
546.2R—Guide to Underwater Repair of Concrete, 6.3

Toughness, see also Properties

544.2R—Measurement of Properties of Fiber-Reinforced Concrete

374.1—Acceptance Criteria for Moment Frames Based on Structural Testing, 2.6
544.4R—Design Considerations for Steel Fiber-Reinforced Concrete, 2.5

Tower, see Cooling tower

Towing

357.2R—Report on Floating and Float-In Concrete Structures, Ch. 7

357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, 6.10

371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 4.1.6
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 5.6
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 11.2
506R—Guide to Shotcrete, 8.7
506.2—Specification for Shotcrete, 3.12
522.1—Specification for Pervious Concrete Pavement, 3.9
523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, 5.3
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels, 3.4
530.1—Specification for Masonry Structures, 3.3
533R—Guide for Precast Concrete Wall Panels, 3.3
ITG-7—Specification for Tolerances for Precast Concrete, 2.2, 3.2, 4.2, 5.2

Torsion, see also Shear strength

318—Building Code Requirements for Structural Concrete, Ch. 22
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 11

343R—Analysis and Design of Reinforced Concrete Bridge Structures, 9.15
343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures, 7.3
349—Code Requirements for Nuclear Safety-Related Concrete Structures, 11.6
369R—Guide for Seismic Rehabilitation of Existing Concrete Frame Buildings and Commentary, 3.4
Trench backfill, see also Controlled low-strength materials
   229R—Controlled Low-Strength Materials, 2.2, 6.4
   346—Specification for Cast-in-Place Concrete Pipe, 3.1

Troubleshooting, see Repair

Truck-mounted pumps, see also Pumping
   304.2R—Placing Concrete by Pumping Methods, 2.4

Truss model, see also Strut-and-tie models
   445R—Recent Approaches to Shear Design of Structural Concrete, Ch. 3, 2.5

Tunnels
   224R—Control of Cracking in Concrete Structures, Ch. 7
   210R—Erosion of Concrete in Hydraulic Structures, 3.4
   309R—Guide for Consolidation of Concrete, 8.5

Two-way slabs, see also Slabs
   421.1R—Guide to Shear Reinforcement for Slabs
   224.4R—Guide to Design Detailing to Mitigate Cracking, Ch. 4
   318—Building Code Requirements for Structural Concrete, Ch. 8
   350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 13
   209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 2.7
   347.2R—Guide for Shoring/Reshoring of Concrete Multistory Buildings, 5.1
   ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, 6.3

Ultimate strength, see also Strength design, Structural design
   213R—Guide for Structural Lightweight-Aggregate Concrete, 4.13

Unbonded prestressing, see also Prestressing, Post-tensioning
   423.7—Specification for Unbonded Single-Strand Tendon Materials
   440.4R—Prestressing Concrete Structures with FRP Tendons, Ch. 7
   222.2R—Report on Corrosion of Prestressing Steels, 5.2
   423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 2.3
   423.4R—Corrosion and Repair of Unbonded Single-Strand Tendons, 3.4

Underwater repair, see also Repair
   546.2R—Guide to Underwater Repair of Concrete
   546R—Guide to Concrete Repair, 3.2.10
   548.1R—Guide for the Use of Polymers in Concrete, 3.7.5.6

Unreinforced concrete
   360R—Guide to Design of Slabs-on-Ground, Ch. 6

Unreinforced masonry
   530—Building Code Requirements for Masonry Structures, 2.2

Vapor retarder/barrier
   302.2R—Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, Ch. 7, 9.3

Vehicle loads, see Loads

Veneers
   530—Building Code Requirements for Masonry Structures, Ch. 6

Vertical alignment, see Tolerances

Vertical clearance, see Tolerances

Vibration, see also Consolidation
   309R—Guide for Consolidation of Concrete
   343.1R—Guide for the Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures
   309.1R—Report on Behavior of Fresh Concrete During Vibration, Ch. 4
   309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, Ch. 4
   207.3R—Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, 3.3
   210R—Erosion of Concrete in Hydraulic Structures, 5.4
   345.2R—Guide for Widening Highway Bridges, 3.4

Vibration frequency
   351.3R—Foundations for Dynamic Equipment
   350.4R—Design Considerations for Environmental Engineering Concrete Structures, 4.5

Void filling, see also Repair
   229R—Controlled Low-Strength Materials, 2.8

Voids, see also Surface defects
   309.2R—Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, 3.2
   423.8R—Report on Corrosion and Repair of Grouted Multistrand and Bar Tendon Systems, 6.2
   506.5R—Guide for Specifying Underground Shotcrete, 8.5
Volume change

207.2R—Report on Thermal and Volume Change Effects on Cracking of Mass Concrete

207.1R—Guide to Mass Concrete, 3.5
207.5R—Report on Roller-Compacted Mass Concrete, 4.6
351.1R—Grouting between Foundations and Bases for Support of Equipment and Machinery, 2.2

Volumetric, see also Batching, Yield

304.6R—Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment
211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete, 3.3, 4.3

Wall thickness, see Tolerances

Walls, see also Shearwalls

523.2R—Guide for Precast Cellular Concrete Floor, Roof, and Wall Units
523.4R—Guide for Design and Construction with Autoclaved Aerated Concrete Panels
524R—Guide to Portland Cement-Based Plaster
533R—Guide for Precast Concrete Wall Panels
551.1R—Guide to Tilt-Up Concrete Construction
ITG-5.1—Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing
ITG-5.2—Requirements for Design of a Special Unbonded Post-Tensioned Precast Shear Wall Satisfying ACI ITG-5.1

122R—Guide to Thermal Properties of Concrete and Masonry Systems, Ch. 3, Ch. 4, Ch. 6
224.4R—Guide to Design Detailing to Mitigate Cracking, Ch. 7
314R—Guide to Simplified Design for Reinforced Concrete Buildings, Ch. 12, 4.15, 14.11
318—Building Code Requirements for Structural Concrete, Ch. 11
332—Residential Code Requirements for Structural Concrete, Ch. 7, App. A
332.1R—Guide to Residential Concrete Construction, Ch. 4
349—Code Requirements for Nuclear Safety-Related Concrete Structures, Ch. 14, 11.10, 15.8
350—Code Requirements for Environmental Engineering Concrete Structures, Ch. 14, 11.10, 21.7
440.7R—Guide for the Design and Construction of Externally Bonded Fiber-Reinforced Polymer Systems for Strengthening Unreinforced Masonry, Ch. 9, Ch. 10
ITG-4.3R—Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, Ch. 9
ITG-6R—Design Guide for the Use of ASTM A1035/A1035M Grade 100 (690) Steel Bars for Structural Concrete, Ch. 7

216.1—Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, 2.2, 3.3, 4.3
223R—Guide for the Use of Shrinkage-Compensating Concrete, 5.7
224.3R—Joints in Concrete Construction, 8.2
303R—Guide to Cast-in-Place Architectural Concrete Practice, 3.7
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 4.5, 5.5, 6.10, 7.5
346—Specification for Cast-in-Place Concrete Pipe, 3.2
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 4.3.1.2, 5.2.2.5, 5.4.1.4
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 3.3
376—Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases, 8.4, 9.5
423.3R—Recommendations for Concrete Members Prestressed with Unbonded Tendons, 3.7
530—Building Code Requirements for Masonry Structures, 1.9, 2.1, 5.3, 5.6 through 5.8

Warping, see also Slab-on-ground, Tolerances

201.1R—Guide for Conducting a Visual Inspection of Concrete in Service, 2.2.21
209R—Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, 3.6
435R—Control of Deflection in Concrete Structures, 4.3

Waste containment, see also Containment

232.2R—Use of Fly Ash in Concrete, 8.8

Water, see also Mixture proportioning

126.3R—Guide to a Recommended Format for Concrete in a Materials Property Database, Ch. 10
308.1—Specification for Curing Concrete, Ch. 2, Ch. 3
346—Specification for Cast-in-Place Concrete Pipe, Ch. 3
207.1R—Guide to Mass Concrete, 2.6
207.4R—Cooling and Insulating Systems for Mass Concrete, 2.3
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 2.3, 3.3
213R—Guide for Structural Lightweight-Aggregate Concrete, 4.15
223R—Guide for the Use of Shrinkage-Compensating Concrete, 4.3
229R—Controlled Low-Strength Materials, 3.6
230.1R—Report on Soil Cement, 4.7
234R—Guide for the Use of Silica Fume in Concrete, 3.5, 4.1
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete, 4.3
Water-cement ratio, see also Water-cementitious material ratio, Mixture proportioning
211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, 3.5
211.2—Standard Practice for Selecting Proportions for Structural Lightweight Concrete, 2.3
363R—Report on High-Strength Concrete, 3.4
555R—Removal and Reuse of Hardened Concrete, 5.5

Water-cementitious material ratio, see also Water-cement ratio, Mixture proportioning
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, Ch. 6 through 8, 3.2, 5.2
318—Building Code Requirements for Structural Concrete, Ch. 19, 26.4
211.3R—Guide for Selecting Proportions for No-Slump Concrete, 3.4
301—Specification for Structural Concrete, 4.2.2
350—Code Requirements for Environmental Engineering Concrete Structures, 4.1

Waterproof coating, see also Liners, Waterproofing, or Protective coatings
350.1—Specification for Tightness Testing of Environmental Engineering Concrete Structures
222R—Protection of Metals in Concrete against Corrosion, Ch. 3

Waterproofing, see also Protective coatings

Water-reducing admixtures, see Admixtures

Waterstop
350.2R—Concrete Structures for Containment of Hazardous Materials, 3.1
372R—Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 4.9, 5.8

Watertightness
309.5R—Compaction of Roller-Compacted Concrete, 3.3

Wave loads, see also Loads
350.3—Seismic Design of Liquid-Containing Concrete Structures, Ch. 7
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, App. A

Wear, see Abrasion

Wear resistance, see also Abrasion resistance
302.1R—Guide for Concrete Floor and Slab Construction, 11.3

Welded-wire reinforcement
301—Specification for Structural Concrete, Sec. 3
Welding
301—Specifications for Structural Concrete, Sec. 3

Wind loads, see also Loads
307—Code Requirements for Reinforced Concrete Chimneys, 4.2
313—Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, 4.4.7
334.3R—Construction of Concrete Shells Using Inflated Forms, 3.15
343R—Analysis and Design of Reinforced Concrete Bridge Structures, 5.5.1
347R—Guide to Formwork for Concrete, 4.2
357R—Guide for the Design and Construction of Fixed Offshore Concrete Structures, A.8
357.3R Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures, 7.5
371R—Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, 5.1.2.6
530—Building Code Requirements for Masonry Structures, 1.7

Wire Reinforcement Institute (WRI) method, see also Slabs
360R—Guide to Design of Slabs-on-Ground, App. 2

Wire-wrapped structures, see Water tanks

Workability
238.1R—Report on Measurements of Workability and Rheology of Fresh Concrete

Yield, as in volume
211.4R—Guide for Selecting Proportions for High-Strength Concrete Using Portland Cement and Other Cementitious Materials, Ch. 4, 5.3, 7.1.1.4
309.1R—Report on Behavior of Fresh Concrete During Vibration, Ch. 2
544.2R—Measurement of Properties of Fiber-Reinforced Concrete, Ch. 2

Wind loads, see also Loads
207.5R—Report on Roller-Compacted Mass Concrete, 3.3.1
221R—Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, 3.3
225R—Guide to the Selection and Use of Hydraulic Cements, 6.2
232.3R—Report on High-Volume Fly Ash Concrete for Structural Applications, 3.2
233R—Slag Cement in Concrete and Mortar, 4.1
234R—Guide for the Use of Silica Fume in Concrete, 4.2
309R—Guide for Consolidation of Concrete, 2.2, 2.3
330R—Guide for the Design and Construction of Concrete Parking Lots, 4.5
363R—Report on High-Strength Concrete, 3.8
544.3R—Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, 4.3
548.3R—Report on Polymer-Modified Concrete, 4.1.3.2.2

Yield strength, see also Reinforcement – steel, Prestressing steel
437R—Strength Evaluation of Existing Concrete Buildings, 3.2.2
ACI CONCRETE TERMINOLOGY
(accessed from www.concrete.org, 12/01/14)
<table>
<thead>
<tr>
<th>ACI Concrete Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A/F ratio</strong> — the molar or mass ratio of aluminum oxide ($\text{Al}_2\text{O}_3$) to iron oxide ($\text{Fe}_2\text{O}_3$), as in portland cement.</td>
</tr>
<tr>
<td><strong>Abrams’ law</strong> — a rule stating that, with given concrete materials and conditions of test, the ratio of the amount of water to the amount of the cement in the mixture determines the strength of the concrete, provided the mixture is of a workable consistency. (See also water-cement ratio.)</td>
</tr>
<tr>
<td><strong>abrasion damage</strong> — wearing away of a surface by rubbing and friction. (See also cavitation damage and erosion.)</td>
</tr>
<tr>
<td><strong>abrasion resistance</strong> — ability of a surface to resist being worn away by rubbing and friction.</td>
</tr>
<tr>
<td><strong>absolute volume</strong> — (1) in the case of solids, the displacement volume of particles themselves, including their permeable and impermeable voids, but excluding space between particles; (2) in the case of fluids, their volume.</td>
</tr>
<tr>
<td><strong>absorbed moisture</strong> — moisture that has entered the permeable pores of a solid and has physical properties not substantially different from ordinary water at the same temperature and pressure. (See also absorption.)</td>
</tr>
<tr>
<td><strong>absorbed water</strong> — see absorbed moisture</td>
</tr>
<tr>
<td><strong>absorption</strong> — (1) the process by which a liquid is drawn into and tends to fill permeable voids in a porous solid body; (2) the increase in mass of a porous solid body resulting from the penetration of a liquid into its permeable voids.</td>
</tr>
<tr>
<td><strong>abutment</strong> — (1) in bridges, the end foundation that is typically constructed with concrete that supports the superstructure of the bridge; (2) in dams, the side of the gorge or bank of the stream against which a dam abuts.</td>
</tr>
<tr>
<td><strong>accelerating admixture</strong> — an admixture that causes an increase in the rate of hydration of the hydraulic cement and thus shortens the time of setting, increases the rate of strength development, or both.</td>
</tr>
<tr>
<td><strong>acceleration</strong> — increase in rate of natural progress of setting or hardening of concrete. (See also accelerating admixture.)</td>
</tr>
<tr>
<td><strong>accelerator</strong> — see accelerating admixture</td>
</tr>
<tr>
<td><strong>accidental air</strong> — see entrapped air (preferred term)</td>
</tr>
<tr>
<td><strong>acid etching</strong> — the removal of a cementitious surface through controlled dissolution to expose sand or aggregates, roughen a smooth cementitious surface in preparation for cementitious coating material application, or create art, create design, or create an architectural finish.</td>
</tr>
<tr>
<td><strong>acrylic resin</strong> — one of a group of thermoplastic resins formed by polymerizing the esters or amides of acrylic acid used to make polymer-modified concrete and polymer concretes.</td>
</tr>
<tr>
<td><strong>active crack</strong> — a crack whose width changes with time.</td>
</tr>
<tr>
<td><strong>addition</strong> — a material that is interground or blended in limited amounts into a hydraulic cement during manufacture either as a processing addition to aid in manufacturing and handling the cement or as a functional addition to modify the use properties of the finished product.</td>
</tr>
<tr>
<td><strong>additive</strong> — a substance added to another in relatively small amounts to impart or improve desirable properties or suppress undesirable properties.</td>
</tr>
<tr>
<td><strong>adhesion</strong> — the state in which two surfaces are held together by interfacial effects that may consist of molecular forces, interlocking action, or both.</td>
</tr>
<tr>
<td><strong>adhesives</strong> — the group of materials used to join or bond similar or dissimilar materials, for example, in concrete work, the epoxy resins.</td>
</tr>
<tr>
<td><strong>adiabatic</strong> — a condition in which heat neither enters or leaves a system.</td>
</tr>
<tr>
<td><strong>admixture</strong> — a material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing.</td>
</tr>
<tr>
<td><strong>adsorbed water</strong> — water held on surfaces of a material by electrochemical forces and having physical properties substantially different from those of absorbed water.</td>
</tr>
</tbody>
</table>
or chemically combined water at the same temperature and pressure. (See also adsorption.)

**adsorption** — (1) development of a higher concentration of a substance at the surface of either a liquid or solid, such as cement, cement paste, or aggregates, than exists in the bulk of the medium; (2) the process by which a substance is adsorbed. (See also adsorbed water.)

**advancing-slope grouting** — a method of grouting by which the front of a mass of grout is caused to move horizontally through preplaced aggregate by use of a suitable grout injection sequence.

**advancing-slope method** — a method of placing concrete, as in tunnel linings, in which the face of the fresh concrete is not vertical and moves forward as concrete is placed.

**aerated concrete** — see cellular concrete and foamed concrete

**afwillite** — a mineral with composition $3\text{CaO} \cdot 2\text{SiO}_2 \cdot 3\text{H}_2\text{O}$ occurring naturally in South Africa, Northern Ireland, and California, and artificially in some hydrated portland cement mixtures.

**agent** — a general term for a material that may be used either as an addition to cement or an admixture in concrete, for example, an air-entraining agent.

**agglomeration** — a gathering into a ball or mass.

**aggregate** — granular material, such as sand, gravel, crushed stone, crushed hydraulic-cement concrete, or iron blast-furnace slag, used with a cementing medium to produce either concrete or mortar. (See also heavyweight aggregate and lightweight aggregate.)

**aggregate blending** — the process of intermixing two or more aggregates to produce a combination with improved grading or other properties

**aggregate gradation** — see grading (preferred term).

**aggregate interlock** — the effect of portions of aggregate particles from one side of a joint or crack in concrete protruding into recesses in the other side of the joint or crack so as to transfer load in shear and maintain alignment.

**aggregate transparency** — discoloration of a concrete surface consisting of darkened areas over coarse aggregate particles immediately below the concrete surface.

**aggregate-cement ratio** — the ratio of total aggregate to cement, either by mass or volume.

**agitating speed** — the rate of rotation of the drum of a truck mixer or agitator when used for agitating mixed concrete.

**agitating truck** — a vehicle in which freshly mixed concrete can be conveyed from the site of mixing to the site of placement; while being agitated, the truck body can either be stationary and contain an agitator or it can be a drum rotated continuously so as to agitate the contents (also called agitating lorry in the United Kingdom).

**agitation** — (1) the process of providing motion in mixed concrete just sufficient to prevent segregation or loss of workability; (2) the mixing and homogenization of slurries or finely ground powders by either mechanical means or injection of air. (See also agitator.)

**agitator** — a device for maintaining workability and preventing segregation of mixed concrete by agitation. (See also agitation.)

**air content** — the volume of air voids in cement paste, mortar, or concrete, exclusive of pore space in aggregate particles, usually expressed as a percentage of total volume of the paste, mortar, or concrete.

**air entraining** — the capability of a material or process to develop a system of microscopic bubbles of air in cement paste, mortar, or concrete during mixing. (See also air entrainment.)

**air entrainment** — the incorporation of air in the form of microscopic bubbles (typically smaller than 1 mm [0.04 in.]) during the mixing of either concrete or mortar. (See also air entraining and entrained air.)

**air lift** — equipment whereby slurry or dry powder is lifted through pipes by means of compressed air.

**air meter** — a device for measuring the air content of concrete and mortar.

**air ring** — perforated manifold in nozzle of wet-mix shotcrete equipment through which high-pressure air is introduced into the material flow.
air separator — an apparatus that separates various size fractions of ground materials pneumatically; fine particles are discharged as product, oversized particles are returned to the mill as tailing.

air void — a space in cement paste, mortar, or concrete filled with air. (See also entrained air and entrapped air.)

air-blown mortar — see shotcrete (preferred term).

air-cooled blast-furnace slag — see blast-furnace slag.

air-entraining admixture — an admixture that causes the development of a system of microscopic air bubbles in concrete, mortar, or cement paste during mixing, usually to increase its workability and resistance to freezing and thawing. (See also entrained air.)

air-entraining agent — see air-entraining admixture

air-entraining hydraulic cement — hydraulic cement containing sufficient amounts of air-entraining agent to produce a cementitious mixture containing entrained air within specified limits.

air-permeability test — a procedure for measuring the fineness of powdered materials such as portland cement. (See also Blaine test.)

air-water jet — a high-velocity jet of air and water mixed at the nozzle, used in clean-up of surfaces of rock or concrete, such as horizontal construction joints.

alignment wire — see ground wire (preferred term)

alite — a form of tricalcium silicate that is the principal phase in portland-cement clinker. (See also belite and celite.)

alkali — salts of alkali metals, principally sodium and potassium; specifically sodium and potassium occurring in constituents of concrete and mortar, usually expressed in chemical analyses as the oxides Na₂O and K₂O. (See also low-alkali cement.)

alkali reactivity (of aggregate) — susceptibility of aggregate to alkali-aggregate reaction.

alkali-aggregate reaction — chemical reaction in either mortar or concrete between alkalies (sodium and potassium) from portland cement or other sources and certain constituents of some aggregates.

alkali-carbonate rock reaction — the reaction between the alkalies (sodium and potassium) in portland cement and certain carbonate rocks, particularly calcitic dolomite and dolomitic limestones, present in some aggregates.

alkali-silica reaction — the reaction between the alkalies (sodium and potassium) in portland cement and certain siliceous rocks or minerals, such as opaline chert, strained quartz, and acidic volcanic glass, present in some aggregates.

alkyl aryl sulfonate — synthetic detergent used to entrain air in hydraulic-cement mixtures.

allowable bearing capacity — the maximum pressure to which a soil or other material should be subjected to guard against shear failure or excessive settlement.

allowable load — see service dead load and service live load.

allowable stress — maximum permissible stress used in design of members of a structure and based on a factor of safety against rupture or yielding of any type.

alumina — aluminum oxide (Al₂O₃).

aluminate cement — see calcium-aluminate cement


aluminous cement — see calcium-aluminate cement (preferred term)

amount of mixing — the extent of mixer action employed in combining the ingredients for either concrete or mortar; in the case of stationary mixers, the mixing time; in the case of truck mixers, the number of revolutions of the drum at mixing speed after the intermingling of the cementitious materials with water and aggregates. (See also mixing time.)

amplitude — the maximum displacement from the mean position in connection with vibration.

anchor — (1) in prestressed concrete, to lock the stressed tendon in position so that it will retain its stressed condition; (2) in precast-concrete construction, to attach the precast units to the building frame; (3) in slabs-on-grade or walls, to fasten to rock or adjacent structures to prevent movement of the slab or wall with respect to the foundation, adjacent structure, or rock.
anchor bolt — a metal bolt or stud, headed or threaded, cast in place, grouted in place, or drilled and fastened into existing concrete either by expansion or by chemical adhesives.

anchorage — (1) in post-tensioning, a device used to anchor the tendon to the concrete member; (2) in pretensioning, a device used to maintain the elongation of a tendon during the time interval between stressing and release; (3) in precast-concrete construction, the devices for attaching precast units to the building frame; (4) in slab or wall construction, the device used to anchor the slab or wall to the foundation, rock, or adjacent structure.

anchorage bond stress — the bar forces divided by the product of the bar perimeter or perimeters and the embedment length.

anchorage deformation — the loss of elongation or stress in the tendons of prestressed concrete due to the deformation or seating of the anchorage when the prestressing force is transferred from the jack to the anchorage (also called anchorage loss). (See also slip.)

anchorage device — see anchorage (preferred term)

anchorage loss — see anchorage deformation

anchorage slip — see anchorage deformation or slip.

anchorage zone — (1) in post-tensioning, the region adjacent to the anchorage subjected to secondary stresses resulting from the distribution of the prestressing force; (2) in pretensioning, the region in which the transfer bond stresses are developed.

angle of repose — the angle between the horizontal and the natural slope of loose material below which the material will not slide.

angular aggregate — aggregate particles that possess well-defined edges formed at the intersection of roughly planar faces.

anhydrite — (1) a mineral, anhydrous calcium sulfate (CaSO₄); (2) gypsum from which the water of crystallization has been removed, usually by heating above 325°F (160°C).

anhydrous calcium chloride (CaCl₂) — a solid, usually 94 percent calcium chloride, typically in pellet form.

anti-washout admixture — a concrete admixture that reduces the loss of fine material from concrete when placed in water.

apparent specific gravity — the ratio of the mass of a volume of the impermeable portion of a material at a stated temperature to the mass of an equal volume of distilled water at a stated temperature.

arc spectrography — spectrographic identification of elements in a sample of material heated to volatilization in an electric arc or spark.

architect-engineer — architect, engineer, architectural firm, engineering firm, or architectural and engineering firm issuing contract documents, administering the work under contract documents, or both (also called engineer-architect).

architectural concrete — concrete that will be permanently exposed to view and therefore requires special care in selection of the concrete materials, forming, placing, and finishing to obtain the desired architectural appearance.

area of steel — the cross-sectional area of the steel reinforcement.

arenaceous — composed primarily of sand; sandy.

argillaceous — composed primarily of clay or shale; clayey.

arris — the sharp external corner edge that is formed at the junction of two planes or surfaces.

arrissing tool — a tool similar to a float, but having a form suitable for rounding an edge of freshly placed concrete.

artificial pozzolan — materials such as fly ash and silica fume. (See also fly ash and silica fume).

asbestos-cement products — products manufactured from rigid material composed essentially of asbestos fiber and portland cement.

ashlar masonry — masonry composed of bonded blocks of concrete, either rectangular or square, always of two or more sizes.
asphalt — a dark brown to black cementitious material in which the predominating constituents are bitumens that occur in nature or are obtained in petroleum processing.

asphalt cement — asphalt that is refined to meet specifications for use in the manufacture of bituminous pavements.

asphaltic concrete — a mixture of asphalt cement and aggregate.

atmospheric-pressure steam curing — steam curing of concrete products or cement at atmospheric pressure, usually at maximum ambient temperature between 100 to 200°F (40 to 95°C).

autoclave — a high-pressure steam vessel.

autoclave curing — curing of concrete products in an autoclave at maximum ambient temperature generally between 340 and 420°F (170 and 215°C).

autoclave cycle — (1) the time interval between the start of the temperature-rise period and the end of the blowdown period; (2) a schedule of the time and temperature-pressure conditions of periods that make up the cycle.

autoclaved — see autoclave curing.

autoclaving — see autoclave curing.

autogenous healing — a natural process of filling and sealing dormant cracks in concrete or in mortar when kept damp.

autogenous length change — length change caused by autogenous volume change. (See also autogenous volume change.)

autogenous shrinkage — see autogenous volume change.

autogenous volume change — change in volume due to the chemical process of hydration of cement, exclusive of effects of applied load and change in either thermal condition or moisture content.

automatic batcher — see batcher.

auxiliary reinforcement — reinforcement in addition to that required by analysis for strength.

average bond stress — the force in a bar divided by the product of the perimeter and the development length of the bar.

axle load — the portion of the gross weight of a vehicle transmitted to a structure or a roadway through wheels supporting a given axle.

axle steel — steel from carbon-steel axles for railroad cars.

axle-steel reinforcement — either plain or deformed reinforcing bars rolled from axle steel.

$b/b_o$ — see coarse-aggregate factor (preferred term).

back form — see top form (preferred term).

back plastering — plaster applied to one face of a lath system following application and subsequent hardening of plaster applied to the opposite face. (See also parge.)

back stay — see brace (preferred term).

backfill concrete — nonstructural concrete used to over-fill excavated pockets in rock or prepare a surface to receive structural concrete. (See also controlled low-strength material [preferred term].)

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

bacterial corrosion — destruction of a material by bacterial processes brought about by the activity of certain bacteria that consume the material and produce substances, such as hydrogen sulfide, ammonia, and sulfuric acid.

bag of cement — a quantity of portland cement: 94 lb (43 kg) in the United States; for other kinds of cement, a quantity indicated on the bag. (Also called sack of cement.)

balanced load — load capacity at simultaneous crushing of concrete and yielding of tension steel. (See also load balancing.)

balanced moment — moment capacity at simultaneous crushing of concrete and yielding of tension steel.

balanced reinforcement — (1) an amount and distribution of reinforcement in a flexural member such that in working-stress design, the allowable tensile stress in the
steel and the allowable compressive stress in the concrete are attained simultaneously; (2) an amount and distribution of reinforcement in a flexural member such that in strength design, the tensile reinforcement reaches its specified yield strength simultaneously with the concrete in compression reaching its assumed ultimate strain of 0.003.

**ball mill** — horizontal, cylindrical, rotating mill charged with large grinding media.

**ball test** — a test to determine the consistency of freshly mixed concrete by measuring the depth of penetration of a cylindrical metal weight with a hemispherical bottom. (See also Kelly ball.)

**bar** — a long, slender structural element, normally composed of steel, used to reinforce concrete.

**bar bender** — (1) a tradesman who cuts and bends steel reinforcement; (2) a machine for bending steel reinforcement.

**bar mat** — see mat (1).

**bar schedule** — a list of the reinforcement showing the shape, number, size, and dimensions of every different element required for a structure or a portion of a structure.

