

# Contents—Concrete Repair Manual

## *Third Edition*

The documents in this manual were provided from the following organizations:

ACI	American Concrete Institute
ASCE	American Society of Civil Engineers
BRE	Building Research Establishment
CRC	Construction Research Communications
CS	Concrete Society
ICRI	International Concrete Repair Institute
NACE International	(Formerly the National Association of Corrosion Engineers)
SSPC	The Society for Protective Coatings
USACE	United States Army Corps of Engineers

### VOLUME 1

#### General

ICRI—Concrete Repair Terminology.....	19
Vision 2020—A Vision for the Concrete Repair, Protection, and Strengthening Industry .....	71

#### Condition Evaluation

ACI 201.1R-92 (Reapproved 1997)—Guide for Making a Condition Survey of Concrete in Service.....	105
ACI 364.1R-07—Guide for Evaluation of Concrete Structures Before Rehabilitation .....	121
CS TR 54—Diagnosis of Deterioration in Concrete Structures.....	139
BRE Digest 444—Corrosion of Steel in Concrete.....	207
Part 1: Durability of Reinforced Concrete Structures.....	207
Part 2: Investigation and Assessment.....	219
CS TR 32—Analysis of Hardened Concrete .....	235
ACI 228.2R-98 (Reapproved 2004)—Nondestructive Test Methods for Evaluation of Concrete in Structures.....	339
BRE Digest 434—Corrosion of Reinforcement in Concrete: Electrochemical Monitoring.....	401
CS TR 60—Electrochemical Tests for Reinforcement Corrosion .....	413
ACI 224.1R-07—Causes, Evaluation, and Repair of Cracks in Concrete Structures .....	453
CS TR 22—Non-structural Cracks in Concrete .....	475
ACI 437R-03—Strength Evaluation of Existing Concrete Buildings .....	521
ICRI Guideline No. 03736—Guide for the Evaluation of Unbonded Post-Tensioned Concrete Structures .....	549
ACI 341.3R-07—Seismic Evaluation and Retrofit Techniques for Concrete Bridges.....	575
ACI 437.1R-07—Load Tests of Concrete Structures: Methods, Magnitude, Protocols, and Acceptance Criteria.....	605
ACI 364 Technical Notes (FAQ).....	643
FAQ—Carbonation of Concrete .....	643
FAQ—Parking Deck Service Life .....	645
FAQ—Cracks in a Repair .....	647
FAQ—Hydrodemolition for Concrete Removal.....	649
FAQ—Alkali-Aggregate Reaction.....	651
FAQ—Surface Bruising .....	655
FAQ—Corroded Reinforcing Steel .....	657

## Concrete Restoration

### General

ACI 546.04—Concrete Repair Guide ..... 663

### Spall Repair, Overlays, and Full-Depth Replacement

ACI 325.13R-06—Concrete Overlays for Pavement Rehabilitation.....719

### Materials for Repair

ICRI Guideline No. 03733—Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces.....761

ICRI Guideline No. 03738—Guide for the Selection of Grouts to Control Water Leakage in Concrete Structures..... 795

ICRI Guideline No. 03740—Guideline for Inorganic Repair Material Data Sheet Protocol ..... 827

ACI 503R-93 (Reapproved 1998)—Use of Epoxy Compounds with Concrete..... 837

ACI 503.5R-92 (Reapproved 2003)—Guide for the Selection of Polymer Adhesives with Concrete..... 865

ACI 546.3R-06—Guide for the Selection Of Materials for the Repair of Concrete ..... 881

### Preparation

ICRI Guideline No. 03730—Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion .....917

ICRI Guideline No. 03737—Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods..... 925

### Application Methods

ICRI Guideline No. 03731—Guide for Selecting Application Methods for the Repair of Concrete Surfaces ..... 943

ACI E706 - Repair Application Procedures .....951

RAP-1: Structural Crack Repair by Epoxy Injection ..... 951

RAP-2: Crack Repair by Gravity Feed with Resin ..... 957

RAP-3: Spall Repair by Low-Pressure Spraying ..... 963

RAP-4: Surface Repair Using Form-and-Pour Techniques..... 969

RAP-5: Surface Repair Using Form-and-Pump Techniques ..... 977

RAP-6: Vertical and Overhead Spall Repair by Hand Application ..... 985

RAP-7: Spall Repair of Horizontal Concrete Surfaces ..... 991

RAP-8: Installation of Embedded Galvanic Anodes..... 997

RAP-9: Spall Repair by the Preplaced Aggregate Method .....1003

ACI 506.2-95—Specification for Shotcrete ..... 1009

ACI 506.4R-94 (Reapproved 2004)—Guide for the Evaluation of Shotcrete ..... 1017

ACI 506R-05—Guide to Shotcrete .....1029

ACI 503.4-92 (Reapproved 1997)—Standard Specification for Repairing Concrete with Epoxy Mortars..... 1069

