RESTORING SPALLED CONCRETE AREAS
(REV 04-01-2026)

The following new Section is added:

SECTION 401
RESTORING SPALLED CONCRETE AREAS

401-1 Description.

401-1.1 General: The work consists of repairing spalled or otherwise deficient concrete by form and pour, and shotcreting methods at locations indicated in the Plans or as directed by the Engineer. The work includes identifying and removing the spalled and other unsound concrete areas, including removal of solid concrete at the edges of spalls and behind bars (for the mechanical bond), surface preparation, and concrete restoration. This specification does not apply to precast or `prestress elements prior to their placement.

401-2 Materials.

Portland Cement Concrete-Class IV	Section 346
Coarse Aggregate**	Section 901
Fine Aggregate***	Section 902
Portland Cement and Portland Blend Cement	Section 921
Water	Section 923
Admixtures*	Section 924
Supplementary Cementitious Materials	Section 929
Bonding Agent	Section 930
Epoxy*	Section 926
Polymer-Modified Portland Cement Concrete*	Section 930
Polymer Resin-Based Concrete (not cementitious)	Section 930
Shotcrete*	Section 930
Fibers****	ASTM C1116

* Use only Type E and F

**Use only #89 stone except as provided in 901.

*** Use only silica sand except as provided in 902.

****Fibers - When specified, use non-metallic fibers meeting the requirements of ASTM C1116, Type II, or Type III per manufacturer or approved design mix specifications.

401-3 Construction.

401-3.1 Tracking Repair Quantities. Perform a pre-construction inspection by sounding the concrete within and around the areas indicated on the Plans. Include in the inspection survey all areas already identified in the Plans to verify locations, dimensions, and newly identified areas. Perform the survey in the presence of the Engineer prior to commencing any repair work. Obtain the Engineer's approval before removing or replacing damaged concrete.

401-3.1.1 Report. Prepare a detailed report with the identified areas documented, indicating the square footage of each deficiency and estimated total amount of repairs. Format the report to indicate the precise location of each area, estimated quantities for each repair, and calculations for each.

401-3.1.2 Work Documents: When work assignments are issued, do not commence work on any new work assignment until satisfactory completion or substantial

progress (more than 40% completion) of previously issued assignments has been confirmed in writing by the Engineer.

401-3.2 Shop Drawings: Provide and submit shop drawings indicating the proposed type of access and form systems, including supports, method of concrete placement and containment of concrete and waste materials. Inspect and ensure containment system functionality daily as a minimum. Approval of the containment system will be based upon continued satisfactory performance.

401-3.3 Work Plan and Work Schedule: Submit a detailed proposed testing and work plan and schedule to the Engineer for all the types of concrete restoration work stated in the Contract Documents for review and written approval prior to beginning the concrete restoration work. Include in the work plan, the anticipated repair volumes, personnel qualifications, materials for spalls with concrete volumes exceeding that allowed by the manufacturer of prepacked materials, and repair methods before beginning work.

401-3.4 Repair for Corrosion Damage: Perform repairs of corrosion-induced concrete spalls in phases for specific components where the structural integrity of the component may be affected due to the amount of required concrete removal when indicated in the Plans or as directed by the Engineer. Perform an inspection to locate and document spalled, cracked, and/or unsound concrete to be repaired prior to commencing the repair work when only estimated quantities are indicated in the Plans due to the continuous progression of damage by active corrosion.

401-3.5 Surface Preparation: Provide surface preparation by hydro demolition or mechanically removing all unsound concrete within the repair area to sound concrete. Chip away unsound concrete. Provide surfaces sound, clean, and free of any contaminants to all areas to be repaired prior to placing the spall repair material. Remove all delaminated, cracked, and unsound concrete from the areas that are hollow-sounding when tested or areas with visible cracks. Additionally, remove 3/4 to 1 inch of concrete behind the existing reinforcing steel if the reinforcing steel is exposed when unsound concrete is removed. A mechanical bond is required for all spall repairs. In no case shall a spall edge exceed 4 inches without a mechanical bond in a vertical or horizontal direction. Insert stainless steel dowels if no reinforcement is available to provide the mechanical bond. Use a maximum 15-pound chipping hammer to remove the concrete behind the bars and a 4-pound scaling hammer to provide the surface profile. Remove an additional 6 inches of sound concrete beyond the edge of the spall if corrosion is observed at the edge of the spall.