**bar spacing** — the distance between parallel reinforcing bars, measured center to center of the bars perpendicular to their longitudinal axes.

**bar support** — hardware used to support or hold reinforcing bars in proper position to prevent displacement before and during concrete placement. (See also slab bolster.)

**bar-end check** — a check of the ends of reinforcing bars to determine whether they fit the devices intended for connecting the bars. (See also mechanical connection.)

**barite** — a mineral, barium sulfate (BaSO₄), used in either pure or impure form as concrete aggregate primarily for the construction of high-density radiation shielding concrete (also called barytes in the United Kingdom).

**barrel (of cement)** — (obsolete) a quantity of portland cement: four bags or 376 lb in the United States.

**base** — (1) a subfloor slab or working mat, either previously placed and hardened or freshly placed, on which floor topping is placed in a later operation; (2) the underlying stratum on which a concrete slab, such as a pavement, is placed. (See also mud mat and subbase.)

**base bead** — see base screed (preferred term).

**base coat** — any plaster coat or coats applied before application of the finish coat.

**base course** — (1) a layer of specified select material of planned thickness constructed on the subgrade or subbase of a pavement to serve one or more functions, such as distributing loads, providing drainage, or minimizing frost action; (2) the lowest course of masonry in a wall or pier.

**base plate** — a metallic plate, typically steel, used to distribute forces and moments.

**base screed** — a preformed metal screed with perforated or expanded flanges to provide a guide for thickness and planeness of plaster and to provide a separation between plaster and other materials.

**basic creep** — creep that occurs without migration of moisture to or from the concrete. (See also creep and drying creep.)

**bassanite** — calcium sulfate hemihydrate, 2CaSO₄·H₂O. (See also hemihydrate and plaster of paris.)

**batch** — (1) quantity of material mixed at one time or in one continuous process; (2) to weigh or volumetrically measure and introduce into the mixer the ingredients for a quantity of material.

**batch mixer** — a machine that mixes batches of either concrete or mortar.

**batch plant** — an installation for batching or for batching and mixing concrete materials.

**batch weights** — the quantities of the various ingredients (cement, water, the several sizes of aggregate, and admixtures, if used) that compose a batch of concrete.

**batched water** — see mixing water.

**batcher** — a device for measuring ingredients for a batch of concrete.

(1) **manual batcher** — a batcher equipped with gates or valves that are
operated manually, with or without supplementary power (pneumatic, hydraulic, or electrical), the accuracy of the weighing operation being dependent on the operator’s observation of the scale.

(2) **semiautomatic batcher** — a batcher equipped with gates or valves that are separately opened manually to allow the material to be weighed but that are closed automatically when the designated quantity of each material has been reached.

(3) **automatic batcher** — a batcher equipped with gates or valves that, when actuated by a single starter switch, will open automatically at the start of the weighing operation of each material and close automatically when the designated quantity of each material has been reached, interlocked in such a manner that: (a) the charging mechanism cannot be opened until the scale has returned to zero; (b) the charging mechanism cannot be opened if the discharge mechanism is open; (c) the discharge mechanism cannot be opened if the charging mechanism is open; (d) the discharge mechanism cannot be opened until the designated quantity has been reached within the allowable tolerance; and (e) if different kinds of aggregates or different kinds of cements are measured cumulatively in a single batcher, interlocked sequential controls are provided.

**batten** — a narrow strip of wood placed over the vertical joint of sheathing or paneling; also used to hold several boards together (also called batten strip). (See also **cleat**.)

**batter pile** — a pile installed at an angle to the vertical.

**bauxite** — a rock composed principally of hydrous aluminum oxides that is the principal ore of aluminum and a raw material for manufacture of calcium-aluminate cement.

**bay** — (1) the space, in plan, between the centerlines of adjacent piers, mullions, or columns; (2) a small, well-defined area of concrete placed at one time in the course of placing large areas, such as floors, pavements, or runways.

**beam** — a structural member subjected primarily to flexure but may also be subjected to axial load. (See also **spandrel beam**, **girder**, **joist**, **ledger**, and **stringer**.)

**beam bottom** — soffit or bottom form for a beam.

**beam pocket** — (1) opening left in a vertical member in which a beam is to rest; (2) an opening in the column or girder form where forms for an intersecting beam will be framed.

**beam test** — a method of measuring the flexural strength (modulus of rupture) of concrete by testing a standard unreinforced beam.

**beam-column** — a structural member subjected to axial load and bending moment.

**bearing capacity** — see **allowable bearing capacity**.

**bearing stratum** — the soil or rock stratum on which a concrete footing or mat bears or that carries the load transferred to it by a concrete pile, caisson, or similar deep foundation unit.

**belite** — a form of dicalcium silicate that occurs as a phase in portland-cement clinker. (See also **alite** and **celite**.)

**belled pier** — a drilled pier shaft with an enlarged base.

**bending moment** — the bending effect at any section of a structural element equal to the algebraic sum of the moments of the vertical and horizontal forces, with respect to the centroidal axis of a member, acting on a freebody of the member.

**bending-moment diagram** — a graphical representation of the variation of bending moment along the length of the member for a given stationary system of loads.

**beneficiation** — improvement of the chemical or physical properties of a raw material or intermediate product by the removal or modification of undesirable components or impurities.

**bent bar** — a reinforcing bar bent to a prescribed shape. (See also **hook**, **hooked bar**, **stirrup**, and **tie**.)
bentonite — a clay composed principally of minerals of the montmorillonoid group, characterized by high adsorption and large volume change with wetting or drying.

billet steel — steel, either produced directly from ingots or continuously cast, made from properly identified heats of open-hearth, basic oxygen, or electric-furnace steel, or lots of acid Bessemer steel and conforming to specified limits on chemical composition.

binary mixture — concrete containing two cementitious materials.

binder — (1) material forming the matrix of concretes, mortars, and sanded grouts; (2) chemical treatment applied to fibers to give integrity to mats, roving, and reinforcement.

biological shielding — shielding provided to attenuate or absorb nuclear radiation, such as neutron, proton, alpha, and beta particles, and gamma radiation; the shielding is provided mainly by the density of the concrete, except that in the case of neutrons, the attenuation is achieved by compounds of some of the lighter elements (for example, hydrogen and boron). (See also shielding concrete.)

bituminous cement — a black solid, semisolid, or liquid substance at natural air temperatures and appreciably soluble only in carbon disulfide or some volatile liquid hydrocarbon, being composed of mixed indeterminate hydrocarbons mined from natural deposits, produced as a residue in the distillation of petroleum, or obtained by the destructive distillation of coal or wood.

Blaine apparatus — air-permeability apparatus for measuring the surface area of a finely ground cement, raw material, or other product. See ASTM C204.

Blaine fineness — the fineness of powdered materials such as cement and pozzolans, expressed as surface area per unit mass usually in square meters per kilogram, determined by the Blaine apparatus. (See also specific surface.)

Blaine test — a method for determining the fineness of cement or other fine material on the basis of the permeability to air of a sample prepared under specified conditions.

blast-furnace slag — the nonmetallic product consisting essentially of silicates and aluminosilicates of calcium and other bases that develops in a molten condition simultaneously with iron in a blast furnace.

(1) air-cooled blast-furnace slag — the material resulting from solidification of molten blast-furnace slag under atmospheric conditions; subsequent cooling may be accelerated by application of water to the solidified surface.

(2) expanded blast-furnace slag — the low density cellular material obtained by controlled processing of molten blast-furnace slag with water, or water and other agents, such as steam, compressed air, or both.

(3) granulated blast-furnace slag — the glassy, granular material formed when molten blast-furnace slag is rapidly chilled, as by immersion in water.

(4) ground-granulated blast-furnace slag — (obsolete) see slag cement (preferred term).

bleed — to undergo bleeding. (See also bleeding.)

bleeding — the autogenous flow of mixing water within, or its emergence from, a newly placed cementitious mixture caused by the settlement of solid materials within the mass.

bleeding capacity — the ratio of volume of water released by bleeding to the volume of paste or mortar.

bleeding rate — the rate at which water is released from a paste or mortar by bleeding.

blemish — any superficial defect that causes visible variation from a consistently smooth and uniformly colored surface of hardened concrete. (See also bug holes, efflorescence, honeycomb, lift joint, laitance, popout, rock pocket, and sand streak.)

blended cement — a hydraulic cement consisting of portland cement uniformly mixed with slag cement or pozzolan, or both.
blinding — the filling or plugging of the openings in a screen or sieve by the material being separated.

blistering — (1) the irregular raising of a thin layer at the surface of a placed cementitious mixture during or soon after completion of the finishing operation, or, in the case of pipe, after spinning; (2) bulging of a finish coat as it separates and draws away from a base coat.

block beam — a flexural member composed of individual blocks that are joined together by prestressing.

blockout — a space within a concrete structure under construction in which fresh concrete is not to be placed, called core in United Kingdom.

blowholes — see surface air voids (preferred term).

blowpipe — air jet used in shotcrete gunning to remove rebound or other loose material from the work area.

blowup — the raising of two concrete slabs off the subgrade where they meet as a result of greater expansion than the joint between them will accommodate; typically occurs only in unusually hot weather where joints have become filled with incompressible material; often results in cracks on both sides of the joint and parallel to it.

board butt joint — construction joint in shotcrete formed by sloping the sprayed surface to a 1 in. (25 mm) board laid flat.

bolt sleeve — a tube surrounding a bolt in a concrete wall to prevent concrete from adhering to the bolt and acting as a spreader for the formwork.

bond — (1) adhesion of concrete or mortar to reinforcement or other surfaces against which it is placed, including friction and mechanical interlock; (2) adhesion of cement paste to aggregate; (3) adhesion, cohesion, or both between materials; (4) patterns formed by the exposed faces of masonry units, for example, running bond or Flemish bond.

bond area — the nominal area of interface between two elements across which adhesion, cohesion, or both, develop(s) or may develop, as between cement paste and aggregate.

bond breaker — a material used to prevent adhesion of newly placed concrete to the substrate. (See also form oil and release agent.)

bond length — see development length (preferred term).

bond plaster — a specially formulated gypsum plaster designed as first-coat application over monolithic concrete.

bond prevention — measures taken to prevent adhesion of concrete or mortar to surfaces against which it is placed.

bond strength — (1) resistance to separation of mortar and concrete from reinforcing and other materials with which it is in contact; (2) a collective expression for forces such as adhesion, friction due to shrinkage, and longitudinal shear in the concrete engaged by the bar deformations that resist separation.

bond stress — (1) the force of adhesion per unit area of contact between two bonded surfaces, such as concrete and reinforcing steel, or any other material, such as foundation rock; (2) shear stress at the surface of a reinforcing bar, preventing relative movement between the bar and the surrounding concrete when the bar carries tensile force.

bonded hollow-wall masonry — a cavity wall, built of masonry units, in which the inner and outer walls are tied together by bonders.

bonded member — a prestressed concrete member in which the tendons are bonded to the concrete either directly or through grouting.

bonded post-tensioning — post-tensioned construction in which the annular spaces around the tendons are grouted after stressing, thereby bonding the tendon to the concrete section.

bonded tendon — a prestressing tendon that is bonded to the concrete either directly or through grouting.

bonder — a masonry unit that ties two or more wythes (leaves) of a wall together by overlapping. (See also header and wythe [leaf].)
bonding agent — a substance applied to a suitable substrate to create a bond between it and a succeeding layer.

bonding layer — a layer of mortar, usually 1/8 to 1/2 in. (3 to 13 mm) thick, which is spread on a moist and prepared hardened concrete surface before placing fresh concrete.

bored pile — see drilled pier.

boring — (1) the removal of a sample by drilling of rock; (2) a generic name for cylindrical sample of soil or rock.

boron frits — clear, colorless, synthetic glass produced by fusion and quenching, containing boron. (See also boron-loaded concrete.)

boron-loaded concrete — high density concrete including a boron-containing admixture or aggregate, such as the mineral colemanite, boron frits, or boron metal alloys, to act as a neutron attenuator. (See also biological shielding and shielding concrete.)

box out — a formed opening in concrete (also called a boxout).

brace — a structural member used to provide lateral support for another member, generally for the purpose of ensuring stability or resisting lateral loads.

bracing — see brace (preferred term).

bracket — (1) an overhanging member projecting from a wall or other body to support weight acting outside the wall; (2) formed shapes of channel or pencil rod used as structural reinforcement in erecting furred assemblies. (See also corbel.)

bredigite — a mineral, alpha prime dicalcium silicate (2CaO·SiO₂), occurring in slags and portland cement.

breeze — (1) usually clinker; (2) fine divided material from coke production.

brick seat — ledge on wall or footing to support a course of masonry.

bridge deck — the structural concrete slab or other structure that is supported on the bridge superstructure and serves as the roadway or other traveled surface.

briquette — a molded specimen of mortar with enlarged extremities and reduced center having a cross section of definite area, used for measurement of tensile strength (also called a briquet).

broadcast — to toss granular material, such as sand, over a horizontal surface so that a thin, uniform layer is obtained.

broom finish — the surface texture obtained by stroking a broom over freshly placed concrete.

brown coat — the leveling coat of plaster, either the second coat of plaster in a three-coat application or the entire base coat of plaster in a two-coat application.

brown out — to complete application of base coat plaster.

brownmillerite — a ternary compound originally regarded as 4CaO·Al₂O₃·Fe₂O₃ (C₄AF) occurring in portland and calcium-aluminate cement, now used to refer to a series of solid solutions between 2CaO·Fe₂O₃ (C₂F) and 2CaO·Al₂O₃ (C₂A).

brucite — a mineral having the composition magnesium hydroxide, Mg(OH)₂, and a specific crystal structure.

buckling — lateral or torsional instability of a structural member.

bug holes — see surface air voids (preferred term).

buggy — a two-wheeled hand- or motor-driven cart (usually rubber-tired) for transporting small quantities of concrete from hoppers or mixers to forms (also called a concrete cart).

building official — (1) the official charged with administration and enforcement of the applicable building code; (2) the duly authorized representative of the official.

build-up — (1) spraying of shotcrete in successive layers to form a thicker mass; (2) the accumulation of residual hardened concrete in a mixer.

bulk cement — cement that is transported and delivered in bulk (usually in specially constructed vehicles) instead of in bags.

bulk density — the mass of a material per unit volume including voids between particles.

bulk specific gravity — (obsolete) see oven-dry specific gravity (preferred term).
bulkhead — (1) a partition in formwork blocking fresh concrete from a section of the form, or a partition closing a section of the form, such as at a construction joint; (2) a partition in a storage tank or bin, as for cement or aggregate.

bulking — increase in the volume occupied by a quantity of sand in a moist condition over the volume of the same quantity dry or completely inundated.

bulking factor — ratio of the volume of moist sand to the volume of the sand when dry.

bull float — a tool comprising a large, flat, rectangular piece of wood, aluminum, or magnesium usually 8 in. (200 mm) wide and 42 to 60 in. (1 to 1.50 m) long, and a handle 4 to 16 ft (1 to 5 m) in length used to smooth unformed surfaces of freshly placed concrete.

bundled bars — a group of not more than four parallel reinforcing bars in contact with each other, usually tied together.

burlap — a coarse fabric of jute, hemp, or less commonly flax for use as a water-retaining covering in curing concrete surfaces (also called Hessian).

burnishing — (1) to hard trowel the surface of concrete or plaster up to time of final setting; (2) to otherwise produce a smooth surface.

bush hammer — (1) a hammer having a serrated face, as rows of pyramidal points used to roughen or dress a surface; (2) to finish a concrete surface by application of a bush hammer.

butt joint — a plain square joint between two members.

butter — (1) to spread mortar on a masonry unit with a trowel; (2) the process by which the interior of a concrete mixer, transportation unit, or other item coming in contact with fresh concrete is provided with a mortar coating so that fresh concrete coming in contact with it will not be depleted of mortar.

buttress — a projecting structure to support either a wall or a building.

butyl stearate — a colorless, oily, and practically odorless material (C₁₇H₃₅COOC₄H₉) used as an admixture for concrete to provide dampproofing.

cable — see tendon (preferred term).

cage — a rigid assembly of reinforcement ready for placing in position.

caisson — part of a foundation, a watertight chamber used in construction underwater, or a hollow floating box used as a floodgate for a dock or basin.

calcareous — containing calcium carbonate or, less generally, containing the element calcium.

calcine — to alter composition or physical state by heating below the temperature of fusion.

calcite — (1) a mineral having the composition calcium carbonate (CaCO₃) and a specific crystal structure; (2) the principal constituent of limestone, chalk, and marble; (3) a major constituent in the manufacture of portland cement.

calcium — a silver-white metallic element of the alkaline-earth group occurring naturally only in combination with other elements.

calcium chloride — CaCl₂, a crystalline solid, is primarily used in concrete as an accelerating admixture. (See also accelerating admixture.)

calcium chloride solution — an aqueous solution of calcium.

calcium hydroxide — see hydrated lime.

calcium stearate — Ca(C₁₈H₃₅O₂)₂, commonly marketed in powder form, insoluble in water, used as a water repellent admixture in concrete.

calcium-aluminate cement — the product obtained by pulverizing clinker consisting essentially of hydraulic calcium aluminates resulting from fusing or sintering a suitably proportioned mixture of aluminous and calcareous materials (called high-alumina cement in the United Kingdom).

calcium-silicate brick — a concrete product made principally from sand and lime that is hardened by autoclave curing.

calcium-silicate hydrate — the primary product of silicate reactions that contribute to concrete strength and density. (See also dicalcium silicate and tricalcium silicate.)

caliche — gravel, sand, and desert debris cemented by calcium carbonate or other salts.

California bearing ratio (CBR) — a method to determine the load-bearing capacity of soil.
calorimeter — an instrument for measuring heat exchange during a chemical reaction, such as the quantity of heat liberated by the combustion of a fuel or hydration of a cement.

camber — a deflection that is intentionally built into a structural element or form to improve appearance or to compensate for the deflection of the element under the effects of loads, shrinkage, and creep.

canister-type anchor bolt — anchorage assembly that includes a sleeve, a threaded rod, and means of removing the rod and adjusting rod location, projection, and tension.

cant strip — see chamfer strip (preferred term).

cap — a smooth, plane surface of suitable material bonded to the bearing surfaces of test specimens to distribute the load during strength testing.

cap pile — a concrete element that transfers load from a column or pedestal to the top of one or more supporting piles.

capacity — (1) a measure of the rated volume of a particular concrete mixer or agitator, usually limited by specifications to a maximum percentage of total gross volume; (2) the output of concrete, aggregate, or other product per unit of time (as plant capacity or screen capacity); (3) load-carrying limit of a structure.

capacity-reduction factor — see nominal strength reduction factor (preferred term).

capillarity — the movement of a liquid in the interstices of concrete, soil, or other finely porous material due to surface tension (also called capillary rise, capillary action, or capillary suction).

capillary action — see capillarity.

capillary pores — microscopic channels within hydrated paste that will draw liquid water due to surface tension.

capillary suction — see capillarity.

carbon black — a finely divided form of carbon produced by the combustion or partial decomposition of hydrocarbon, used as an admixture to color concrete.

carbonation — (1) reaction between carbon dioxide and a hydroxide or oxide to form a carbonate, especially in cement paste, mortar, or concrete; (2) the reaction with calcium compounds to produce calcium carbonate.

carbonation shrinkage — shrinkage resulting from carbonation.

cast stone — concrete or mortar cast into blocks or small slabs in special molds so as to resemble natural building stone.

castable refractory — a packaged dry mixture of hydraulic cement, generally calcium-aluminate cement, and specially selected and proportioned refractory aggregates that, when mixed with water, will produce refractory concrete or mortar.

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, as opposed to precast concrete.

cast-in-place pile — a concrete pile that is cast with or without a casing in its permanent location, as distinguished from a precast pile. (See also drilled pier and precast pile.)

cast-in-situ — see cast-in-place concrete (preferred term).

cathead — (1) a notched wedge placed between two formwork members meeting at an oblique angle; (2) a spindle on a hoist; (3) the large, round retention nut used on shear bolts.

cathodic protection — the form of corrosion protection wherein one metal is caused to corrode in preference to another, thereby protecting the latter from corrosion.

caulk — to place a material in a crack or joint with the intent of retarding entry of dirt or water. (See also joint filler or joint sealant.)

cavitation damage — pitting of concrete caused by implosion, that is, the collapse of vapor bubbles in flowing water that form in areas of low pressure and collapse as they enter areas of higher pressure. (See also abrasion damage and erosion.)

celite — a name used to identify the calcium aluminoferrite constituent of portland cement. (See also alite and belite.)
cellular concrete — a low-density product consisting of portland cement, cement-silica, cement-pozzolan, lime-pozzolan, or lime-silica pastes, or pastes containing blends of these ingredients and having a homogeneous void or cell structure, attained with gas-forming chemicals or foaming agents.

cellular construction — a method of cast-in-place concrete construction where a large ratio of hollow cores is produced in a flat slab.

cement — any of a number of materials that are capable of binding aggregate particles together. (See also hydraulic cement.)

cement bacillus — see ettringite (preferred term).

cement content — quantity of cement contained in a concrete, mortar, or grout preferably expressed as mass per unit volume of concrete, mortar, or grout.

cement factor — see cement content (preferred term).

cement gel — the colloidal material that makes up the major portion of the porous mass of which mature hydrated cement paste is composed.

cement gun — a machine for pneumatic placement of mortar or small aggregate concrete. (See also shotcrete.)

cement paint — a paint consisting generally of white portland cement and water, pigments, hydrated lime, water repellents, or hygroscopic salts.

cement paste — binder of concrete and mortar consisting essentially of cement, water, hydration products, and admixtures together with very finely divided materials included in the aggregates. (See also neat cement paste.)

cement plaster — see plaster and stucco.

cement rock — natural impure limestone that contains the ingredients for production of portland cement in approximately the required proportions.

cementation process — the process of injecting cement grout under pressure into certain types of ground (for example, gravel, fractured rock) to solidify it.

cement-bound macadam — a road consisting of crushed stone, crushed slag, or gravel and either a grout or mortar filler.

cementitious — having cementing properties.

cementitious materials — pozzolans and hydraulic cements. (See also fly ash, silica fume, and slag cement.)

cementitious mixture — a mixture (mortar, concrete, or grout) containing hydraulic cement.

centering — falsework used in the construction of arches, shells, space structures, or any continuous structure where the entire falsework is lowered (struck or decentered) as a unit. (See also falsework and formwork.)

central mixer — a stationary concrete mixer from which the freshly mixed concrete is transported to the work.

central-mixed concrete — concrete that is completely mixed in a stationary mixer from which it is transported to the delivery point.

centrifugal process — a process for producing concrete products, such as pipe, that uses an outer form that is rotated about a horizontal axis and into which concrete is fed by a conveyor, also called spinning process. (See also centrifugally cast concrete, dry-cast process, packerhead process, tamp process, and wet-cast process.)

centrifugally cast concrete — concrete compacted by centrifugal action, for example, in the manufacture of pipe and poles. (See also centrifugal process.)

ceramic bond — bond that is the result of thermo-chemical reactions between materials exposed to temperatures approaching the fusion point of the mixture.

center — see bar support (preferred term).

ch risco Materials provided by: www.concrete.org
charge — to introduce, feed, or load materials into a concrete or mortar mixer, furnace, or other container or receptacle where they will be further treated or processed.

checking — development of shallow cracks at closely spaced but irregular intervals on the surface of plaster, cement paste, mortar, or concrete. (See also crack and crazing.)

chemical attack of concrete — the alteration or deterioration of concrete through chemical reaction or just presence of chemicals with either the cement paste, coarse aggregate, or embedded steel reinforcement.

chemical bond — bond between materials that is the result of cohesion and adhesion developed by chemical reaction.

chemically prestressing cement — a type of expansive cement containing a higher percentage of expansive component than a shrinkage-compensating cement, when used in concretes with adequate internal or external restraint, that will expand sufficiently due to chemical reactions within the matrix to develop the stresses necessary for prestressing the concrete.

chert — a very fine-grained siliceous rock characterized by hardness and conchoidal fracture in dense varieties, the fracture becoming splintery and the hardness decreasing in porous varieties and in a variety of colors; composed of silica in the form of chalcedony, cryptocrystalline or microcrystalline quartz, opal, or a combination of any of these minerals.

chipping — treatment of a hardened concrete surface by chiseling.

chips — broken fragments of marble or other mineral aggregate screened to specified sizes.

chute — a sloping trough or tube for conducting concrete, cement, aggregate, or other free-flowing materials from a higher to a lower point.

clamp — see coupler (preferred term).

class (of concrete) — an arbitrary characterization of concrete of various qualities or usages, usually by compressive strength.

classifier — machine for separating coarse and fine particles of granular material.

clay — natural mineral material having plastic properties and composed of very fine particles; the clay mineral fraction of a soil is usually considered to be the portion consisting of particles finer than 2 μm; clay minerals are essentially hydrous aluminum silicates or occasionally hydrous magnesium silicates.

clay content — mass fraction of clay of a heterogeneous material such as a soil or a natural concrete aggregate or crushed stone.

cleanout — (1) an opening in the forms for removal of refuse to be closed before the concrete is placed; (2) a port in tanks, bins, or other receptacles for inspection and cleaning.

cleanup — treatment of horizontal construction joints to remove surface material and contamination down to a condition of soundness corresponding to that of a freshly broken surface of hardened concrete.

cleat — small board used to connect formwork members or used as a brace. (See also batten.)

climbing form — a form that is raised vertically for succeeding lifts of concrete in a given structure.

clinker — (1) a partially fused product of a kiln that is ground to make cement; (2) other vitrified or burnt material. (See also portland-cement clinker.)

clip — wire or sheet-metal device used to attach various types of lath to supports or to secure adjacent lath sheets.

coarse aggregate — aggregate predominantly retained on the 4.75 mm (No. 4) sieve or that portion retained on the 4.75 mm (No. 4) sieve.

coarse-aggregate factor — the ratio, expressed as a decimal, of the amount (mass or solid volume) of coarse aggregate in a unit volume of well-proportioned concrete to the amount of dry-rodded coarse aggregate compacted into the same volume ($b/b_0$).

