

**The Philadelphia Parking Authority  
701 Market Street, Suite 5400  
Philadelphia, PA 19106**

**Bid No. 21-10**

**Structural Repairs and Maintenance at the Autopark at The Fashion District  
Addendum Two**

To: See Email Distribution List  
From: Mary Wheeler  
Manager of Contract Administration  
Date: April 7, 2021  
No Pages: 1 plus Exhibit A

This addendum is issued on April 7, 2021 prior to the bid due date to add, delete, modify, clarify and/or to respond to questions submitted by prospective bidders regarding the work included in the above referenced solicitation.

**CHANGES, CLARIFICATIONS AND ADDITIONS TO THE BID PACKAGE**

1. Specification "Section 03 01 00 – Maintenance of Concrete" and "Section 03 30 00 – Cast-in-Place Concrete" shall be replaced with the attached "Section 03 93 00 – Concrete Repair", Exhibit A.

**END OF ADDENDUM TWO**

**SECTION 03 93 00**  
**Concrete Repair**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Removal of deteriorated concrete and subsequent replacement and concrete repair.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Placement and curing of repair materials

B. References:

1. "Specifications for Structural Concrete for Buildings" (ACI 301) by American Concrete Institute, herein referred to as ACI 301, is included in total as specification for this structure except as otherwise specified herein.
2. Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown on Drawings or specified herein:
3. ACI 546R-14 - Concrete Repair Guide
4. ASTM C33 - Concrete Aggregates.
5. ASTM C41 - Standard Test Method for Slump.
6. ASTM C138 - Test method for unit weight, yield, and air content of concrete.
7. ASTM C150 - Portland Cement.
8. ASTM C231 - Test for Air Content of Freshly Mixed Concrete.
9. ASTM C260 - Air Entraining Admixtures for Concrete.
10. ASTM C387 - Specifications for High Strength Mortars.
11. ASTM C494 - Chemical Admixtures in Concrete.
12. ACI 305R - Recommended Practice for Hot Weather Concreting.
13. ACI 306R - Recommended Practice for Cold Weather Concreting.
14. ACI 318 - Building Code Requirements for Reinforced Concrete.
15. ACI 562 - Code Requirement for Evaluation, Repair, and Rehabilitation of Concrete Buildings
16. ACI 562 - Specifications for Repair of Concrete in Buildings

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site 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.

1. Representatives of each entity directly concerned with concrete repair procedures to attend.
- B. Mockups: Provide mockups to demonstrate the effectiveness and suitability of various methods intended to be used for concrete removal and surface preparation. Architect/Engineer will evaluate the mockups and testing results to determine if extent of concrete removal and proposed methods satisfy the project requirements and achieve desired tensile pull-off strengths.
1. Prepared substrate surface within the mockup shall be made available for testing to determine if the required pull-off strength, profile, and moisture condition can be met.
  2. Test for the minimum pull-off tensile bond strength of prepared substrate surface of mock-up area in accordance with ASTM C1583/C1583M.
  3. Change or modify the concrete removal and surface preparation methods if the prepared substrates in the mockups do not satisfy the project requirements and the specified pull-off strengths are not met.
  4. Test for the minimum pull-off tensile bond strength of mock-up area between the repair material and the prepared substrate surface in accordance with ASTM C1583/C1583M.
  5. The required pull-off strengths shall be at least equal to the minimum pull-off value as indicated in Section 3.13 - E.1

#### 1.4 SUBMITTALS

- A. Product Data and SDS: For each type of product.
1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.
- B. Material Certificates:
1. Repair materials
  2. Reinforcement
  3. Protective coatings
  4. Adhesives
  5. Injection Materials
- C. Submit manufacturer's data sheet for concrete repair material consistent with the requirements of ACI 364.3R-09
- D. Product Test Reports: For each concrete repair material, joint-filler, and crack-injection adhesive for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Submit design mixes for concrete, associated laboratory test reports, and product data for admixtures. Include additional mix proportion tests for characteristics of materials that may be varied for special project conditions, weather, or other circumstances. As a performance-based system, design responsibility rests with the contractor.
- F. Substitution requests shall specifically identify proposed substitution, reason for substitution, demonstrate compliance with performance requirements, and cost and schedule impacts
- G. Field quality-control reports.
- H. Contractor's quality control plan
1. Submit quality control plan defining means and methods to control the purchase, use, and placement of materials.

