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DENVER, COLORADO | OCTOBER 22-25, 2024

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Understanding and Using the New ACI 563-24 Repair Specifications – For Engineers and Specifiers

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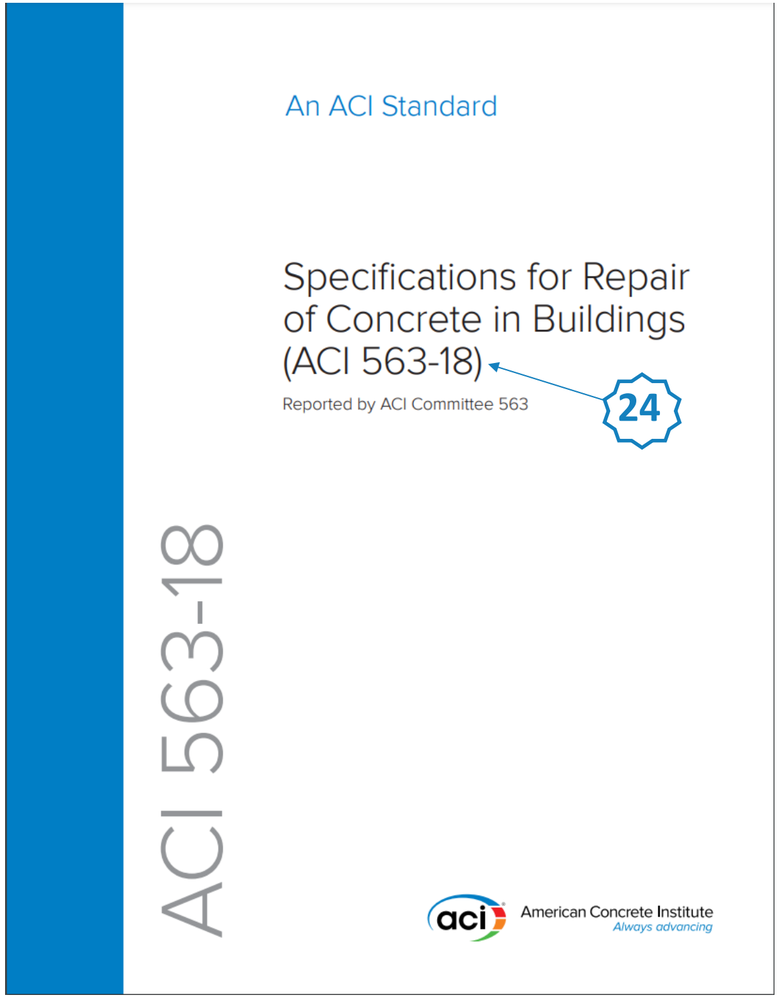
Chair, ACI 563

Today's Presentation



- General introduction to ACI 563:
  - History, Usage, Specification Language
- Review similarities and differences between ACI 301 and ACI 563
- Review specification sections currently included in ACI 563-18
- Preview new specification sections that will be included in ACI 563-24

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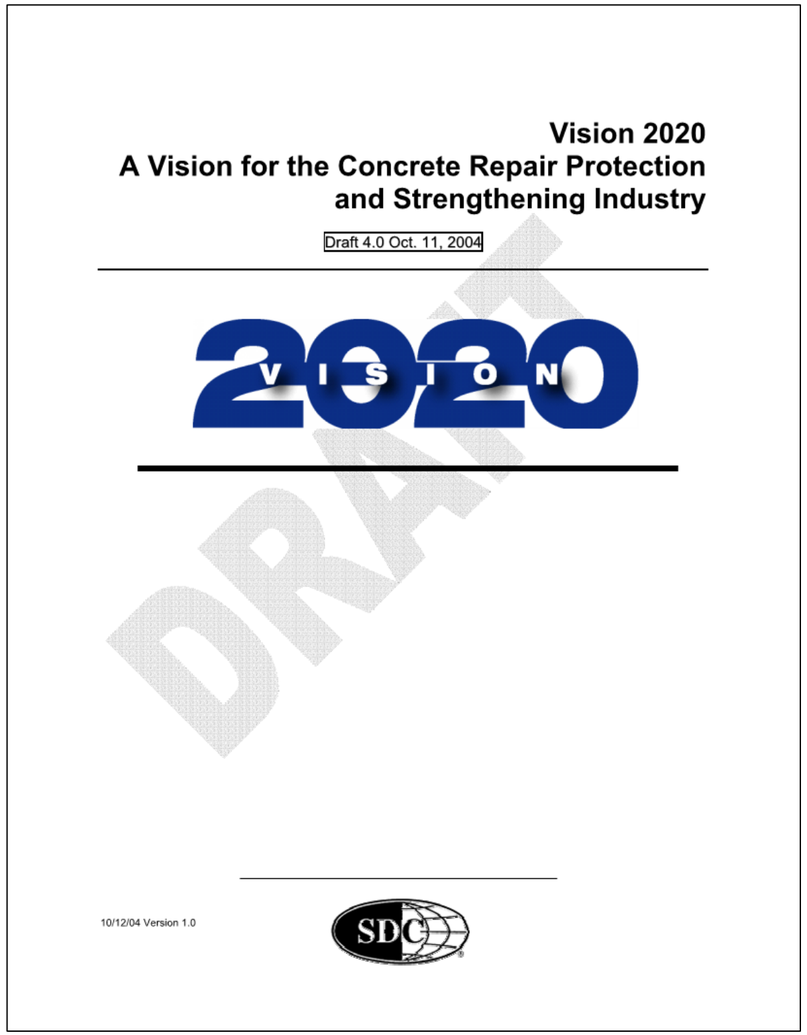
History of ACI 563