coarse-grained soil — soil in which the larger grain sizes, such as sand and gravel, predominate.
coat — a film or layer as of paint or plaster applied in a single operation.
coated bar — a bar on which a coating has been applied, usually to increase resistance to corrosion.
coating — (1) (on concrete) — material applied to a surface by brushing, dipping, mopping, spraying, troweling, etc., to preserve, protect, decorate, seal, or smooth the substrate.
(2) (on aggregate particles) — foreign or deleterious substances found adhering to the aggregate particles.
(3) (on architectural concrete) — material used to protect a concrete surface from atmospheric contaminants and those that penetrate slightly and leave a visible clear or pigmented film on the surface. (See also sealer.)
cobble — in geology, a rock fragment between 2-1/2 and 10 in. (64 and 256 mm) in diameter; as applied to coarse aggregate for concrete, the material in the nominal size range 3 to 6 in. (75 to 150 mm).
cobblestone — a rock fragment, usually rounded or semirounded, with an average dimension between 3 and 12 in. (75 and 300 mm).
coefficient of permeability to water — the rate of discharge of water under laminar flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions, usually 20°C (68°F).
coefficient of subgrade friction — the coefficient of friction between a slab and its subgrade, commonly used in design of slabs-on-grade to estimate the force induced in the slab due to volume changes and elastic shortening if prestressed.
coefficient of subgrade reaction — ratio of the load per unit area of soil to the corresponding settlement of the soil, typically evaluated in place per ASTM D1196 (also called modulus of subgrade reaction).
coefficient of thermal expansion — change in linear dimension per unit length per degree of temperature change.
coefficient of variation — the standard deviation divided by the mean value of a variable.
cold joint — a joint or discontinuity resulting from a delay in placement of sufficient duration to preclude intermingling and bonding of the material, or where mortar or plaster rejoin or meet.
cold strength — the compressive or flexural strength of refractory concrete determined before drying or firing.
cold weather — a period when the average daily ambient temperature is below 40°F (5°C) for more than 3 successive days.
Note: The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50°F (10°C) occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.
cold-drawn wire — wire made from rods that are hot-rolled from billets and then cold-drawn through dies. (See also cold-drawn wire reinforcement.)
cold-drawn wire reinforcement — steel wire made from rods that have been hot rolled from billets and cold-drawn through a die.
cold-joint lines — visible lines on the surfaces of formed concrete indicating the presence of discontinuities where one layer of concrete had reached final set before subsequent concrete was placed. (See also cold joint.)
cold-worked steel reinforcement — steel bars or wires that have been rolled, twisted, or drawn at normal ambient temperatures.
colemanite — a mineral, hydrated calcium borate (Ca₅B₆O₁₁·5H₂O). (See also boron-loaded concrete.)
colloidal grout — grout in which a substantial proportion of the solid particles have the size range of a colloid.
colloidal mixer — a mixer designed to produce colloidal grout.
colorimetric value — an indication of the amount of organic impurities present in fine aggregate.
column — member with a ratio of height-to-least-lateral-dimension exceeding 3 used primarily to support axial compressive load.
column capital — an enlargement of a column below a slab intended to increase the shearing resistance.
column clamp — any of various types of tying or fastening units to hold column form sides together.
column side — one of the vertical panel components of a column form.
column strip — the portion of a flat slab over the columns and consisting of the two adjacent quarter panels on each side of the column center line.
combined footing — a structural unit or assembly of units supporting more than one column.
combined-aggregate grading — particle-size distribution of a mixture of fine and coarse aggregate.
come-along — (1) a hoe-like tool with a blade approximately 4 in. (100 mm) high and 20 in. (500 mm) wide and curved from top to bottom, used for spreading concrete; (2) a colloquial name for a device (load binder) used to tighten chains holding loads in place on a truck bed.
compacted strand — prestressing strand that is drawn through a circular die to deform the wires and produce a strand with a smaller circular shape.
compacting factor — the ratio obtained by dividing the observed mass of concrete that fills a container of standard size and shape when allowed to fall into it under standard conditions of test by the mass of fully compacted concrete that fills the same container.
compaction — the process of reducing the volume of voids in a material such as soil by input of mechanical energy. (See also consolidation.)
composite — engineering materials made from two or more constituent materials that remain distinct but combine to form materials with properties not possessed by any of the constituent materials individually.
composite column — a concrete compression member reinforced longitudinally with structural steel shapes, pipe, or tubing with or without longitudinal reinforcing bars.
composite concrete flexural members — concrete flexural members consisting of concrete elements constructed in separate placements but so interconnected that the elements respond to loads as a unit.
composite construction — a type of construction using members produced by combining different materials (for example, concrete and structural steel), members produced by combining cast-in-place and precast concrete, or cast-in-place concrete elements constructed in separate placements but so interconnected that the combined components act together as a single member and respond to loads as a unit.
composite pile — a pile made up of different materials, usually concrete and wood, or steel fastened together end to end, to form a single pile.
composite sample — sample obtained by blending two or more individual samples of a material.
compression flange — the widened portion of an I, T, or similar cross-sectional beam that is compressed by bending under normal loads.
compression member — any member in which the primary stress is longitudinal compression.
compression reinforcement — reinforcement designed to carry compressive stresses. (See also stress.)
compression test — test made on a test specimen of mortar or concrete to determine the compressive strength.
concentric tendons — tendons following a line coincident with the gravity axis of the prestressed concrete member.
concordant tendon — a tendon with a profile that does not produce secondary moments and support reactions due to the prestressing force.
concrete — mixture of hydraulic cement, aggregates, and water, with or without admixtures, fibers, or other cementitious materials.
concrete block — a concrete masonry unit, usually containing hollow cores.
concrete breakout failure — a concrete failure mode that develops a cone or edge failure of the test member due to setting of the anchor or to applied loads.
concrete brick — solid concrete masonry units of relatively small prescribed dimensions.
concrete cart — see buggy.
concrete compressive strength — the measured maximum resistance of a concrete specimen to axial compressive loading and expressed as force per unit cross sectional area.
concrete containment structure — a composite concrete and steel assembly that is designed as an integral part of a pressure retaining barrier that, in an emergency, prevents the release of radioactive or hazardous effluents from nuclear power plant equipment enclosed therein.

concrete finishing machine — (1) a machine mounted on flanged wheels that ride on forms or on specially set tracks, used to finish surfaces such as those of pavements; (2) a portable power-driven machine for floating and finishing of floors and other slabs.

concrete flatwork — a general term applicable to concrete floors and slabs that require finishing operations.

concrete masonry unit — either a hollow or solid unit (block) composed of portland-cement concrete.

concrete paver — (1) a slipforming machine that places concrete pavement on the subgrade; (2) precast-concrete paving brick.

concrete pile — see cast-in-place pile and precast pile.

concrete pryout strength — the strength corresponding to formation of concrete spall behind short, stiff anchors displaced in the direction opposite to the applied shear force.

concrete pump — an apparatus that forces concrete to the placing position through a pipeline or hose.

concrete reactor vessel — a composite concrete and steel assembly that functions as a component of the principal pressure-containing barrier for the nuclear fuel’s primary heat extraction fluid (primary coolant).

concrete spreader — a machine, usually carried on side forms or on rails parallel thereto, designed to spread concrete from heaps already dumped in front of it, or to receive and spread concrete in a uniform layer.

concrete strength — see concrete compressive strength, fatigue strength, flexural strength, shear strength, splitting tensile strength, tensile strength, and ultimate strength.

concrete vibrating machine — a machine that consolidates a layer of freshly mixed concrete by vibration.

condensed silica fume — see silica fume (preferred term).

cone bolt — a type of tie rod for wall forms with cones at each end inside the forms so that a bolt can act as a spreader as well as a tie.

confined concrete — concrete within the reinforcement cage.

confined region — region with transverse reinforcement within beam-column joints.

consistency — the degree to which a freshly mixed concrete, mortar, grout, or cement paste resists deformation. (See also normal consistency, plastic consistency, and wettest stable consistency.)

consistency factor — a measure of grout fluidity, roughly analogous to viscosity, which describes the ease with which grout may be pumped into voids or fissures; usually a laboratory measurement in which consistency is reported in degrees of rotation of a torque viscosimeter in a specimen of grout.

consistometer — an apparatus for measuring the consistency of cement pastes, mortars, grouts, or concretes.

consolidation — the process of reducing the volume of voids, air pockets, and entrapped air in a fresh cementitious mixture, usually accomplished by inputting mechanical energy. (See also compaction, vibration, rodding, and tamping.)

construction joint — interface between concrete placements intentionally created to facilitate construction.

construction loads — the loads to which a permanent or temporary structure is subjected during construction.

contact ceiling — a ceiling that is secured in direct contact with the construction above without use of furring.

contact pressure — pressure acting at and perpendicular to the contact area between soil and a concrete element.

contact splice — a means of connecting reinforcing bars in which the bars are lapped and in direct contact. (See also lap splice.)

continuous beam — see continuous slab or beam.
continuous grading — a particle size distribution in which intermediate size fractions are present, as opposed to gap-grading. (See also gap-graded aggregate.)

continuous mixer — a mixer into which the ingredients of the mixture are fed without stopping, and from which the mixed product is discharged in a continuous stream.

continuous mixing — producing concrete by continuously blending ingredients in fixed proportions. The discharge of the concrete mixture may be started or stopped as required.

continuous sampling — sampling without interruptions throughout an operation or for a predetermined time.

continuous slab or beam — a slab or beam that extends as a unit over three or more supports in a given direction.

continuously reinforced pavement — a pavement with uninterrupted longitudinal steel reinforcement and no intermediate transverse expansion or contraction joints.

contract documents — a set of documents supplied by the owner to the contractor as the basis for construction. These documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

contraction joint — formed, sawed, or tooled groove in a concrete structure to create a weakened plane to regulate the location of cracking resulting from the dimensional change of different parts of the structure. (See also isolation joint, expansion joint, and construction joint.)

contraction-joint grouting — injection of grout into contraction joints.

contractor — the person, firm, or corporation with whom the owner enters into an agreement for construction of the work.

control joint — formed, sawed, or tooled groove in a concrete structure to create a weakened plane to regulate the location of cracking resulting from the dimensional reduction of adjacent sections of the structure.

controlled low-strength material (CLSM) — self-consolidating cementitious mixture that is intended to result in a compressive strength of 1200 psi (8.3 MPa) or less.

conveying hose — see delivery hose (preferred term).

conveyor — a device for moving materials, usually a continuous belt, an articulated system of buckets, a confined screw, or a pipe through which material is moved by air or water.

coping — the material or units used to form a cap or finish on top of a wall, pier, pilaster, or chimney.

corbel — a projection from the face of a beam, girder, column, or wall used as a beam seat or a decoration.

core (n.) — (1) the soil material enclosed within a tubular pile after driving (it may be replaced with concrete); (2) the mandrel used for driving casings for cast-in-place piles; (3) a structural shape used to internally reinforce a drilled-in-caisson; (4) a cylindrical sample of hardened concrete or rock obtained by means of a core drill; (5) the molded open space in a concrete masonry unit or precast concrete unit (see also blockout); (6) the area enclosed by ties or spiral reinforcement in a concrete column.

core (v.) — the act of obtaining cores from concrete structures, rock foundations, or soils.

core test — compression test on a concrete specimen cut from hardened concrete by means of a core drill.

cored beam — a beam whose cross section is partially hollow or a beam from which cored samples of concrete have been taken.

coriuging — the act of obtaining cores from hardened concrete or masonry structures, rock, or soil.

corner reinforcement — (1) concrete reinforcement used at wall intersections or near corners of square or rectangular openings in walls, slabs, or beams; (2) metal reinforcement for plaster at reentrant corners to provide continuity between two intersecting planes.

corrosion — deterioration of a material, usually a metal, that results from a chemical reaction with its environment.
**corrosion inhibitor** — a chemical compound that effectively decreases corrosion rate of steel reinforcement without reducing the concentration of the corrosive agent at the bar level.

**cotton mats** — cotton-filled quilts fabricated for use as a water-retaining covering in curing concrete surfaces.

**coupler** — (1) a device for connecting reinforcing bars or prestressing tendons end to end; (2) a device for locking together the component parts of a tubular metal scaffold (also known as a clamp); (3) internal threaded device for joining reinforcing bars with matching threaded ends for the purpose of providing transfer of either axial compression, axial tension, or both from one bar to the other. (See also **coupling sleeve**, **end-bearing sleeve**, and **mechanical connection**.)

**coupling agent** — a substance used between the transducer and test surface to permit or improve transmission of ultrasonic energy.

**coupling sleeve** — device fitting over the ends of two reinforcing bars for the eventual purpose of providing transfer of either axial compression or axial tension or both from one bar to the other. (See also **coupler**, **end-bearing sleeve**, and **mechanical connection**.)

**course** — in concrete construction, a horizontal layer of concrete, usually one of several making up a lift; in masonry construction, a horizontal layer of block or brick. (See also **lift**.)

**cover** — the least distance between the surface of embedded reinforcement and the surface of the concrete.

**crack** — a complete or incomplete separation of either concrete or masonry into two or more parts produced by breaking or fracturing. (See also **fracture**.)

**crack-control reinforcement** — reinforcement in concrete construction designed to minimize opening of cracks, often effective in limiting them to uniformly distributed small cracks. (See also **shrinkage reinforcement** and **temperature reinforcement**.)

**cracked section** — a section designed or analyzed on the assumption that concrete has no resistance to tensile stress.

**cracking load** — the load that causes tensile stress in a member to exceed the tensile strength of the concrete.

**craze cracks** — fine random cracks or fissures in a surface of plaster, cement paste, mortar, or concrete.

**crazing** — the development of craze cracks; the pattern of craze cracks existing in a surface. (See also **checking** and **crack**.)

**creep** — time-dependent deformation due to sustained load.

**critical saturation** — a condition describing the degree of filling by freezeable water of a pore space in cement paste or aggregate that affects the response of the material to freezing; usually taken to be 91.7 percent because of the 9 percent increase in volume of water undergoing the change of state to ice.

**cross bracing** — crossing members usually designed to act only in tension, often used in scaffolding systems. (See also **sway brace** and **X-brace**.)

**cross section** — (1) a plane through a body perpendicular to a given axis of the body; (2) a drawing showing such a plane.

**crush plate** — an expendable strip of wood attached to the edge of a form or intersection of fitted forms to protect the form from damage during prying, pulling, or other stripping operations.

**crushed gravel** — the product resulting from the artificial crushing of gravel with a specified minimum percentage of fragments having one or more faces resulting from fracture. (See also **coarse aggregate**.)

**crushed stone** — the product resulting from the artificial crushing of rocks, boulders, or large cobblestones, substantially all faces of that possess well-defined edges resulting from the crushing operation. (See also **coarse aggregate**.)

**crusher-run aggregate** — aggregate that has been mechanically broken and has not been subjected to subsequent screening.
cube strength — concrete compressive strength determined using a standard cube test specimen. (See also concrete compressive strength.)
cumulative batching — measuring more than one ingredient of a batch in the same container by bringing the batcher scale into balance at successive total weights as each ingredient is accumulated in the container.
curing — action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop.
curing agent — a catalytic or reactive agent that induces cross-linking in a thermosetting resin. (See also hardener.)
curing blanket — a covering of sacks, matting, burlap, straw, waterproof paper, or other suitable material placed over freshly finished concrete. (See also burlap.)
curing compound — a liquid applied to the surface of newly placed concrete that retards the loss of water and, if pigmented, reflects sunlight. (See also curing and membrane curing.)
curing cycle — see autoclave.
curing delay — see presteaming period (preferred term).
curing kiln — see autoclave curing.
curing membrane — see membrane curing and curing compound.
curing — out-of-plane deformation of the corners, edges, and surface of a pavement, slab, or wall panel from its original shape. (See also warping.)
curtain grouting — injection of grout into a subsurface formation in such a way as to create a zone of grouted material transverse to the direction of anticipated water flow.
curvature friction — friction resulting from bends or curves in the specified prestressing cable profile.
cutting screed — sharp-edged tool used to trim shotcrete to the finished outline. (See also rod.)
cylinder strength — see concrete compressive strength and splitting tensile strength.
dampproofing — treatment of concrete or mortar to retard the passage or absorption of water or water vapor either by application of a suitable coating to exposed surfaces, or by use of a suitable admixture or treated cement, or by use of a preformed film such as polyethylene sheets placed on ground before placing a slab. (See also vapor retarder.)
darby — a hand-manipulated straightedge, usually 3 to 8 ft (1 to 2.5 m) long, used in the early stage leveling operations of concrete or plaster, preceding supplemental floating and finishing.
dash-bond coat — a thick slurry of portland cement, sand, and water flicked on surfaces with a paddle or brush to provide a base for subsequent portland cement plaster coats, sometimes used as a final finish on plaster.
davit — a device used to support and swing the access covers away from openings of vessels and tanks.
D-cracking — a series of cracks in concrete near and roughly parallel to joints and edges resulting from use of coarse aggregate that is susceptible to damage during cycles of freezing and thawing.
dead end — in the stressing of a tendon from one end only, the end opposite that to which the load is applied.
dead load — (1) the weights of the structural members, supported structure, and permanent attachments or accessories that are likely to be present on a structure in service; (2) loads meeting specific criteria found in the governing building code (without load factors).
dead-end anchorage — the anchorage at that end of a tendon that is opposite the jacking end.
deadman — an anchor for a guy line, usually a beam, block, or other heavy item buried in the ground, to which a line is attached.
debonding — (1) preventing bond of prestressing tendons to surrounding concrete; (2) bond failure at the interface between a substrate and a strengthening or repair system.
decentering — lowering or removing centering or shoring.

dek — the form on which concrete for a slab is placed, also the floor or roof slab itself. (See also bridge deck.)

decking — sheathing material for a deck or slab form.

decorative concrete — concrete that has received treatments to create aesthetic effects. These treatments may include coloring, polishing, texturing, embossing, molding, etching, applying cementitious toppings, embedding items, or a combination of these.

deflected tendons — see draped tendons (preferred term).

deflection — movement of a point on a structure or structural element, usually measured as a linear displacement or as succession displacements transverse to a reference line or axis.

deformation — a change in dimension or shape. (See also expansion, creep, length change, volume change, shrinkage, and time-dependent deformation.)

defomed bar — a reinforcing bar with a manufactured pattern of surface ridges intended to reduce slip and increase pullout resistance of bars embedded in concrete.

defomed reinforcement — metal bars, wire, or reinforcement with a manufactured pattern of surface ridges that provide a locking anchorage with surrounding concrete.

defomed tie bar — see tie bar.

dehydrate — removal of chemically bound, adsorbed, or absorbed water from a material.

decer — a chemical, such as sodium or calcium chloride, used to melt ice or snow on slabs and pavements; such melting being due to depression of the freezing point.

delamination — a planar separation in a material that is roughly parallel to the surface of the material.

delay — see presteaming period.

delayed ettringite formation — a form of sulfate attack by which mature hardened concrete is damaged by internal expansion during exposure to cyclic wetting and drying in service and caused by the late formation of ettringite, not because of excessive sulfate; not likely to occur unless the concrete has been exposed to temperatures during curing of 158°F (70°C) or greater and less likely to occur in concrete made with pozzolan or slag cement. (See also ettringite.)

delivery hose — hose through which shotcrete, grout, or pumped concrete or mortar passes (also called conveying hose or material hose).

demold — to remove molds from concrete test specimens or precast products. (See also strip.)

dense-graded aggregate — aggregates graded to produce low void content and maximum density when compacted. (See also well-graded aggregate.)

density — mass per unit volume.

density (dry) — the mass per unit volume of a dry substance at a stated temperature.

density control — control of density of concrete in field construction to ensure that specified values as determined by standard tests are obtained.

design load — applicable loads and forces or their related internal moments and forces used to proportion members.

design strength — nominal strength multiplied by a strength reduction factor $\phi$. (See also nominal strength and phi factor.)

deterioration — (1) physical manifestation of failure of a material (for example, cracking, delamination, flaking, pitting, scaling, spalling, and staining) caused by environmental or internal autogenous influences on rock and hardened concrete as well as other materials; (2) decomposition of material during either testing or exposure to service. (See also disintegration and weathering.)

development bond stress — see anchorage bond stress (preferred term).

development length — the bonded length required to achieve the design strength of a reinforcement at a critical section.
devils float — a wooden float with two nails protruding from the toe used to roughen the surface of a brown plaster coat. (See also texturing.)
diagonal crack — (1) in a flexural member, an inclined crack caused by shear stress, usually at approximately 45 degrees to the axis; (2) a crack in a slab, not parallel to either the lateral or longitudinal directions.
diagonal cracking — development of diagonal cracks. (See also diagonal tension.)
diagonal tension — the principal tensile stress resulting from the combination of normal and shear stresses acting upon a structural element.
diametral compression test — see splitting tensile test.
diamond mesh — a metallic fabric having rhomboidal openings in a geometric pattern. (See also expanded-metal lath.)
diatomaceous earth — a friable earthy material composed primarily of nearly pure hydrous amorphous silica (opal) in the form of frustules of the microscopic plants called diatoms.
dicalcium silicate — a compound having the composition 2CaO·SiO₂, abbreviated C₂S, an impure form of which occurs in portland-cement clinker (belite). (See also belite.)
differential thermal analysis (DTA) — indication of thermal reaction by differential thermocouple recording of temperature changes in a sample under investigation compared with those of a thermally passive control sample, both of which are subjected simultaneously to the same heating condition.
dilation — an expansion of concrete during cooling or freezing generally calculated as the maximum deviation from the normal thermal contraction predicted from the length change/temperature curve or length change/time curve established at temperatures before initial freezing.
direct dumping — discharge of concrete directly into place from crane bucket or mixer.
discoloration — departure of color from that which is normal or desired.
disintegration — reduction into small fragments and subsequently into particles. (See also deterioration and weathering.)
dispersing agent — a material capable of increasing the fluidity of pastes, mortars, or concretes by reduction of inter-particle attraction.
distortion — see deformation
distress — physical manifestation of cracking and distortion in a concrete structure as the result of stress, chemical action, or both.
distribution-bar reinforcement — small diameter bars, usually at right angles to the main reinforcement, intended to spread a concentrated load on a slab and to prevent cracking.
D-line cracks — see D-cracking (preferred term).
dome — square prefabricated pan form used in two-way (waffle) concrete joist floor construction.
dormant crack — a crack whose width does not change with time.
double-tee beam — a precast-concrete member composed of two stems and a combined top flange, commonly used as a beam but also used vertically in exterior walls.
double-up — a method of plastering characterized by application in successive operations with no setting or drying time between coats.
dowel — (1) a steel pin, commonly a plain or coated round steel bar that extends into adjoining portions of a concrete construction, as at an expansion or contraction joint in a pavement slab, so as to transfer shear loads; (2) a deformed reinforcing bar intended to transmit tension, compression, or shear through a construction joint.
dowel rod — see dowel (preferred term).
dowel-bar reinforcement — see dowel.

drainage fill — (1) base course of granular material placed between floor slab and subgrade to impede capillary rise of moisture; (2) lightweight concrete placed on floors or roofs to promote drainage.
draped tendons — tendons that have a trajectory that is curved or bent with respect to the gravity axis of the concrete member.
drier — chemical that promotes oxidation or drying of a paint or adhesive.
drilled pier — a concrete pier with or without a casing, cast in place in a hole previously bored in soil or rock. (See also cast-in-place pile.)

drilled pile — see drilled pier.

drilled-in caisson — cast-in-place pile formed by driving an open-ended steel pipe into bedrock or other bearing layer, cleaning out the pipe, drilling a socket into the bedrock or other bearing layer, and placing the steel reinforcement and concrete (also called caisson foundation or caisson).

drip — a transverse groove in the underside of a projecting piece of wood, stone, or concrete to prevent water from flowing back to a wall.

drop panel — the thickened structural portion of a flat slab in the area surrounding column, column capital, or bracket to reduce the intensity of stresses.

drop chute — a device used to confine or to direct the flow of a falling stream of fresh concrete.

(1) articulated drop chute — a device consisting of a succession of tapered metal cylinders so designed that the lower end of each cylinder fits into the upper end of the one below

(2) flexible drop chute — a device consisting of a heavy rubberized canvas or plastic collapsible tube.

dry mix — (1) a concrete, mortar, or plaster mixture, commonly sold in bags, containing all components except water; (2) a concrete of near-zero slump.

dry mixing — blending of the solid materials for mortar or concrete before adding the mixing water.

dry pack — concrete or mortar mixtures deposited and consolidated by dry packing.

dry packing — placing of zero-slump, or near zero-slump, concrete, mortar, or grout by ramming into a confined space.

dry process — in the manufacture of cement, the process in which the raw materials are ground, conveyed, blended, and stored in a dry condition. (See also wet process.)

dry rodding — in measurement of the mass per unit volume of coarse aggregates, the process of consolidating dry material in a calibrated container by rodding under standardized conditions.

dry topping — see dry-shake (preferred term)

dry-batch weight — the mass of the materials, excluding water, used to make a batch of concrete.

dry-cast process — a process for producing concrete products, such as pipe, using low-frequency high-amplitude vibration to consolidate dry-mix concrete in the form. (See also centrifugal process, packerhead process, tamp process, and wet-cast process.)

dry-mix shotcrete — shotcrete in which most of the mixing water is added at the nozzle (also called dry-process shotcrete).

dry-packed concrete — concrete placed by dry packing.

dry-rod density — mass per unit volume of dry aggregate, which includes the volume of the particles and the voids between particles, compacted by rodding under standardized conditions.

dry-rodded volume — the bulk volume occupied by a dry aggregate compacted by rodding under standardized conditions; used in measuring density of aggregate.

dry-rodded weight — (deprecated term) see dry-rodded density.

dry-shake — a dry mixture of hydraulic cement and fine aggregate (either mineral or metallic) that is distributed evenly over the surface of concrete flatwork and worked into the surface before time of final setting and then floated and troweled to desired finish.

dry-tamp process — see dry packing (preferred term).

drying creep — creep caused by drying. (See also creep and basic creep.)

drying shrinkage — shrinkage resulting from loss of moisture.

duct — the material creating a conduit in a concrete member to accommodate the prestressing steel of a post-tensioning tendon.

ductility — the ability of a material to undergo large permanent deformation without rupture.
Dunagan analysis — (obsolete) a method of separating the ingredients of freshly mixed concrete or mortar to determine the proportions of the mixture.

durability — the ability of a material to resist weathering action, chemical attack, abrasion, and other conditions of service.

durability factor — (1) a measure of the change in a material property over a period of time as a response to exposure to a treatment that can cause deterioration, usually expressed as percentage of the value of the property before exposure; (2) in ASTM C666/C666M, a measure of the effects of freezing and thawing action on concrete specimens.

dust of fracture (in aggregate) — rock dust created during production, processing, or handling.

dusting — the development of a powdered material at the surface of hardened concrete.

dynamic analysis — analysis of stresses in framing as functions of displacement under transient loading.

dynamic load — an imposed load that is in motion and may vary with time in magnitude or direction.

dynamic loading — loading from units (particularly machinery) that, by virtue of their movement or vibration, impose stresses in excess of those imposed by their dead load.

dynamic modulus of elasticity — the modulus of elasticity computed from the size, mass, shape, and fundamental frequency of vibration of a concrete test specimen, or from pulse velocity. (See also pulse velocity.)

early age (of concrete) — the period after final setting during which properties are changing rapidly.

early stiffening — the early development of an abnormal reduction in the working characteristics of a hydraulic-cement paste, mortar, or concrete, which may be further described as false setting, quick setting, or flash setting.

early strength — strength of concrete or mortar usually as developed at various times during the first 72 hours after placement.

early-entry dry cut saw — a tool designed to cut joints in concrete commencing 1 to 4 hours after finishing and without raveling the cut edges.

eccentric tendon — a prestressing tendon that follows a trajectory not coincident with the gravity axis of the concrete member.

edge beam — a stiffening beam at the edge of a slab.

edge form — formwork used to limit the horizontal spread of fresh concrete on flat surfaces such as pavements or floors.

edge reinforcement — tensile reinforcement sometimes used to strengthen otherwise inadequate edges in a slab without resorting to edge thickening.

edger — a finishing tool used on the edges of fresh concrete to provide a rounded edge.

edging — the operation of tooling the edges of a fresh concrete slab to provide a rounded corner.

effective area of concrete — area of a concrete section assumed to resist shear or flexural stresses.

effective depth — depth of a beam or slab section measured from the compression face to the centroid of the tensile reinforcement.

effective flange width — width of slab adjoining a beam stem where the slab is assumed to function as the flange element of a T-beam section.

effective prestress — stress remaining in prestressing steel after all losses have occurred (also called final prestress or final stress).

effective span — the lesser of the two following distances: (a) the distance between supports; (b) the clear distance between supports plus the effective depth of the beam or slab.

effective stress — see effective prestress

effective width of slab — that part of the width of a slab taken into account when designing T- or L-beams.

efflorescence — a generally white deposit formed when water-soluble compounds emerge in solution from concrete, masonry, or plaster substrates and precipitate by reaction such as carbonation or crystallize by evaporation.
elastic design — design based on a linear distribution of flexural stresses and strains and corresponding limiting elastic properties of the material.

elastic limit — the limit of stress beyond which the strain is not wholly recoverable.

elastic loss — in prestressed concrete, the reduction in prestressing load resulting from the elastic shortening of the member.

elastic shortening — in prestressed concrete, the shortening of a member that occurs immediately on the application of forces induced by prestressing.

elasticity — that property of a material by virtue of which it tends to recover its original size and shape after deformation.

electrical curing — a system in which a favorable temperature is maintained in freshly placed concrete by supplying heat generated by electrical resistance.

electrolysis — production of chemical changes by the passage of current through an electrolyte.

electrolyte — a conducting medium in which the flow of current is accompanied by movement of matter; usually an aqueous solution.

elephant trunk — an articulated tube or chute used in concrete placement. (See also dropchute and tremie.)

elongated piece (of aggregate) — particle of aggregate for which the ratio of the length to the width of its circumscribing rectangular prism is greater than a specified value. (See also flat piece of aggregate.)

elongation — increase in length. (See also expansion, elastic shortening, and swelling.)

embedment length — the length of embedded reinforcement provided beyond a critical section.

emery — a rock consisting essentially of an intercrystalline mixture of corundum and either magnetite or hematite. (See also dry-shake.)

emulation — designing precast elements and their structural connections to perform as if the structure was a conventional cast-in-place concrete structure.

emulative detail — a connection in which the structural performance is equivalent to that of a continuous member or a monolithic connection.

emulsion — a two-phase liquid system in which small droplets of one liquid (the internal phase) are immiscible in, and dispersed uniformly throughout, a second continuous liquid phase (the external phase).

enclosure wall — a nonload-bearing wall intended only to enclose space.

encrustation — see incrustation (preferred term).

end anchorage — (1) length of reinforcement, mechanical anchor, hook, or combination thereof, beyond the point of nominal zero stress in the reinforcement of cast-in-place concrete; (2) mechanical device to transmit prestressing force to the concrete in a post-tensioned member. (See also anchorage.)

end block — an enlarged end section of a member intended to reduce anchorage stresses to allowable values and provide space needed for post-tensioning anchorages.

end-bearing sleeve — device fitting over the abutting ends of two reinforcing bars for the purpose of assuring transfer of only axial compression from one bar to the other. (See also coupler, coupling sleeve, and mechanical connection.)

endothermic reaction — a chemical reaction that occurs with the absorption of heat.

engineer-architect — see architect-engineer.

entrained air — microscopic air bubbles intentionally incorporated in mortar or concrete during mixing, usually by use of a surface-active agent; typically between 10 μm (0.004 in.) and 1 mm (0.04 in.) in diameter and spherical or nearly so. (See also air entrainment.)

entrapped air — air voids incorporated into concrete during mixing that are mainly irregular in shape and usually 1 mm (0.04 in.) or larger in size.

epoxy — a thermosetting polymer that is the reaction product of epoxy resin and an amino hardener. (See also epoxy resin.)

epoxy concrete — a mixture of epoxy resin and hardener, fine aggregate, and coarse aggregate. (See also polymer concrete, mortar, epoxy, and epoxy resin.)

epoxy grout — a grout consisting of an epoxy bonding system, aggregate or fillers, and possibly other materials.
epoxy mortar — a mixture of epoxy resin, hardener, and fine aggregate. (See also epoxy resin.)

epoxy resin — a class of organic chemical bonding systems used in the preparation of special coatings or adhesives for concrete or as binders in epoxy-resin mortars, concretes, and fiber reinforced polymer composites.

epoxy-coated bar — a reinforcing bar coated with an epoxy resin.

equilibrium density — the density reached by structural lightweight concrete after exposure to relative humidity of 50 ± 5 percent and a temperature of 73.5 ± 3.5°F (23 ± 2°C) for a period of time sufficient to reach a density that changes less than 0.5 percent in a period of 28 days.

equivalent embedment length — the length of embedded reinforcement that can develop the same stress as that which can be developed by a hook or mechanical anchorage.

equivalent fiber diameter — diameter of a circle having an area equal to the average cross-sectional area of a fiber.

equivalent rectangular stress distribution — an assumption of uniform stress on the compression side of the neutral axis in the strength design method to determine flexural capacity.

erosion — progressive loss of material from a solid surface due to a mechanical interaction between that surface and a fluid, a multi-component fluid, or solid particles carried with the fluid. (See also abrasion damage and cavitation damage.)

ettringite — (1) a mineral, high-sulfate calcium sulfoaluminate (3CaO·Al2O3·3CaSO4·30-32H2O), occurring in nature or formed by sulfate attack on mortar and concrete; (2) the product of the principal expansion-producing reaction in expansive cements.

evaporable water — water in set cement paste present in capillaries or held by surface forces; measured as that removable by drying under specified conditions. (See also nonevaporable water.)

evaporation reducer — see evaporation retardant.

evaporation retardant — a material applied to the surface of concrete before initial setting to reduce the evaporation rate of water without interfering with finishing operations (also called evaporation reducer). (See also monomolecular.)

exfoliation — disintegration occurring by peeling off in successive layers, swelling up and opening into leaves or plates like a partly opened book.

exothermic reaction — a chemical reaction that occurs with the evolution of heat.

expanded blast-furnace slag — see blast-furnace slag.

expanded shale (clay or slate) — lightweight vesicular aggregate obtained by firing suitable raw materials in a rotary kiln or on a sintering grate under controlled conditions.

expanded-metal fabric reinforcement — see expanded-metal lath.

expanded-metal lath — a metal network, often used as reinforcement in construction, formed by suitably stamping or cutting sheet metal and stretching it to form open meshes, either of diamond-shaped or rhomboidal-shaped openings. (See also diamond mesh.)

expansion — increase in either length or volume. (See also shrinkage, volume change, and autogenous volume change.)

expansion joint — (1) a separation provided between adjacent sections of a concrete structure to allow movement due to dimensional increases and reductions of the adjacent sections and through which some or all of the bonded reinforcement is interrupted; (2) a separation between pavement slabs on ground, filled with a compressible filler material.

expansion sleeve — a tubular metal covering for a dowel bar to allow its free longitudinal movement at a joint.

expansive cement — a cement that when mixed with water produces a paste that after setting increases in volume to a greater degree than does portland-cement paste. (1) Type K expansive cement — a mixture of portland cement, anhydrous tetracalcium trialuminate sulfate (C4A3S), calcium sulfate (CaSO4), and lime (CaO).