- I. Shoring and bracing
  1. Calculations: Submit signed and sealed calculations performed by a specialty engineer 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.
  2. Shop drawings: Submit shoring layout shop drawings depicting the arrangement of equipment for shoring, inclusive of installation details, maintenance requirements, and permitted changes.
  3. Sequencing: Submit sequencing requirements of shoring installation and removal, concrete removals, surface preparation, repair installation, curing and minimum concrete strength at removal. Demonstrate that safety of structure is maintained through calculations prepared by specialty engineer.
  4. Certifications: Submit documentation of inspections and certifications required from specialty engineer

#### 1.5 QUALITY ASSURANCE

- A. Repair materials and operations may be tested and inspected as Work progresses. Failure to detect defective Work or material will not prevent rejection if a defect is discovered later nor shall it obligate Architect/Engineer for final acceptance
- B. Manufacturer Qualifications: Each concrete repair material, crack injection adhesive, and corrosion inhibiting treatment manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance. All manufacturers of specified products shall be ISO 9001 certified.
- C. Concrete Repair Contractor Qualifications: Contractor must employ installers and supervisors who are trained and approved by manufacturer to apply concrete repair materials, crack injection adhesives, and corrosion inhibitors to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.
  1. Field Supervision: Concrete Repair Contractor shall maintain experienced full-time supervisors on Project site during times that concrete repair work is in progress.
- D. Quality Standards: Comply with provisions of the following standards and industry practice guidelines, except where more stringent requirements are indicated.
  1. ACI Manual of Concrete Practice, including the following standard.
    - a. ACI 301, "Specifications for Structural Concrete for Buildings".
    - b. ACI 562, "Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings".
  2. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".
  3. International Concrete Repair Institute (ICRI).
- E. Quality Control: Duties and Responsibilities of Contractor:
  1. 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.

2. Advise Owner's testing agency at least 24 hours in advance of operations that require services as specified to allow for scheduling of quality assurance tests, review of project requirements, and assignment of personnel.
3. Provide secure location and sources of water and electrical power on project site acceptable to Owner's testing agency for initial curing of concrete strength test specimens as required by ASTM C31/C31M. Unless noted otherwise, provide similar secured location and sources of water and electrical power for repair materials.
4. Submit procedures for executing the Work as indicated in Contract Documents.
  - a. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work
5. Submit test data and documentation for repair materials as indicated in Contract Documents.
6. Inspect and test surface preparation in accordance with Section 3.4 - J
7. Inspect reinforcement in accordance with Section 3.4 - M
8. Inspect Work in progress to verify that Work is being performed in accordance with approved procedures, manufacturer's instructions, specific instructions from Architect/Engineer if given, or reference standards cited in Contract Documents.
9. Inspect bracing and shoring on an ongoing basis as Work progresses.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- B. Store cementitious materials off the ground, under cover, and in a dry location.
- C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.
- D. Damaged materials must be removed from the job site immediately.
- E. Deliver packaged materials clearly marked with legible and intact labels with manufacturer's name, brand name, lot number, and identifying contents of containers. Store materials in areas where conditions conform with repair material manufacturer's recommendations and instructions

#### 1.7 PROJECT SITE

- A. Protect the structure and its contents, specific Work areas, and adjacent construction from risks associated with Work in this Specification and/or as indicated in Contract Documents, including impact, marring of surfaces, and other types of damage. Protect areas adjacent to repair Work from damage and stains with appropriate barriers and masking. Repair damage and remove stains resulting from Work of this Specification to its condition at the start of work, or if such cannot be determined, to its original condition.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.