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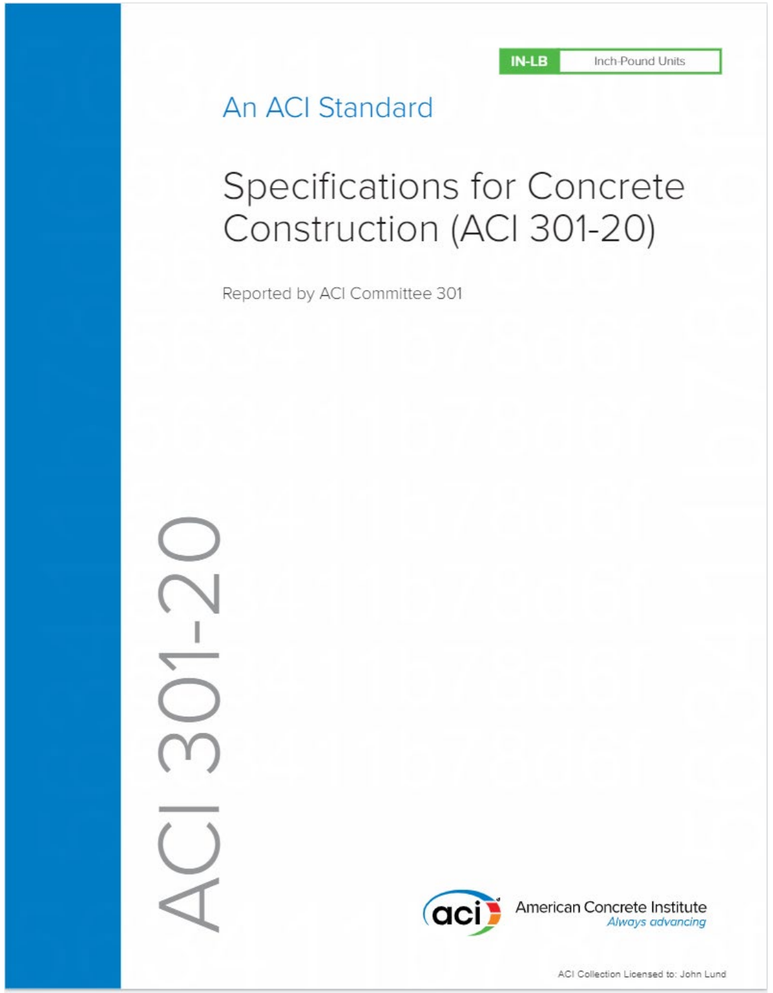
VISION 2020

- Developed by ACI's Strategic Development Council (SDC) in 2004.
- One of the SDC's goals is to ***"Develop goals, visions, and road maps that transform the concrete industry"***
- One of the specific goals of the Vision 2020 document was to: *Develop performance-based guide specifications for specific and generic repair designs to improve specifications*
- We took it one step further…

What is ACI 563?



ACI 563 is a set of Reference Specifications for the Repair of Concrete

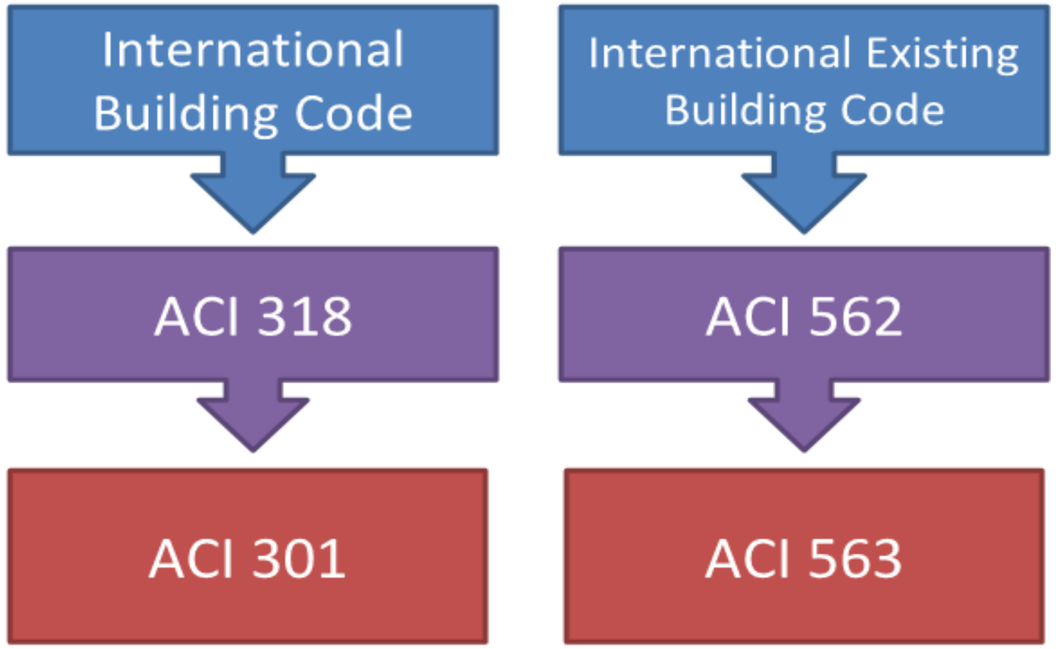
- Reference Specifications are specifications that are incorporated into a project by reference. Reference Specifications are most commonly cited in the General Notes or in the Project Specifications.
- Most specifiers are familiar with ACI 301, which is a Reference Specification for New Concrete Construction.

What is ACI 563?

- ACI 563 incorporates Industry Consensus on best practices for repair
- Including ACI 563 into the Contract Documents minimizes confusion between Engineers/Architects and Contractors – providing a solid, reliable framework for quality repair projects
- When properly used, ACI 563 provides a clear understanding of construction requirements – particularly for smaller repair projects

***Results**: Improved durability of repairs, and lower environmental, economic and societal costs.*
SUSTAINABILITY

How does ACI 563 Align with Codes?



