TECHNICAL SPECIAL PROVISION
FOR
RESTORING SPALLED CONCRETE AREAS USING CONCRETE

SECTION T401

T401-1 Description.

T401-1.1 General: The work under this Section consists of repairing spalled or otherwise deficient concrete by form and pour 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 elements prior to their placement and does not cover restoration of defective concrete areas by the shotcrete method.

T401-1.2 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 determined 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.

T401-1.2.1 Quantities When the work quantities are to be determined based on the Contractor's inspection as indicated in 401-1.1, the Department shall have the authority to increase, decrease, or delete the Plan quantities above or below the percentages allowed in Section 4-3.1 of the Standard Specifications 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. Propose the repair schedule based on the above inspection for Engineer's approval.

Perform the inspection by sounding the concrete within the areas indicated in 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 before commencing any repair work.

The removal and replacement of damaged concrete require Engineer's approval.

T401-1.2.2 Tracking Repair Quantities: Prepare a detailed report with the identified areas documented as per 401-1.2.1, 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.

When work assignments are issued, do not commence work on any new work assignment until the satisfactory completion or substantial progress (more than 40% completion) of previously issued assignments has been confirmed in writing by the Engineer.

T401-1.3 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 an appropriate approved mortar or epoxy. Do not anchor to bridge superstructure segments. Do not use permanent attachments or modify the bridge structure for staging/access.

T401-1.4 Shop Drawings: Provide shop drawings indicating the proposed type of access and form systems, including supports, method of concrete placement, and containment of concrete and waste

materials. Assure containment systems continually function as intended daily as a minimum. Approval of the containment system will ultimately be based upon continued satisfactory performance.

T401-1.5 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, prepackaged mixes, approach to spalls with concrete volumes exceeding that allowed by the manufacturer of prepacked materials, and repair methods before beginning work.

T401-2 Materials.

Use the appropriate repair materials as specified in the Plans. When a prepackaged material is specified or approved by the Engineer, use materials from the Department's Approved Products List (APL) that meet the requirements of Section 930 unless otherwise specified in the Plans or approved by the Engineer. Use aggregates that meet the product manufacturer recommendations or from a Department-approved source for applications where there is a need to extend the patching material by adding coarse aggregate. Materials with field added aggregate (extended) shall meet the minimum specified compressive strength.

Provide the Engineer with a certified test report for the repair material(s) proposed for use and described in this specification, indicating that the material meets all requirements specified for the work. Include intended use for each material submitted.

T401-2.1 Epoxy: Use epoxy compounds meeting the requirements of Section 926.

T401-2.2 Polymer Modified Concrete: Use a polymer-modified portland cement mortar/concrete containing corrosion inhibitors for all form and pour repairs unless otherwise specified. Use the polymer-modified Portland cement mortar/concrete with anti-washouts for spalls below water. Polymer-modified Products not included in the APL shall meet the requirements of Section 930 for ultra-high-performance materials when allowed.

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.

T401-2.3 Rapid and Very Rapid Hardening Mortar/Concretes: Use rapid or very rapid hardening cementitious repair material per Section 930 for smaller spalls where a rapid set of the concrete is required.

T401-2.4 Polymer Mortars/Concretes (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 the Plans. 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.

T401-2.5 Portland Cement Concrete: Use an FDOT-approved Section 346 flowable Class IV concrete containing #89 coarse aggregate from a department's approved concrete producer where specified or if the size of spalls exceeds the allowable volume or depth allowed by the manufacturer of prepackaged materials.

T401-2.6 Bonding Agent: Use bonding agent compounds meeting the requirements of Section 926.

T401-3 Construction Methods.

T401-3.1 Surface Preparation: Provide surface preparation by hydro demolition or mechanically removing all unsound concrete within the repair area to sound concrete. Chip back unsound concrete to sound 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, sound concrete will require removal to obtain the ¾ inch to 1 inch behind the existing reinforcing steel to achieve a mechanical bond. 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 15-pound chipping hammer (maximum size) to remove the spalled and behind bars concrete 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 noted at the edge of the spall.

Chip concrete substrate to obtain a surface profile of 1/16 inch to ⅛ inch in depth with a new 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, or other contaminants shall be present after sandblasting. Special attention shall be observed to 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 great care to prevent damage to any reinforcing steel and damage to sound concrete not intended for removal within or outside the delaminated areas. Stop work and submit to the Engineer the report of the damages to the concrete and reinforcing steel due to the Contractor's operation. Submit a repair method for the damaged area(s) for the Engineer's approval prior to continuing the concrete removal and restoration work.

Saw cut the perimeter of the spalls to a minimum depth of ¾ 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. The depth adjustment requires Engineer's approval. 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 for Engineer's approval prior to commencing any work.

Place welded wire reinforcement or supplemental reinforcing bars as shown in the Plans.