- B. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above 45 deg F (5 deg C) and will remain so for at least 48 hours after completion of Work.
- C. Cold-Weather Requirements for Cementitious Materials: Comply with the following procedures:
  - 1. When air temperature is below 45 deg F (5 deg C), heat patching-material ingredients and existing concrete to produce temperatures between 45 and 90 deg F (5 and 32 deg C).
  - 2. When mean daily air temperature is between 25 and 45 deg F (minus 4 and plus 5 deg C), cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.
  - 3. When mean daily air temperature is below 25 deg F (minus 4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.
- D. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F (32 deg C) and above.
- E. During the curing period, protect repair materials from damage by temperature, humidity, sunlight, wind, precipitation, water, and deleterious materials.

## 1.9 WARRANTY

- A. Provide written contractor warranties in compliance with contract requirements.
- B. Provide written manufacturers warranties for all materials for maximum manufacturer warranty period available.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.
  - 1. BASF Corporation, Shakopee, MN 55379
  - 2. Sika Corporation, Lyndhurst, NJ 07071
  - 3. MAPEI Corporation, FL 33442
- B. Obtain and coordinate services of a repair material manufacturer's field representative at the project site before mixing or installing proprietary materials or components to train personnel in preparation, installation, and quality control procedures. Unless otherwise specified, they shall remain at the job site as Work commences and continue to observe the Work until the project manufacturer's field representative, the Contractor, and the Owner are satisfied that the crew has mastered the technique of preparing and installing the proprietary products acceptably. Unless otherwise specified, manufacturer's field representative shall make periodic visits to

review completed Work and distribute reports describing workmanship and conformance with manufacturer's requirements.

1. The repair material manufacturer's field representative shall be qualified to perform the Work as indicated in Contract Documents and subject to the approval of the Owner.

## 2.2 CONCRETE REPAIR MATERIAL

### A. MANUFACTURERS:

1. Only use repair materials that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Horizontal Concrete Repair Materials
  - a. BASF MasterEmaco 1061
  - b. SIKA SikaQuick 1000
  - c. MAPEI Planitop 11
  - d. MAPEI Planitop 18 ES
  - e. MAPEI Planitop 18 TG
  - f. Or approved equal
3. Vertical/Overhead Concrete Repair Materials
  - a. BASF MasterEmaco N425
  - b. SIKA Sikacrete VOH
  - c. MAPEI Planitop X
  - d. Or approved equal
4. Form and Pour Concrete Repair Materials
  - a. BASF MasterEmaco S440CI
  - b. SIKA Sikacrete 211 SCC Plus
  - c. MAPEI Planitop 11SCC
  - d. MAPEI Planitop 15
  - e. Or approved equal
5. Anti-Corrosion Rebar Coating
  - a. BASF Emaco P24
  - b. SIKA Armatec 110 EpoCem
  - c. MAPEI Mapefer 1K
  - d. Or approved equal

## 2.3 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Plywood, metal, or other approved panel materials.
    - a. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      - 1) High-density overlay, Class 1 or better.
      - 2) Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
      - 3) Structural 1, B-B or better; mill oiled and edge sealed.
      - 4) B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

- B. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Use commercially manufactured formwork release agent that reduces form-work moisture absorption, prevents bond with repair material, does not stain concrete and repair material surfaces, and does not interfere with bond of subsequently-applied sealers, coatings, waterproofing materials, and other finishes.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
- F. Unless otherwise specified, locate and detail repair material construction joints per the following requirements:
  - 1. Locate joints within the middle third of spans of slabs, beams, and girders. When a beam intersects a girder within this region, offset construction joint in the girder a distance equal to or greater than twice width of beam.
  - 2. Locate joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.
  - 3. Make joints perpendicular to main reinforcement.
  - 4. Locate joints to match construction joints in the existing structure.
- G. Unless otherwise specified, maximum deflection of facing materials reflected on repair material surfaces exposed to view shall be 1/240 of span between structural members of formwork.
- H. 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.
  - 1. Submit design calculations for engineer-designed formwork, shoring, reshoring and backshoring, signed and sealed by a specialty engineer as required by jurisdiction where Work will be done.

## 2.4 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Portland Cement: ASTM C 150, Type I, Low-Alkali.
  - 1. Fly Ash: ASTM C 618, Class F.
  - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 3. Supplementary cementitious materials to be added in accordance with requirements of ACI 318.