NEW CONCRETE DESIGN

REPAIR DESIGN

NEW CONCRETE CONSTRUCTION

REPAIR CONSTRUCTION

ACI 563 CAN ALSO BE REFERENCED AS A STANDALONE SPECIFICATION FOR SMALLER REPAIR PROJECTS

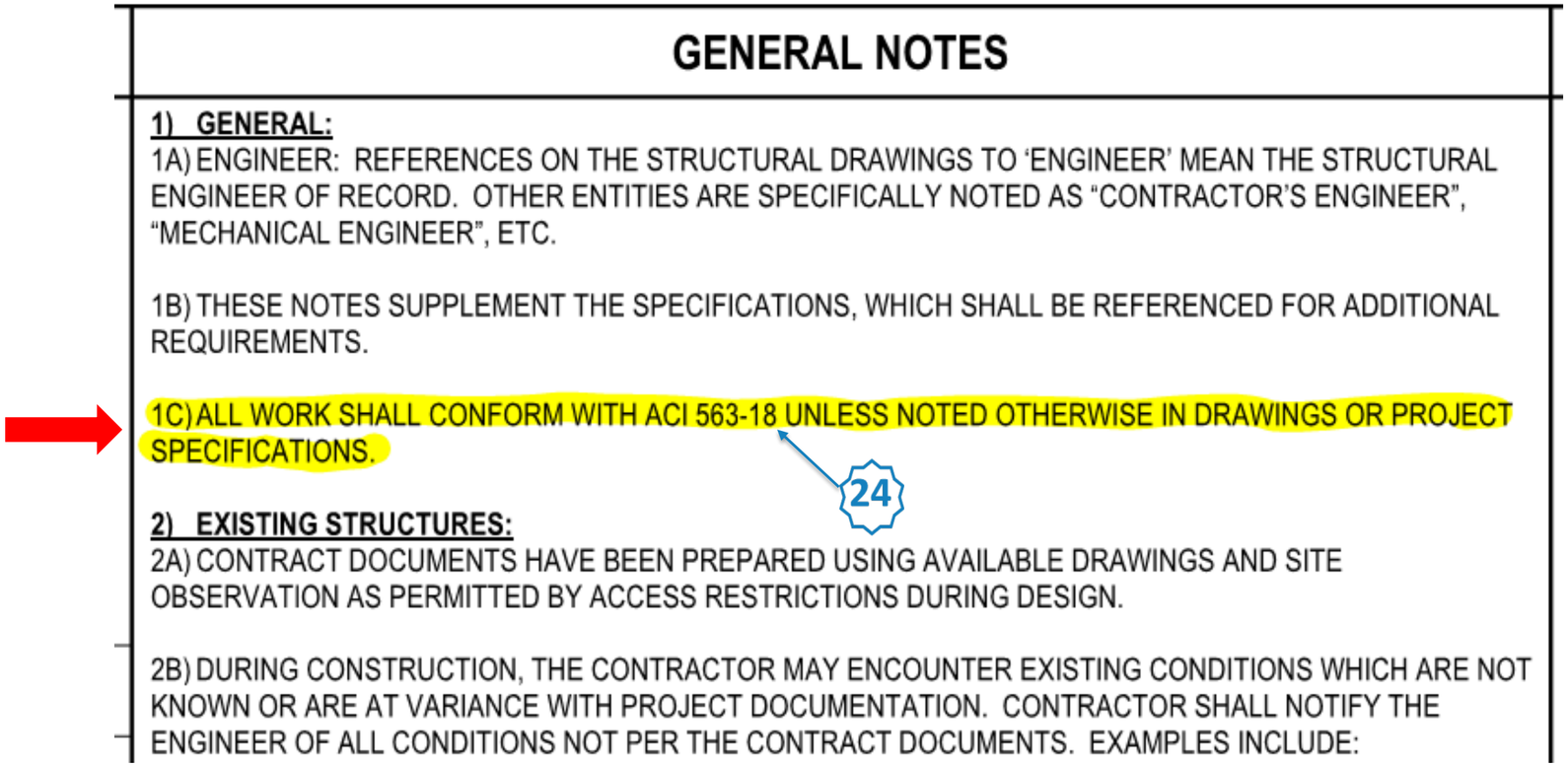
Specification Basics

Specifications are instructions from the Owner to the Contractor for completing the Work *to meet Owner's Project Requirements* in Mandatory Language

- These instructions should be:
  - Clear, with only one interpretation & responsibilities assigned consistent with industry practice
  - Concise, tailored to include only what the project needs
  - Constructible/technically feasible for anticipated conditions

- ACI construction standards are written to direct the producers, testing agencies and construction team and not the design professional
  - Construction standards are worded in explicit, mandatory language so that there is only one possible interpretation

Reference ACI 563 from General Notes on Repair Drawings



GENERAL NOTES

1) GENERAL:

1A) ENGINEER: REFERENCES ON THE STRUCTURAL DRAWINGS TO 'ENGINEER' MEAN THE STRUCTURAL ENGINEER OF RECORD. OTHER ENTITIES ARE SPECIFICALLY NOTED AS "CONTRACTOR'S ENGINEER", "MECHANICAL ENGINEER", ETC.

1B) THESE NOTES SUPPLEMENT THE SPECIFICATIONS, WHICH SHALL BE REFERENCED FOR ADDITIONAL REQUIREMENTS.

1C) ALL WORK SHALL CONFORM WITH ACI 563-18 UNLESS NOTED OTHERWISE IN DRAWINGS OR PROJECT SPECIFICATIONS.

24

2) EXISTING STRUCTURES:

2A) CONTRACT DOCUMENTS HAVE BEEN PREPARED USING AVAILABLE DRAWINGS AND SITE OBSERVATION AS PERMITTED BY ACCESS RESTRICTIONS DURING DESIGN.

2B) DURING CONSTRUCTION, THE CONTRACTOR MAY ENCOUNTER EXISTING CONDITIONS WHICH ARE NOT KNOWN OR ARE AT VARIANCE WITH PROJECT DOCUMENTATION. CONTRACTOR SHALL NOTIFY THE ENGINEER OF ALL CONDITIONS NOT PER THE CONTRACT DOCUMENTS. EXAMPLES INCLUDE:

Reference ACI 563 from Project Specifications

3.5 REMOVAL OF CONCRETE

A. Comply with ACI 563 and as specified in this article.

B. Do not overload structural elements with debris.

3.9 CONCRETE PLACEMENT

A. Place concrete according to ACI 563 and as specified in this article.

B. Pretreatment: Apply [**epoxy-modified, cementitious bonding and anticorrosion agent**] [**epoxy bonding agent**] <**Insert requirement**> to reinforcement[**and concrete substrate**].

Specifier needs to make these changes manually to the specifications – they are not currently in the standard MasterSpec

Mandatory Trigger Language

“As indicated in Contract Documents”

Main Text

3.3.1.1 Configure geometry of removal area to maximize the use of right-angle geometry, avoiding reentrant corners, and to obtain uniformity of depth, as indicated in Contract Documents.

Mandatory Checklist Item

3.3.1.1 Indicate the required depth of removal in concert with perimeter requirements 3.3.2.2.b.

1.8.2 *Quality control: duties and responsibilities of Contractor*

1.8.2.1 *Field technicians*—Field tests of repair materials required in 1.8.2 shall be performed by field personnel with specified credentials and experience as indicated in Contract Documents.

1.8.2.2 Unless otherwise specified, Contractor assumes the duties and responsibilities given in 1.8.2.2(a) through 1.8.2.2(j).

1.8.2.2(a) Allow access to the project site or to the source of materials and assist Owner’s testing agency in obtaining and handling samples at the project site or at the source of materials.