(2) Type M expansive cement — interground or blended mixtures of portland cement and calcium sulfate suitably proportioned.
(3) **Type S expansive cement** — a portland cement containing a high computed tricalcium aluminate (C₃A) content and an amount of calcium sulfate above the usual amount found in portland cement.

**expansive component** — the portion of an expansive cement that is responsible for the expansion, generally one of several anhydrous calcium aluminate or sulfoaluminate compounds and a source of sulfate, with or without free lime (CaO).

**exposed-aggregate finish** — a decorative finish for concrete work achieved by removing, generally before the concrete has hardened, the outer skin of mortar and exposing the coarse aggregate.

**exposure class** — designation used to describe environmental conditions to which concrete will be exposed.

**extender** — a finely divided inert mineral added to provide economical bulk in paints, synthetic resins and adhesives, or other products.

**extensibility** — that property by virtue of which a material can undergo extension or elongation following the application of force.

**exterior panel** — in a flat slab, a panel having at least one edge that is not in common with another panel.

**external vibrator** — see vibrator.

**extreme compression fiber** — farthest fiber from the neutral axis on the compression side of a member subjected to bending.

**extreme tension fiber** — farthest fiber from the neutral axis on the tension side of a member subjected to bending.

**exudation** — a liquid or viscous gel-like material discharged through a pore, crack, or opening in the surface of concrete.

**factor of safety** — the ratio of the ultimate capacity to the magnitude of the demand at the service level.

**factored load** — load, multiplied by appropriate load factors, used to proportion members by the strength-design method.

**false header** — see header.

**false setting** — the rapid development of rigidity in a freshly mixed portland cement paste, mortar, or concrete without the evolution of much heat, which rigidity can be dispelled and plasticity regained by further mixing without addition of water. (See also flash setting.)

**falsework** — the temporary structure erected to support work in the process of construction. (See also formwork.)

**fascia** — a flat member or band at the surface of a building or the edge beam of a bridge; also exposed eave of a building.

**fastener** — a device designed to attach, join, or hold two or more objects one to another.

**fatigue** — the weakening of a material by repeated loads.

**fatigue failure** — rupture of a material, when subjected to repeated loadings, at a stress substantially less than the static strength.

**fatigue strength** — the greatest stress that can be sustained for a given number of stress cycles without failure.

**faulting** — differential displacement of a slab or wall along a joint or crack.

**feather edge** — the edge of a concrete or mortar patch or topping that is beveled at an acute angle.

**feed wheel** — material distributor or regulator in certain types of shotcrete equipment.

**ferrocement** — a composite structural material comprising thin sections consisting of cement mortar reinforced by a number of closely spaced layers of steel wire mesh.

**fiber** — a slender and elongated solid material, generally with a length at least 100 times its diameter.

**fiber aspect ratio** — the ratio of length to diameter of a fiber in which the diameter may be an equivalent diameter. (See also equivalent fiber diameter.)

**fiber count** — the number of fibers in a unit volume of fiber-reinforced concrete.

**fiber-reinforced concrete** — concrete containing dispersed, randomly oriented fibers.
fiber-reinforced polymer (FRP) — a general term for a composite material comprising a polymer matrix reinforced with fibers in the form of fabric, mat, strands, or any other fiber form. (See composite.)

field bending — bending of reinforcing bars at the job site rather than in a fabricating shop.

field concrete — concrete delivered to or mixed, placed, and cured on the job site.

field-cured cylinders — test cylinders that are left at the job site for curing as nearly as practicable in the same manner as the concrete in the structure to indicate when supporting forms may be removed, additional construction loads may be imposed, or the structure may be placed in service.

field-proportioned grout — a hydraulic-cement grout batched at the job site using water and predetermined portions of hydraulic cement, aggregate, and other ingredients.

filler — (1) a finely divided, relatively inert material (such as pulverized limestone, silica, or colloidal substances) added to portland cement, paint, resin, or other materials to reduce shrinkage, improve workability, reduce cost, or reduce density; (2) material used to fill an opening in a form.

fillet — see chamfer strip.

fin — (1) a narrow linear projection on a formed concrete surface, resulting from mortar flowing into spaces in the formwork; (2) a type of blade in a concrete mixer drum.

final curing — deliberate action taken between the final finishing and termination of curing to reduce the loss of water from the surface of the concrete and control the temperature of the concrete.

final prestress — see effective prestress.

final setting — a degree of stiffening of a cementitious mixture greater than initial setting, generally stated as an empirical value indicating the time required for the cementitious mixture to stiffen sufficiently to resist, to an established degree, the penetration of a weighted test device. (See also initial setting.)

final setting time — the time required for a freshly mixed cement paste, mortar, or concrete to achieve final set. (See also initial setting time.)

final stress — see effective prestress (preferred term).

fine aggregate — (1) aggregate passing the 9.5 mm (3/8 in.) sieve, almost entirely passing the 4.75 mm (No. 4) sieve, and predominantly retained on the 75 mm (No. 200) sieve; (2) that portion of aggregate passing the 4.75 mm (No. 4) sieve and predominantly retained on the 75 mm (No. 200) sieve. (See also aggregate and sand.)

fine-grained soil — soil in which the smaller grain sizes predominate, such as fine sand, silt, and clay.

fineness — a measure of particle size.

fineness modulus — a factor obtained by adding the total percentages of material in the sample that are coarser than each of the following sieves (cumulative percentages retained), and dividing the sum by 100: 150 μm (No. 100), 300 μm (No. 50), 600 μm (No. 30), 1.18 mm (No. 16), 2.36 mm (No. 8), 4.75 mm (No. 4), 9.5 mm (3/8 in.), 19.0 mm (3/4 in.), 37.5 mm (1-1/2 in.), 75 mm (3 in.), and 150 mm (6 in.)

finish — the texture of a concrete surface after consolidating and finishing operations have been performed.

finish coat — (1) final thin coat of shotcrete in preparation for hand finishing; (2) final exposed coat of plaster or stucco.

finish grinding — (1) the final grinding of clinker into cement, with calcium sulfate in the form of gypsum or anhydrite generally being added; (2) the final grinding operation required for a finished concrete surface, for example, bump cutting of pavement, fin removal from structural concrete, and terrazzo floor grinding.

finish screens — vibrating horizontal screens operated at a batching plant so that an excessive amount of significant undersize material is removed.
finishing — leveling, smoothing, consolidating, and otherwise treating surfaces of fresh or recently placed concrete or mortar to produce desired appearance and service. (See also float and trowel.)

finishing machine — a power-operated machine used to produce the desired surface texture on a concrete slab.

fire clay — an earthy or stony mineral aggregate that has as the essential constituent hydrous silicates of aluminum with or without free silica and that is plastic when sufficiently pulverized and wetted, rigid when subsequently dried, and of suitable refractoriness for use in commercial refractory products.

fire resistance — (1) the property of a material or assembly to withstand fire or give protection from it; (2) the ability of building elements to confine a fire or, when exposed to fire, to continue to perform a given structural function, or both.

fired strength — the compressive or flexural strength of refractory concrete determined upon cooling after first firing to a specified temperature for a specified time.

flash coat — a thin coat of shotcrete used to cover minor blemishes on a concrete surface.

flash setting — the rapid development of rigidity in a freshly mixed portland cement paste, mortar, or concrete, characteristically with the evolution of considerable heat, which rigidity cannot be dispelled nor can the plasticity be regained by further mixing without addition of water (also called quick setting). (See also false setting.)

flashing — a thin impermeable sheet (narrow in comparison with its length) installed as a cover to exclude water from exposed joints and at roof valleys, hips, parapets, or intersections of roof and chimney.

flat jack — a hydraulic jack consisting of light gauge metal that is folded and welded to a flat shape that expands under internal pressure.

flat piece (of aggregate) — one in which the ratio of the width to thickness of its circumscribing rectangular prism is greater than a specified value. (See also elongated piece [of aggregate].)

flat plate — a flat slab without column capitals or drop panels. (See also flat slab.)

flat slab — a concrete slab reinforced in two or more directions and having drop panels, column capitals, or both. (See also flat plate.)

flexible pavement — a pavement structure that maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

flexural bond stress — in structural-concrete members, the stress between the concrete and the reinforcing element that results from the application of external load.

flexural rigidity — a measure of stiffness of a member, indicated by the product of modulus of elasticity and moment of inertia divided by the length of the member.

flexural strength — the measured maximum resistance of a concrete specimen to flexural loading and reported as modulus of rupture. (See also modulus of rupture.)

flint — a variety of chert. (See also chert.)

float — a tool (not a darby), usually of wood, aluminum, or magnesium used in finishing operations to impart a relatively even but still open texture to an unformed fresh concrete surface. (See also darby.)

float finish — a rough, granular concrete surface texture obtained by finishing with a float.

floating — smoothing and subsequent compaction and consolidation of the unformed concrete surface.

flow — (1) time-dependent irreversible deformation (see also creep); (2) a measure of the consistency of freshly mixed concrete, mortar, or cement paste expressed in terms of the increase in diameter of a molded truncated cone specimen after jiggling a specified number of times; (3) movement of uncured resin under gravity loads or differential pressure.
flow cone — (1) a device for measurement of grout consistency in which a predetermined volume of grout is permitted to escape through a precisely sized orifice, the time of efflux being used as the indication of consistency; (2) the mold used to prepare a specimen for the flow test.

flow line — detectable line on a concrete wall or column usually departing somewhat from horizontal, that shows where the concrete in one placement has flowed horizontally before succeeding placement has been made.

flow table — a flat, circular jigging device used in making flow tests for consistency of cement paste, mortar, or concrete. (See also flow [2].)

flow trough — a sloping trough used to convey concrete by gravity flow from either a truck mixer or a receiving hopper to the point of placement. (See also chute.)

flowable consistency — the consistency at which a grout will form a nearly level surface when lightly rodded; the consistency of a grout with at least 125 percent at five drops on the ASTM C230/C230M flow table and an efflux time through the ASTM C939 flow cone of more than 30 seconds.

flowing concrete — a cohesive concrete mixture with a slump greater than 7-1/2 in. (190 mm).

fluid consistency — (1) the consistency at which a grout will form a nearly level surface without vibration or rodding; (2) the consistency of a grout that has an efflux time of less than 30 seconds through an ASTM C939 flow cone.

fluidifier — an admixture employed in grout to increase fluidity without changing water content. (See also water-reducing admixture.)

fly ash — the finely divided residue that results from the combustion of ground or powdered coal and that is transported by flue gases from the combustion zone to the particle removal system.

flying forms — large prefabricated units of formwork incorporating support and designed to be moved from place to place.

foamed concrete — low-density concrete made by the addition of a prepared foam or by generation of gas within the fresh mixture.

fog curing — (1) storage of concrete in a moist room in which the desired high humidity is achieved by the atomization of water (see also moist room); (2) application of atomized water to concrete, stucco, mortar, or plaster.

fog room — see moist room (preferred term).

folded plate — (1) a framing assembly composed of sloping slabs in a hipped or gabled arrangement; (2) prismatic shell with open polygonal section.

footing — a structural element of a foundation that transmits loads directly to the soil.

form — a temporary structure or mold for the support of concrete while it is setting and gaining sufficient strength to be self-supporting. (See also formwork.)

form anchor — device used to secure formwork to previously placed concrete of adequate strength, normally embedded in the concrete during placement.

form coating — a liquid applied to formwork surfaces to promote easy release from the concrete, preserve the form material, or retard setting of the near-surface matrix for preparation of exposed-aggregate finishes.

form hanger — device used to support formwork from a structural framework (the dead load of forms, mass of concrete, and construction and impact loads must be supported).

form insulation — insulating material applied to the outside of forms between studs and over the top in sufficient thickness and air tightness to conserve heat of hydration to maintain concrete at required temperatures in cold weather.

form lining — materials used to line the concreting face of formwork either to impart a smooth or patterned finish to the concrete surface, to absorb moisture from the concrete, or to apply a set-retarding chemical to the formed surface. (See also sheathing.)

form oil — oil applied to the interior surfaces of forms to promote easy release from the concrete when the forms are removed. (See also release agent and bond breaker.)
form pressure — lateral pressure acting on vertical or inclined formed surfaces, resulting from the fluid-like behavior of the fresh concrete confined by the forms.

form release agent — see release agent.

form spacer — see spacer and spreader.

form spreader — see spreader.

form tie — a mechanical connection in tension used to prevent concrete forms from spreading due to the fluid pressure of fresh concrete.

formwork — total system of support for freshly placed concrete including the mold or sheathing that contacts the concrete as well as supporting members, hardware, and necessary bracing (also called shuttering in the United Kingdom). (See also falsework and centering.)

formwork tiers — the number of frames of scaffolding erected one above the other.

foundation — a system of structural elements that transmits loads from the structure above to the earth.

foundation bolt — see anchor bolt (preferred term).

fracture — (1) a crack or break in concrete or masonry; (2) the configuration of a broken surface; (3) the action of cracking or breaking. (See also crack.)

free fall — (1) descent of freshly mixed concrete into forms without dropchutes or other means of confinement; (2) the distance through which such descent occurs; (3) uncontrolled fall of aggregate.

free lime — calcium oxide (CaO) (as in clinker and cement) that has not combined with SiO₂, Al₂O₃, or Fe₂O₃ during the burning process, usually because of underburning, insufficient grinding of the raw mixture, or the presence of traces of inhibitors.

free moisture — (1) moisture having essentially the properties of pure water in bulk; (2) moisture not absorbed by aggregate. (See also surface moisture.)

free water — see free moisture and surface moisture.

fresh concrete — concrete that possesses enough of its original workability that it can be placed and consolidated by the intended methods.

fresno trowel — a thin steel trowel that is rectangular (with or without rounded corners), usually 4 to 10 in. (100 to 250 mm) wide and 20 to 36 in. (420 to 900 mm) long, with a 4 to 16 ft (1 to 5 m) long handle, and used to smooth surfaces of nonbleeding concrete and shotcrete.

friction loss — the stress loss in a prestressing tendon resulting from friction between the tendon and duct or other device during stressing.

friction pile — a load-bearing pile that receives its principal vertical support from skin friction between the surface of the buried pile and the surrounding soil.

frog — a depression in the bed surface of a masonry unit (also called a panel).

Fuller’s curve — an empirical curve for gradation of aggregates. (See also grading curve.)

Fuller-Thompson ideal grading curve — see Fuller’s curve (preferred term).

furring — strips of wood or metal fastened to a wall or other surface to even it, to form an air space, to give appearance of greater thickness, or for the application of an interior finish such as plaster.

ganged forms — prefabricated panels joined to make a much larger unit (up to 30 by 50 ft (9 by 15 m) for convenience in erecting, stripping, and reusing; usually braced with wales, strongbacks, or special lifting hardware.

gap-graded aggregate — aggregate graded so that portions of aggregate retained on specified intermediate sieves is substantially absent.

gehlenite — a mineral of the melilite group, Ca₂Al(AlSi)O₇. (See also melilite and merwinit.)

Gillmore needle — a device used in determining time of setting of hydraulic cement.

girder — a large beam, usually horizontal, that serves as a main structural member.

glass-transition temperature — the midpoint of the temperature range over which an amorphous material (such as glass or a high polymer) changes from (or to) a brittle, vitreous state to (or from) a plastic state.

go-devil — (1) a ball of rolled-up burlap or paper or a specially fabricated device put into the pump end of a pipeline and forced through the pipe by water
pressure to clean the pipeline; (2) a device used with tremie concrete operations.

**grab setting** — see **flash setting** (preferred term).

**gradation** — see **grading** (preferred term).

**grade** — (1) the prepared surface on which a concrete slab is cast; (2) the process of preparing a plane surface of granular material or soil on which to cast a concrete slab.

**grade beam** — a reinforced-concrete beam, usually at ground level, that strengthens or stiffens the foundation or supports overlying construction.

**grade strip** — usually a thin strip of wood tacked to the inside surface of forms at the elevation to which the top of the concrete lift is to rise, either at a construction joint or the top of the structure.

**graded standard sand** — see **standard sand**.

**gradient** — rate of change in a variable over a distance.

**grading** — the distribution of particles of granular material among various sizes.

**grading curve** — a graphical representation of the proportions of different particle sizes in a granular material, obtained by plotting the cumulative or individual percentages of the material passing through sieves in which the aperture sizes form a given series.

**granolithic concrete** — concrete suitable for use as a wearing surface finish to floors, made with specially selected aggregate of suitable hardness, surface texture, and particle shape.

**granolithic finish** — a surface layer of granolithic concrete that may be laid on a base of either fresh or hardened concrete.

**granulated blast-furnace slag** — see **blast-furnace slag**.

**gravel** — aggregate retained on the 4.75 mm (No. 4) sieve and resulting either from natural disintegration and abrasion of rock or processing of weakly bound conglomerate. (See also **coarse aggregate**.)

**green concrete** — a surface finish that has undergone final setting but not hardened appreciably.

**grid foundation** — a combined footing formed by intersecting continuous footings, loaded at the intersection points, and covering much of the total area within the outer limits of the assembly.

**grinding aids** — materials used to expedite the process of grinding by eliminating ball coating, dispersing the finely ground product, or both.

**grinding medium** — a hard, free-moving charge in a ball or tube mill to reduce the particle size of introduced materials by attrition or impact.

**grizzly** — a simple, stationary screen or series of equally spaced parallel bars set at an angle to remove oversized particles in processing aggregate or other material.

**grog** — burned refractory material, usually calcined clay or crushed brick bats.

**groove joint** — see **control joint** (preferred term).

**groover** — a tool used to form grooves or weakened-plane joints in a concrete slab before final setting to control crack location or provide pattern.

**ground wire** — small-gauge high-strength steel wire used to establish line and grade as in shotcrete work (also called alignment wire and screed wire).

**grounded blast-furnace slag** — (obsolete) see **slag cement** (preferred term).

**grout** — mixture of cementitious materials and water, or other binding medium, with fine aggregate. (See also **neat cement grout** and **sanded grout**.)

**grout slope** — the natural slope of fluid grout injected into preplaced-aggregate concrete.

**grouted masonry** — unit masonry composed of either hollow units wherein the cells are filled with grout or multiple wythes where spaces between the wythes are filled with grout.

**grouted-aggregate concrete** — see **preplaced-aggregate concrete**.

**grouting** — the process of filling with grout. (See also **grout**.)

**gun** — (1) shotcrete material delivery equipment; (2) pressure cylinder used to propel freshly mixed concrete pneumatically.

**gun finish** — undisturbed final layer of shotcrete as applied from nozzle without hand finishing.
Gunite — a proprietary term for shotcrete.
gunman — workman on shotcreting crew who operates delivery equipment.
gunning — the act of applying dry-mix shotcrete.
gypsum — a mineral having the composition calcium sulfate dihydrate (CaSO$_4$·2H$_2$O).
gypsum plaster — plaster made with plaster of paris. (See plaster and plaster of paris.)

Hairline crack — a concrete surface crack with a width so small as to be barely perceptible.

Hairpin — (1) the wedge used to tighten some types of form ties; (2) a hairpin-shaped anchor set in place before concrete reaches initial setting; (3) a light hairpin-shaped reinforcing bar used for shear reinforcement in beams, tie reinforcement in columns, or prefabricated column shear heads.

Hamm tip — (1) flared shotcrete nozzle having a larger diameter at midpoint than at either inlet or outlet; (2) designated premixing tip.
hanger — a device used to suspend one object from another object. (See also form hanger.)

Hard-burned lime — the product of heating limestone to temperatures sufficient to change the calcium carbonate to calcium oxide, which can undergo expansion when it slowly reacts with water.

Hardened concrete — concrete that has developed sufficient strength to serve a defined purpose or resist stipulated loading without failure.

Hardener — (1) a chemical (including certain fluosilicates or sodium silicate) applied to concrete floors to reduce wear and dusting; (2) in a two-component adhesive or coating, the chemical component that causes the resin component to cure.

Hardening — gain of strength and other properties of a cementitious mixture as a result of hydration after final setting.

Hardy Cross method — see moment distribution.

Harped tendons — see draped tendons (preferred term).

Harsh mixture — a concrete mixture that lacks desired workability due to a deficiency of mortar or aggregate fines.

Haunch — a deepened portion of a beam in the vicinity of a support.
hawk — a tool used by plasterers to hold and carry plaster mortar; generally a flat piece of wood or metal approximately 10 to 12 in. (0.25 to 0.3 m) square with a wooden handle centered and fixed to the underside. (See also hod and mortar board.)

Head — a separate piece of steel of any shape firmly attached to the end of a bar or a protuberance of the bar itself at the end, used to anchor a steel reinforcing bar in concrete.

Head anchorage capacity — the maximum force that can be transmitted from the head of the bar to the surrounding concrete.

Head bearing area — area of the head projected onto a plane orthogonal to the longitudinal axis of the bar minus the bar cross sectional area, representing the contact surface between head and concrete where the bar tensile force is transferred through compression stress.

Headed bar — a steel reinforcing bar that has steel head(s) on one or both ends with the purpose of anchoring the bar in concrete.

Header — a masonry unit laid flat with its greatest dimension at a right angle to the face of the wall (when the unit is only the depth of the face wythe, it is known as a false header). (See also bonder and wythe [leaf].)

Heat of hydration — (1) heat evolved by chemical reactions with water; (2) the difference between the heat of solution of dry cement and that of partially hydrated cement. (See also heat of solution.)

Heat of solution — heat evolved or absorbed when a substance is dissolved in a solvent.

Heat-deflection temperature — the temperature at which a plastic material has an arbitrary deflection when subjected to an arbitrary load and test condition; this is an indication of the glass-transition temperature.

Heating rate — the rate expressed in degrees per hour at which the temperature is raised to the desired maximum temperature.
heavy concrete — see high-density concrete (preferred term).

heavy-media separation — a method in which a liquid or suspension of given specific gravity is used to separate particles into a portion lighter than (those that float) and a portion heavier than (those that sink) the medium.

heavyweight aggregate — aggregate of high density, such as barite, magnetite, hematite, limonite, ilmenite, iron, or steel, used in heavyweight concrete.

heavyweight concrete — see high-density concrete.

helical reinforcement — see spiral reinforcement (preferred term).

hematite — a mineral, iron oxide (Fe₂O₃), used as aggregate in high-density concrete and in finely divided form as a red pigment in colored concrete.

hemihydrate — (1) a hydrate containing one-half molecule of water to one molecule of compound; (2) partially dehydrated gypsum (also known as plaster of paris), CaSO₄·1/2H₂O. (See also bassanite and plaster of paris.)

hesitation setting — see false setting (preferred term).

Hessian — see burlap (preferred term).

high-alumina cement — see calcium-aluminate cement (preferred term).

high-density concrete — concrete of substantially higher density than that made using normal-density aggregates, usually obtained by use of high-density aggregates and used especially for radiation shielding.

high-discharge mixer — see inclined-axis mixer (preferred term).

high-early-strength cement — portland cement characterized by attaining a given level of strength in mortar or concrete earlier than does normal portland cement (referred to as ASTM C150 Type III).

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

high-fineness cement — a hydraulic cement of substantially higher specific surface and substantially smaller mean particle diameter than typical for products of similar composition produced by additional grinding or by separation by particle size.

high-lift grouting — a technique in masonry wall construction in which the grouting operation is delayed until the wall has been laid up to a full story height. (See also low-lift grouting.)

high-performance concrete — concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices.

high-pressure steam curing — see autoclave curing (preferred term).

high-range water-reducing admixture — a water-reducing admixture capable of producing large water reduction or great flowability without causing undue set retardation or entrainment of air in mortar or concrete.

high-strength concrete — concrete that has a specified compressive strength for design of 8000 psi (55 MPa) or greater.

high-strength reinforcement — see high-strength steel.

high-strength steel — steel with a high yield point (in the case of reinforcing bars 60,000 psi [414 MPa] and greater). (See also prestressing steel.)

high-temperature steam curing — see atmospheric-pressure steam curing and autoclave curing

hod — a V-shaped trough or a tray, supported by a pole handle that is borne on the carrier’s shoulder, for carrying small quantities of brick, tile, mortar, or similar load. (See also hawk and mortar board.)

hold-down bolt — anchor bolt provided near the ends of shear walls for transferring boundary-member loads from the shear wall to the foundation. (See also anchor bolt.)

hollow-unit masonry — masonry consisting either entirely or partially of hollow masonry units laid in mortar.

honeycomb — voids left in concrete between coarse aggregates due to inadequate consolidation.

hook — a bend in the end of a reinforcing bar.

Hooke’s law — the law, for strains within the elastic limit, that the strain is proportional to the stress producing it. (See also elastic limit and proportional.)
hooked bar — a reinforcing bar with the end bent into a hook to provide anchorage.

hoop reinforcement — a closed or continuously wound tie, each having hooks meeting seismic detailing requirements.

horizontal shoring — metal or wood load-carrying strut, beam, or trussed section used to carry a shoring load from one bearing point, column, frame, post, or wall to another (may be adjustable).

horizontal-shaft mixer — a mixer having a stationary cylindrical mixing compartment, with the axis of the cylinder horizontal and one or more rotating horizontal shafts to which mixing blades or paddle are attached (also called a pugmill).

hot cement — newly manufactured cement that has not had an opportunity to cool after grinding of the clinker.

hot face — the surface of a refractory section exposed to the source of heat.

hot-load test — a test for determining the resistance to deformation or shear of a refractory material when subjected to a specified compressive load at a specified temperature for a specified time.