- C. Normal Weight Aggregates: ASTM C-33 and as herein specified. Provide aggregates from a single source for exposed concrete. Coarse aggregates shall be clean, sound crushed and graded limestone or approved equal conforming to ASTM C33. No chert shall be permitted.
1. Maximum Coarse-Aggregate Size: 3/8" to No. 8, except where larger diameter aggregates can be accommodated. Free of materials with deleterious reactivity to alkali.
    - a. Nominal maximum size of coarse aggregate shall not exceed three-fourths of the minimum clear spacing between reinforcing bars or the clearance of the reinforcing bars over the prepared concrete substrate, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs, toppings, or partial-depth repairs.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali.
  3. Chloride ion level in aggregate shall be tested by laboratory making trial mixes. Test shall conform to FHA Report No. FHWA-RD-77-85, "Sampling and Testing for Chloride Ion in Concrete" or AASHTO Method T260. Water soluble chloride ion content of mix from all constituents shall not exceed 0.1% by weight of cement
- D. Silica Fume: ASTM C 1240, amorphous silica.
- E. Water: Potable: ASTM C 94
- F. Concrete Temperatures
1. Maximum temperature: The temperature of concrete as delivered shall not exceed 95°F
  2. Minimum temperature: When the average of the highest and lowest ambient temperature from midnight to midnight is expected to be less than 40°F for more than three successive days, deliver concrete to meet the following minimum temperatures immediately after placement:
    - a. 50°F/24 hours for sections with least dimension less than 12 in.
    - b. 40°F/24 hours for sections with least dimension from 12 to 36 in.
    - c. 30°F/24 hours for sections with least dimension greater than 36 to 72 in.
    - d. 20°F/24 hours for sections with least dimension greater than 72 in.
- G. Admixtures, General: (ACI 301) Provide admixtures for concrete that are free from chloride ions. Use of any admixtures must be approved by Engineer prior to its use. Use approved admixtures in strict accordance with manufacturer's recommendation
1. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
- H. Air-Entraining Admixture: ASTM C-260, certified by manufacturer to be compatible with other required admixtures.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
    - a. "Air-Mix" or "Perma-Air," Euclid Chemical Co.
    - b. "Darex AEA" or "Daravair," W.R. Grace & Co.
    - c. "MB-VR" or "Micro-Air," Master Builders, Inc.
    - d. "Sika AER," Sika Corp.
    - e. MAPEI/GRT
    - f. Or approved equal
- I. Water-Reducing Admixture: ASTM C 494, Type A.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
  - a. "Eucon WR-75, Eucon WR-89 or Eucon MR" Euclid Chemical Co.
  - b. "WRDA with Hycol," W.R. Grace & Co.
  - c. "Pozzolith 322N or Polyheed 997," Master Builders, Inc.
  - d. "Plastocrete 161," Sika Corp.
  - e. "Polychem 400NC," **MAPEI/GRT**
  - f. Or approved equal
  
- J. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F or Type G.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
    - a. "Eucon 37, Eucon 1037 or Plastol 5000" Euclid Chemical Co.
    - b. "Daracem," W.R. Grace & Co.
    - c. "Rheobuild 1000, or Rheobuild 716" Master Builders, Inc.
    - d. "Sikament 300," Sika Corp.
    - e. "Polychem 441," MAPEI/GRT
    - f. Or approved equal
  
- K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
    - a. "Eucon Retarder 75," Euclid Chemical Co.
    - b. "Daratard-17," W.R. Grace & Co.
    - c. "Pozzolith R," Master Builders, Inc.
    - d. "Plastiment," Sika Corporation.
    - e. "Polychem R," MAPEI/GRT
    - f. Or approved equal
  
- L. Calcium Nitrite-Based Corrosion Inhibitor.
  1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
    - a. DCI or DCI-s Corrosion Inhibitor, WR Grace & Co.
    - b. Rheocrete CNI, Master Builders
    - c. Eucon CIA, The Euclid Chemical Company
    - d. "Polychem CI," MAPEI/GRT
    - e. Or approved equal

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Silicate-based liquid surface densifiers are prohibited as curing compounds.