Mandatory Trigger Language

MANDATORY REQUIREMENTS CHECKLIST

Section/Part/ Article	Notes to Specifier
1.5.1.1	Indicate maximum live and dead loads, and any temporary reduction in loads, to be permitted during repair and after completion of repair program, in concert with the requirements of 2.1.1.1. Indicate location and magnitude of minimum dead loads if needed to act as counterweights.
1.5.2	Indicate Owner-approved work areas, and schedule requirements.
1.5.4.1	Indicate the demarcation line of the project location, specific Work areas, and adjacent construction.
1.8.2.1	Indicate the required certifications and experience for every repair material, when deemed necessary and possible alternate credentials and experience. Examples of possible field personnel include, but are not limited to: a) ACI Concrete Field Testing Technician - Grade I b) ACI Adhesive Anchor Installation Inspector c) ACI Concrete Construction Special Inspector d) ACI Masonry Field Testing Technician e) CSA-Based Concrete Construction Special Inspector (Canada Only) f) CSA-Based Concrete Field Testing Technician - Grade I (Canada Only) g) ICRI Concrete Surface Repair Technician—Grade 1 h) ICRI Concrete Slab Moisture Testing Technician—Grade 1 i) NACE Coatings Inspector Program, Levels 1 through 3 j) SSPC Concrete Coating Inspector
1.8.2.2(d)	Indicate specific repair procedures that require review and approval.
1.8.2.2(e)	Indicate submittal of component materials, repair material mixture proportions or batch requirements, and concrete supplier's or repair material manufacturer's quality control program.

Optional Trigger Language

OPTIONAL REQUIREMENTS CHECKLIST

Section/Part/ Article	Notes to Specifier
1.5.2	Indicate designated tool and equipment storage areas.
1.6	Indicate if preinstallation meetings are not required, or are only required for certain Work scopes or particular repair materials and assemblies. Indicate alternate representatives and topics for the meeting. Indicate alternate submittal submission schedule. Indicate specific meeting preconstruction meeting time(s) and location(s).
1.7.3	Indicate if Contractor is required to submit a Quality Control Plan, and timing of plan submission.
1.8.2.2	Indicate if other testing duties and responsibilities are required.
1.8.2.2(c)	Indicate additional or alternative project site requirements specific to the repair materials to be used.
1.8.2.2(i)	Specify quality control requirements to verify conformance of repair Work.
1.8.3.2	Indicate if other testing services will be provided.
1.8.3.3(e)	Indicate when compressive test specimens are to be tested if other than at 28 days.
1.8.3.3(i)	Indicate circumstances that justify alternate or supplementary testing and who pays for such testing.

The Optional Requirements Checklist identifies alternatives to default requirements or optional requirements that the specifier may want to incorporate into the Contract Documents

Optional Trigger Language

“If specified” or “Unless otherwise specified”

Main Text

5.2.1.4 Bar mats—If specified, use bar mats conforming to ASTM A184/A184M...

Optional Checklist Item

5.2.1.4 Indicate use of bar mats.

(or nothing is written in the checklist!)

1.7—Submittals

1.7.1 *General*—Provide submittals required by this Specification as indicated in Contract Documents.

1.7.2 *Substitution*—Substitution requests shall specifically identify proposed substitution, reason for substitution, demonstrate compliance with performance requirements, and cost and schedule impacts.

1.7.3 *Contractor's quality control plan*—Unless otherwise specified, submit quality control plan defining means and methods to control the purchase, use, and placement of materials. Provide information related to quality control in accordance with 1.8.2.

ACI 563-24 Specification Sections

Included in ACI 563-18:

- Section 1 – General Requirements
- Section 2 – Shoring and Bracing
- Section 3 – Concrete Removal and Preparation for Repair
- Section 4 – Formwork
- Section 5 – Reinforcing and Reinforcing Supports
- Section 6 – Conventional Concrete Mixtures
- Section 7 – Handling and Placing of Conventional Concrete
- Section 8 – Proprietary Cementitious and Polymer Repair Materials
- Section 16 – Crack Repair by Epoxy Injection (ACI 503.7)
- Section 17 – Shotcrete (ACI 506.2)

ACI 563-24 Specification Sections

Added in ACI 563-24:

- Section 9 - Crack Repair by Chemical Grout Injection
- Section 10 - Architectural Concrete Repair
- Section 11 – Structural Precast Concrete Repair
- Section 12 – Unbonded Post-Tensioned Concrete Repair
- Section 13 – Overlays
- Section 14 - Protective Membranes
- Section 15 – Cathodic Protection by Galvanic Anodes
- Section 18 - Wet Layup FRP (ACI 440.12)

Section 1: General Requirements

Section 1: General Requirements

Preinstallation Conference

- Unless otherwise specified, a Preinstallation Conference is required.
- An agenda is provided, and Contractor/Subcontractors are required to attend.

(a) Conduct preinstallation meeting(s) to discuss and review Contract Documents, scope of Work, repair process, repair materials performance requirements, repair materials, dust control, preparation, acceptance criteria, tolerances, quality assurance program, quality control program, and roles and responsibilities for Work.

Section 1: General Requirements

Quality Assurance, Quality Control, Testing and Inspection

- Defines Owner's responsibilities and Contractor's responsibilities
- Addresses concrete strength tests for conventional concrete and proprietary materials, including core testing and in-place testing

1.8.3.2(a) Owner's testing agency will inspect, sample, and test fresh and hardened repair materials for conformance with requirements in Contract Documents. If repair material furnished or work performed by Contractor fails to conform to Contract Documents, testing agency shall report such deficiency to Architect/Engineer, Owner, Contractor, and repair material supplier.

Section 2: Shoring and Bracing

Shoring Design by Specialty Engineer

2.1.1.1 *Design of shoring and bracing*—Employ a Specialty Engineer to design all shoring and bracing that shall address preexisting unsafe structural conditions, load and deflection requirements during repair, and to maintain stability of the structure and structural members during construction for locations as indicated in Contract Documents. Comply with limits on concrete or reinforcement removal prior to shoring as indicated in Contract Documents. Shoring design and scheduling shall meet requirements for location, spacing, placement, and sequencing to minimize impact on building operations as indicated in Contract Documents. The design shall comply with the requirements of ACI 562 and 2.1.1.2(a) through 2.1.1.2(b).

Section 2: Shoring and Bracing

Calculation Requirements

2.1.2.1(a) *Calculations*—Submit calculations delineating the load effects on the structure and parts thereof occurring throughout the duration of the repair Work, and establish that all loadings are supported by the shoring and bracing system, unless more stringent requirements are delineated by the Architect/Engineer. When shoring is continuous over several floors or across several bays, the calculations shall delineate the sharing of loads between the existing structure and the shoring. Submittals shall delineate locations and maximum reactions at all points of bearing of the shoring against the existing structure, sufficient to permit Architect/Engineer to assess the impact of the proposed shoring on the overall structure.

Section 3: Concrete Removal and Preparation for Repair

Surface Preparation Requirements and Testing

3.1.1.2 Provide surface profile and remove laitance, debris, and bond-inhibiting materials using methods that shall satisfy these requirements as indicated in Contract Documents.