Hoyer effect — radial expansion of the prestress material due to its Poisson coefficient caused by the release of pretension.

hydrate — a chemical combination of water with another compound or an element.

hydrated lime — calcium hydroxide, a dry powder obtained by treating quicklime with water.

hydration — the chemical reaction between hydraulic cement and water.

hydraulic cement — a binding material that sets and hardens by chemical reaction with water and is capable of doing so underwater. For example, portland cement and slag cement are hydraulic cements.

hydraulic hydrated lime — the hydrated dry cementitious product obtained by calcining a limestone containing silica and alumina to a temperature short of incipient fusion so as to form sufficient free calcium oxide to permit hydration and at the same time leaving unhydrated sufficient calcium silicates to give the dry powder its hydraulic properties.

hydraulic-cement grout — a grout that is a mixture of hydraulic cement, aggregate, water, and possibly admixtures.

hydromix nozzle — a shotcrete hose and nozzle configuration used in place of a predampening system to introduce pressurized water into the material stream via a water ring.

hydrous calcium chloride (CaCl2·2H2O) — a solid, usually 77 percent calcium chloride, in flake form.

ignition loss — see loss on ignition (preferred term).

ilmenite — a mineral, iron titanate (FeTiO3), that, in pure or impure form, is commonly used as aggregate in high-density concrete.

impact hammer — see rebound hammer (preferred term).

impending slough — consistency of a shotcrete mixture containing the maximum amount of water such that the product will not flow or sag after placement.

inclined-axis mixer — a truck with a revolving drum that rotates about an axis inclined to the bed of the truck chassis.

incrustation — a crust or coating, generally hard, formed on the surface of concrete or masonry construction or on aggregate particles.

Indented wire — wire having machine-made surface indentations intended to improve bond; depending on type of wire, used for either concrete reinforcement or pretensioning tendons.

initial curing — deliberate action taken between placement and final finishing of concrete to reduce the loss of water from the surface of the concrete.

initial prestress — the prestressing stress (or force) applied to the concrete at the time of stressing.

initial setting — a degree of stiffening of a cementitious mixture less than final set, generally stated as an empirical value indicating the time required for the cementitious mixture to stiffen sufficiently to resist, to an established degree, the penetration of a weighted test device. (See also final setting.)

initial setting time — the time required for a freshly mixed cement paste, mortar, or concrete to achieve initial setting. (See also final setting time.)
initial stresses — the stresses occurring in prestressed-concrete members before any losses occur.
insert — anything other than reinforcing steel that is rigidly positioned within a concrete form for permanent embedment in the hardened concrete.
in-situ concrete — see cast-in-place concrete (preferred term).
insoluble residue — the portion of a cement or aggregate that is not soluble in dilute hydrochloric acid of stated concentration.
insulating concrete — concrete having low thermal conductivity. (See also lightweight concrete and low-density concrete.)
internal curing — process by which the hydration of cement continues because of the availability of internal water that is not part of the mixing water.
internal vibration — see vibration.
inverted L-beam — a beam having a cross section in the shape of an inverted L. (See also L-beam.)
inverted T-beam — a beam having a cross section in the shape of an inverted T. (See also T-beam.)
I-section — beam cross section consisting of top and bottom flanges connected by a vertical web.
isolation joint — a separation between adjacent sections of a concrete structure to allow relative movement in three directions and through which all of the bonded reinforcement is interrupted.
jacking device — (1) the device used to stress the tendons for prestressed concrete; (2) the device for raising a vertical slipform.
jacking force — in prestressed concrete, the temporary force exerted by the device that introduces tension into the tendons.
jacking stress — the maximum stress occurring in a prestressed tendon during stressing.
jaw crusher — a machine having two inclined jaws, one or both being actuated by a reciprocating motion so that the charge is repeatedly nipped between the jaws.
jitterbug — a grate tamper for pushing coarse aggregate slightly below the surface of a slab to facilitate finishing. (See also tamper.)
joint — (1) a physical separation in a concrete system, whether precast or cast-in-place, including cracks if intentionally made to occur at specified locations; (2) the region where structural members intersect.
joint filler — compressible material used to fill a joint to prevent the infiltration of debris and provide support for sealants applied to the joint.
joint sealant — compressible material used to exclude water and solid foreign materials from joints.
joint spall — a spall adjacent to a joint.
jointed detail — a connection where the bending stiffness differs from that of the members and requires special design to collect, transfer, and redistribute forces from one member to another through the connection.
jointer (concrete) — a metal tool used to cut a joint in fresh concrete.
jointing — the process of producing joints in a concrete slab.
joint-sealing compound — an impervious material used to fill joints in pavements or structures.
joist — a comparatively narrow beam used in closely spaced arrangements to support floor or roof slabs.
kaolinite — a common clay mineral having the general formula Al_2(Si_2O_5)(OH_4) and the primary constituent of kaolin.
Kelly ball — (1) an apparatus used for indicating the consistency of fresh concrete in accordance with ASTM C360 (withdrawn); (2) an apparatus used for determining suitability for load application in controlled low strength material (CLSM) in accordance with ASTM D6024. (See also ball test.)
kern area — the area within a geometric shape in which a compressive force may be applied without tensile stresses resulting in any of the extreme fibers of the section.
key — see keyway.
keyway — a recess or groove in one lift or placement of concrete that is filled with
cementitious material of the next lift, giving shear strength to the joint. (See also
tongue and groove.)

kick strip — see kicker.
kicker — a wood block or board attached to a formwork member in a building frame
or formwork to make the structure more stable.
kiln — a furnace or oven for drying, charring, hardening, baking, calcining,
sintering, or burning various materials.
lacing — horizontal bracing between shoring members.
lagging — heavy sheathing used in underground work to withstand earth pressure.
(See also sheathing.)

laitance — a layer of weak material derived from cementitious material and aggregate
fines either: (1) carried by bleeding to the surface or to internal cavities of
freshly placed mixture; (2) separated from the mixture and deposited on
the surface or internal cavities during placement of the mixture.
lap — the length by which one bar or sheet of reinforcement overlaps another.
lap splice — a connection of reinforcing steel made by lapping the ends of bars.
lapping (reinforcing steel) — the overlapping of reinforcing steel bars, welded-wire reinforcement, or
expanded metal so that there may be continuity of stress in the reinforcing
when the concrete member is subjected to loading.

lateral reinforcement — transverse reinforcement usually applied to ties, hoops, and spirals used to
enclose reinforcement in columns or column-like members.
latex — a dispersion of organic polymer particles in water.
layer — see course and lift.
L-beam — (1) a beam having a cross section in the shape of an L; (2) a beam having a
ledge on one side only.
leaf — see wythe (leaf).

lean concrete — concrete of low cementitious material content.
lean mixture — see lean concrete.
ledger — any member with a protrusion or protrusions that support other structural
members. (See also L-beam and inverted T-beam.)

length change — increase or decrease in length. (See also volume change and
deformation.)

lever arm — (1) in a structural member, the distance from the center of the tensile
reinforcement to the center of action of the compression zone; (2) the
perpendicular distance of a transverse force from a point about which
moment is taken.

licensed design professional — (1) an engineer or architect who is licensed to practice structural design as
defined by the statutory requirements of the professional licensing laws of
a state or jurisdiction; (2) the architect or engineer, licensed as described,
who is responsible for the structural design of a particular project (also
historically engineer of record).
lift — the concrete placed between two consecutive horizontal construction
joints, usually consisting of several layers or courses.
lift joint — surface at which two successive lifts meet.
lift slab — (1) a method of concrete construction in which floor and roof slabs are cast
on or at ground level and hoisted into position by jacking; (2) a slab that is
a component of such construction.

lightweight aggregate — aggregate of low density such as (1) expanded or sintered clay, shale,
slate, diatomaceous shale, perlite, vermiculite, or slag; (2) natural pumice,
scoria, volcanic cinders, tuff, and diatomite; (3) sintered fly ash or
industrial cinders.

lightweight concrete — concrete of substantially lower density than that made using aggregates of
normal density; consists entirely of lightweight aggregate or a combination
of lightweight aggregate and normal-density aggregate; its equilibrium
densities are generally between 70 and 120 lb/ft³ (1120 and 1920 kg/m³).
(See also insulating concrete and low-density concrete.)
lime — specifically, calcium oxide (CaO), loosely, a general term for the various chemical and physical forms of quicklime, hydrated lime, and hydraulic hydrated lime. (See also hydrated lime, hydraulic hydrated lime, and quicklime.)

limestone — a sedimentary rock consisting primarily of calcium carbonate.

limit design — a method of proportioning reinforced-concrete members based on calculation of their strength. (See also strength-design method.)

limonite — an iron ore composed of a mixture of hydrated ferric oxides occasionally used in heavyweight concrete because of its high density and combined-water content, which contribute to its effectiveness in radiation shielding; a mineral occurring commonly as a constituent of particles of natural aggregate.

linear transformation — the method of altering the path of the prestressing tendon in any statically indeterminate prestressed structure by changing the location of the tendon at one or more interior supports without altering its position at the end supports and without changing the basic shape of the path between any supports (does not change the location of the path of the pressure line).

linear-traverse method — determination of the volumetric composition of a solid by integrating the distance traversed across areas of each component along a line or along regularly spaced lines in one or more planes intersecting a sample of the solid; frequently employed to determine characteristics of the air-void system in hardened concrete by microscopical examination along a series of traverse lines on finely ground sections of the concrete (also called the Rosiwal method). (See also point count method and point count method [modified].)

lining — any sheet, plate, or layer of material attached directly to the inside face of formwork to improve or alter the surface texture and quality of the finished concrete. (See also form lining, tunnel lining, and sheathing.)

lintel — a horizontal supporting member above an opening, such as a window or a door.

live load — (1) load that is not permanently applied to a structure but is likely to occur during the service life of the structure (excluding environmental loads); (2) loads meeting specific criteria found in the governing building code (without load factors).

load balancing — a technique used in the design of prestressed-concrete members in which the amount and path of the prestressing is selected so that the forces imposed upon the member or structure by the prestressing counteract or balance a portion of the dead and live loads for which the member or structure must be designed.

load factor — a factor by which a service load is multiplied to determine a factored load used in the strength-design method.

load-bearing wall — a wall designed and built to carry superimposed vertical loads, in-plane and shear loads, or both. (See also nonbearing wall.)

long column — a column whose load capacity is limited by buckling rather than strength. (See also slender column.)

longitudinal bar — see longitudinal reinforcement (preferred term).

longitudinal crack — a crack that develops parallel to the length of a member.

longitudinal joint — a joint parallel to the length of a structure or pavement.

longitudinal reinforcement — reinforcement parallel to the length of a concrete member or pavement.

Los Angeles abrasion test — test for abrasion resistance of concrete aggregates.

loss of prestress — (1) the reduction in the prestressing force that results from the combined effects of slip at anchorage; (2) relaxation of steel stress; (3) frictional loss due to curvature in the tendons; (4) the effects of elastic shortening, creep, and shrinkage of the concrete.

loss on ignition — the percentage loss in mass of a sample ignited to constant mass at a specified temperature, usually 1650 to 1830°F (900 to 1000°C).

low-alkali cement — (1) a portland cement that contains a relatively small amount of sodium, potassium, or both; (2) in ASTM C150, a portland cement containing not
more than 0.60 percent Na₂O equivalent, that is, percent Na₂O + 0.658 percent K₂O.

**low-density concrete** — concrete having an oven-dry density of less than 50 lb/ft³ (800 kg/m³). (See also **insulating concrete** and **lightweight concrete**.)

**low-heat cement** — a portland cement for use when a low heat of hydration is desired, referred to as ASTM C150 Type IV cement.

**low-lift grouting** — a technique of masonry wall construction in which the wall sections are built to a height of not more than 5 ft (1.7 m) before the cells of the masonry units are filled with grout. (See also **high-lift grouting**.)

**low-pressure steam curing** — see **atmospheric-pressure steam curing** (preferred term).

**low-strength materials** — see **controlled low-strength material** (preferred term).

**machine-base grout** — a grout that is used in the space between plates or machinery and the underlying foundation and that is expected to maintain complete contact with the base and to maintain uniform support.

**macrofiber** — a fiber with an equivalent diameter greater than or equal to 0.012 in. (0.3 mm) for use in concrete.

**macroscopic** — visible to the naked eye.

**magnetite** — a mineral, ferrous ferric oxide (FeO·Fe₂O₃), the principal constituent of magnetic black iron ore with a density of approximately 5.2 g/cc (325 lb/ft³) and Mohs hardness of approximately 6 that is used as an aggregate in high-density concrete.

**manual batcher** — see **batcher** (1).

**manufactured sand** — see **sand**.

**map cracking** — intersecting cracks that extend below the surface of hardened concrete that vary in width from fine and barely visible to open and well-defined (also called pattern cracking). (See also **checking** and **crazing**.)

**marble** — a metamorphic rock composed essentially of recrystallized calcite, dolomite, or both.

**mason** — an artisan who builds with concrete masonry units, bricks, stone, and tile; name sometimes given to a concrete finisher.

**masonry** — construction composed of shaped or molded units, usually small enough to be handled by one person and composed of stone, ceramic brick or tile, concrete, glass, adobe, or the like.

**masonry cement** — a hydraulic cement used for masonry and plastering construction, containing one or more of the following materials: portland cement, portland-pozzolan cement, natural cement, slag cement, or hydraulic hydrated lime, and, in addition, usually contains one or more materials such as hydrated lime, limestone, chalk, calcareous shell, talc, slag, or clay as prepared for this purpose.

**masonry grout** — a mixture of hydraulic cement, aggregate, water, and possibly other materials (ASTM C476) used for filling designated spaces in masonry construction.

**masonry lift** — the height to which masonry is laid between periods of grouting.

**mass** — (1) the physical property of matter that causes it to have weight in a gravitational field; (2) the quantity of matter in a body.

**mass concrete** — any volume of concrete in which a combination of dimensions of the member being cast, the boundary conditions can lead to undesirable thermal stresses, cracking, deleterious chemical reactions, or reduction in the long-term strength as a result of elevated concrete temperature due to heat from hydration.

**mass density** — see **density**.

**mat** — (1) an assembly of steel reinforcement composed of two or more layers of bars placed at angles to each other and secured together either by welding or tying; (2) a thin layer of randomly oriented chopped filaments, short fibers (with or without a carrier fabric), or long random filaments loosely held together with a binder and used as reinforcing for a fiber-reinforced polymer composite material.
**mat foundation** — a foundation consisting of a continuous concrete slab extending in both directions that is usually reinforced and supports an array of columns, walls, or both.

**material hose** — see delivery hose.

**matrix** — (1) the cement paste in which the fine aggregate particles in mortar are embedded; (2) the mortar in which the coarse aggregate particles in concrete are embedded; (3) the resin or binders that hold the fibers in fiber-reinforced polymer together, transfer load to the fibers, and protect them against environmental attack and damage due to handling.

**maturity factor** — a factor that is a function of the age of the concrete (hours or days) multiplied by the difference between the mean temperature of the concrete (degrees) during curing and a datum temperature below which hydration stops. (See also temperature-time factor.)

**maximum size (of aggregate)** — in specifications for and in description of aggregate, the smallest sieve opening through which the entire amount of aggregate is required to pass. (See also nominal maximum size [of aggregate].)

**mean stress** — the average of the maximum and minimum stress in one cycle of fluctuating loading.

**mechanical anchorage** — any mechanical device capable of developing the specified yield strength of the reinforcement without damage to the concrete.

**mechanical bond** — interlock created when a fresh cementitious mixture is placed and hardens to conform to the surface texture of the existing solid material.

**mechanical connection** — the complete assembly of an end-bearing sleeve, a coupler, or a coupling sleeve, and possibly additional intervening material or other components to effect connection of reinforcing bars. (See also bar-end check, coupler, coupling sleeve, and end-bearing sleeve.)

**mechanical lap splice** — complete assembly of a coupling sleeve device and any additional components configured to accomplish positive splicing of overlapping reinforcing bars.

**megascopic** — see macroscopic (preferred term).

**melilite** — a group of minerals ranging from the calcium magnesium silicate (akermanite) to the calcium aluminate silicate (gehlenite) that occur as crystals in blast-furnace slag. (See also gehlenite and merwinite.)

**melt** — the molten portion of the raw material mass during the burning of cement clinker, firing of lightweight aggregates, or expanding of blast-furnace slags.

**membrane curing** — a process that involves the application of a liquid membrane-forming compound or covering with a protective sheet material, both of which function as a barrier to restrict evaporation of mixing water from concrete surfaces.

**membrane theory** — a theory of design for thin shells, based on the premise that a shell cannot resist bending because it deflects; the only stresses that exist, therefore, in any section are shear stress and direct compression or tension.

**merwinite** — one of the principal crystalline phases found in blast-furnace slags. (See also gehlenite and melilite.)

**mesh reinforcement** — see welded-wire reinforcement and woven-wire reinforcement.

**mesh roller** — a finishing tool consisting of a rolling drum attached to a handle of which the surface of the drum is made of mesh, sometimes used for rolling over the surface of fresh concrete to embed coarse aggregate.

**Mesnager hinge** — a permanent semiarticulation or flexible joint in a reinforced-concrete arch wherein the angles of rotation at the hinge are very small; by crossing steel reinforcing bars within the opening between the concrete structural segments, the resultant articulation presents very small resistance to rotation, resists either axial thrust or shearing forces, and is permanently flexible; the center of rotation occurs at the intersection of the reinforcing bars.

**metakaolin** — a natural pozzolan produced by heating kaolin-containing clays.
microconcrete — a mixture of portland cement, water, and suitably graded sand for simulating concrete in small-scale structural models.

microcracks — small, numerous cracks that develop in hardened concrete.

microfiber — a fiber with an equivalent diameter less than 0.012 in. (0.3 mm) for use in concrete.

microscopic — discernible only with the aid of a microscope.

microsilica — see silica fume (preferred term).

middle strip — in flat-slab framing, the slab portion that occupies the middle half of the span between columns. (See also column strip.)

mill scale — the partially adherent layers of oxidation products (heavy oxides) developed on metallic surfaces during either hot fabrication or heat treatment of metals, as on hot-rolled steel reinforcing bars.

mineral aggregate — aggregate consisting essentially of inorganic nonmetallic rock materials, either natural or crushed and graded.

mineral filler — a finely divided mineral product at least 65 percent of which passes the 75 μm (No. 200) sieve. (See also silt.)

minimum film-forming temperature — the minimum temperature at which a synthetic latex or emulsion will coalesce when laid on a substrate as a thin film.

mix (n.) — see mixture.

mix design — see mixture proportion (preferred term).

mixer — a machine used for blending the constituents of concrete, grout, mortar, cement paste, or other mixture.

mixer efficiency — the adequacy of a mixer in rendering a homogeneous product within a stated period.

mixing cycle — the time taken for a complete cycle in a batch mixer, that is, the time elapsed between successive repetitions of the same operation (for example, successive discharges of the mixer).

mixing plant — see batch plant (preferred term).

mixing speed — rotation rate of a mixer drum or of the paddles in an open-top, pan, or trough mixer when mixing a batch, expressed in revolutions per minute (rpm) or in peripheral feet per minute (meters per minute) of a point on the circumference at maximum diameter.

mixing time — the period during which the constituents of a batch of concrete are mixed by a mixer; for a stationary mixer, time is given in minutes from the completion of mixer charging until the beginning of discharge; for a truck mixer, time is given in total minutes at a specified mixing speed or expressed in terms of total revolutions at a specified mixing speed. (See also amount of mixing.)

mixing water — the water in freshly-mixed cementitious mixtures, exclusive of any previously absorbed by the aggregate (also called batch water or batched water.) (See also water-cement ratio and surface moisture.)

mixture — (1) the assembled, blended, commingled ingredients of mortar, concrete, or the like; (2) the proportions for their assembly.

mixture proportion — the proportions of ingredients that make the most economical use of available materials to produce mortar or concrete of the required properties. (See also proportion.)

mobile placer — a small belt conveyor mounted on wheels or a truck that can be readily moved to the job site for conveying concrete from the concrete truck to the forms or slab.

mobility — the ability of fresh concrete or mortar to flow.

moderate exposure condition — an environment, normally in temperate climate regions, in which concrete will only occasionally be exposed to moisture and will not be saturated before freezing and where no deicing agents or other aggressive chemicals are used.

moderate sulfate-resisting cement — a portland cement for use when either moderate sulfate resistance, moderate heat of hydration, or both is desired, now referred to as ASTM C150 Type II cement.
modified cement — (obsolete) a portland cement for use when either moderate heat of hydration, moderate sulfate resistance, or both, is desired, now referred to as ASTM C150 Type II cement.

modified cube — a portion of a rectangular beam of hardened concrete previously broken in flexure, used in determining the compressive strength of the concrete.

modified portland cement — (obsolete) a portland cement having moderate heat of hydration; this term was replaced by ASTM C150 Type II cement beginning in 1960. (See also modified cement.)

modular ratio — the ratio of modulus of elasticity of steel $E_s$ to that of concrete $E_c$ usually denoted by the symbol $n$.

modulus of resilience — see resilience.

modulus of rupture — the calculated apparent tensile stress in the extreme tension fiber of a plain concrete beam test specimen under flexure at the load that produces rupture. (See also flexural strength.)

modulus of subgrade reaction — ratio of the load per unit area of soil to the corresponding settlement of the soil, typically evaluated in place per ASTM D1196 (also called coefficient of subgrade reaction).

Mohs scale — relative scale of the hardness of minerals ranging from 1 through 10.

moist cabinet — an upright and compartmented case having doors and shelves of moderate dimensions for storing and curing small test specimens of cement paste, mortar, and concrete in an atmosphere of approximately 73°F (23°C) and at least 95 percent relative humidity. (See also moist room.)

moist room — a room with controlled temperature and relative humidity for the purpose of curing and storing cementitious test specimens (also called a fog room).

moisture barrier — see vapor barrier.

moisture content of aggregate — the ratio expressed as a percentage of the mass of water in a given quantity of aggregate to the dry mass of that quantity of aggregate.

moisture-free — the condition of a material that has been dried in air until there is no further significant change in its mass. (See also mass.)

mold — (1) a device containing a cavity into which neat cement, mortar, or concrete test specimens are cast; (2) a form used in the fabrication of precast mortar or concrete units (for example, masonry units).

moment distribution — a method of structural analysis for continuous beams and rigid frames whereby successive converging corrections are made to an assumed set of moments until the desired precision is obtained (also called the Hardy Cross method).

monolithic concrete — concrete cast with no joints other than construction joints.

monolithic surface treatment — see dry-shake.

monolithic topping — on flatwork, a higher quality, more serviceable topping course placed promptly after the base course has lost all slump and bleed water.

monomolecular — composed of single molecules; specifically, films that are one molecule thick; denotes a thickness equal to one molecule, for example, certain chemical compounds develop a monomolecular film over bleeding water at the surface of freshly placed concrete or mortar as a means of reducing the rate of evaporation. (See also evaporation retardant.)

montmorillonite — a swelling clay mineral of the smectite group; main constituent of bentonite. (See also smectite.)

mortar — a mixture of cement paste and fine aggregate; in fresh concrete, the material occupying the interstices among particles of coarse aggregate; in masonry construction, joint mortar may contain masonry cement, or may contain hydraulic cement with lime (and possibly other admixtures) to afford greater plasticity and workability than are attainable with standard portland cement mortar. (See also hydraulic cement and masonry.)

mortar board — a platform or tray for holding freshly mixed mortar. (See also hawk and hod.)

mortar-flow — see flow (2).

mosaic — inlaid exposed surface designs of aggregates or other material.
mottling — uneven color shading or blotchiness across a surface. (See also discoloration.)

moving forms — large prefabricated units of formwork incorporating supports and designed to be moved horizontally on rollers or similar devices with a minimum amount of dismantling between successive uses.

mud mat — a layer of concrete beneath a structural concrete floor or footing over soft, wet soil.

mud pumping — see pumping (of pavements).

mudjacking — see slab-jacking (preferred term).

multielement prestressing — prestressing accomplished by stressing an assembly of several individual structural elements as a means of producing one integrated structural member.

nailer — a strip of wood or other fitting attached to or set in concrete or attached to steel to facilitate making nailed connections.

natural cement — a hydraulic cement produced by calcining an argillaceous limestone at a temperature below the sintering point and then grinding to a fine powder.

natural pigment — the class of pigments that are produced by physical processing of materials mined directly from the earth (also called natural or mineral pigments or colors).

natural pozzolan — a raw or calcined natural material that has pozzolanic properties.

natural sand — sand resulting from natural disintegration and abrasion of rock. (See also sand and coarse aggregate.)

neat cement grout — a fluid mixture of hydraulic cement and water with or without other ingredients.

neat cement paste — a mixture of hydraulic cement and water.

neat plaster — plaster without sand.

negative moment — a condition of flexure in which top fibers of a horizontally placed member, or external fibers of a vertically placed exterior member, are subjected to tensile stresses.

negative reinforcement — steel reinforcement for negative moment.

net cross-sectional area (of masonry) — the gross cross-sectional area of a section of masonry minus the area of cavities, cells, or cored spaces.

net mixing water — see mixing water.

neutral axis — a line in the plane of a structural member subject to bending where the longitudinal stress is zero.

neutral refractory — a refractory that is resistant to chemical attack by either acidic or basic substances.

no-fines concrete — a concrete mixture containing little or no fine aggregate. (See pervious concrete.)

nominal flexural strength — the flexural strength of a member or cross section calculated in accordance with provisions and assumptions of the strength-design method before application of any strength-reduction (\( \phi \)) factor.

nominal maximum size (of aggregate) — in specifications for and in descriptions of aggregate, the smallest sieve opening through which the entire amount of the aggregate is permitted to pass. (See also maximum size of aggregate.)

nominal shear strength — the shear strength of a member or cross section calculated in accordance with provisions and assumptions of the strength design method before application of any strength-reduction (\( \phi \)) factor.

nominal size — see nominal maximum size (of aggregate).

nominal strength — strength of a member or cross section calculated in accordance with provisions and assumptions of the strength design method before application of any strength-reduction (\( \phi \)) factor.

nominal strength reduction factor — the factor by which the nominal strength is multiplied to obtain the design strength.

nonagitating unit — a truck-mounted container for transporting central-mixed concrete not equipped to provide agitation (slow mixing) during delivery.

non-air-entrained concrete — concrete in which neither an air-entraining admixture nor air-entraining cement has been used.
nonbearing wall — a wall that supports no vertical load other than its own weight and no in-plane shear loads. (See also load-bearing wall.)

noncombustible — any material that neither ignites nor supports combustion in air when exposed to fire.

onevaporable water — the water that is chemically combined during cement hydration. (See also evaporable water.)

nonferrous — relating to metals other than iron, not containing or including iron.

nonprestressed reinforcement — reinforcing steel not subjected to either pretensioning or post-tensioning.

nonrecoverable creep — the residual or nonreversible deformation remaining in hardened concrete after removal of sustained load.

nontilting mixer — a horizontal rotating drum mixer that charges, mixes, and discharges without tilting.

nonvolatile content — the portion of a material that remains after volatile matter has been evaporated under specified ambient or accelerated conditions.

normal cement — general purpose portland cement, referred to as ASTM C150 Type I cement.

normal consistency — the consistency of cement paste satisfying appropriate limits defined in a standard test method, for example, ASTM C187.

normal portland cement — see normal cement.

normal stress — the stress component that is perpendicular to the plane on which the force is applied, designated tensile if the force is directed away from the plane and compressive if the force is directed toward the plane. (See also stress.)

normalweight aggregate — aggregate that is neither heavy nor lightweight.

normalweight concrete — concrete having a density of approximately 150 lb/ft³ (2400 kg/m³) made with normal-density aggregates.

no-slump concrete — freshly mixed concrete exhibiting a slump of less than 1/4 in. (6 mm). (See also zero-slump concrete.)

nozzle — a metal or rubber tip attached to the discharge end of a heavy thick-walled rubber hose from which a continuous stream of shotcrete is ejected at high velocity.

nozzle liner — a replaceable rubber lining fitted into the nozzle tip to prevent abrasion of the interior surface of the nozzle.

nozzle operator — the technician who manipulates the nozzle of a placing machine and controls placement of the shotcrete.

nozzle velocity — the rate at which shotcrete is ejected from the nozzle.

obsidian — a natural volcanic glass of relatively low water content, usually of rhyolite composition. (See also perlite.)

offset — (1) an abrupt change in alignment or dimension, either horizontally or vertically; (2) a horizontal ledge occurring along a change in wall thickness of the wall above.

offset bend — (1) an intentional distortion from the normal straightness of a steel reinforcing bar to move the center line of a segment of the bar to a position parallel to the original position of the center line; (2) a mechanical operation commonly applied to vertical bars that reinforce concrete columns.

offset yield strength — the stress at which the strain exceeds, by a specified amount, an extension of the initially proportional part of the stress-strain curve.

oil-well cement — hydraulic cement suitable for use under high pressure and temperature in sealing water and gas pockets and setting casing during the drilling and repair of wells, and often contains retarders to meet the requirements of use.

one-way system — the arrangement of steel reinforcement within a slab that presumably bends in only one direction.

opal — a mineral composed of amorphous hydrous silica (SiO₂·nH₂O).

opaline chert — chert composed entirely or mainly of opal.

open-graded aggregate — aggregate where the voids between the particles are relatively large when compacted.
open-top mixer — a truck-mounted mixer consisting of a trough or a segment of a cylindrical mixing compartment within which paddles or blades rotate about the horizontal axis of the trough. (See also horizontal-shaft mixer.)

ordinary portland cement — the term used in the United Kingdom and elsewhere to designate the equivalent to ASTM C150 Type I cement.

orthotropic — a hypothetical plate consisting of beams and a slab acting together with different flexural rigidities in the longitudinal and transverse directions, as in a composite beam bridge. (This term is a contraction of the terms “orthogonal anisotropic” as in the phrase “orthogonal anisotropic plate.”)

oven-dry — the condition resulting from having been dried to essentially constant mass in an oven at a temperature that has been fixed.

oven-dry specific gravity — the ratio of the mass of a volume of a material (including the permeable and impermeable pores in the material but not including the voids between particles of the material) at a stated temperature to the mass of an equal volume of distilled water at a stated temperature. (Historically called bulk specific gravity.)

overlay — a layer of concrete or mortar placed on a concrete slab to either restore or improve the function of the previous surface.

oversanded — containing more sand than would be necessary to produce adequate workability and a satisfactory condition for finishing.

overvibration — excessive use of vibrators during placement of freshly mixed concrete causing segregation, stratification, and excessive bleeding.

owner — the corporation, association, partnerships, individual, or public body or authority with whom the contractor enters into an agreement and for whom the work is provided.

pack setting — see sticky cement and warehouse setting.

packaged concrete, mortar, or grout — mixtures of dry ingredients in packages, requiring only the addition of water to produce concrete, mortar, or grout.

packer — a device inserted into a hole in which grout is to be injected that acts to prevent return of the grout around the injection pipe, usually an expandable device actuated mechanically, hydraulically, or pneumatically.

packerhead process — a process for producing concrete pipe that uses a rotating device that forms the interior surface of the pipe as concrete is fed into the form from above. (See also centrifugal process, dry-cast process, tamp process, and wet-cast process.)

paddle mixer — see open-top mixer (preferred term).

pan — (1) a prefabricated form unit used in concrete joist floor construction; (2) a container that receives particles passing the finest sieve during sieve analysis of granular materials.

pan mixer — see vertical-shaft mixer (preferred term).

panel — (1) a section of form sheathing that can be erected and stripped as a unit; (2) a concrete element that is relatively thin with respect to other dimensions and is bordered by joints or edges; (3) a region of a suspended slab system bounded by column, beam, or wall centerlines.

panel strip — a strip extending across the length or width of a flat slab for structural design and construction or for architectural purposes.

parapet — (1) the part of a wall that extends above the roof level; (2) a low wall along the top of a dam.

parge — to coat with plaster, particularly foundation walls and rough masonry. (See also back plastering.)

partial prestressing — prestressing to a stress level such that, under design loads, tensile stresses exist in the precompressed tensile zone of the prestressed member.

particle shape — the form of a particle. (See also elongated piece [of aggregate], and flat piece [of aggregate].)

particle-size distribution — see grading.

parting agent — see release agent (preferred term).

pass — layer of shotcrete placed in one movement over the area of operation.

paste — see neat cement paste.
**paste content** — amount of cement paste in concrete, mortar, or the like, expressed as volume percent of the entire mixture. (See also neat cement paste.)