Chip concrete substrate to obtain a surface profile of 1/16 inch to 1/8 inch in depth with a newly fractured aggregate surface. Roughen profile to the edge of spall. Sandblast exposed steel to a near white condition as per The Society for Protective Coatings (SSPC) report number 10 (SP 10). No rust, mill scale, epoxy, mortar or other contaminants shall be present after sandblasting. Ensure proper cleaning and preparation of the backside of exposed reinforcement. Add new rebars where reinforcement with over 25% of section loss is determined as indicated in the Plans.

Exercise care to prevent damage to any reinforcing steel and damage to sound concrete not intended for removal within or outside the defective areas. If damage occurs to sound concrete or reinforcing bars, stop work and submit to the Engineer the report of the damage to the concrete and reinforcing steel due to the Contractor's operation. Submit a repair method and obtain the Engineer's approved before continuing the concrete removal and restoration work.

Saw cut the perimeter of the spalls to a minimum depth of 3/4 inch to sound concrete or as specified by the repair product manufacturer to prevent feathering. Adjust the depth of the sawcut if shallow steel is encountered. Obtain the Engineer's approval before depth adjustment. Provide horizontal and vertical straight cuts that follow the general pattern of the spall. The sawcut method and equipment shall be included in the Work Plan prior to commencing any work.

Place welded wire or supplemental reinforcing bars where needed, as shown in the Plans, or when the depth of repair work without reinforcement exceeds 3 inches.

401-3.6 Work Staging: Do not place or store equipment on the roadway unless specifically approved. Use proper equipment to execute the work and proper staging to house all the equipment considering site conditions. The Department will not allow additional time for work delays if it determines that the chosen equipment was inadequate for the existing site conditions.

Provide special access system for sounding and repairs for spalls located at high elevations and inside pier columns and/or superstructure segments. Remove any anchors and patch any holes created to support scaffold, forms, falsework, and related holes with approved repair materials. Do not anchor to bridge superstructure segments. Do not use permanent attachments or modify the bridge structure for staging or access.

401-3.7 Placement

401-3.7.1 Portland Cement Concrete: For large volume spall repairs deeper than 10 inches or exceeding the limitations of the prepackaged mixes, use an FDOT-approved Concrete. Sample and perform acceptance testing for Portland cement concrete per Specification 346. Place concrete by form, and pump/pour methods.

Apply an APL approved bonding agent to the existing concrete and reinforcing steel before the concrete repair material is placed. Ensure that such bonding agent is solvent-free and epoxy-cement based. Use a bonding agent that is suitable for application over concrete and reinforcement with a minimum application time of 1 hour after mixing. Mix the bonding agent and apply per the manufacturer's specifications.

Conduct a preconstruction trial mix of all prepacked materials before commencing any concrete repair when the estimated total quantity of repair material for the project exceeds 15 cubic feet.

401-3.7.2 Epoxy Concrete: Use Materials in accordance with Section 930 and Contract Documents for mixing and placement requirement. Mix and place the epoxy per the manufacturer's recommendations.

401-3.7.3 Polymer-Modified Portland Cement Concrete: Use polymer-modified Portland cement concrete for spall repairs 10 inches deep or less or that are of a small volume not exceeding the placement limitations of the prepackaged mix. Mix and place the polymer-modified repair materials per the manufacturer's recommendations.

401-3.7.4 Polymer Resin-Based Concrete (not cementitious): Mix and place polymer resin-based concrete as per manufacturer recommendations. Mix polymer resin-based concrete using dry, dust-free containers and mixing tools. Do not use mixing containers or tools that may be contaminated. Mix the material within the manufacturer-specified temperatures and time windows and in a manner that will not introduce air into the mix.