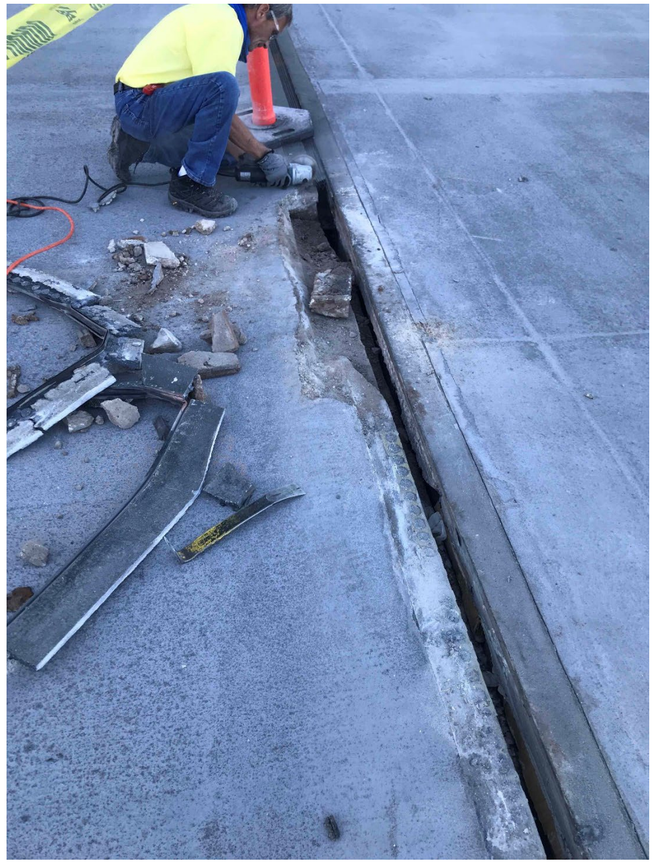
3.1.3.1 Test for the minimum pull-off tensile bond strength between the repair material and the prepared substrate surface in accordance with ASTM C1583/C1583M as indicated in Contract Documents.

Section 3: Concrete Removal and Preparation for Repair

Repair Geometry, Depth and Profile

3.3.1.1 Configure geometry of removal area to maximize the use of right-angle geometry, avoiding reentrant corners, and to obtain uniformity of depth, as indicated in Contract Documents.

3.3.2.2 Remove concrete from repair areas to indicated depth and profile. Unless otherwise specified, notify Architect/Engineer if additional delaminated, fractured, or unsound concrete is present, and attain approval before proceeding.



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Section 4: Formwork

Responsibility for Formwork Design

4.2.2.1 Contractor is responsible for design and engineering of all formwork. Unless otherwise specified, design calculations and drawings for engineer-designed formwork shall be signed and sealed by a specialty engineer as required by state or jurisdiction where Work will be done.

4.2.2.2 Design formwork, shores, reshores, and backshores to support loads transmitted to them and to comply with applicable building code requirements. Design formwork to withstand repair material pressures, as well as pressure resulting from placement, and consolidation procedures to maintain specified tolerances.

Section 4: Formwork

Timing of Formwork Removal

4.3.2.5 Unless otherwise specified, leave formwork and shoring in place to support existing loads, construction loads, and weight of repair material in beams, slabs, and other structural members until in-place strength of repair material determined in accordance with 4.3.4 is at least f_c'. For post-tensioned construction, leave formwork and shoring in place until stressing is complete. Unless otherwise specified, when shores and other supports are arranged to allow removal of form-facing material without allowing structural slab or member to deflect, form-facing material and its horizontal supporting members may be removed at an earlier age.

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Section 5: Reinforcing and Reinforcing Supports

Mockups

5.1.4.2 *Mockups*—Prepare samples and mockups of reinforcement for review and approval by Architect/Engineer, as indicated in Contract Documents. Mockups are intended to display surface preparation and cleaning of existing reinforcement, installation of supplemental reinforcement and dowels, and coating of steel in repair locations. Approved mockups may become part of completed Work if accepted by Architect/Engineer prior to commencing Work.

Section 5: Reinforcing and Reinforcing Supports

Reinforcement Conflicts and Relocation

5.3.3.2 *Reinforcement relocation*—When it is necessary to move reinforcement beyond specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, submit a proposed plan to Architect/Engineer for acceptance. Placing concrete or repair material in area of relocated reinforcement is prohibited before receiving acceptance by Architect/Engineer.

Section 6: Conventional Concrete Mixtures

Submittals required include Mixture Proportions, Strength Data, Concrete Materials, Test/Trial Mixture Records, and requests to modify Time of Discharge

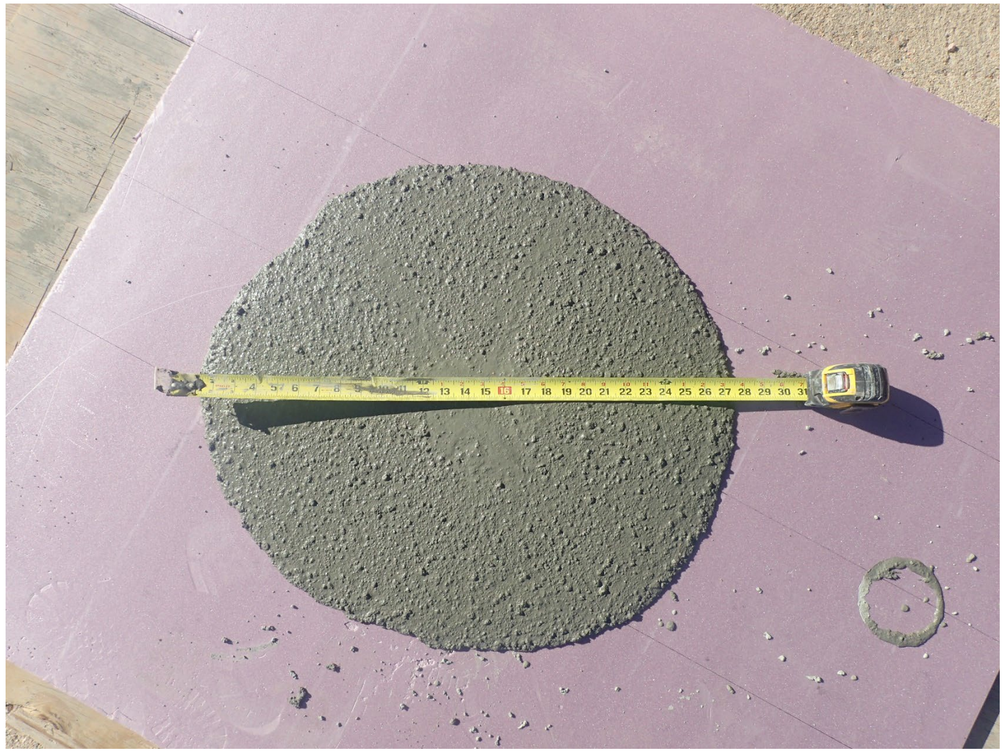
6.1.2.2 *Mixture strength data*—Submit field test records used to establish the required average compressive strength in accordance with 6.2.3.3. Submit test data used to establish the average compressive strength of the mixture in accordance with 6.2.3.4.