**2.6 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.

**2.7 Reinforcement Accessories**

- A. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.
- B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

**2.8 MIXES**

- A. General: Mix products, in clean containers, according to manufacturer's written instructions.
  - 1. Do not add water, thinners, or additives unless recommended by manufacturer.
  - 2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
  - 3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.
- B. Mortar Scrub Coat: Mix dry ingredients with enough water to provide consistency of thick cream.
- C. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

**2.9 SHORING AND BRACING**

- 1. This section covers design, construction, installation and removal of shoring and bracing to support the structure before, during, and after the performance of repairs, until the structure or members of the structure is/are self-supporting and accepted by Architect/Engineer. Use temporary shoring to accommodate in-place conditions in the structure and expected superimposed loads. Consider the effects of compatibility of deformations on the shoring system and supported/supporting structural members.
- 2. 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

3. Unloading: When the removal of applied loads is desired, either from redistribution of loads as a result of distress, deterioration or deformation of a member, to permanently remove a member or portion of a structure, or to create load sharing between the existing member and the repair, jacking loads applied to the existing construction shall be accounted for in assessing the need for and in the design of shoring and temporary bracing.
4. Prestressed reinforcement—When repairs involve altering forces in prestressed reinforcement, whether intentional or due to the unintentional damage to prestressing reinforcement, deterioration of prestressing, or the imposition of new forces, the change in forces shall be considered in the design of bracing and shoring. Install appropriate shoring or temporary bracing, as required, until the final prestress forces are re-imposed on the member or structure.

### PART 3 - EXECUTION

#### 3.1 CONCRETE REPAIR

- A. Comply with all manufacturer's written instructions
- B. Notify Engineer if manufacturer's written instructions conflict with Contract Documents prior to ordering material.

#### 3.2 EXAMINATION

- A. Notify Engineer seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.
- B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated. 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.
- C. Perform surveys as the Work progresses to detect hazards resulting from concrete repair work.

#### 3.3 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete repair work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete repair work.

1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
  2. Use only proven protection methods appropriate to each area and surface being protected.
  3. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.
  4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
  5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
  6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
- C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Engineer immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.
1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
  2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- D. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete repair work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.
1. Verify that affected utilities have been disconnected and capped.
  2. Verify the location of all electrical lines and lock out/ tag out as needed
  3. Inventory and record the condition of items to be removed for reinstallation or salvage.
  4. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.
- 3.4 CONCRETE REMOVAL AND SURFACE PREPARATION
- A. Do not overload structural elements with debris.
  - B. Submit documentation of existing conditions, especially areas of preexisting damage and deterioration unrelated to the Work, including finishes of surfaces, before starting demolition.
  - C. Provide perpendicular edges at perimeter of repair area. Unless noted otherwise, perimeter of the repair areas shall be saw cut to a depth of ½ in. Do not cut or damage embedded reinforcement or other embedded items. If embedded reinforcing bars or other embedded items are too close to the surface to provide the perpendicular edge cut, notify Architect/Engineer for direction before proceeding.