**paste volume** — see paste content.

**pattern cracking** — see crack, craze cracks, and map cracking.

**pattern cracks** — see crack, craze cracks, and map cracking.

**patterned ashlar** — see ashlar masonry.

**pavement (concrete)** — a layer of concrete on such areas as roads, sidewalks, canals, playgrounds, and those used for storage or parking. (See also rigid pavement.)

**paving train** — an assemblage of equipment designed to place and finish a concrete pavement.

**pea gravel** — screened gravel, most of the particles of which pass a 9.5 mm (3/8 in.) sieve and are retained on a 4.75 mm (No. 4) sieve.

**peak load** — the highest load sustained by a specimen or structural element during a test.

**peak load strength** — strength computed using the peak load.

**pedestal** — compression member with a ratio of height-to-least lateral dimension less than or equal to three.

**peeling** — a process in which thin flakes of mortar are broken away from a concrete surface, such as by deterioration or by adherence of surface mortar to forms as forms are removed.

**pencil rod** — plain metal rod of approximately 1/4 in. (6 mm) diameter.

**penetration** — an opening through which pipe, conduit, or other item passes through a wall or floor.

**penetration probe** — a device for obtaining an indirect measure of the concrete compressive strength by measuring the resistance of concrete to penetration, customarily determined by the distance that a steel pin is driven into the concrete from a special gun by a precisely measured explosive charge.

**penetration resistance** — (1) the resistance of fresh mortar or cement paste to penetration by a plunger or needle under standard conditions used to determine time of setting; (2) the resistance of hardened concrete to penetration by a steel rod driven into the surface by a high-powered driver.

**percent fines** — (1) the amount, expressed as a percentage, of material in aggregate finer than a given sieve, usually the 75 μm (No. 200); (2) the amount of fine aggregate in a concrete mixture expressed as a percent by absolute volume of the total amount of aggregate.

**percentage of reinforcement** — the ratio of cross-sectional area of reinforcing steel to the effective cross-sectional area of a member, expressed as a percentage.

**performance-based specification** — a specification in which the requirements are stated in terms of required results with criteria for verifying compliance rather than specific composition, design, or procedure.

**periclase** — a crystalline mineral, magnesia (MgO), the equivalent of which may be present in portland-cement clinker, portland cement, and other materials such as open-hearth slags and certain basic refractories.

**perlite** — a volcanic glass having a perlitic structure, usually having a higher water content than obsidian and, when expanded by heating, used as an insulating material and as a lightweight aggregate in concretes, mortars, and plasters.

**permanent setting** — inelastic elongation or shortening.

**permeability** — the ability of a given concrete to permit liquids or gases to pass through.

**pervious concrete** — concrete containing little, if any, fine aggregate that results in sufficient voids to allow air and water to pass easily from the surface to underlying layers.

**pervious pavement** — a pavement comprising material with sufficient continuous voids to allow water to pass from the surface to the underlying layers.

**petrography** — (1) the branch of petrology dealing with description and systematic classification of rocks aside from their geologic relations, mainly by laboratory methods, largely chemical and microscopical (also, loosely, petrology or lithology); (2) laboratory study of concrete and mortar
samples to determine various characteristics including, but not limited to, w/c, paste-aggregate bond, and air content.

**petrology** — the science of rocks, treating of their origin, structure, and composition from aspects and in all relations. (See also *petrography*.)

**phenolic resin** — a class of synthetic, oil-soluble resins (plastics) produced as condensation products of phenol, substituted phenols and formaldehyde, or some similar aldehyde that may be used in paints for concrete.

**phi (φ) factor** — see nominal strength reduction factor (preferred term).

**Philleo factor** — a distance, used as an index of the extent to which hardened cement paste is protected from the effects of freezing, so selected that only a small portion of the cement paste (usually 10 percent) lies farther than that distance from the perimeter of the nearest air void. (See also protected paste volume.)

**pier** — (1) a slender isolated foundation member of either plain or reinforced concrete that is cast on end in the ground; (2) an isolated vertical masonry member whose horizontal dimension measured at right angles to its thickness is not less than three times its thickness nor greater than six times its thickness and whose height is less than five times its length.

**pigment** — a coloring matter, usually in the form of an insoluble fine powder.

**pilaster** — column built with a wall, usually projecting beyond the wall.

**pile** — a slender structural element that is driven, jetted, or otherwise embedded on end in the ground to support a load or compact the soil. (See also composite pile.)

**pile bent** — two or more piles driven in a row transverse to the long dimension of the structure and fastened together by capping and (sometimes) bracing.

**pile cap** — a structural member that is placed on top of a group of piles and used to transmit loads from the structure through the pile group into the soil.

**pipe column** — column made of steel pipe, often filled with concrete.

**pipe pile** — a steel pipe generally driven with open ends to firm bearing and then excavated and filled with concrete.

**pitting** — development of relatively small cavities in a surface; in concrete, localized disintegration, such as a popout; in steel, localized corrosion evident as minute cavities on the surface.

**placeability** — see workability.

**placement** — (1) the process of placing and consolidating concrete; (2) a quantity of concrete placed and finished during a continuous operation (often inappropriately referred to as pouring).

**placing** — the deposition, distribution, and consolidation of freshly mixed concrete in the place where it is to harden (often inappropriately referred to as pouring).

**plain bar** — a reinforcing bar without surface deformations, or one having deformations that do not conform to the applicable requirements.

**plain concrete** — structural concrete with no reinforcement or with less reinforcement than the minimum amount specified for reinforced concrete in the applicable building code.

**plain masonry** — (1) masonry without reinforcement; (2) masonry reinforced only for shrinkage or thermal change.

**plain pavement** — unreinforced concrete pavement.

**plane of weakness** — the plane along which a body under stress will tend to fracture and which may exist by design, by accident, or because of the nature of the structure and its loading.

**plaster** — (1) a mixture consisting essentially of a cementitious material or materials, fine aggregate, and water that forms a cohesive and workable mass; (2) the act of placing such material. (See also *stucco*.)

**plaster of paris** — gypsum, CaSO₄·1/2H₂O, from which three-quarters of the chemically bound water has been driven off by heating. (See also hemihydrate and bassanite.)

**plastic** — possessing plasticity adequate plasticity. (See also plasticity.)
plastic cement — a cement manufactured for plaster and stucco applications consisting of a blend of cement and lime that may include pozzolans, fillers, or additives to increase plasticity, workability, and crack resistance of the cement and the plaster.

plastic consistency — the consistency at which a mixture subjected to a constant shearing stress undergoes increasing deformation without rupture.

plastic flow — see creep and stress relaxation.

plastic hinge — region where ultimate moment capacity in a member may be developed and maintained with corresponding significant inelastic rotation as main tensile steel elongates beyond yield strain.

plastic shrinkage — shrinkage that takes place before cement paste, mortar, grout, or concrete sets.

plasticity — the property of freshly mixed cement paste, concrete, or mortar that determines its resistance to deformation or ease of molding.

plasticity index (PI) — the range of water content in which a soil remains plastic, evaluated as the numerical difference between liquid limit and plastic limit, as calculated according to ASTM D4318 (also called plasticity).

plasticizer — (1) a material that increases the plasticity of a fresh cementitious mixture; (2) a substance added to a material to improve the material’s flexibility.

plastic-shrinkage crack — surface crack that occurs in concrete before initial set.

plumb — vertical or to make vertical.

pneumatically applied mortar — see shotcrete.

point count method — method for determination of the volumetric composition of a solid by observation of the frequency with which areas of each component coincide with a regular system of points in one or more planes intersecting a sample of the solid. (See also linear-traverse method.)

point count method (modified) — the point count method supplemented by a determination of the frequency with which areas of each component of a solid are intersected by regularly spaced lines in one or more planes intersecting a sample of the solid.

point load — a load whose area of contact with the resisting body is negligible in comparison with the area of the resisting body.

point of contraflexure — see point of inflection (preferred term).

point of inflection — the point on the length of a structural member subjected to flexure where the bending moment is zero and the curvature changes from concave to convex or convex to concave (also called point of contraflexure).

Poisson’s ratio — the absolute value of the ratio of transverse strain to the corresponding longitudinal strain resulting from uniformly distributed axial stress below the proportional limit of the material.

polarizing microscope — a microscope equipped with elements permitting observations and determinations to be made using polarized light.

polish or final grind — the final operation in which fine abrasives are used to hone a surface to its desired smoothness and appearance.

polyethylene — a thermoplastic high-molecular-weight organic compound used in formulating protective coatings or, in sheet form, as a protective cover for concrete surfaces during the curing period, or to provide a temporary enclosure for construction operations.

dpolymer — the product of polymerization or, more commonly, a rubber or resin consisting of large molecules formed by polymerization.

dpolymer concrete — concrete in which an organic polymer serves as the binder.

dpolymer-cement concrete — a mixture comprising hydraulic cement and aggregate combined at the time of mixing with organic monomers or polymers that are dispersed in water.

dpolymer-impregnated concrete — a hydrated hydraulic-cement concrete that has been impregnated with a monomer that is subsequently polymerized.

dpolymerization — the reaction in which two or more molecules of the same substance combine to form a compound containing the same elements and in the same proportions but of higher molecular weight.
polystyrene resin — synthetic resins, varying from colorless to yellow, formed by the polymerization of styrene on heating with or without catalysts, which may be used in paints for concrete, for making sculptured molds, or as insulation.

polyurethane — reaction product of an isocyanate with any of a wide variety of other compounds containing an active hydrogen group, also used to formulate tough, abrasion-resistant coatings.

polyvinyl chloride — a synthetic resin prepared by the polymerization of vinyl chloride, used in the manufacture of nonmetallic waterstops for concrete.

ponding — (1) the creation and maintaining of a shallow pond of water on the surface of a concrete slab to assist curing; (2) accidental or incidental occurrence of a shallow pond or ponds on a nominally flat surface of concrete; (3) a condition in which a horizontal slab deforms downward between supports.

popout — the breaking away of small portions of a concrete, mortar, and plaster surface due to localized internal pressure that leaves a shallow, typically conical, depression.

porosity — the ratio, usually expressed as a percentage of the volume of voids in a material to the total volume of the material including the voids.

portland blast-furnace slag cement — a hydraulic cement consisting of an intimately interground mixture of portland-cement clinker and granulated blast-furnace slag or an intimate and uniform blend of portland cement and fine granulated blast-furnace slag in which the amount of the slag constituent is within specified limits.

portland cement — a hydraulic cement produced by pulverizing portland-cement clinker and usually with addition of calcium sulfate to control setting.

portland-cement clinker — a partially fused product of kiln that is ground to make cement.

portland-cement concrete — see concrete.

portlandite — a crystalline calcium hydroxide (Ca(OH)₂).

portland-pozzolan cement — a hydraulic cement consisting of an intimate and uniform blend of portland cement or portland blast-furnace slag cement and fine pozzolan produced by intergrinding portland-cement clinker and pozzolan, by blending portland cement or portland blast-furnace slag cement and finely divided pozzolan, or a combination of intergrinding and blending, in which the pozzolan constituent is within specified limits.

position coupler — threaded device for joining reinforcing bars where bars are not rotated.

positive moment — a condition of flexure in which, for a horizontal simply supported member, the deflected shape is normally considered to be concave downward and the top fibers subjected to compression stresses (for other members and other conditions, consider positive and negative as relative terms). (See also negative moment.)

Note: for structural design and analysis, moments may be designated as positive or negative with satisfactory results as long as the sign convention adopted is used consistently.

positive reinforcement — reinforcement for positive moment.

post — vertical formwork member used as a support (also called shore, prop, and jack).

post shore — individual vertical member used to support loads.

(1) adjustable timber single-post shore — individual timber used with a fabricated clamp to obtain adjustment and not normally manufactured as a complete unit.

(2) fabricated single-post shore — Type I: single all-metal post with a fine-adjustment screw or device in combination with pin-and-hole adjustment or clamp; Type II: single or double wooden post members adjustable by a metal clamp or screw and usually manufactured as a complete unit.

(3) timber single-post shore — timber used as a structural member for shoring support.
**post-tensioning** — method of prestressing reinforced concrete in which tendons are tensioned after the concrete has attained a specified minimum strength or a specified minimum age.

**pot life** — time interval after mixing of thermosetting resin and initiators during which the mixture can be applied without degrading the final performance of the resulting polymer beyond specified limits.

**pouring (of concrete)** — see placement and placing.

**power float** — see rotary float (preferred term).

**Powers’ spacing factor** — see spacing factor (preferred term).

**pozzolan** — a siliceous or silico-aluminous material that will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds having cementitious properties (there are both natural and artificial pozzolans).

**pozzolanic** — of or pertaining to a pozzolan.

**pozzolanic reaction** — reaction between calcium hydroxide and the oxides in a pozzolan resulting in reaction products having cementitious properties similar to the products that result from the hydration of portland cement.

**pozzolanic-activity index** — an index that measures pozzolanic activity based on the strength of cementitious mixtures containing hydraulic cement with and without the pozzolan, or containing the pozzolan with lime.

**preblended grout** — a hydraulic-cement grout that is a commercially available mixture of hydraulic cement, aggregate, and other ingredients that requires only the addition of water and mixing at the job site (also called premixed grout).

**precast concrete** — concrete cast elsewhere than its final position.

**precast pile** — a reinforced pile manufactured in a casting plant or at the site but not in its cast-in-place pile.

**precompressed zone** — the area of a flexural member that is compressed by the prestressing tendons.

**prefire** — to raise the temperature of refractory concrete under controlled conditions before placing it in service.

**preformed foam** — foam produced in a foam generator before introduction of the foam into a mixer with other ingredients to produce cellular concrete. (See also cellular concrete.)

**premature stiffening** — see early stiffening (preferred term).

**preplaced-aggregate concrete** — concrete produced by placing coarse aggregate in a form and later injecting a portland cement-sand grout, usually with admixtures, to fill the voids.

**pre-post-tensioning** — a method of fabricating prestressed concrete in which some of the tendons are pretensioned and a portion of the tendons are post-tensioned.

**preservation** — the process of maintaining a structure in its present condition and arresting further deterioration. (See also rehabilitation, repair, and restoration).

**preset period** — see presteaming period (preferred term).

**preshrunk concrete (mortar or grout)** — (1) concrete that has been mixed for a short period in a stationary mixer before being transferred to a transit mixer; (2) grout, mortar, or concrete that has been mixed 1 to 3 hours before placing to reduce shrinkage during hardening.

**pressed edge** — edge of a footing along which the greatest soil pressure occurs under conditions of overturning.

**presteaming period** — in the manufacture of concrete products, the time between molding of a concrete product and start of the temperature-rise period.

**prestress** — (1) to place a hardened concrete member or an assembly of units in a state of compression before application of service loads; (2) the stress developed by prestressing, such as by pretensioning or post-tensioning. (See also prestressed concrete, prestressing steel, pretensioning, and post-tensioning.)

**prestressed concrete** — structural concrete in which internal stresses have been introduced to reduce potential tensile stresses in concrete resulting from loads.
prestressing steel — high-strength steel elements such as wire, bar, or strands used to impart prestress forces to concrete. (See also prestress, prestressed concrete, pretensioning, and post-tensioning.)

pretensioning — method of prestressing in which prestressing steel is tensioned before the concrete is placed.

pretensioning bed (or bench) — the casting bed on which pretensioned members are manufactured and which resists the pretensioning force before release.

primary crusher — a heavy crusher suitable for the first stage in a process of size reduction of rock, slag, or the like.

principal planes — see principal stress.

principal stress — maximum and minimum stresses at any point acting at right angles to the mutually perpendicular planes of zero shearing stress, which are designated as the principal planes.

probabilistic design — design based on principles of statistics (probability) for evaluation of structural safety.

prop — see post and shore.

proportion — to select proportions of ingredients to make the most economical use of available materials to produce mortar or concrete of the required properties. (See also mixture.)

proportional limit — the greatest stress that a material can sustain without any deviation from proportionality of stress to strain. (See also Hooke’s law.)

protected paste volume — the portion of hardened cement paste that is protected from the effects of freezing by proximity to an entrained air void. (See also Philleo factor and spacing factor.)

pugmill — see horizontal-shaft mixer.

pullout failure — a failure mode in which the anchor pulls out of the concrete without development of the full steel or concrete capacity.

pull-through failure — a failure mode in which the anchor body pulls through the expansion mechanism without development of the full steel or concrete capacity.

pulse velocity — the speed at which a pulse of ultrasonic compressional stress waves travel through a material.

pulverized-fuel ash — see fly ash (preferred term).

pumice — a highly porous and vesicular lava usually of relatively high silica content composed largely of glass drawn into approximately parallel or loosely entwined fibers, which themselves contain sealed vesicles.

pumicite — naturally occurring finely divided volcanic ash composed of angular and porous particles of siliceous glass and varying proportions of crystal fragments differing from pumice only in grain size. (See also pumice.)

pumping (of pavements) — the ejection of water or water and solid materials such as clay or silt along transverse or longitudinal joints and cracks and along pavement edges caused by downward slab movement activated by the passage of loads over the pavement after the accumulation of free water on or in the base course, subgrade, or subbase.

punching shear — failure of a base or slab when a concentrated load punches a hole through it or where a heavily loaded suspended slab breaks away at the perimeter of a column.

putty — a plaster composed of quicklime or hydrated lime and water with or without plaster of paris or sand.

pyrite — a mineral, iron disulfide (FeS₂), that, if it occurs in aggregate used in concrete, can cause popouts and dark brown or orange-colored staining.

quality assurance — actions taken by an organization to provide and document assurance that what is being done and what is being provided are in accordance with the contract documents and standards of good practice for the work.

quality control — actions taken by an organization to provide control and documentation over what is being done and what is being provided so that the applicable standard of good practice or the contract documents for the work are followed.

quick setting — see flash setting (preferred term).
quicklime — calcium oxide (CaO).

rail-steel reinforcement — reinforcing bars hot-rolled from standard T-section rails.

ramming — a form of heavy tamping of concrete, grout, or the like by means of a blunt tool forcibly applied. (See also dry pack and tamping.)

random ashlar — see ashlar masonry (preferred term).

raveling — the wearing away of the concrete surface caused by the dislodging of aggregates particles.

raw mix — blend of raw materials ground to desired fineness, correctly proportioned, and blended ready for burning, used in the manufacture of cement clinker.

Rayleigh wave — a surface wave in which the particle motion is elliptical and effective penetration is less than one wavelength.

reactive aggregate — aggregate containing substances capable of reacting chemically with the products of solution or hydration of the portland cement in concrete or mortar under ordinary conditions of exposure, resulting in some cases in harmful expansion, cracking, or staining.

reactive silica material — several types of materials that react at high temperatures with portland cement or lime during autoclaving, includes pulverized silica, natural pozzolan, and fly ash.

ready-mixed concrete — concrete manufactured for delivery to a purchaser in a fresh state. (See also central-mixed concrete, shrink-mixed concrete, and transit-mixed concrete.)

rebar — colloquial term for reinforcing bar. (See also reinforcement.)

rebound — shotcrete materials or wet shotcrete that bounces away from the surface against which the shotcrete is being projected.

rebound hammer — an apparatus that provides a relative indication of the strength or hardness of concrete based on the rebound distance of a spring-driven mass after it impacts a rod in contact with the concrete surface.

recycled concrete — hardened concrete that has been processed for reuse, usually as aggregate.

reference standards — standardized mandatory language documents of a technical society, organization, or association, including the building codes of local or state authorities that are referenced in the contract documents or other standardized documents.

refractories — materials, usually nonmetallic, used to withstand high temperatures.

refractoriness — in refractories, the property of being resistant to softening or deformation at high temperatures.

refractory — resistant to high temperatures.

refractory aggregate — aggregate that is resistant to high temperatures and suitable to produce refractory concrete.

refractory concrete — hardened hydraulic-cement concrete that is suitable for use at temperatures between 600 and 2400°F (315 and 1315°C).

refractory-insulating concrete — refractory concrete having low thermal conductivity.

regulated-set cement — a hydraulic cement containing fluorine-substituted calcium aluminate, capable of very rapid setting.

rehabilitation — the process of repairing or modifying a structure to a desired useful condition. (See also preservation, repair, and restoration.)

reinforced concrete — structural concrete reinforced with no less than the minimum amount of prestressing steel or nonprestressed reinforcement as specified in the applicable building code.

reinforced masonry — unit masonry in which reinforcement is embedded in such a manner that the two materials act together in resisting forces.

reinforcement — bars, wires, strands, fibers, or other slender elements that are embedded in a matrix such that they act together to resist forces.

reinforcement bar — see reinforcement.

reinforcement ratio — ratio of the area of the reinforcement to the area of the concrete at any section of a structural member. (See also percentage of reinforcement.)

reinforcing bar — see bar and deformed reinforcement.
relative humidity — the ratio of the quantity of water vapor actually present to the amount present in a saturated atmosphere at a given temperature expressed as a percentage.

release agent — material used to prevent bonding of concrete to a surface. (See also bond breaker and form oil.)

remoldability — the readiness with which freshly mixed concrete responds to a remolding effort such as jigging or vibration, causing it to reshape its mass around reinforcement and to conform to the shape of the form. (See also remolding test.)

remolding test — a test to measure remoldability. (See remoldability.)

render — to apply a coat of mortar by a trowel or float.

repair — to replace or correct deteriorated, damaged, or faulty materials, components, or elements of a structure. (See also preservation, rehabilitation, and restoration.)

repeatability — variability among replicate test results obtained on the same material within a single laboratory by one operator.

reproducibility — variability among test results obtained on the same material in different laboratories.

required average strength — the average strength of concrete used in mixture proportioning to ensure a high likelihood that the concrete will meet specified strength acceptance criteria.

required strength — strength of a member or cross section required to resist factored loads or related internal moments and forces in such combinations as are stipulated in the applicable code or specification.

resetting (of forms) — setting of forms separately for each successive lift of a wall to avoid offsets at construction joints.

reshore — a temporary support placed against the bottom of a slab or other structural member immediately after the forms and original shores have been removed.

residual deformation — see nonrecoverable creep.

residual strength — strength in the post-peak load region of a static load-deflection curve.

resilience — the capability of a strained body to recover its size and shape after deformation.

resin — (1) general term for a class of materials made by polymerization of organic liquid compounds called monomers; (2) a plastic, viscous liquid, or monomer that is capable of hardening when mixed with appropriate catalysts or hardeners.

resin concrete — see polymer concrete (preferred term).

resin mortar — see polymer concrete.

restoration — the process of reestablishing the materials, form, and appearance of a structure to those of a particular era of the structure. (See also preservation, rehabilitation, and repair.)

restraint (of concrete) — restriction of free movement of fresh or hardened concrete following completion of placing in formwork or molds or within an otherwise confined space.

retardation — (1) reduction in the rate of either setting, hardening, or both; (2) an increase in the time required to reach time of initial and final setting or to develop early strength in a cementitious mixture. (See also retarder.)

retarder — an admixture that delays the setting of a cementitious mixture. (See also retarding admixture.)

retarding admixture — an admixture that causes a decrease in the rate of hydration of the hydraulic cement and lengthens the time of setting.

retemper — to add water and remix a cementitious mixture to restore workability to a condition in which the mixture is placeable or usable. (See also temper.)

reveal (n.) — (1) the vertical surface forming the side of an opening in a wall, as for a window or door; (2) depth of exposure of aggregate in an exposed aggregate finish. (See also exposed-aggregate finish.)
revibration — one or more applications of vibration to fresh concrete after completion of placing and initial consolidation but preceding initial setting of the concrete.

revolving-blade (or paddle) mixer — see open-top mixer.

rib — (1) one of a number of parallel structural members backing sheathing; (2) the portion of a T-beam that projects below the slab; (3) in deformed reinforcing bars, the deformations or the longitudinal parting ridge.

ribbed panel — a panel composed of a thin slab reinforced by a system of ribs in one or two directions, usually orthogonal.

ribbed slab — see ribbed panel.

ribbon loading — method of batching concrete in which the solid ingredients, and sometimes also the water, enter the mixer simultaneously (also called ribbon feeding).

rich concrete — concrete of high cement content. (See also lean concrete.)

rich mixture — a concrete mixture containing a high proportion of cement.

rider cap — see pile cap (preferred term).

rigid frame — a frame depending on moment in joints for stability.

rigid pavement — pavement that will provide high bending resistance and distribute loads to the foundation over a comparatively large area.

rock pocket — a porous, mortar-deficient portion of hardened concrete consisting of coarse aggregate and open voids. (See also honeycomb.)

rod — (1) a tool that is used as a straightedge or screed to provide a uniform and even surface across a plaster coat usually by trimming to a ground or dot; (2) a tool used as a guide for a scoring (combed) finish or similar repeating pattern finish; (3) a sharp-edged cutting screed used to trim shotcrete to forms or ground wires. (See also screed.)

rodding — consolidation of concrete by means of a tamping rod. (See also rod and tamping.)

roller compaction — a process for compacting concrete using a roller, often a vibratory roller.

roller-compacted concrete — (1) concrete compacted by roller compaction; (2) concrete that, in its unhardened state, will support a roller while being compacted.

rotary float — a motor-driven revolving disc that smooths, flattens, and compacts the surface of concrete floors and floor toppings (also called a power float).

rotary kiln — a long steel cylinder with a refractory lining supported on rollers so that it can rotate about its own axis, and erected with a slight inclination from the horizontal so that prepared raw materials fed into the higher end move to the lower end where fuel is blown in by air blast.

rout — to deepen and widen a crack to prepare it for patching or sealing.

rubbed finish — a finish obtained by using an abrasive to remove surface irregularities from concrete. (See also sack rub.)

rubber setting — see false setting (preferred term).

rubbing brick — a silicon-carbide brick used to smooth and remove irregularities from surfaces of hardened concrete.

rubble — (1) rough stones of irregular shape and size, broken from larger masses by geological processes or by quarrying; (2) concrete reduced to irregular fragments, as by demolition or natural catastrophe.

rupture modulus — see modulus of rupture.

rupture strength — see modulus of rupture.

rustication — a groove in a concrete surface.

rustication strip — a strip of wood or other material attached to a form surface to produce a groove or rustication in the concrete.