401-3.7.5 Rapid-Hardening Concrete: Mix and place rapid hardening concrete as per manufacturer's recommendations. Place the material within the time limits specified by

the manufacturer but before the material's initial set. Obtain the Engineer's approval prior to material use.

Wet cure the placed material after the initial set for 7 days before applying the curing compound except for temporary spall repairs. Increase the wet curing time if cracks develop upon setting to prevent the development of cracks.

401-3.7.6 Shotcrete Placement:

401-3.7.6.1 Machine Operating Requirements: Provide equipment that supplies shotcrete material at the nozzle that is uniform and not segregated, providing a steady, constant flow of shotcrete with no detrimental surging or pulsing. Maintain the velocity and consistency of shotcrete exiting the nozzle at a uniform rate appropriate. Provide gauges at or near the dispensing guns at or near the nozzles to check working pressures. Air for the shotcrete application shall be constant, dry, and free of oils or other contaminants.

401-3.7.6.2 Shotcrete Application Personnel: Use only experienced workers under the constant direction of an experienced superintendent. The superintendent must have a minimum of 5 years of experience working with the same type of shotcrete method used and on projects of a similar type. Provide references showing satisfactory performance on at least three similar previous projects.

Use a nozzlemen with at least 100 hours of documented experience in using the proposed shotcrete method on other similar projects. Alternatively, when the proposed nozzlemen do not have the required minimum experience or the Engineer deems the work critical, nozzlemen shall possess a valid, up-to-date American Concrete Institute (ACI) Mix Process Shotcreter Certification for the type of shotcrete being used (dry or wet mix). Obtain the Engineer's approval of documentation for the superintendent and nozzlemen. Documentation showing compliance with the above requirements must be submitted to the Engineer for approval prior to starting the shotcrete operation.

401-3.7.6.3 Mixing Process:

1. Wet Process: Mix materials for wet process shotcrete per Section 346 unless pre-packed shotcrete is used. Apply the shotcrete within 90 minutes after batching. The consistency of each batch must be uniform within each batch and uniform from batch to batch when discharged into the shotcrete placement equipment.

2. Dry Process: Pre-dampen solid ingredients for dry-mix shotcrete as needed and mix in a batch-type or continuous-type mixer. Add the mixing water at the nozzle. Accurately control the proportion of water added to the mixture to produce thorough and uniform hydration of the shotcrete. Apply dry-mix shotcrete material within 30 minutes after batching or pre-dampening. Do not use shotcrete material mix left in the hopper overnight.

3. Mix pre-packed shotcrete as per manufacturer's instructions.

401-3.7.6.4 Shotcrete Application Requirements: Maintain shotcrete temperature at minimum 50°F and maximum 90°F during application. The ambient-temperature and the surface-temperature of the repair shall be at least 50°F.

Provide shotcrete layers with appropriate thickness such that no sloughing, sagging, tearing, or debonding will occur. Allow the initial set of the prior layer using the initial set time determined from the demonstration mix prior to placing the following layer. Then, remove loose, uneven, or excess material. Remove glaze and rebound by brooming, scraping, or other means.

Whenever possible, sections should be gunned in one layer to the full design thickness. However, for multiple layers of reinforcement, gunning of one layer of shotcrete may be required for each layer of reinforcement.

Place shotcrete starting from the bottom on vertical surfaces. Do not incorporate rebound or previously applied material in any layer. Remove all such material from the surface and work area before the final set and before placing shotcrete on adjacent surfaces. Do not place shotcrete if drying or stiffening of the mixture is occurring.

Presoak the prepared concrete surface with fresh potable water to provide a saturated, surface dry (SSD) condition or the condition which the bonding agent's manufacturer specifies.

Apply shotcrete in layers less than 1 inch thick when more than one layer is required. Avoid trapping air pockets in the voids.