- D. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement. Take care not to damage existing structure.
- E. Do not cut, damage or remove existing embedded reinforcing steel, electrical conduits, etc., unless directed by the Engineer.
- F. Concrete removal around existing reinforcement
  1. Extend concrete removal along the reinforcement to a point where there is no further delamination, concrete cracking, or reinforcement corrosion, and where the reinforcement is bonded to the surrounding concrete.
  2. Unless otherwise specified, remove concrete around the exposed layers of reinforcement to a uniform depth within the repair areas and provide a minimum clearance between exposed reinforcement and surrounding concrete of 0.75 in., or at least 0.25 in. larger than the maximum nominal size of the coarse aggregate in the repair material. If specified, extend the concrete removal beneath other layers of reinforcement within the repair area.
  3. Unless otherwise specified, do not remove concrete behind vertical reinforcing bars in columns. Obtain direction from the Architect/Engineer if further concrete removal is required.
- G. Confirm perpendicular edges at repair area perimeter, and reinstate if damaged by concrete removal process. Remove loosely bonded concrete, bruised surface or fractured concrete, and bond-inhibiting materials such as dirt, concrete slurry, or any other detrimental materials from the concrete substrate
- H. Test areas where concrete has been removed by tapping with hammer and remove additional concrete until unsound and de-bonded concrete is completely removed.
- I. Remove laitance, debris, and bond-inhibiting materials using methods that shall satisfy these requirements as indicated in Contract Documents.
- J. Mechanically prepare the concrete substrate to obtain a surface profile of +/- 1/4" (CSP 8 or greater as per ICRI Guidelines) with a new exposed aggregate surface.
- K. Removal methods producing bruised surfaces (microcracking) of the prepared substrate shall be followed by secondary removal/surface preparation methods to remove the bruised surface layer. Avoid directly striking reinforcement with impact tools used for concrete removal.
- L. Notify Engineer of any unanticipated mechanical, electrical, or structural elements that impede the progress of the work or affect the installation of the repairs as per the drawings and specifications.
- M. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by abrasive blast cleaning (SSPC-SP3) until only tightly adhered light rust remains.
  1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, notify Engineer.
  2. Remove additional concrete as necessary to provide at least 6" of sound reinforcement.
  3. Splice replacement bars to existing bars according to ACI 318 by lapping, welding, or using mechanical couplings.
  4. Apply two coats of approved anti-corrosion rebar coating
  5. Attach specified galvanic anodes to existing reinforcing steel to provide sufficient electrical connection and mechanical bond

### 3.5 SCRUB/SLURRY COAT APPLICATION

- A. Mortar Scrub Coat for Job-Mixed repair material and Concrete:
1. Scrub coat of material; to be prepared with a neat mix of the approved repair mortar as per manufacturer's instructions
  2. Dampen repair area and surrounding concrete 6 inches beyond repair area to a saturated surface dry condition. Remove standing water and apply scrub coat with a brush, scrubbing it into surface and thoroughly coating repair area. If scrub coat dries, recoat before placing patching mortar or concrete.
- B. Mortar Scrub Coat for Ready-Mixed repair material and Concrete:
1. For scrub-coat material, mix one-part portland cement and one part sand by loose volume with water to form a thick slurry. Use sand meeting the requirements of ASTM C144 or ASTM C404
  2. Dampen repair area and surrounding concrete 6 inches beyond repair area to a saturated surface dry condition. Remove standing water and apply scrub coat with a brush, scrubbing it into surface and thoroughly coating repair area. If scrub coat dries, recoat before placing patching mortar or concrete.

### 3.6 PATCHING MORTAR APPLICATION

- A. Place concrete repair material as specified in this article unless otherwise recommended in writing by manufacturer.
1. Provide forms where necessary to confine patch to required shape.
  2. Wet substrate and forms thoroughly and then remove standing water.
- B. Pretreatment: Apply scrub coat as per section 3.5
- C. General Placement: Place concrete repair material by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
- D. Vertical Patching: Place material in lifts of not more than specified by manufacturer. Do not feather edge.
- E. Overhead Patching: Place material in lifts of not more specified by manufacturer. Do not feather edge.
- F. Consolidation: After each lift is placed, consolidate material and screed surface.
- G. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
- H. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.
- I. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray, water-saturated absorptive cover, or approved curing compound.

**3.7 DRY-PACK-MORTAR APPLICATION**

- A. Use dry-pack mortar for deep cavities. Place as specified in this article unless otherwise recommended in writing by manufacturer.
  - 1. Provide forms where necessary to confine patch to required shape.
  - 2. Wet substrate and forms thoroughly and then remove standing water.
- B. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
- C. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.
- D. Wet-cure patch for not less than seven days as per section 3.11