R-value — see thermal resistance.

sack — see bag of cement (preferred term).

sack rub — a finish for formed concrete surfaces, designed to produce even texture and fill pits and air holes. (See also surface air voids and rubbed finish.)

sagging — see sloughing (preferred term).

sample — either a group of units or portion of material taken, respectively, from a larger collection of units or a larger quantity of material that serves to...
provide information that can be used as a basis for action on the larger collection or quantity or on the production process.

**sampling plan** — (1) a procedure that specifies the number of units of product from a lot that is to be inspected to establish acceptability of the lot; (2) a prearranged program stipulating locations and procedures for securing samples of a material for testing purposes, for example, as concrete in construction or aggregates in a quarry, pit, or stockpile.

**sand** — (1) granular material passing the 9.5 mm (3/8 in.) sieve and almost entirely passing the 4.75 mm (No. 4) sieve and predominantly retained on the 75 μm (No. 200) sieve, and resulting either from natural disintegration and abrasion of rock or processing of completely friable sandstone; (2) that portion of an aggregate passing the 4.75 mm (No. 4) sieve and predominantly retained on the 75 μm (No. 200) sieve, and resulting either from natural disintegration and abrasion of rock or processing of completely friable sandstone. (See also fine aggregate.)

Note: the definitions are alternatives to be applied under differing circumstances. Definition (1) is applied to an entire aggregate either in a natural condition or after processing. Definition (2) is applied to a portion of an aggregate. Requirements for properties and grading should be stated in the specifications. Fine aggregate produced by crushing rock, gravel, or slag commonly is known as manufactured sand.

**sand equivalent** — a measure of the relative proportions of detrimental fine dust, clay-like material, or both in soils or fine aggregate.

**sand pocket** — a zone in concrete or mortar containing fine aggregate with little or no cement.

**sand streak** — a streak of exposed fine aggregate in the surface of formed concrete caused by bleeding.

**sandblast** — a system of cutting or abrading a surface such as concrete by a stream of sand ejected from a nozzle at high speed by compressed air, often used for cleanup of horizontal construction joints or for exposure of aggregate in architectural concrete.

**sand-coarse aggregate ratio** — ratio of fine to coarse aggregate in a batch of concrete, by mass or by volume.

**sanded grout** — grout in which fine aggregate is incorporated into the mixture.

**sand-lightweight concrete** — concrete made with a combination of expanded clay, shale, slag, or slate or sintered fly ash and natural sand, with a density generally between 105 and 120 lb/ft³ (1680 and 1920 kg/m³).

**sand-lime brick** — see calcium-silicate brick (preferred term).

**sandstone** — a cemented or otherwise indurated sedimentary rock composed predominantly of sand grains.

**sandwich panel** — a prefabricated panel that is a layered composite formed by attaching two thin facings to a thicker core, for example, a precast-concrete panel consisting of two layers of concrete separated by a nonstructural insulating core.

**Santorin earth** — a volcanic tuff originating on the Greek island of Santorin (also called Santorini, Thira, or Thera) and used as a pozzolan.

**saponification** — the alkaline hydrolysis of fats forming a soap, more generally the hydrolysis of an ester by an alkali with the formation of an alcohol and a salt of the acid portion.

**saturated surface-dry** — condition of an aggregate particle or other porous solid when the permeable pores are filled with water and no water is on the exposed surfaces.

**saturated surface-dry particle density** — the mass of the saturated surface-dry aggregate divided by its displacement volume in water.

**saturated surface-dry bulk specific gravity** — see saturated surface-dry specific gravity.

**saturated surface-dry specific gravity** — the ratio of the saturated surface-dry mass of a volume of a material, including the volume of impermeable pores and permeable water-filled pores but not including voids between particles, at a stated temperature to
the mass of an equal volume of distilled water at a stated temperature. (See also density.)

- **saturation** — the condition such that no more liquid can be held or placed within aggregate or hardened concrete.

- **saw cut** — a cut in hardened concrete made using abrasive blades or discs.

- **sawdust concrete** — concrete in which the aggregate consists mainly of sawdust from wood.

- **sawed joint** — a joint cut in hardened concrete, generally not to the full depth of the member, by means of special equipment.

- **scaffolding** — a temporary structure for the support of deck forms, cartways, or workers, or a combination of these, such as an elevated platform for supporting workers, tools, and materials; adjustable metal scaffolding is frequently adapted for shoring in concrete work.

- **scaling** — local flaking or peeling away of the near-surface portion of hardened concrete or mortar.

- **scalping screen** — a sieve for removing oversize particles.

- **scanning electron microscope** — an electron microscope in which the image is formed by a beam operating in synchronism with an electron probe scanning the object; the intensity of the image-forming beam is proportional to the scattering or secondary emission of electrons by the specimen where the probe beam strikes it.

- **scarf connection** — a connection made by precasting, beveling, halving, or notching two pieces to fit together; after overlapping, the pieces are secured by bolts or other means.

- **Schmidt hammer** — see rebound hammer.

- **scoria** — vesicular volcanic ejecta of larger size, usually of basic composition and characterized by dark color; the material is relatively heavy and partly glassy, partly crystalline; the vesicles do not generally interconnect. (See also lightweight aggregate.)

- **scour** — (1) erosion of soil around concrete members by water; (2) erosion of a concrete surface, exposing the aggregate.

- **scratch coat** — the first coat of plaster or stucco applied to a surface in three-coat work, usually cross-raked or scratched to form a mechanical key with the brown coat.

- **screed** — (1) to strike off a cementitious mixture lying beyond the desired plane or shape; (2) a tool for striking off the cementitious mixture surface, sometimes referred to as a strikeoff; (3) a ribbon or pad of a cementitious mixture that is preplaced to act as a guide for maintaining the desired level as more material is placed.

- **screed guide** — firmly established grade strips or side forms for unformed concrete that guide the strikeoff in producing the desired plane or shape.

- **screed rails** — see screed guide.

- **screed wire** — see ground wire.

- **screeding** — the operation of forming a surface using a screed. (See also strikeoff.)

- **screen** — production equipment for separating granular material according to size using woven-wire cloth or other similar device with regularly spaced openings of uniform size.

- **sealant** — see joint sealant.

- **sealer** — a liquid that is applied to the surface of hardened concrete, is colorless, is absorbed by the concrete, leaves little or nothing visible on the surface, and either prevents or decreased the penetration of liquid or gaseous media. (See also coating and curing compound.)

- **sealing compound** — see sealer.

- **seating** — see anchorage deformation.

- **secondary crusher** — a crusher used for the second stage in a process of size reduction of aggregate and the like. (See also primary crusher.)

- **segmental construction** — method of construction whereby individual elements are prestressed together by post-tensioning so that the elements act as a monolithic unit in resisting applied loads.
segregation — (1) nonuniform concentration of components in concrete or mortar; (2) nonuniform distribution of size fractions in a mass of aggregate; (3) the gravitational settlement of solids from a liquid (also called separation).

(See also bleeding.)

self-consolidating concrete — fresh concrete that can flow around reinforcement and consolidate within formwork under its own weight without vibration.

self-desiccation — the consumption of free water by chemical reaction so as to leave insufficient water to cover the solid surfaces and cause a decrease in the relative humidity of the system.

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.

self-stressing concrete (mortar or grout) — expansive-cement concrete (mortar or grout) in which expansion, if restrained, induces compressive stresses in the concrete (mortar or grout).

self-furring — metal lath or welded-wire reinforcement formed in the manufacturing process to include means by which the material is held away from the supporting surface, thus creating a space for keying of the insulating concrete, plaster, or stucco.
shearwall — a wall portion of a structural frame intended to resist lateral forces, such as earthquake, wind, and blast, acting in the plane of the wall.
sheath — an enclosure in which post-tensioning tendons are encased to prevent bonding during concrete placement. (See also duct.)
sheathing — (1) material encasing prestressing steel to prevent bonding of the prestressing steel with the surrounding concrete to provide corrosion protection and to contain the corrosion inhibiting coating (also called a sheath); (2) the material forming the contact face of forms (also called lagging or sheeting).
sheet pile — a pile in the form of a plank driven in close contact or interlocking with others to provide a tight wall to resist the lateral pressure of water, adjacent earth, or other materials.
sheeting — see sheathing (preferred term).
shelf angles — structural angles with holes or slots in one leg for bolting to the structure to support brick work, stone, or terra cotta.
shielding concrete — concrete employed as a biological shield to attenuate or absorb nuclear radiation, usually characterized by high density or high hydrogen (water) or boron content, having specific radiation attenuation effects. (See also biological shielding.)
shim — a strip of metal, wood, or other material employed to set base plates or structural members at the proper level for placement of grout, or to maintain the elongation in some types of post-tensioning anchorages.
shooting — placing of shotcrete. (See also gunning.)
shore — a temporary support for formwork and fresh concrete or for recently built structures that have not developed full design strength (also called prop, tom, post, and strut).
shoring — (1) props or posts of timber or other material in compression used for the temporary support of excavations, formwork, or unsafe structures; (2) the process of erecting shores.
shoring layout — a drawing prepared before erection showing arrangements of equipment for shoring.
short column — (1) a column whose load capacity is limited by strength rather than buckling; (2) a column so stocky and sufficiently restrained that at least 95 percent of the cross-sectional strength can be developed.
shorten — to decrease in length. (See also elongation and shrinkage.)
shotcrete — concrete placed by a high velocity pneumatic projection from a nozzle.
shoulder — an unintentional offset in a formed concrete surface usually caused by bulging or movement of formwork.
shrinkage — decrease in either length or volume of a material resulting from changes in moisture content or chemical changes.
shrinkage crack — crack due to restraint of shrinkage.
shrinkage cracking — cracking of a structure or member due to failure in tension caused by external or internal restraints as moisture content is reduced, carbonation occurs, or both.
shrinkage loss — reduction of stress in prestressing steel resulting from shrinkage of concrete.
shrinkage reinforcement — reinforcement designed to resist shrinkage stresses in concrete.
shrinkage-compensating — a characteristic of grout, mortar, or concrete made using expansive cement in which volume increases after setting and, if properly elastically restrained, induces compressive stresses that are intended to approximately offset the tendency of drying shrinkage to induce tensile stresses.
shrinkage-compensating cement — see expansive cement.
shrinkage-compensating concrete — concrete containing expansive components usually based on formation of calcium sulfoaluminate (ettringite) in a mixture of calcium aluminate and gypsum. (See also expansive cement.)
shrink-mixed concrete — ready-mixed concrete mixed partially in a stationary mixer and then mixed in a truck mixer.
SI (Système International) — the modern metric system (refer to ASTM E380).
side-face blowout failure — concrete spalling on the side face around the embedded head with no major breakout at the top concrete surface.

sieve — a metallic plate or sheet, woven-wire cloth, or other similar device with regularly spaced apertures of uniform size mounted in a suitable frame or holder for use in separating granular material according to size.

sieve analysis — the process of determining particle-size distribution of an aggregate. (See also grading.)

sieve fraction — that portion of a sample that passes through a standard sieve of specified size and is retained by some finer sieve of specified size.

sieve number — a number used to designate the size of a sieve. (See also sieve size [preferred term].)

sieve size — nominal size of openings between cross wires of a testing sieve.

significant — values of a test statistic that lie outside of predetermined limits of test precision and so taken to indicate a difference between populations (also called statistically significant).

silica — silicon dioxide (SiO₂).

silica flour — very finely divided silica, a siliceous binder component that reacts with lime under autoclave curing conditions, prepared by grinding silica, such as quartz, to a fine powder (also called silica powder).

silica fume — very fine noncrystalline silica produced in electric arc furnaces as a byproduct of the production of elemental silicon or alloys containing silicon.

silica powder — see silica flour (preferred term).

silicate — salt of a silicic acid. (See also alite, belite, blast-furnace slag, bredigite, calcium-silicate brick, calcium-silicate hydrate, celite, clay, dicalcium silicate, fire clay, hydraulic hydrated lime, kaolinite, mellite, siliceous-aggregate concrete, smectite, Stratling’s compound, tricalcium silicate, vermiculite, and xonolite).

siliceous-aggregate concrete — concrete made with normal-density aggregates having constituents composed mainly of silica or silicates.

silicone — a resin characterized by water-repellent properties in which the main polymer chain consists of alternating silicon and oxygen atoms with carbon-containing side groups.

silt — a granular material resulting from the disintegration of rock with grains largely passing a 75 μm (No. 200) sieve; particles in the range from 2 to 50 μm diameter.

simple beam — a beam without rotational restraint or continuity at its supports (also called a simply supported beam).

single-sized aggregate — aggregate in which a major portion of the particles is in a narrow size range.

sinter — (1) a ceramic material or mixture fired to less than complete fusion, resulting in a coherent mass; (2) the process of creating a ceramic material or mixture fired to less than complete fusion, resulting in a coherent mass.

sintering — the formation of a porous mass of material by the agglomeration of fine particles during particle fusion.

skid resistance — a measure of the frictional characteristics of a surface.

slab — a molded layer of plain or reinforced concrete, flat, horizontal (or nearly so), usually of uniform but sometimes of variable thickness, and supported by beams, columns, walls, other framework, or on the ground. (See also flat slab and flat plate.)

slab bolster — continuous wire bar support used to support bars in the bottom of slabs where the top wire is corrugated at 1 in. (25 mm) centers to hold bars in position. (See also bar support.)

slab strip — see middle strip (preferred term).

slab-jacking — the process of either raising concrete pavement slabs or filling voids under them, or both, by injecting a material (cementitious, noncementitious, or asphaltic) under pressure.

slab-on-ground — a slab cast directly on the ground (also called slab-on-grade).
slag — see blast-furnace slag.
slag cement — granulated blast-furnace slag that has been finely ground and that is hydraulic cement.
slag-activity index — the ratio of the compressive strength of a mortar cube made with equal amounts of slag and portland cement to the compressive strength of a mortar cube made with the same portland cement.
slate — a fine-grained metamorphic rock possessing a well-developed fissility (slaty cleavage), usually not parallel to the bedding planes of the rock.
sleeve — (1) a pipe or tube passing through formwork for a wall or slab through which pipe, wires, or conduit can be passed after the forms have been stripped; (2) a device used around an anchor to accommodate adjustment and preloading of the anchor after the concrete has hardened.
slender beam — a beam that, if loaded to failure without lateral bracing of the compression flange, would fail by buckling rather than in flexure.
slender column — a column whose load capacity is reduced by the increased eccentricity caused by secondary deflection moments.
slenderness ratio — the effective unsupported length of a uniform column divided by the least radius of gyration of the cross-sectional area.
slick line — end section of a pipe line used in placing concrete by pump that is immersed in the placed concrete and moved as the work progresses.
slipform — see slipform (preferred term).
slip — movement occurring between steel reinforcement and concrete in stressed reinforced concrete, indicating anchorage breakdown.
slipform — a form that is pulled or raised as concrete is placed.
sloped footing — a footing having sloping top or side faces.
sloughing — subsidence of shotcrete, plaster, or the like, generally due to excessive water in the mixture (also called sagging).
slugging — pulsating and intermittent flow of shotcrete material due to improper use of delivery equipment and materials.
slump — a measure of consistency of freshly mixed concrete, mortar, or stucco equal to the subsidence measured to the nearest 1/4 in. (5 mm) of the molded specimen immediately after removal of the slump cone.
slump cone — a mold in the form of the lateral surface of the frustum of a cone with a base diameter of 8 in. (203 mm), top diameter 4 in. (102 mm), and height 12 in. (305 mm), used to fabricate a specimen of freshly mixed concrete for the slump test.
slump loss — the amount by which the slump of freshly mixed concrete changes during a period of time after an initial slump test was made on a sample or samples thereof.
slurry — a mixture of water and any finely divided insoluble material, such as portland cement, slag, or clay in suspension.
smectite — a group of clay minerals, including montmorillonite, characterized by a sheet-like internal atomic structure, consisting of extremely finely-divided hydrous aluminum or magnesium silicates that swell on wetting, shrink on drying, and are subject to ion exchange.
snap tie — a proprietary concrete wall-form tie, the end of which can be twisted or snapped off after the forms have been removed.
snow load — the force considered in the design of a flat or pitched surface, usually a roof, for the possible amount of snow, ice, or both, lying on it.
soffit — the underside of a part or member of a structure, such as a beam, stairway, or arch.
soil — a generic term for unconsolidated natural surface material above bedrock.
soil cement — a mixture of soil and measured amounts of portland cement and water compacted to a high density.
soil pressure — see contact pressure.
soil stabilization — chemical or mechanical treatment designed to either increase or maintain the stability of a mass of soil or otherwise to improve its engineering properties.
solid masonry unit — a unit whose net cross-sectional area in every plane parallel to the bearing surface is 75 percent or more of its gross cross-sectional area measured in the same plane.

solid masonry wall — a wall built of blocks or solid masonry units, the mortar completely filling the joints between units.

solid panel — a solid slab, usually of constant thickness.

solid volume — see absolute volume.

solid-unit masonry — masonry consisting wholly of solid masonry units laid in mortar.

solubility — the amount of one material that will dissolve in another, generally expressed as mass percent, as volume percent, or parts per 100 parts of solvent by mass or volume at a specified temperature.

solution — a liquid consisting of at least two substances, one of which is a liquid solvent in which the other or others, that may be either solid or liquid, are dissolved.

soundness — the freedom of a solid from cracks, flaws, fissures, or variations from an accepted standard; in the case of a cement, freedom from excessive volume change after setting; in the case of aggregate, the ability to withstand the aggressive action to which concrete containing it might be exposed, particularly that due to weather.

spacer — device that maintains reinforcement in proper position, also a device for keeping wall forms apart at a given distance before and during concreting. (See also spreader.)

spacing factor — an index related to the maximum distance of any point in a cement paste or in the cement paste fraction of mortar or concrete from the periphery of an air void (also called Powers’ spacing factor). (See also Philleo factor.)

spading — consolidation of mortar or concrete by repeated insertion and withdrawal of a flat, spade-like tool.

spall — a fragment, usually in the shape of a flake, detached from a larger mass by a blow, the action of weather, pressure, or expansion within the larger mass.

spalling — the development of spalls.

span — distance between the support reactions of members carrying transverse loads.

span length — see effective span.

span-depth ratio — the numerical ratio of total span to member depth.

spandrel — that part of a wall between the head of a window and the sill of the window above it.

spandrel beam — a beam in the perimeter of a building, spanning between columns and usually supporting a floor or roof.

spatterdash — a rich mixture of portland cement and coarse sand thrown onto a background by a trowel, scoop, or other appliance so as to form a thin, coarse-textured, continuous coating; as a preliminary treatment before rendering, it assists bond of the undercoat to the background, improves resistance to rain penetration, and evens out the suction of variable backgrounds. (See also dash-bond coat and parge.)

specific gravity factor — the ratio of the mass of aggregates (including moisture), as introduced into the mixer, to the effective volume displaced by the aggregates.

specific heat — the amount of heat required per unit mass to cause a unit rise of temperature over a small range of temperature.

specific surface — the surface area of particles or of air voids contained in a unit mass or unit volume of a material.

specification (in ASTM) — an explicit set of requirements to be satisfied by a material, product, system, or service.

specified compressive strength — compressive strength of concrete used in design.

specified concrete compressive strength — the specified resistance of a concrete specimen to axial compressive loading used in design calculations and as the basis for acceptance of concrete used in the work.
specified concrete equivalent strength — in-place concrete compressive strength adjusted by correction factors that can be directly substituted into conventional strength equations with customary strength reduction factors.

specimen — a piece or portion of a sample used to make a test.

spinning — the essential factor of the process of producing spun concrete. (See also spun concrete.)

spiral reinforcement — continuously wound reinforcement in the form of a cylindrical helix.

spirally reinforced column — a column in which the vertical bars are enveloped by spiral reinforcement. (See also spiral reinforcement)

splice — (1) connection of one reinforcing bar to another by lapping, welding, mechanical couplers, or other means; (2) connection of welded-wire reinforcement by lapping; (3) connection of piles by mechanical couplers.

split-face block — a concrete masonry unit with one or more faces purposely fractured to provide architectural effects in masonry wall construction.

splitting tensile strength — tensile strength of concrete determined by a splitting tensile test (also called indirect tension strength).

splitting tensile test — a test for tensile strength in which a cylindrical specimen is loaded to failure in diametral compression applied along the entire length (also called indirect tension test).

spray drying — a method of evaporating the liquid from a solution or dispersion by spraying it into a heated gas.

sprayed concrete — see shotcrete (preferred term).

sprayed mortar — see shotcrete (preferred term).

spread footing — a generally rectangular prism of concrete, larger in lateral dimensions than the column or wall it supports, to distribute the load of a column or wall to the subgrade.

spreader — (1) a piece of lumber approximately 1 by 2 in. (25 by 50 mm) cut to the thickness of a wall or other formed element and inserted in the form to hold it temporarily at the correct dimension against tension of form ties; (2) a device consisting of reciprocating paddles, a revolving screw, or other mechanism for distributing concrete to required uniform thickness in a paving slab.

spud vibrator — a vibrator with a vibrating casing or a vibrating head used to consolidate freshly placed concrete by insertion into the mass.

spun concrete — see centrifugally cast concrete (preferred term).

stacking tube — a slender, free-standing tubular structure used to store granular materials; the material is loaded into the top of the tube and spills out of wall openings to make a conical pile surrounding the tube.

stain — discoloration by foreign matter.

standard curing — exposure of test specimens to specified conditions of moisture and temperature.

standard fire test — the test prescribed by ASTM E119.

standard hook — a hook at the end of a reinforcing bar made in accordance with a standard.

standard hooked bar — a reinforcing bar with the end bent into a hook of prescribed geometry to provide anchorage.

standard sand — silica sand, composed almost entirely of naturally rounded grains of nearly pure quartz, used for preparing mortars in the testing of hydraulic cements.

standard time-temperature curve — the graphic time table for application of temperature to a material or member for the ASTM E119 fire test.

static load — (1) the mass of a single stationary body or the combined masses of stationary bodies in a structure (such as the load of a stationary vehicle on a roadway); (2) during construction, the combined mass of forms, stringers, joists, reinforcing bars, and the actual concrete to be placed. (See also dead load.)

static modulus of elasticity — the value of Young’s modulus of elasticity obtained by arbitrary criteria from measured stress-strain relationships derived from other than dynamic loading.

stationary hopper — a container used to receive and temporarily store freshly mixed concrete.
steam curing — (1) curing of concrete, mortar, grout, or neat-cement paste in water vapor at atmospheric or higher pressures and at temperatures between approximately 100 and 420°F (40 and 215°C). (See also atmospheric-pressure steam curing, and autoclave curing.)

stearic acid — a white crystalline fatty acid, obtained by saponifying tallow or other hard fats containing stearin. (See also butyl stearate).

steel sheet — cold-formed sheet or strip steel shaped as a structural member for the purpose of carrying the live and dead loads in lightweight concrete roof construction.

steel trowel — see trowel.

stepped footing — a step-like support consisting of prisms of concrete of progressively diminishing lateral dimensions superimposed on each other to distribute the load of a column or wall to the subgrade.

sticky cement — finished cement that develops low or zero flowability during or after storage in silos or after transportation in bulk containers or hopper-bottom cars; may be caused by interlocking of particles, mechanical compaction, or electrostatic attraction between particles. (See also warehouse setting.)

stiffback — see strongback (preferred term).

stiffness — resistance to deformation.

stirrup — bar or wire reinforcement oriented normal to or at an acute angle to the longitudinal reinforcement in a flexural member and extending as close as practical to the extreme tension and compression fibers of the cross section. (See also transverse reinforcement and tie.)

stoichiometric — (1) characterized by or being a proportion of substances or energy in a specific chemical reaction in which there is no excess of any reactant or product; (2) proportioning based on atomic or molecular weight.

stone sand — fine aggregate resulting from the mechanical crushing and processing of rock. (See also fine aggregate and sand.)

storage hopper — see stationary hopper.

straightedge — (1) a rigid, straight piece of either wood or metal used to strikeoff or screed a concrete surface to proper grade or to check the planeness of a finished grade (see also rod, screed, and strikeoff); (2) a highway tool for truing surfaces instead of a bull float.

straight-line theory — an assumption in reinforced-concrete analysis according to which the strains in a member under flexure are assumed to vary in linear proportion to the distance from the neutral axis.

strain — the change in length per unit of length, in a linear dimension of a body.

strand — a prestressing tendon composed of a number of wires twisted above the center wire or core.

strand wrapping — application of high tensile strand, wound under tension by machines around circular concrete or shotcrete walls, domes, or other tension-resisting structural components.

stratification — (1) the separation of overwet or overvibrated concrete into horizontal layers with increasingly lighter material toward the top; water, laitance, mortar, and coarse aggregate tend to occupy successively lower positions in that order; (2) a layered structure in concrete resulting from placing of successive batches that differ in appearance; (3) occurrence in aggregate stockpiles of layers of differing grading or composition; (4) a layered structure in a rock foundation.

Stratling’s compound — dicalcium aluminate monosilicate-8-hydrate, a compound that has been found in reacted lime-pozzolan and cement-pozzolan mixtures.

strength — a generic term for the ability of a material to resist strain or rupture induced by external forces. (See also concrete compressive strength, fatigue strength, flexural strength, shear strength, splitting tensile strength, tensile strength, ultimate strength, and yield strength.)

strength-design method — a design method that requires service loads to be multiplied by load factors and computed nominal strengths to be multiplied by strength reduction factors.
stress — force per unit area.
stress corrosion — corrosion of a metal either initiated or accelerated by stress.
stress relaxation — the time-dependent decrease in stress in a material held at constant strain.
(See also creep.)
stressing end — in prestressed concrete, the end of the tendon at which the load is applied
when tendons are stressed from one end only.
stress-strain diagram — a diagram in which corresponding values of stress and strain are plotted
against each other.
stretcher — a masonry unit laid with its length horizontal and parallel with the face of
a wall or other masonry member. (See also header.)
strikeoff — to remove concrete in excess of that which is required to fill the form
evenly or bring the surface to grade; performed with a straightedged piece
of wood or metal by means of a forward sawing movement or by a power-
operated tool appropriate for this purpose (this is also the name applied to
the tool). (See also screed and screeding.)
stringer — a secondary flexural member that is parallel to the longitudinal axis of a
bridge or other structure. (See also beam.)
strip — (1) to remove formwork or a mold; (2) a long thin piece of wood, metal, or
other material. (See also demold and stripping.)
strip foundation — a continuous foundation wherein the length considerably exceeds the
breadth.
stripper — a liquid compound formulated to remove coatings by either chemical
action, solvent action, or both.
stripping — the removal of formwork or a mold. (See also demold.)
strongback — a frame attached to the back of a form or precast structural member to
stiffen or reinforce the form or member during concrete placing operations
or handling operations.
structural adhesive — a bonding agent used for transferring required loads between adherents
exposed to service environments typical for the structure involved.
structural concrete — plain or reinforced concrete in a member that is part of a structural system
required to transfer gravity loads, lateral loads, or both, along a load path
to the ground.
structural end-point — the acceptance criterion of ASTM E119, which states that the specimen
shall sustain the applied load without collapse.
structural lightweight concrete — structural concrete made with lightweight aggregate and having an air-dry
density of not more than 115 lb/ft³ (1850 kg/m³).
structural load test — procedure consisting of applying loads to verify the load-carrying capacity
of a structure or structural member.
structural repair — a repair that reestablishes or enhances the structural capacity of a member.
structural sandwich construction — a laminar construction comprising a combination of alternating dissimilar
simple or composite materials assembled and intimately fixed in relation
to each other so as to use the properties of each to attain specific structural
and thermal advantages for the whole assembly.
strut — see shore.
stub wall — low wall, usually 4 to 8 in. (100 to 200 mm) high, placed monolithically
with a concrete floor or other members to provide for control and
attachment of wall forms (also called kicker in the United Kingdom).
stucco — a portland cement-based plaster used for coating exterior walls and other
exterior surfaces. (See also plaster.)
stud — (1) member of appropriate size and spacing to support sheathing of
concrete forms; (2) a headed steel device used to anchor steel plates or
shapes to concrete members.
subaqueous concrete — see underwater concrete.
subbase — the layer in a pavement system between the subgrade and the base course,
or between the subgrade and the pavement.
subgrade — the soil prepared and compacted to support a structure or a pavement
system.
subgrade modulus — see coefficient of subgrade reaction.
subgrade reaction — see contact pressure and coefficient of subgrade reaction.
substrate — any material on the surface of which another material is applied.
substructure — all of that part of a structure below grade.
sulfate attack — a chemical reaction, physical reaction, or both, between sulfates usually in soil or ground water and concrete or mortar.
sulfate resistance — ability of concrete or mortar to withstand sulfate attack. (See also sulfate attack.)
sulfate-resistant cement — portland cement that is low in tricalcium aluminate, to reduce susceptibility of concrete to attack by dissolved sulfates in water or soils, referred to as ASTM C150 Type V cement.
sulfoaluminate cement — see expansive cement (1).
superimposed load — the load, other than its own weight, that is resisted by a structural member or system.
superplasticizer — see high-range water-reducing admixture (preferred term).
superstructure — all of that part of a structure above grade.
supersulfated cement — a hydraulic cement made by intimately intergrinding a mixture of granulated blast-furnace slag; calcium sulfate; and a small amount of lime, portland cement, or portland cement clinker; so named because the equivalent content of sulfate exceeds that for portland blast-furnace slag cement.
supplementary cementitious material — inorganic material such as fly ash, silica fume, metakaolin, or slag cement that reacts pozzolantically or hydraulically.
surface active — having the ability to modify surface energy and to facilitate wetting, penetrating, emulsifying, dispersing, solubilizing, foaming, frothing, and other substances.
surface air voids — small regular or irregular cavities, usually not exceeding 5/8 in. (15 mm) in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and consolidation. (See also sack rub.)
surface area — see specific surface.
surface bonding (of masonry) — bonding of dry-laid masonry by paring with a thin layer of fiber-reinforced mortar.
surface moisture — free water retained on surfaces of aggregate particles and considered to be part of the mixing water in concrete, as distinguished from absorbed moisture.
surface retarder — a retarder applied to the contact surface of a form or to the surface of newly placed concrete to delay setting of the cement, facilitate construction joint cleanup, or facilitate production of exposed-aggregate finish.
surface tension — an internal molecular force that exists in the surface film of all liquids and affects the wetting characteristics of the liquid.
surface texture — degree of roughness or irregularity of the exterior surfaces of aggregate particles and also of hardened concrete.
surface vibrator — a vibrator used for consolidating concrete by application to the surface of a mass of freshly mixed concrete; four principal types exist: vibrating screeds, pan vibrators, plate or grid vibratory tampers, and vibratory roller screeds.
surface voids — cavities visible on the surface of a solid. (See also surface air voids.)
surface water — see surface moisture (preferred term)
surface-active agent — a substance that affects markedly the interfacial or surface tension of solutions when present, even in low concentrations.
surfactant — a shortened form of the term surface-active agent.
sustained modulus of elasticity — term including elastic and inelastic effects in one expression to aid in visualizing net effects of stress-strain up to any given time, computed by dividing the unit sustained stress by the sum of the elastic and inelastic deformations at that time.
sway brace — a diagonal brace used to resist wind or other lateral forces. (See also bracing, cross bracing, and X-brace.)
swelling — increase in either length or volume. (See also expansion, volume change, and autogenous volume change.)

swirl finish — a nonskid texture imparted to a concrete surface during final troweling by keeping the trowel flat and using a rotary motion.