Thoroughly wash down the shotcrete surface with a stream of fresh potable water and air hose excess water before continuing with the remaining shotcrete layer(s) if work stops for longer than 2 hours on any shotcrete layer before it has been built up to the required thickness. Remove any surface deposits that take a final set by abrasive blast cleaning and clean the surface with an air-water blast from the nozzle. Do not apply the curing compounds to the surfaces that will be covered by an additional layer of shotcrete.

In-place shotcrete shall be uniform and dense, free from hollow sound areas that indicate laminations, voids, sand pockets, or debonded material. Do not square the shotcrete construction joints. Slope the material at all construction joints to a thin edge. Thoroughly clean and wet all construction joints before shooting an adjacent section. Do not apply shotcrete on surfaces with standing or running water.

401-3.7.6.5 Field Demonstration of Shotcrete Mix: Ensure that the field demonstration of the proposed shotcrete mix includes the fabrication, evaluation, and testing of a mock-up product representative of the production work. The preconstruction field demonstration of the Shotcrete mix shall include the following:

1. Prepare two 24-inch × 24-inch × 4-inch-deep test panels containing steel reinforcement representing the partial mock-up of the project.

2. Each nozzleman shall gun two test panels with the proposed mix design to be used on the project and for each gunning orientation to be encountered on the job.

3. Cure the panels in the field in the same manner as the structure for 1 day and then transport them to the designated testing laboratory, where curing shall be continued until the testing time.

4. Cut one of the test panels with a trowel or a metal template before the initial set to visually check for possible voids under the reinforcement for shotcrete projects of less than 200 square feet in the presence of the Engineer. For larger-size projects where specific evidence of good encasement of reinforcing bars is needed, cut cores from the test panels after the concrete has hardened for at least 3 days. Cores shall be cut through the steel for evaluation.

5. Use the second panel for small and large projects for compressive strength testing of the applied shotcrete. Take 2-inch to 4-inch diameter core samples from the panel at the locations between the reinforcement. The designated laboratory shall perform the compressive strength test of the cores at the specified age per ASTM C42.

6. Determine the initial and final set time for the shotcrete mix using ASTM C191 or ASTM C403 as applicable.

7. Ensure that the in-place shotcrete demonstrates consistent quality and is free from segregation, honeycombing, sand pockets, sand lenses, sagging, dry patches, overspray, rebound, or incomplete encasement of reinforcement. Shotcrete shall also be free from delamination, cracking, or single voids larger than ¼-inch.

401-4 Finishing.

401-4.1 Portland Cement Concrete: Vibrate concrete as necessary to ensure proper consolidation and prevent voids. Surfaces of all repaired areas shall be smooth and uniform and shall match the original profile of the concrete components unless otherwise required in the Contract Documents. Adjust concrete placement methods to prevent gaps between the existing concrete and the concrete patching material. Surfaces of all repaired areas shall be smooth and uniform and match the original surface profile of the existing structure.

401-4.2 Other Repair Materials: For Epoxy, Polymer-Modified Portland Cement Concrete, Polymer Resin-Based Concrete (not cementitious), and Rapid-Hardening Concrete, **f**ollow the manufacturer's technical data sheet to finish the surface and apply the placement method for each material in accordance with the manufacturer's instructions.

401-4.3 Shotcrete: Prior to the initial set, the shotcrete surface shall be scraped or cut with a trowel or metal template to obtain an even and aesthetically acceptable appearance. The final finishing shall be with a wet sponge unless otherwise specified. Troweling or floating is not allowed. Surfaces of all repaired areas shall be smooth and uniform and match the original surface profile of the existing structure.

401-5 Curing.

401-5.1 Portland Cement Concrete: Follow Section 400 to cure the concrete. Do not apply curing compound to the repair material within the limits of cathodic protection.

401-5.2 Other Repair Materials: For Epoxy, Polymer-Modified Portland Cement Concrete, Polymer Resin-Based Concrete (not cementitious), and Rapid-Hardening Concrete, Cure the repair materials per the manufacturer's recommendations.

401-5.2 Shotcrete: Protect the surfaces of finished shotcrete from drying and cracking after placement. Use fogging before the application of moist curing when necessary.