6.1.2.8 *Time of discharge*—When Contractor wants to exceed the maximum time for discharge of concrete permitted by ASTM C94/C94M, submit a request along with a description of the precautions to be taken.

Section 6: Conventional Concrete Mixtures

Slump Requirements

6.2.2.2 *Slump*—Unless otherwise specified, select a target slump or slump flow at the point of delivery of concrete mixtures for each application. Selected target slump shall not exceed 9 in. Selected target slump flow shall not exceed 30 in. Concrete shall not show visible signs of segregation. The target slump or slump flow value shall be enforced for the duration of Project. Determine the slump by ASTM C143/C143M. Slump tolerances shall meet the requirements of ACI 117. Determine slump flow by ASTM C1611/C1611M. Slump flow tolerances shall meet the requirements of ASTM C94/C94M.



Section 7: Handling and Placing of Conventional Concrete

Concrete Consolidation

7.3.2.5 *Consolidating*—Unless otherwise specified, consolidate concrete by vibration. Consolidate concrete around reinforcement, embedded items, and into corners. Use immersion-type vibrators with nonmetallic heads for consolidating concrete around epoxy-coated or zinc and epoxy dual-coated reinforcing bars. Do not use vibrators to move concrete within the forms. Spacing of immersion vibrator insertions shall not exceed 1-1/2 times the vibrator's radius of action in the concrete being consolidated.

Section 7: Handling and Placing of Conventional Concrete

Repair of Surface Defects

7.3.7.3 *Repair of surface defects other than tie holes*—Unless otherwise specified, outline honeycombed or otherwise defective concrete as defined in Contract Documents with a 1/2 to 3/4 in. deep saw cut and remove such concrete down to sound concrete. When chipping is necessary, leave chipped edges perpendicular to the surface or slightly undercut. Do not leave feather edges. Dampen the area to be repaired plus 6 in. around the repair area perimeter. Thoroughly brush scrub coat into the surface. When the scrub coat begins to lose water sheen, apply repair mortar prepared in accordance with 7.3.7.4 and thoroughly consolidate mortar into place. Strike off mortar, leaving the repair slightly higher than the surrounding surface to compensate for shrinkage. Leave the repair undisturbed for 1 hour before finishing. Keep the repair damp for 7 days.

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Section 8: Proprietary Cementitious and Polymer Repair Materials

Repair Materials

8.1.2.1 *Repair materials*—Submit the following:

(a) Repair Material Manufacturer (RMM) product data sheets and certifications that include performance data. Performance data shall have been collected from standardized test methods developed by a national standards body such whenever possible. In cases where these test methods are modified or not standardized, the modifications or non-standardized methods shall be sufficiently documented in writing so that the published values may be verified by independent third parties if so required when reproducibility is considered;

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Section 8: Proprietary Cementitious and Polymer Repair Materials

Mockups

8.1.3 *Mockups*—Prepare mockups that demonstrate quality control of materials source(s), and including mixing, placement, application or installation, finishing, consolidation, and curing as indicated in Contract Documents. Obtain Architect/Engineer and Owner review for conformance with acceptance criteria as indicated in Contract Documents. Obtain approval of other reviewers, unless otherwise specified. Notify the Architect/Engineer when mockup repairs are ready for review. Comply with minimum notification period as indicated in Contract Documents.

Section 9: Crack Repair by Chemical Grout Injection

Quality Control

9.1.3.3 Establish a quality control program that includes 9.1.3.3(a) through 9.1.3.3(g).

9.1.3.3(c) If specified, conduct mock-ups to verify effective execution of procedures in accordance with Contract Documents.

9.1.3.3(d) Inspect preparation and surface condition prior to chemical injection.

9.1.3.3(f) Monitor operation of the grouting equipment.

9.1.3.3(g) Complete a daily grouting operation report as described in 9.1.3.8.

Section 9: Crack Repair by Chemical Grout Injection

Operation Procedure Requirements

9.3.6 Install injection packers into holes and tighten.

9.3.7 Inject water through injection packers, fully flushing crack with water to remove dust and debris and to ensure intersect with crack to allow grout penetration into crack.

9.3.7.1 During water flushing process, inspect injection packer seals for water leakage. Reinstall injection packers as necessary to eliminate leakage.

9.3.8 Mix chemical grout and activators in accordance with manufacturers published instructions.

9.3.9 Starting at one end of crack, or bottom end if filling a vertical crack, inject chemical grout into first injection packer until foaming material extrudes from crack and approaches next drilled hole. Detach injection nozzle, cap injection packer and begin injecting through next hole. Continue operation for entire length of actively leaking crack until water leakage is controlled or stopped.

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Section 10: Architectural Concrete Repair

Submittals

10.1.2.1 *Drawings and data*—Unless otherwise specified, submit shop drawings or method of procedures for architectural concrete repair. Include in shop drawings or method of procedures:

a) Formwork

b) Mixture design

c) Curing

d) Finishing

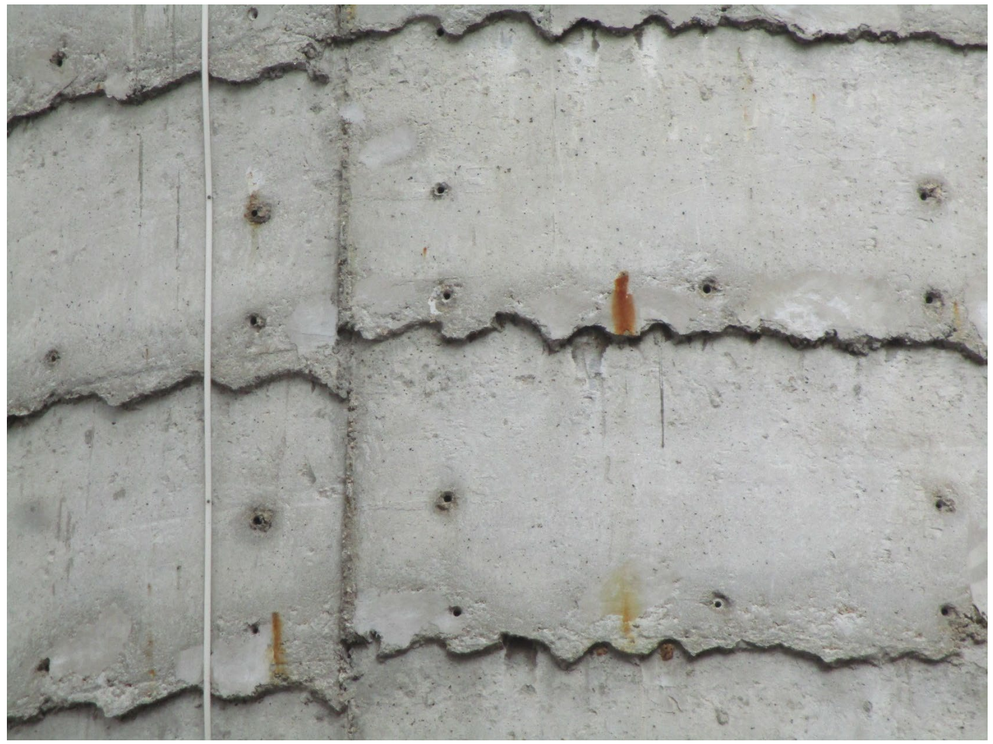
e) Jointing of facing panels

f) Locations and details of form ties and recesses

g) Details of joints, anchorages, and other accessories

h) Mock-ups

i) Shoring



Section 10: Architectural Concrete Repair

Field Mock Up Requirements

10.1.3.5 *Field mock-up*

10.1.3.5.a Construct field mock-ups using same procedures, orientation, equipment, and materials that will be used for production of cast-in-place architectural concrete. Use field mock-ups as sample of acceptable quality of finished product. Construct field mock-ups at an acceptable location on site. Provide a simulated repair to determine an acceptable repair procedure and appearance. Use repair procedure suitable to provide an acceptable color and texture match. Maintain and protect mock-ups until final acceptance of architectural concrete repair.

Section 11: Structural Precast Concrete Repair

Scope of Specification for Precast Repair

11.1.1 *Scope* – This specification covers repairs to structural precast concrete members consisting of precast double tee flanges, precast double tee stems with prestressing, precast columns, precast column corbels and haunches, precast beams, and grout pockets only. This specification does not include specification for architectural precast concrete repairs and other precast members not listed.

11.3.6.2 *Precast Double Tee Flange Repairs* – Review extents of removals including reinforcement and connection hardware prior to demolition. During removal, inspect existing reinforcement and connection hardware and notify Architect/Engineer if reinforcement and connection hardware vary from that indicated in the Construction Documents and if reinforcement has lost more than the specified maximum area loss. Repair or replace or both corroded reinforcement as indicated in the Contract Documents.

Section 11: Structural Precast Concrete Repair

Reinforcing and Connections, Column Repair

11.3.6.2.c *Reinforcement and connections*- Unless otherwise specified , preserve reinforcement and embedded connection members. Review exposed connection hardware with Architect/Engineer and identify location and quantity of diminished or failed connection members. Install connection hardware, connection reinforcement, new reinforcement, and post-installed anchors as indicated in the Contract Documents. Install new or restore existing connection components as indicated in the Contract Documents prior to returning double tees to service.

11.3.6.5 *Precast Column Repairs* – Review temporary shoring requirements and specified allowable extents of demolition, prior to starting work. Install temporary bracing and shoring prior to demolition. During the removal of unsound concrete, do not proceed beyond the extent and size as indicated in the Contract Documents. When extent of distress is beyond the specified maximum, provide additional temporary shoring and bracing or relocate temporary shoring and bracing as required to maintain the stability of the structure and review distress with Architect/Engineer before proceeding.

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Section 12: Unbonded Post-Tensioned Concrete Repair

Field Personnel Requirements

12.1.3.2 (a) Both the Field Installation and Field Tensioning crew foreman must have PTI Level 2 Unbonded PT Installer or Inspector, PTI Level 2 Unbonded PT Repair, Rehabilitation, & Strengthening, or Ironworker certification.

12.1.3.2(b) At least 50 percent of Installation Field Personnel must have PTI Level 1 Unbonded PT Installation certification, PTI Level 1 Unbonded PT Repair, Rehabilitation, & Strengthening, Ironworker certification or higher.

12.1.3.2(c) At least 50 percent of Tensioning Field Personnel must have PTI Level 2 Unbonded Installer or Inspector, PTI Level 2 Unbonded PT Repair, Rehabilitation, & Strengthening, or Ironworker certification, and the remaining portion of the Tensioning Field Personnel having PTI Level 1 Unbonded PT Field Installation, PTI Level 1 Unbonded PT Repair, Rehabilitation, & Strengthening, or Ironworker certification.

Section 12: Unbonded Post-Tensioned Concrete Repair

Tendon Repair

12.3.3.1 Identify, document, and clearly mark locations of distressed, deteriorated or damaged concrete covering potentially corroded or otherwise damaged sections of prestressing steel.

12.3.3.2 Install shoring in accordance with Section 2.

12.3.3.3 Remove concrete, sheathings, and anchorages according to Section 3.3.2.2(a). Do not remove concrete at or in front (bearing side) of post-tensioning anchorages as indicated in the Contract Documents. Maintain tendon profile. Do not damage sheathing. Use grout or other means to securely maintain tendon horizontal and vertical position during Work.

12.3.3.4 Unless otherwise specified, extract and replace the length of prestressing steel to be repaired. Remove concrete to expose the prestressing steel where it cannot be extracted from existing sheathing. Notify Engineer when prestressing steel cannot be extracted.

Section 13: Overlays

Weather Considerations/Evaporation

13.3.6.2 *Weather Considerations*

13.3.6.2a Weather considerations shall be in accordance with 7.3.2.1.

13.3.6.2b When evaporation rate determined in accordance with ACI SPEC 305.1 exceeds 0.10 lb/ft²/h, control measures shall be taken in accordance with ACI SPEC 305.1 including supplementary requirements as indicated in Contract Documents, to provide adequate protection of and prevent rapid evaporation from fresh concrete surface.

13.3.6.2c Unless otherwise specified, place overlay concrete when surface and ambient temperatures are greater than 45°F.