## VOLUME 2

### Contractual

CS TR 38—Patch Repair of Reinforced Concrete—Subject to Reinforcement Corrosion .....1093

ICRI Guideline No. 03735—Guide for Methods of Measurement and Contract Types for Concrete Repair Work..... 1179

### Strengthening

ACI 440.2R-02—Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures..... 1197

ICRI Guideline No. 03742—Guide for the Selection of Strengthening Systems for Concrete Structures ..... 1243

## Protection

### General

CS TR 50—Guide to Surface Treatments for Protection and Enhancement of Concrete .....1279

### Surface Preparation

ICRI Guideline No. 03732—Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays..... 1361

USACE TN CS MR 4.4—Cleaning Concrete Surfaces.....1403

USACE TN CS MR 4.3 ER—Removal and Prevention of Efflorescence on Concrete and Masonry Building Surfaces .....1407

### Installation

ICRI Guideline No. 03741—Guide for the Design, Installation and Maintenance of Protective Polymer Flooring Systems for Concrete ..... 1413

ICRI Guideline No. 03743—Guide for the Repair of Unbonded Post-Tensioned Concrete Structures ..... 1451

ACI 504R-90—Guide to Sealing Joints in Concrete Structures ..... 1475

SSPC—Paint Application Specification No. 7: Applying Thin Film Coatings to Concrete ..... 1519

SSPC—Paint Specification No. 37: Waterborne Epoxy Coating for Cementitious Substrates Performance-Based.....1529

SSPC—Qualification Procedure No. 8: Standard Procedure for Evaluating the Qualifications of Contracting Firms that Install Polymer Coatings and Surfacing on Concrete and Other Cementitious Substrates ..... 1535

SSPC—Joint Technology Update No. 10: Procedures For Applying Thick Film Coatings and Surfacing Over Concrete Floors ..... 1541

### Testing

ICRI Guideline No. 03734—Guide for Verifying Field Performance of Epoxy Injection of Concrete Cracks..... 1567

ICRI Guideline No. 03739—Guide to Using In-Situ Tensile Pull-Off Tests to Evaluate Bond Of Concrete Surface Materials ..... 1577

BRE Information Paper—Testing Anti-Carbonation Coatings for Concrete .....1589

### Corrosion Management

ACI 222R-01—Protection of Metals in Concrete Against Corrosion..... 1597

BRE Digest 444—Corrosion of Steel in Concrete Part 3: Protection and Remediation .....1639

CS TR 36—Cathodic Protection of Reinforced Concrete ..... 1651

CS TR 37—Model Specification for Cathodic Protection of Reinforced Concrete..... 1723

NACE International—RP0187 – 2005 Design Considerations for Corrosion Control of Reinforcing Steel in Concrete ..... 1773

NACE International—RP0390 – 2006 Maintenance and Rehabilitation Considerations for Corrosion Control of Atmospherically Exposed Existing Steel-Reinforced Concrete Structures ..... 1785

NACE International—SP0107 – 2007 Electrochemical Realkalization and Chloride Extraction for Reinforced Concrete ..... 1797

NACE International—SP0290 – 2007 Impressed Current Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structures ..... 1811

## References

BRE Digest 405—Carbonation of Concrete and Its Effects on Durability— <i>Reference only</i> .....	1829
BRE Digest 392—Assessment of Existing High Alumina Cement Concrete Construction in the UK— <i>Reference only</i> .....	1831
ASCE—Standard Practice Manual for Underwater Investigations— <i>Reference only</i> .....	1833
ACI 349.3R-02—Evaluation of Existing Nuclear Safety-Related Concrete Structures— <i>Reference only</i> .....	1835
ACI 345.1R-06—Guide for Maintenance of Concrete Bridge Members— <i>Reference only</i> .....	1837

## Special Cases

CS TR 33—Assessment and Repair of Fire-Damaged Concrete Structures .....	1841
ACI 546.2R-98—Guide to Underwater Repair of Concrete .....	1915
ACI 210R-93 (Reapproved 1998)—Erosion of Concrete in Hydraulic Structures .....	1939
ACI 210.1R-94 (Reapproved 1999)—Compendium of Case Histories on Repair of Erosion-Damaged Concrete in Hydraulic Structures.....	1963
USACE EM 1110-2-2002, Chapter 8—Evaluation and Repair of Concrete Structures .....	1997
ACI 362.2R-00—Guide for Structural Maintenance of Parking Structures .....	2063