Wet cure all finished shotcrete surfaces for 7 days by saturating the surface a minimum of four times daily with a fine spray of fresh potable water. The shotcrete may be cured with a curing compound. The rate of curing-compound-application shall be less than 1 gallon of curing compound per 100 square feet of the surface. The color of the curing compound shall be approximately that of the existing concrete.

Wet burlap curing may be necessary as directed by the Engineer. Start curing as soon as the finished shotcrete surface can withstand the curing operation without damage.

Do not apply curing compound to shotcrete within the limits of cathodic protection.

401-6 Sampling and Testing.

401-6.1 General: Quality Assurance (QA) testing shall be performed by the Engineer to ensure materials utilized during production meet the specified requirements. Notify the Engineer at least 48 hours prior to placing any repair materials. Furnish sufficient materials as required by the Engineer for QA testing. The Engineer may independently verify materials in accordance with Section 6. The Engineer may direct chloride testing based on field observations indicating possible contamination.

401-6.1.1 Portland Cement Concrete: Compressive strength and plastic concrete testing are required for each field batch of Portland Cement Concrete used for spall repairs that exceed 9 cubic feet. A field batch is defined as each load of the concrete mixer. The sampling schedule for field batching may be reduced as directed by the Engineer based on satisfactory test results on three previous consecutive tests and adequate Contractor quality control practices.

401-6.1.2 Other Repair Materials: For Epoxy, Polymer-Modified Portland Cement Concrete, Polymer Resin-Based Concrete (not cementitious), and Rapid-Hardening Concrete, the Engineer may independently verify materials in accordance with Section 6.

401-6.1.3 Shotcrete: Thoroughly check for sags, bridging, and other deficiencies immediately after shotcrete surfaces are brought to final thickness. At a minimum of 3 days after completion of the placing of the shotcrete, thoroughly test with a small hammer for any deficient sections. At this time, the shotcrete will have attained sufficient strength for all sound sections to ring sharply. Remove and replace any unsound portions of the work found during this inspection period or at any other time prior to the final inspection of the work, at no cost to the Department.

401-6.2 Bond Testing: If deemed necessary by the Engineer, the adequacy of the bond between the existing concrete structure and the repair materials shall be determined by ASTM C1583. The Contractor shall engage an experienced independent tester to perform this test. The minimum acceptable bond strength is 250 psi. Do not continue the bond test to failure after reaching 250 psi. Areas not meeting the bond strength or friction requirements shall be removed and replaced at no additional cost for the Department. The sampling schedule for production testing may be reduced as directed by the Engineer based on a minimum of three previous satisfactory test results.

401-7 Method of Measurement.

The quantity to be paid for will be based on the volume, in cubic feet, of defective areas restored as quantified following 401-3.1. The method utilized in determining the volume shall be the area in square feet of each spalled area multiplied by the average depth of each area.

When the work quantities are to be determined based on the Contractor's inspection as indicated in 401-3.1, the Department shall have the authority to increase, decrease, or delete the Plan quantities above or below the percentages allowed in Section 4 with no adjustment to the contract unit prices. When the quantities are determined based on the Contractor's inspection, the work will be assigned by the Engineer to a specific group of locations at a time.

401-8 Basis of Payment.

The quantity to be paid for shall be the volume, in cubic feet, of all spalled or otherwise deficient areas restored, complete, in place, and accepted satisfactory by the Engineer.

The quantity determined as provided in 401-3.1 shall be paid for at the contract unit price bid for restoring the defective concrete areas. Such price and payment shall be full compensation for all work specified in this Section and shall include all materials, testing, equipment, labor, concrete removal and disposal, saw-cutting, surface preparation, new reinforcement, forming, curing, and incidentals necessary to complete the work.

Cost for restored spall areas will be paid based on the volume of actual spalls restored by the Contractor and the specified repair material. Quantities given in the Plans are estimates and may be increased, decreased, or deleted beyond the limits allowed by Section 4 of the Specifications as necessary based on actual conditions found on the structure.