**3.8 CONCRETE PLACEMENT**

- A. Place concrete according to Section 033000 "Cast-in-Place Concrete" and as specified in this article.
- B. Pretreatment: Apply mortar scrub coat to concrete substrate as per Section 3.5.
- C. Standard Placement: Place concrete by form-and-pump method unless otherwise indicated.
  - 1. Use vibrators to consolidate concrete as it is placed.
  - 2. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.
- D. Form-and-Pump Placement: Place concrete by form-and-pump method where indicated.
  - 1. Design and construct forms to resist pumping pressure in addition to weight of wet concrete. Seal joints and seams in forms and where forms abut existing concrete.
  - 2. Pump concrete into place from bottom to top, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to 14 psi.
- E. Wet-cure concrete for not less than seven days by leaving forms in place or per section 3.11.
- F. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

**3.9 STEEL REINFORCEMENT INSTALLATION**

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

**3.10 MIXING AND APPLICATION**

- A. Concrete Repair Materials



1. Mix and place concrete in accordance with manufacturer's directions.
2. Apply concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. Deposit concrete to avoid segregation.
  - a. Do not exceed formwork design pressures.
  - b. Consolidate placed concrete with mechanical vibrating equipment.
  - c. For vertical and overhead applications, trowel apply in lifts in accordance with manufacturer's instructions.

B. Finishing

1. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces
2. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

### 3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

## 3.12 SHORING AND BRACING

- A. Install shoring and bracing in accordance with sequencing documentation provided by specialty engineer
- B. Establish and maintain survey controls and benchmarks in an undisturbed condition
- C. Maintain and adjust shoring and bracing during the repair process to comply with Section 1.4 - I.2.
- D. Unless otherwise specified, remove shoring and bracing after concrete repairs achieve specified strength.
- E. Remove shoring and bracing after completion of all stressing operations.
- F. Inspect shoring and temporary bracing before beginning the repair process and at appropriate intervals throughout the process.
- G. Specialty engineer who designed the shoring shall inspect the installation and certify that the shoring and bracing, as installed, meets the intent of their design.

## 3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. Composite samples of fresh concrete obtained according to ASTM C 172
    - a. Frequency: One sample for each day's placement of each concrete mixture
    - b. Air content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
    - d. Unless otherwise specified, select a target slump or slump low at the point of delivery of concrete mixtures for each application. Selected target slump shall not exceed 9 in. Selected target slump low shall not exceed 30 in. Concrete shall not show visible signs of segregation. The target slump or slump low 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 low by ASTM C1611/C1611M. Slump low tolerances shall meet the requirements of ASTM C94/C94M
    - e. Compression Test Specimens: ASTM C 31
  - 2. Concrete: As specified in Section 033000 "Cast-in-Place Concrete" or in drawing general notes.
- C. Field Acceptance of Concrete Materials
  - 1. Air content: If the measured air content at delivery is greater than the upper limit indicated on Contract Documents, immediately perform a check test of air content on a new sample. If the check test fails, the concrete did not meet the requirements of this Specification. Unless otherwise specified, if the measured air content is less than the lower limits indicated on Contract Documents, make adjustments in accordance with

- ASTM C94/C94M. If the check test of the adjusted mixture fails, the concrete did not meet the requirements of this specification.
2. Slump: If the measured slump at delivery does not meet the requirement of indicated on Contract Documents, immediately perform a check test on a new sample. If the check test fails, the concrete is considered to have failed to meet the requirements of this Specification. Unless otherwise specified, if the measured slump is less than specified in indicated on Contract Documents, make adjustments in accordance with ASTM C94/C94M. If the check test of the slump of the adjusted mixture fails, the concrete did not meet the requirements of this Specification.
  3. Temperature: Unless otherwise specified, if the measured concrete temperature at delivery is not within the limits of indicated on Contract Documents, a check test will be performed immediately at a new location in the sample. If the check test fails, the concrete is considered to have failed to meet the requirements of this specification.
- D. Prepare test and inspection reports.
- E. Tensile Bond Strength:
1. Required minimum pull-off tensile bond strength: minimum direct tension strengths of 150 psi for nonstructural repair and 250 psi for structural repairs.
- F. Inspect completed Work, including visually examining repairs for cracks, testing for de-bonded repair materials, and verifying conformance with repair performance requirements. Correct defective Work.

**END OF SECTION**