Section 13: Overlays

Finishing and Jointing

13.3.7.1 Consolidate and finish proprietary cementitious overlay in accordance with 8.3.3.

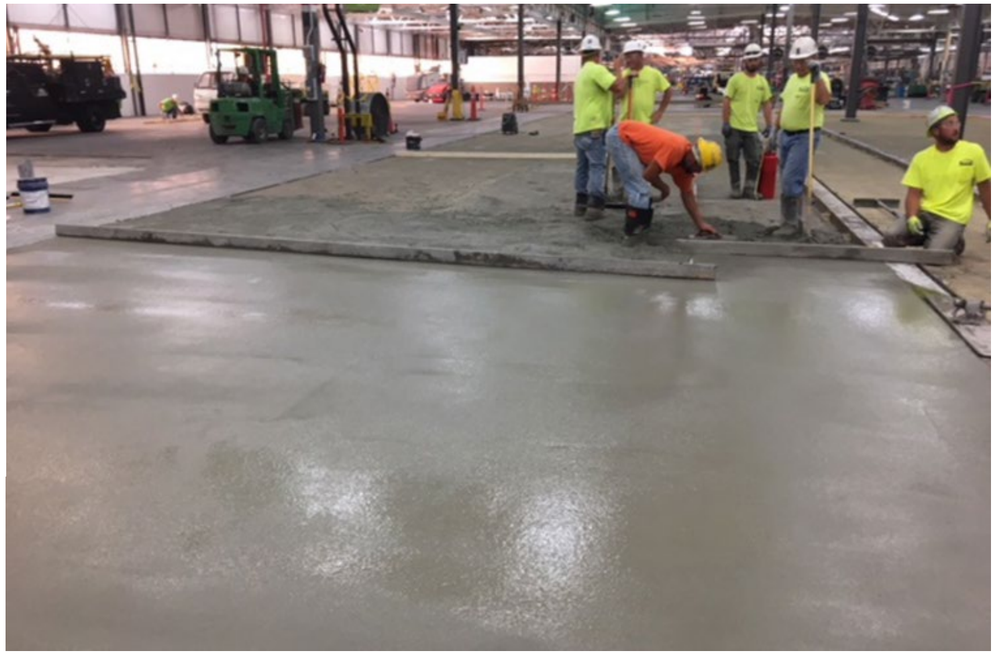
13.3.7.2 Consolidate hydraulic cement concrete in accordance with 7.3.2.5.

13.3.7.3 Finish hydraulic cement concrete overlay in accordance with 7.3.4.

13.3.7.4 Texture the surface with a trowel, broom or other equipment to provide texture indicated in Contract Documents.

13.3.7.5 Complete finishing before overlay has stiffened to the extent that it will no longer respond to finishing actions.

13.3.7.6 Provide joints in overlay that match locations of existing joints in substrate.



Section 14: Protective Membranes

Mockups

14.1.5.1 If specified, install mockups of membrane system for review by Owner and Architect/Engineer. Mockups shall be installed in number, locations, and sizes specified. Mockups shall show individual layers of the membrane system that demonstrate and allow evaluation of finish, color, texture (including aggregate broadcast) and adhesion.

14.1.5.2 After the specified surface preparation has been performed and accepted, perform moisture testing as recommended by manufacturer.

14.3.6.3 Conventional concrete shall be at least 28 days old before application of membrane system, and testing shall indicate that the concrete moisture vapor emission rate (MVER) or relative humidity (RH) satisfies manufacturer's recommendations.

Section 14: Protective Membranes

Quality Control

14.3.10.6 Perform at least three pull-off adhesion tests in accordance with ASTM D7234 within a 5-ft^2 area per 10,000 ft^2 of membrane installed, unless otherwise specified. Before attaching test discs, lightly sand membrane surface to obtain a grit-blasted anchor profile. Adhere 2-inch diameter test disc to the center of each sanded surface. When test disc adhesive has cured sufficiently, score membrane along circumference of each test disc to concrete substrate. Tests shall not fail cohesively in the membrane, and the pull-off adhesion strength shall not be less than 200 psi.

14.3.10.7 Unless otherwise specified, perform two additional adhesion tests per non-compliant area to confirm results. Remove membrane to sound substrate and redo areas that do not meet adhesion strength requirements.

14.1.2.1 (i) Maintenance *Manual* - Submit maintenance manual upon completion of the Work. Indicate project name, locations and date, type of membrane system applied, surface to which the system was applied, and maintenance instructions for cleaning.

Section 15: Cathodic Protection by Galvanic Anodes

Anode Layout Drawings and Design

15.1.2.2 *Anode Layout Drawings* – Submit anode layout drawings, including the following:

a. Layout of anodes and zones or areas of installation by anode type.

b. Maximum spacing between anodes and depths of anode placement.

c. Anode type(s), accessories to be used for installation, and installation details.

d. Locations and details of anode monitoring stations.

15.1.2.3 *Anode design* – If specified, submit anode system design, including calculations and field data to substantiate design performance over time, and qualifications of system designer to satisfy specified performance requirements.

15.1.2.4 Provide documented test results from similar field installations showing that anodes have achieved the specified performance requirements as indicated in the Contract Documents. If specified, submit third party evaluation report.

Section 15: Cathodic Protection by Galvanic Anodes

Electrical Continuity

15.3.4 *Electrical Continuity Verification* – Verify electrical continuity in accordance with manufacturer's written instructions, unless otherwise specified.

15.3.4.1 Locate metallic objects for electrical continuity verification within each designated protection zone. Confirm that the steel reinforcement is electrically continuous. Demonstrate continuity on site by measuring the electrical resistance or potential difference or both between reinforcement bars in diagonally opposite corners of structure. This shall include as a minimum:

a. Electrical continuity checks of reinforcement and any other metallic items exposed during concrete removal.

b. Perform electrical continuity testing using AC resistance meter or DC resistance meter using DC reverse polarity resistance measurement technique. Measurements shall be taken by experienced operator, recorded, and documented.

15.3.4.2 Electrical Continuity Acceptance Criteria: Acceptance criteria for continuity acceptance testing shall include either:

a. Resistance readings less than 1.0 ohm when instrument leads are reversed and resistance readings are measured in both directions, or

b. Potential Difference of less than 1mV.

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Specifications Included by Reference

Chapter 16 - Crack Repair by Epoxy Injection (ACI 503.7)
Chapter 17 – Shotcrete (ACI 506.2)
Chapter 18 – Wet-Layup FRP (ACI 440.12)

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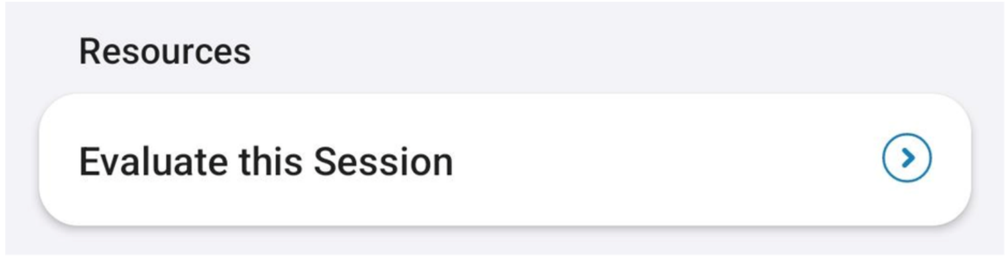

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