

APPROACH SLAB REPLACEMENT

(SPECIAL)

1. DESCRIPTION AND SCOPE OF WORK

This provision addresses replacing the existing approach slabs, in stages, at both ends of the bridge, in accordance with the plans and the *Standard Specifications*.

2. MATERIALS

Concrete used in approach slab shall conform to the specifications described in the “Concrete for Deck Repair” Special Provision.

Reinforcing steel shall conform to the *Standard Specifications*.

3. FINISHED GRADE OF APPROACH SLABS

The grade of the approach slabs has not been designed or described in the plans. The approach slab grades shall be designed to provide a smooth and continuous transition between the bridge deck and the approach roadway pavement. Any modifications to the approach roadway pavement grade shall be incorporated into the design of the approach slab final grade. The final finished elevations shall conform to the profile, cross-slope, and other data in the R-2530B project.

The contractor shall submit to the Engineer designs and construction elevations (including elevations at centerline, crown point, and gutterline) detailing the grade of the approach slabs and demonstrating that the grade is continuous and smooth between approach pavement and the bridge deck.

4. DEMOLITION OF EXISTING APPROACH SLAB

The existing approach slabs shall be demolished in accordance with the plans in stages and all material properly disposed. Provide a saw-cut at the limits of demolition between stages. Use equipment suitable for the operations. Submit a work plan to the Engineer, detailing the equipment used, limits of demolition, containment of waste and disposal methods to the Engineer prior to beginning work.

Protect traffic lanes from construction and demolition activity for flying debris.

5. SUBSURFACE PREPARATION

The contractor shall determine the subsurface preparation required to adequately construct approach slabs that will not settle, crack, or shift over the life of the structure. At a minimum, 12” of compacted ABC stone shall be used. Compaction shall be done in such a way as to not disturb the end bents or shoulder fill. If, at any time during construction, it becomes evident that the approach fill is pushing under the end bent or transversely toward the shoulders, work shall stop, and the condition be reported to the Engineer. The Engineer shall monitor the existing embankments, and any disturbance to the shoulder fill or

approach fill that is deemed detrimental to the overall longevity of the approach slab and fill shall be corrected at no additional cost to the Department. Visual cues indicating such detrimental conditions include, but are not limited to, excessive settlement and failure of shoulder slopes. The Engineer shall note on the as-built plans the type, extent, and construction methods used for the subsurface material.

6. JOINT SURFACE PREPARATION

The proposed approach slab shall rest on the existing backwall as shown on the plans. A blockout shall be formed during construction to accommodate the proposed expansion joint seal. For the preparation of the blockout, refer to the provisions in the Joint Repair Special Provision.

7. MAINTENANCE OF TRAFFIC

The approach slabs shall be constructed in stages in accordance with the construction sequencing plans and maintenance of traffic plans. Shoring shall be installed, as necessary, to facilitate the subsurface preparation.

8. GROOVING

The approach slabs shall be grooved in accordance with the *Standard Specifications*. Measurement and payment for *Grooving Bridge Floors* is addressed separately.

9. MEASUREMENT AND PAYMENT

Approach Slabs will be measured and paid for at the contract lump sum bid price for “Design and Construction of Bridge 50” and will be full compensation for removal of existing approach slabs, subsurface preparation, placement of reinforcing and concrete, and finishing.

ASBESTOS ASSESSMENT FOR BRIDGE DEMOLITION AND RENOVATION ACTIVITIES

(12-30-15)

1.0 INSPECTION FOR ASBESTOS CONTAINING MATERIAL

Prior to conducting bridge demolition or renovation activities, the Contractor shall thoroughly inspect the bridge or affected components for the presence of asbestos containing material (ACM) using a firm prequalified by NCDOT to perform asbestos surveys. The inspection must be performed by a N.C. accredited asbestos inspector with experience inspecting bridges or other industrial structures. The N.C. accredited asbestos inspector must conduct a thorough inspection, identifying all asbestos-containing material as required by the Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants (NESHAP) Code of Federal Regulations (CFR) 40 CFR, Part 61, Subpart M.