T401-3.2 Concrete Placement (General): Place concrete by form, and pump/pour methods unless otherwise approved by the Engineer. Provide forms that allow internal or external vibration and have adequate concrete entrance. Ensure that the resistivity limit of any prepackaged, repaired, or filler material used is 50 kOhm-cm or less when cathodic protection will also be implemented on the repaired component.

Apply an APL or EOR-approved concrete 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. Do not use the bonding compound as a vapor barrier. Use a bonding agent that provides corrosion protection to the reinforcement and 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. Ensure that the bonding agent is in a tacky condition (not allowed to harden) when the repair material is placed. Schedule the placement of the repair material so as not to exceed the bonding agent manufacturer's allowed time.

Conduct a preconstruction trial mix of the repair material before commencing any concrete repair when the estimated total quantity of spalls repair concrete for the project exceeds 15 cubic feet. Perform all required testing to demonstrate that the material can be field batched to meet the requirements of the Contract Documents and the properties specified in the manufacturer's technical data sheet.

In addition to the quality control required by the Standard Specifications for concrete products, compressive strength and plastic concrete testing are required for each field batch of mortar/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. Produce six 4-inch diameter by 8-inch-tall cylinders for testing purposes on extended and un-extended mixes.

T401-4 Concrete Placement of Specific Spall Repair Materials.

Use concrete repair materials included explicitly in the Contract Documents or previously approved by the Engineer. Use field-added aggregate (extended) material per the manufacturer's instructions for all spalls extending deeper than 1 inch for cementitious spall repair materials of all types. Use aggregates that meet all applicable Department specifications or have a certification from the spall repair material manufacturer indicating satisfactory performance when incorporated into their product. Extended materials shall meet the specified minimum compressive and tensile strength.

T401-4.1 Polymer Modified, Cement Base Mortars/Concretes: Use polymer-modified mortars/concretes for spall repairs 10 inches deep or less or that are of a small volume not exceeding the placement limitations of the prepackaged mix unless otherwise specified in the Contract Documents. Perform touch-up work with the same type of material used for the repair when necessary.

Mix and install the polymer-modified spall repair materials per the producer's or manufacturer's recommendations. Require the manufacturer to provide a Field Representative upon request by the Engineer.

T401-4.2 Rapid and Very Rapid Hardening Mortar/Concretes: Mix and place rapid or very rapid hardening material as per manufacturer instructions following the surface preparation methods described in 401-3.1. The Engineer shall approve the material prior to use. Place the material within the time limits specified by the manufacturer but before the material's initial set.

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.

T401-4.3 Polymer Mortars/Concretes: Mix and place thermosetting polymer mortar/concretes as per manufacturer instructions following the surface preparation methods described in 401-3.1. Mix polymer mortars/concretes using dry, dust-free containers and mixing tools. Do not use mixing containers or tools that may be contaminated or with any already polymerized material in the container or on mixing tools. Mix the material within the manufacturer-specified temperatures and time windows and in a manner that will not introduce air into the mix.

Provide test specimens for quality control testing at a minimum frequency of one per production day. Test quality control specimens for compressive strength and flexural strength as per ASTM C579 and ASTM C580, respectively. Require the manufacturer to provide a Field Representative upon request by the Engineer.

T401-4.4 Portland Cement Concrete: Unless otherwise specified, use Portland cement Class IV concrete for large volume spall repairs deeper than 10 inches or exceeding the manufacturer allowed volumes or limitations of the prepackaged mixes. Sampling and acceptance testing per Specification 346.

T401-4.5 Chlorides: Prevent chloride contamination during placement. No placed spall repair material shall exhibit chloride contents greater than 0.4 pounds of chloride per cubic yard of concrete or mortar. The Engineer may direct chloride testing based on field observations indicating possible contamination or if chloride content is not disclosed in the material's manufacturer data sheet.

T401-4.6 Finishing: 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.

T401-4.7 Curing: Cure the repair material per the manufacturer's recommendations. Apply wet curing on materials that show cracking upon initial placement. Trowel finish repair edges requiring touch-up work with the same type of material used for the repair.

Do not apply curing compound to spall repairs on concrete within the limits of cathodic protection.

T401-5 Durability of the Spall Repair.

Use concrete repair materials included explicitly in the Contract Documents or previously approved by the Engineer. Perform repairs on new concrete to last as much as the native concrete. Repairs on ten-year-old or older concrete with Portland-Cement-based mixes shall have a maintenance-free service life of two years. Repairs on ten-year-old or older concrete with Polymer-Modified mixes shall have a maintenance-free service life of four years.

T401-6 Method of Measurement.

The quantity to be paid for will be the volume, in cubic feet, of spalled or otherwise deficient areas restored, complete, in place, and accepted. The method utilized in determining the volume shall be the area in square feet of spalled areas multiplied by the average depth of such areas.

T401-7 Basis of Payment.

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

The quantity determined as provided in 401-5 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:

401-70-A	Restore spalled or deficient Concrete per cubic foot.