Payment will be made under the appropriate Pay Item:

Item No. 401-70-1 Restore Spalled Areas, Epoxy - per cubic foot.

Item No. 401-70-2	Restore Spalled Areas, Latex Modified Mortar - Styrene Butadiene - per cubic foot.
Item No. 401-70-3	Restore Spalled Areas, Latex Modified Mortar - Acrylic- per cubic foot.
Item No. 401-70-4	Restore Spalled Areas, Portland Cement Grout - per cubic foot.
Item No. 401-70-5	Restore Spalled Areas, Rapid Hardening Mortar/Concretes - per cubic foot.
Item No. 401-70-6	Restore Spalled Areas, Shotcrete - per cubic foot.

MATERIALS FOR CONCRETE REPAIR
(REV 04-01-2026)

SECTION 930 is expanded by the following:

SECTION 930
MATERIALS FOR CONCRETE REPAIR

930-8 Materials for Spalled Concrete Restoration

930-8.1 General: This Section covers all materials used for restoring spalled concrete. The requirements and documentation will vary depending on the type of material. Use Department-approved materials for spalled concrete restoration.

930-8.2 Chlorides Requirements: Ensure that the chloride content for all placed spall repair materials is limited to a maximum of 0.50 lb/yd^3.

930-8.3 Materials: The materials to be considered under this classification shall meet the following requirements:

930-8.3.1 Bonding Agent: Bonding Agent shall be compatible with the specified concrete repair materials. For shotcrete, ensure that such bonding agent is a solvent-free epoxy-cement-based agent. Do not use the bonding agent as a vapor barrier. Mix the bonding agent and apply it per the manufacturer's specifications for use with shotcrete. Schedule the placement of the repair material according to the manufacturer's allowed time and conditions when specifically used for shotcrete.

930-8.3.2 Polymer-Modified Portland Cement Concrete: Polymer-modified Products shall meet the requirements of Section 930 for ultra-high-performance materials when allowed. The concrete shall contain corrosion inhibitors for all form and pour repairs. Use the Polymer-Modified Portland Cement Concrete with anti-washouts for spalls below water. Use a styrene-butadiene formulation polymer modified material for horizontal and vertical surfaces where bonding to concrete is desirable without additional bonding agents. Use the styrene butadiene for all spalls on bridge decks and other components where severe exposure to UV rays is expected. Use an acrylic formulation polymer modified material for horizontal and vertical surfaces where the use of a bonding agent is feasible, and the location is not directly subject to UV ray exposure.

930-8.3.3 Polymer Resin-Based Concrete (not cementitious): When specified, use a thermosetting polymer spall repair material with polymer bindings without cement hydrate agents, meeting the required compressive strength specified in Section 930. Use a polymer mortar/concrete that will develop a minimum of 60% of its specified strength in 24 hours. Do not use polymer concretes where fire-resistant properties are required.

930-8.3.4 Shotcrete: Provide a shotcrete mix design meeting the required compressive strengths shown in Table 930-5. Prepare a preconstruction trial mix and a mock-up application using the proposed materials and production equipment to confirm that the mix meets the requirements with sufficient time for testing prior to commencing the production work. Obtain Engineer's approval of a certified test report for the Portland cement shotcrete proposed for use and described in this specification, indicating that the material meets all requirements specified following the preconstruction trial mix. The shotcrete mixture shall be prepackaged material or ready mixed concrete containing at least: Portland cement, silica fume, aggregates, and, if specified in the Plans, synthetic fibers. Admixtures and Class F fly ash or slag cement will be permitted.

Table 930-5 Minimum Compressive Strength of Shotcrete	
Testing Age (days)	Compressive strength (psi)
1	3,000
7	4,000
28	5,500

930-8.3.5 Prepackaged Shotcrete: Use a polymer-modified Portland cement shotcrete containing corrosion inhibitors. The polymer-modified Portland cement shotcrete shall have a maximum water to cementitious materials (w/cm) ratio of 0.45 and meet the requirements shown in Table 930-5. Mix and install the materials per the manufacturer's written recommendations.