The Contractor shall submit an inspection report to the Engineer, which at a minimum must include information required in 40 CFR 763.85 (a)(4) vi)(A)-(E), as well as a project location map, photos of existing structure, the date of inspection and the name, N.C. accreditation number, and signature of the N.C. accredited asbestos inspector who performed the inspection and completed the report. The cover sheet of the report shall include project identification information. Place the following notes on the cover sheet of the report and check the appropriate box:

- A. ☐ ACM was found
- B. ☐ ACM was not found

2.0 REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIAL

If ACM is found, notify the Engineer. Compensation for removal and disposal of ACM is considered extra work in accordance with Article 104-7 of the Standard Specifications.

An Asbestos Removal Permit must be obtained from the Health Hazards Control Unit (HHCU) of the N.C. Department of Health & Human Services, Division of Public Health, if more than 35 cubic feet, 160 square feet, or 260 linear feet of regulated ACM (RACM) is to be removed from a structure and this work must be completed by a contractor prequalified by NCDOT to perform asbestos abatement. RACM is defined in 40 CFR, Part 61, Subpart M. Note: 40 CFR 763.85 (a)(4) vi)(D) defines ACM as surfacing, TSI and Miscellaneous which does not meet the NESHAP RACM.

3.0 DEMOLITION NOTIFICATION

Even if no ACM is found (or if quantities are less than those required for a permit), a Demolition Notification (DHHS-3768) must be submitted to the HHCU. Notifications and Asbestos Permit applications require an original signature and must be submitted to the HHCU 10 working days prior to beginning demolition activities. The 10 working day period starts based on the post-marked date or date of hand delivery. Demolition that does not begin as originally notified requires submission of a separate revision form HHCU

3768-R to HHCUC. Reference the North Carolina Administrative Code, Chapter 10A, Subchapter 41C, Article .0605 for directives on revision submissions.

Contact Information

Health Hazards Control Unit (HHCUC)
N.C. Department of Health and Human Services
1912 Mail Service Center
Raleigh, NC 27699-1912
Telephone: (919) 707-5950
Fax: (919) 870-4808

4.0 SPECIAL CONSIDERATIONS

Buncombe, Forsyth, and Mecklenburg counties also have asbestos permitting and NESHAP requirements must be followed. For projects involving permitted RACM removals, both the applicable county and the state (HHCUC) must be notified.

For demolitions with no RACM, only the local environmental agencies must be notified. Contact information is as follows:

Buncombe County

WNC Regional Air Pollution Control Agency
49 Mt. Carmel Road
Asheville, NC 28806
(828) 250-6777

Forsyth County

Environmental Affairs Department
537 N. Spruce Street
Winston-Salem, NC 27101
(336) 703-2440

Mecklenburg County

Land Use and Environmental Services Agency
Mecklenburg Air Quality
700 N. Tryon Street
Charlotte, NC 28202
(704) 336-5430

5.0 ADDITIONAL INFORMATION

Additional information may be found on N.C. asbestos rules, regulations, procedures and N.C. accredited inspectors, as well as associated forms for demolition notifications and asbestos permit applications at the N.C. Asbestos Hazard Management Program website:

www.epi.state.nc.us/epi/asbestos/ahmp.html

6.0 BASIS OF PAYMENT

Payment for the work required in this provision will be at the lump sum contract unit price for “Design and Construction of Bridge 50” or “Design and Construction of Bridge 51.” Such payment will be full compensation for all asbestos inspections, reports, permitting and notifications.

BEAM REPAIR

(SPECIAL)

1. DESCRIPTION

This provision addresses repairs made to structural steel throughout the superstructure. Work includes replacing loose connection bolts and replacing bent or damaged crossframe members, lateral bracing, and diaphragm members.