Swiss hammer — see rebound hammer (preferred term).

syngenite — potassium calcium sulfate hydrate, a compound sometimes produced during hydration of portland cement, found in deteriorating portland-cement concrete and said to form in portland cement during storage by reaction of potassium sulfate and gypsum.

Système International — see SI.

talc — a mineral with a greasy or soapy feel, very soft, having the composition $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. (See also masonry cement and Mohs scale).

tamp process — a process for producing concrete products, such as pipe, that uses direct mechanical action to consolidate the concrete by the action of tampers that rise automatically as the form is rotated and filled with concrete from above. (See also centrifugal process, dry-cast process, packerhead process, and wet-cast process.)

tamper — (1) an implement used to consolidate concrete or mortar in molds or forms; (2) a hand-operated device for consolidating floor topping or other unformed concrete by impact from the dropped device in preparation for strikeoff and finishing; contact surface often consists of a screen or a grid of bars to force coarse aggregates below the surface to prevent interference with floating or troweling. (See also jitterbug.)

tamping — the operation of consolidating freshly placed concrete by repeated blows or penetrations with a tamper. (See also consolidation and rodding.)

tamping rod — a straight steel rod of circular cross section and having one or both ends rounded to a hemispherical tip.

T-beam — a beam composed of a stem and a flange in the form of a T.

telltale — any device designed to indicate movement of formwork or of a point on the longitudinal surface of a pile under load.

temper — to add water to a cementitious mixture as necessary to initially bring the mixture to the desired workability. (See also retemper.)

temperature cracking — cracking due to tensile failure caused by temperature drop in members subjected to external restraints or by temperature differential in members subjected to internal restraints (also called thermal cracking).

temperature reinforcement — reinforcement designed to carry stresses resulting from temperature changes; also the minimum reinforcement for areas of members that are not subjected to primary stresses or necessarily to temperature stresses.

temperature rise — the increase of temperature caused by either absorption of heat or internal generation of heat, for example, hydration of cement in concrete.

temperature stress — stress in a restrained structure or a member due to changes or differentials in temperature in the structure or member.

temperature-rise period — the time interval during which the temperature of a concrete product rises at a controlled rate to the desired maximum in autoclave or atmospheric-pressure steam curing.

temperature-time factor — product of temperature multiplied by time for a specific interval. (See also maturity factor.)

template — (1) a thin plate or board frame used as a guide in positioning or spacing form parts, reinforcement, or anchors; (2) a full-size mold, pattern, or frame, shaped to serve as a guide in forming or testing contour or shape.

temporary stress — a stress that may be produced in a precast-concrete member or in a component of a precast-concrete member during fabrication or erection, or in cast-in-place concrete structures due to construction or test loadings.

tendon — an assembly consisting of a tensioned element (such as a wire, bar, rod, strand, or a bundle of these elements) used to impart compressive stress in concrete, along with any associated components used to enclose and anchor the tensioned element.

tendon profile — the path or trajectory of the prestressing tendon.
tensile strain capacity — the maximum tensile strain that hardened cement paste, mortar, or concrete can sustain before cracking occurs.

tensile strength — maximum stress that a material is capable of resisting under axial tensile loading based on the cross-sectional area of the specimen before loading.

tension reinforcement — reinforcement designed to carry tensile stresses such as those in the bottom of a simple beam.

ternary mixture — concrete containing three cementitious materials.

terrazzo concrete — marble-aggregate concrete that is cast-in-place or precast and ground smooth for decorative surfacing purposes on floors and walls.

test — a trial, examination, observation, or evaluation used as a means of measuring either a physical or a chemical characteristic of a material, or a physical characteristic of either a structural element or a structure.

tetragonal aluminoferrite — a compound in the calcium aluminoferrite series, having the composition 4CaO·Al₂O₃·Fe₂O₃, abbreviated C₄AF, that is usually assumed to be the aluminoferrite present when compound calculations are made from the results of chemical analysis of portland cement. (See also brownmillerite.)

texture — the pattern or configuration apparent in an exposed surface, as in concrete and mortar, including roughness, streaking, striation, or departure from flatness.

texturing — the process of producing a special texture on either unhardened or hardened concrete.

thermal conductance — (of a gas, liquid, or solid) a measure of the rate at which heat passes perpendicularly through a unit area of material of specified thickness for a temperature difference of one degree.

thermal conductivity — the ability of a homogeneous material to conduct heat, measured as the steady state heat flow per unit area through a body of unit thickness with one degree temperature difference between the surfaces.

thermal contraction — contraction caused by decrease in temperature.

thermal diffusivity — (1) thermal conductivity divided by the product of specific heat and density; (2) an index of the ease which a material undergoes temperature change.

thermal expansion — expansion caused by increase in temperature.

thermal movement — change of dimension of concrete or masonry resulting from change of temperatures. (See also thermal contraction and thermal expansion.)

thermal resistance — the reciprocal of thermal conductance expressed by the symbol R.

thermal shock — the subjection of newly hardened concrete to a rapid change in temperature that may cause surface cracking.

thermal stress — see temperature stress.

thermal volume change — the increase or decrease in volume caused by changes in temperature. (See thermal contraction and thermal expansion.)

thermoplastic — capable of being repeatedly softened by heating and hardened by cooling.

thermosetting — becoming rigid by chemical reaction and not remeltable.

thin-shell precast — precast concrete characterized by thin slabs and web sections.

thixotropy — a property of a material to thin upon isothermal agitation and to thicken upon subsequent rest.

threaded anchorage — an anchorage device that is provided with threads to facilitate attaching the jacking device and to affect the anchorage.

tie — (1) loop of reinforcing bars encircling the longitudinal steel in columns; (2) a tensile unit adapted to holding concrete forms secure against the lateral pressure of unhardened concrete; (3) a tension member in a strut-and-tie model.

tie bar — bar at right angles to and tied to reinforcement to keep it in place.

tie rod — see form tie and tieback.

tieback — a rod fastened to a deadman, a rigid foundation, or either a rock or soil anchor to prevent lateral movement of formwork, sheet pile walls, retaining walls, and bulkheads.

tied column — a column laterally reinforced with ties.
tilting mixer — a revolving-drum mixer that discharges by tilting the drum about a fixed or movable horizontal axis at right angles to the drum axis; the drum axis may be horizontal or inclined while charging and mixing.

tilt-up — a construction technique for casting concrete elements in a horizontal position at the job site and then tilting them to their final position in a structure.

time of haul — in production of ready-mixed concrete, the period from first contact between mixing water and cement until completion of discharge of the freshly mixed concrete.

time of setting — (1) the time required for a freshly mixed cement paste, mortar, or concrete to achieve initial setting (see initial setting); (2) the time required for a freshly mixed cement paste, mortar, or concrete to achieve final set. (See also final setting.)

time-dependent deformation — deformation resulting from effects such as autogenous volume change, thermal contraction or expansion, creep, shrinkage, and swelling, each of which is a function of time.

tilting mixer — see truck mixer.

tilt-up — a construction technique for casting concrete elements in a horizontal position at the job site and then tilting them to their final position in a structure.

time of haul — in production of ready-mixed concrete, the period from first contact between mixing water and cement until completion of discharge of the freshly mixed concrete.

time of setting — (1) the time required for a freshly mixed cement paste, mortar, or concrete to achieve initial setting (see initial setting); (2) the time required for a freshly mixed cement paste, mortar, or concrete to achieve final set. (See also final setting.)

time-dependent deformation — deformation resulting from effects such as autogenous volume change, thermal contraction or expansion, creep, shrinkage, and swelling, each of which is a function of time.

toermorite gel — the binder of concrete cured moist or in atmospheric-pressure steam, a lime-rich gel-like solid containing 1.5 to 1.0 mols of lime per mol of silica.

tolerance — the permitted deviation from a specified dimension, location, or quantity.

tom — see shore (preferred term)

tongue and groove — a joint in which a protruding rib on the edge of one side fits into a groove in the edge of the other side, abbreviated T & G. (See also keyway.)

tooling — the act of compacting and contouring a material in a joint.

top form — form required on the upper or outer surface of a sloping slab or thin shell.

topping — (1) a layer of concrete or mortar placed to form a floor surface on a concrete base; (2) a structural, cast-in-place surface for precast floor and roof systems; (3) the mixture of marble chips and matrix that, when properly processed, produces a terrazzo surface.

torque viscometer — an apparatus used for measuring the consistency of slurries in which the energy required to rotate a device suspended in a rotating cup is proportional to viscosity.

torsional stress — the shear stress on a transverse cross section resulting from a twisting action.

toughness — (1) the ability of a material to absorb energy without rupturing; (2) the amount of energy per unit volume of material required to rupture the material.

transfer — to shift the tensioning force for a strand or strands from a jack or pretensioning bed to a concrete or masonry member.

transferring bond — in pretensioning, the bond stress resulting from the transfer of stress from the tendon to the concrete.

transmission length — see transfer length.

transverse crack — a crack that occurs across the longer dimension of the member.

transverse joint — a joint normal to the longitudinal dimension of a structural element, assembly of elements, slab, or structure.

transverse prestress — prestress that is applied at right angles to the longitudinal axis of a member or slab.

transverse reinforcement — reinforcement at right angles to the longitudinal reinforcement.

transverse strength — see flexural strength and modulus of rupture.

traprock — any of various fine-grained, dense, dark-colored igneous rocks, typically basalt or diabase (also called trap).
trass — a natural pozzolan of volcanic origin found in Germany, namely, trachytic tuffs that are intensely altered by geologic processes.

traveler — an inverted-U-shaped structure usually mounted on tracks that permit it to move from one location to another to facilitate the construction of an arch, bridge, or building.

travertine — dense to irregularly porous, commonly stratified or banded calcium carbonate, either aragonite or calcite, formed by deposition from hot spring waters.

tremie — a pipe or tube through which concrete is deposited under water, having at its upper end a hopper for filling and a bail for moving the assemblage.

tremie seal — (1) the depth to which the discharge end of the tremie pipe is kept embedded in the fresh concrete that is being placed; (2) a layer of tremie concrete placed in a cofferdam for the purpose of preventing the intrusion of water when the cofferdam is dewatered.

trench form — the vertical sides and semicircular bottom of a trench excavated through compacted soil to provide the exterior form and base for a cast-in-place concrete pipe.

trial batch — a batch of concrete prepared to establish acceptable proportions of the constituents.

triaxial compression test — a test in which a specimen is subjected to a confining hydrostatic pressure and then loaded axially to failure.

triaxial test — a test in which a specimen is subjected simultaneously to lateral and axial loads.

tricalcium aluminate — a compound having the composition $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, abbreviated C$_{3}$A.

tricalcium silicate — a compound having the composition $3\text{CaO} \cdot \text{SiO}_2$, abbreviated C$_{3}$S, an impure form of which (alite) is a main constituent of portland cement. (See also alite.)

trough mixer — see open-top mixer (preferred term).

trowel — (1) a flat, broad-blade steel hand tool used in the final stages of finishing operations to impart a relatively smooth surface to concrete floors and other unformed concrete surfaces; (2) a flat, triangular-blade tool used for applying mortar; (3) a flat, broad-blade steel hand tool used to place, spread, shape, finish, or otherwise apply materials. (See also fresno trowel.)

trowel finish — the smooth finish of an unformed concrete surface obtained by troweling.

troweling — smoothing and compacting the unformed surface of fresh concrete by strokes of a trowel.

troweling machine — a motor-driven device that operates orbiting steel trowels on radial arms from a vertical shaft.

truck mixer — a concrete mixer suitable for mounting on a truck chassis and capable of mixing concrete in transit. (See also horizontal-shaft mixer, inclined-axis mixer, open-top mixer, and agitator.)

track-mixed concrete — see transit-mixed concrete.

T-shore — a shore with a T-head.

tub mixer — see open-top mixer (preferred term).

tube-and-coupler shoring — a load-carrying assembly of tubing or pipe that serves as posts, braces, and ties, a base supporting the posts, and special couplers that connect the uprights and join the various members.

tunnel lining — a structural system of concrete, steel, or other materials to provide support for a tunnel for exterior loads, to reduce water seepage, or to increase flow capacity.

turbidimeter — a device for measuring the particle-size distribution of a finely divided material by taking successive measurements of the turbidity of a suspension in a fluid.

turbidimeter fineness — the fineness of a material such as portland cement, usually expressed as total surface area in square centimeters per gram, as determined with a turbidimeter. (See also Wagner fineness.)

turbine mixer — see open-top mixer (preferred term).
twin-twisted bar reinforcement — two bars of the same nominal diameter twisted together.
two-way reinforced footing — a footing having reinforcement in two directions generally perpendicular to each other.
two-way reinforcement — reinforcement arranged in bands of bars at right angles to each other.
two-way system — a system of reinforcement; bars, rods, or wires placed at right angles to each other in a slab and intended to resist stresses due to bending of the slab in two directions.

Type I cement — see normal cement.
Type II cement — see modified cement.
Type III cement — see high-early-strength cement.
Type IV cement — see low-heat cement.
Type V cement — see sulfate-resistant cement.
ultimate load — the maximum load that may be placed on a structure or structural element before its failure.
ultimate moment — (obsolete) see nominal flexural strength.
ultimate shear strength — (obsolete) see nominal shear strength.
ultimate shear stress — see shear strength.
ultimate strength — the maximum stress developed in a specimen.
ultimate-strength design — see strength-design method.
ultrasonic — pertaining to mechanical vibrations having a frequency greater than approximately 20,000 Hz.
unbonded member — a prestressed-concrete member post-tensioned with tendons that are not bonded to the concrete between the end anchorages after stressing.
unbonded post-tensioning — post-tensioning in which the tendons are not grouted after stressing.
unbonded tendon — a tendon that is permanently prevented from bonding to the concrete after stressing.
unbraced length of column — distance between lateral supports.
underbed — the base mortar, usually horizontal, into which strips are embedded and on which terrazzo topping is applied.
undersanded — concrete containing an insufficient proportion of fine aggregate to produce optimum properties in the fresh mixture, especially workability and finishing characteristics.
undersize — particles of aggregate passing a designated sieve.
underwater concrete — concrete placed underwater by tremie or other means.
unhardened concrete — see fresh concrete (preferred term).
unit masonry — a construction element consisting of masonry units.
unit water content — the quantity of water per unit volume of freshly mixed concrete excluding water absorbed by the aggregate.
unit weight — (deprecated term) see density.
unreinforced concrete — see plain concrete.
unsound — not firmly made, placed, or fixed; subject to deterioration or disintegration during service exposure.
U-value — overall coefficient of heat transmission; a standard measure of the rate at which heat will flow through a unit area of a material of known thickness.
vacuum concrete — concrete from which excess water and entrapped air are extracted by a vacuum process before setting occurs.
vacuum dewatering — see vacuum concrete.
vacuum saturation — a process for increasing the moisture content of lightweight aggregate by subjecting it to a vacuum in a sealed chamber, flooding the chamber with water, and releasing the vacuum.
valve bag — paper bag for cement or other material, either glued or sewn, made of four or five plies of kraft paper and completely closed except for a self-sealing paper valve through which the contents are introduced and released.
vapor barrier — membrane located under a concrete floor slab that is placed on the ground to retard transmission of water vapor.
vapor pressure — the pressure exerted when a vapor is in equilibrium with its liquid or solid form at a given temperature.
vapor retarder — a membrane that impedes the transmission of gas molecules.
vebe apparatus — an apparatus for measuring workability of very low-slump or no-slump concrete, including a vibrating table, a sample container, and other ancillary items, that permits measurement of the time (vebe time) required to be consolidated in a mold.

vehicle — liquid carrier or binder of solids.

veneer — a masonry facing that is attached to the backup, but not so bonded as to act with it under load.

Venetian — a type of terrazzo topping that incorporates large chips of stone.

vermiculite — (1) a micaceous mineral; (2) a group name for certain platy minerals, hydrous silicates of aluminum, magnesium, and iron characterized by marked exfoliation on heating; (3) a constituent of clays.

vertical-shaft mixer — a cylindrical or annular mixing compartment having an essentially level floor and containing one or more vertical rotating shafts to which blades or paddles are attached; the mixing compartment may be stationary or rotate about a vertical axis.

vibrated concrete — concrete consolidated by vibration during and after placing.

vibration — energetic agitation of freshly mixed concrete during placement by mechanical devices, either pneumatic or electric, that create vibratory impulses of moderately high frequency to assist in consolidating the concrete in the form or mold.

(1) external vibration — employs vibrating devices attached at strategic positions on the forms and is particularly applicable to manufacture of precast items and for vibration of tunnel-lining forms; in manufacture of concrete products, external vibration or impact may be applied to a casting table.

(2) internal vibration — employs one or more vibrating elements that can be inserted into the fresh concrete at selected locations, and is more generally applicable to in-place construction.

(3) surface vibration — employs a portable horizontal platform on which a vibrating element is mounted.

vibration limit — the age at which fresh concrete has undergone a sufficient degree of setting and developed adequate strength to resist flow when subjected to vibration.

vibrator — an oscillating machine used to agitate fresh concrete so as to eliminate gross voids, including entrapped air but not entrained air, and to produce intimate contact with form surfaces and embedded materials. (See also vibration.)

Vicat apparatus — a penetration device used in the testing of hydraulic cements and similar materials.

Vicat needle — a weighted needle for determining time of setting of hydraulic cements.

viscometer — instrument for determining viscosity of slurries, mortars, or concretes.

viscosity — a measure of the resistance of a fluid to deform under shear stress.

visual concrete — see architectural concrete.

void-cement ratio — volumetric ratio of air plus net mixing water to cement in a concrete or mortar mixture.

volatile material — material that is subject to release as a gas or vapor; liquid that evaporates readily.

volume batching — combining the constituents of mortar or concrete based on volumetric measurement. (See also volumetric measuring.)

volume change — an increase or decrease in volume due to any cause. (See also deformation and time-dependent deformation.)

volumetric measuring — dispensing an ingredient based on volume, either in discrete quantities or by continuous flow.

volumetric mixer — equipment that uses measurements based on the volumes of the ingredients to feed a container that continually agitates and combines those ingredients for the production of concrete (also called volumetric-measuring and continuous-mixing concrete equipment [VMCM]).

w/c — see water-cement ratio.
**w/cm** — see water-cementitious materials ratio.

**waffle** — see dome.

**Wagner fineness** — the fineness of portland cement, expressed as total surface area in square centimeters per gram, determined by the Wagner turbidimeter apparatus and procedure.

**wale** — a long formwork member (usually double) used to gather loads from several studs (or similar members) to allow wider spacing of the restraining ties; when used with prefabricated panel forms, this member is used to maintain alignment.

**wall** — a vertical element used primarily to enclose or separate spaces.

**wall form** — a retainer or mold so erected as to give the necessary shape, support, and finish to a concrete wall.

**warehouse pack** — see warehouse setting and sticky cement.

**warehouse setting** — (1) the partial hydration of cement stored for a time and exposed to atmospheric moisture; (2) mechanical compaction occurring during storage. (See also sticky cement.)

**warping** — out-of-plane deformation of the corners, edges, and surface of a pavement, slab, or wall panel from its original shape. (See also curling.)

**warping joint** — a joint with the sole function of permitting warping of pavement slabs when moisture and temperature differentials occur between the top and bottom of the slabs, that is, longitudinal or transverse joints with bonded steel or tie bars passing through them.

**wash water** — water carried on a truck mixer in a special tank for flushing the interior of the mixer after discharge of the concrete.

**water blast** — a system of cutting or abrading a surface such as concrete by a stream of water ejected from a nozzle at high velocity.

**water pocket** — see water void.

**water ring** — a device in the nozzle body of dry-mix shotcrete equipment through which water is added to the materials.

**water void** — void along the underside of an aggregate particle or reinforcing steel that formed during the bleeding period, initially filled with bleed water.

**water-cement ratio** — the ratio of the mass of water, exclusive only of that absorbed by the aggregates, to the mass of portland cement in a cementitious mixture, stated as a decimal and abbreviated as w/c. (See also water-cementitious materials ratio.)

**water-cementitious materials ratio** — the ratio of the mass of water, excluding that absorbed by the aggregate, to the mass of cementitious material in a mixture, stated as a decimal and abbreviated w/cm. (See also water-cement ratio.)

**waterproof** — an idealized property of a material indicating imperviousness to water in either liquid or vapor state. (See also dampproofing.)

*Note: because nothing can be completely impervious to water under infinite pressure over infinite time, this term should not be used.*

**waterproofed cement** — see water-repellent.

**waterproofing** — see dampproofing (preferred term).

**waterproofing compound** — material used to impart water repellency to a structure or a constructional unit.

**water-reducing admixture** — an admixture that either increases slump of freshly mixed mortar or concrete without increasing water content, or maintains slump with a reduced amount of water, the effect being due to factors other than air entrainment.

**water-repellent** — property of a surface that resists wetting (by matter in either liquid or vapor state) but permits passage of water when hydrostatic pressure occurs. (See also watertight.)

**water-resistant** — see water-repellent (preferred term).

**waterstop** — a thin sheet of metal, rubber, plastic, or other material inserted across a joint to obstruct the seepage of water through the joint.

**watertight** — impermeable to water except when under hydrostatic pressure sufficient to produce structural discontinuity by rupture.
wearing course — a topping or surface treatment to increase the resistance of a concrete pavement or slab to abrasion.

weathering — changes in color, texture, strength, chemical composition or other properties of a natural or artificial material due to the action of the weather.

web bar — see web reinforcement (preferred term).

web reinforcement — reinforcement placed in a concrete member to resist shear and diagonal tension.

wedge — a piece of wood or metal tapering to a thin edge, used to adjust elevation or tighten formwork.

wedge anchorage — a device for anchoring a tendon by wedging.

weigh batching — measuring the constituent materials for mortar or concrete by mass.

welded-butt splice — a reinforcing bar splice made by welding the butted ends.

welded-wire fabric — (obsolete) see welded-wire reinforcement (preferred term).

welded-wire reinforcement — a series of longitudinal and transverse wires arranged approximately at right angles to each other and welded together at all points of intersection.

well-graded aggregate — aggregate having a particle-size distribution that produces high density, that is, low void space.

wet — covered with visible free moisture.

wet process — in the manufacture of cement, the process in which the raw materials are ground, blended, mixed, and pumped while mixed with water. (See also dry process.)

wet screening — screening to remove from fresh concrete aggregate particles larger than a certain size.

wet sieving — use of water to facilitate sieving of a granular material on standard sieves.

wet-cast process — a process for producing concrete items, such as pipe, that uses concrete having a measurable slump, generally placed from above, and consolidated by vibration. (See also centrifugal process, dry-cast process, packerhead process, and tamp process.)

wet-mix shotcrete — shotcrete in which the ingredients, including water, are mixed before introduction into the delivery hose (also called wet-process shotcrete).

wettest stable consistency — the condition of maximum water content at which cement grout and mortar will adhere to a vertical surface without sloughing.

wetting agent — a substance capable of lowering the surface tension of liquids, facilitating the wetting of solid surfaces and permitting the penetration of liquid into the capillaries.

wheel load — the portion of the gross mass of a loaded vehicle transferred to the supporting structure under a given wheel of the vehicle.

white cement — portland cement that hydrates to a white paste; made from raw materials of low iron content, the clinker for which is fired by a reducing flame.

wind load — pressure or suction due to wind on part or all of a surface of a structure.

wing pile — a bearing pile, usually of concrete, widened in the upper portion to form part of a sheet pile wall.

wire mesh — see welded-wire reinforcement.

wire wrapping — application of high tensile wire, wound under tension by machines, around circular concrete or shotcrete walls, domes, or other tension-resisting structural components.

wobble coefficient — a coefficient used in determining the friction loss occurring in post-tensioning, which is assumed to account for the secondary curvature of the tendons.

wobble friction — in prestressed concrete, the friction caused by the unintended deviation of the prestressing sheath or duct from its specified profile.

workability — that property of freshly mixed concrete or mortar that determines the ease with which it can be mixed, placed, consolidated, and finished to a homogenous condition.

working load — forces normally imposed on a member in service.

working stress — maximum permissible design stress using working-stress design methods.
working-stress design — a method of proportioning either structures or members for prescribed service loads and assuming linear stress-strain relationships for the materials. (See also elastic design.)

woven-wire fabric — see woven-wire reinforcement.

woven-wire reinforcement — a prefabricated steel reinforcement composed of cold-drawn steel wires mechanically interlaced to form shape openings.

wrapping — see strand wrapping and wire wrapping.

wythe (leaf) — each continuous vertical section of a wall that is one masonry unit or grouted space in thickness.

X-brace — paired set of crossing sway braces. (See also brace, cross bracing, and sway brace.)

xonotlite — calcium silicate monohydrate (Ca₆Si₆O₁₇(OH)₂), a natural mineral that is readily synthesized at 302 to 662°F (150 to 350°C) under saturated steam pressure; a constituent of sand-lime masonry units.

X-ray diffraction — (1) the diffraction of X-rays by substances having a regular arrangement of atoms; (2) a phenomenon used to identify substances having a regular arrangement of atoms.

X-ray emission spectroscopy — see X-ray fluorescence.

X-ray fluorescence — characteristic secondary radiation emitted by an element as a result of excitation by X-rays, used to yield chemical analysis of a sample.

yellowing — development of yellow color or cast in white or clear coatings as a consequence of aging.

yield — (1) the volume of freshly mixed concrete produced from a known quantity of ingredients; (2) the total mass of ingredients divided by the density mass of the freshly mixed concrete; (3) the number of units produced per bag of cement or per batch of concrete.

yield point — the first engineering stress in a test in which stresses and strains are determined for a material that exhibits the phenomenon of discontinuous yielding, of which an increase in strain occurs without an increase in stress.

yield strength — the stress at which a material exhibits a specific limiting deviation from the proportionality of stress to strain.

yoke — (1) a tie or clamping device around column forms or over the top of wall or footing forms to keep them from spreading because of the lateral pressure of fresh concrete; (2) part of a structural assembly for slipforming that keeps the forms from spreading and transfers form loads to the jacks.

zero-slump concrete — concrete of stiff or extremely dry consistency showing no measurable slump after removal of the slump cone. (See also slump and no-slump concrete.)