2. MATERIALS

All structural steel shall be AASHTO M270 Grade 50W or equivalent, as approved by the Engineer. All replaced bolts shall be high strength bolts in accordance with section 440-8 of the Standard Specifications.

3. EQUIPMENT

Provide equipment necessary for access, removal, and replacement of loose bolts and bent members. Bolts shall be tightened as required in the Standard Specifications using appropriate tightening means.

4. REPLACEMENT OF BOLTS

All loose connection bolts shall be replaced and tightened accordingly. Locations of loose bolts shown in the plans are given for the convenience of the contractor. The Engineer shall be responsible for identifying any and all bolts on the bridge subject to replacement. Any additional loose bolts, not indicated in the plans, shall be replaced at no additional cost to the Department.

Locations of bolt replacement may include, but are not limited to, girder splices, diaphragm connections, crossframe connections, and lateral bracing connections.

A loose bolt is one where either the nut or bolt head is visibly not in contact with the base metal, or the bolt or nut can be turned by hand.

The contractor shall verify the sizes of existing bolts and replace with like bolts. Replacement bolts shall be high-strength bolts of the same diameter and length. No cutting or drilling of existing connection plates, girders, diaphragm, crossframe, or lateral bracing members shall be permitted.

Loose bolts shall be removed and replaced one at a time. Immediately replace bolts after removal. Simultaneous bolt replacement shall not occur within a span. Provide a positive temporary connection for members with loose bolts during replacement, and provide means to prevent members from falling during bolt replacement. One lane (if prior to Intermediate Contract Time #1) or two lanes (if after Intermediate Contract Time #1) must be allowed to be on the bridge during bolt replacement.

Bolts shall be installed in accordance with the *Standard Specifications*.

5. REPLACEMENT OF BENT MEMBERS

All crossframe, diaphragm, and lateral bracing members that are bent or visibly deformed (“bent members”) shall be replaced, and their respective connection bolts (if applicable) shall be replaced in accordance to methods specified in this provision. For welded bent members, replacement members shall be welded in accordance with the *Standard Specifications*, AWS, and AASHTO requirements, except as noted below. Locations of bent members shown on the plans are given for the convenience of the contractor. The Engineer shall make the final determination as to which members shall be replaced. Any additional bent members, not indicated in the plans, shall be replaced at no additional cost to the Department.

A bent member shall be one which exhibits a visual kink, local or general damage, or deformation of over ½” within any 1ft of the member. A metal straight edge should be placed against the member to measure deformations.

When replacing bent members, the existing member and connection (bolts or welds) shall be removed in such a way to prevent damage to the existing structure. All removal and replacement operations shall be conducted to prevent any member or connector from falling into the water. Any damage caused by removal shall be repaired to the satisfaction of the Engineer at no additional cost to the Department. Members shall be removed and replaced in one operation. At no time shall any 2 members in a span be removed simultaneously. The maximum amount of time permitted to elapse between removal and replacement is 2 hours. Bent members shall not be replaced during times where the average wind speed is greater than 15 mph or gusts greater than 25 mph. If such weather conditions are encountered during repair operations, the member shall be immediately replaced and operations ceased. Bent member replacement shall be permitted to occur under live traffic.

The contractor shall verify the bent member length, member section size, bolt locations, bolt and bolt hole size (if applicable), weld size and length (if applicable) and installation access requirements prior to removing the damaged member.

The replacement member shall be the same member as that removed, except that if the exact member is not readily available, alternate member sections may be substituted provided that the section properties (including cross section shape, gross cross section area, moment of inertia about both axes, torsional constant, etc.) meet or exceed that of the original member and the weight of the proposed member is within 5% of that of the original member. The replacement member shall be connected in the same manner as the original member. Any deviations shall be submitted to the Engineer and working drawings prepared and submitted prior to any removal or installation.

Welded locations shall be ground smooth and cleaned prior to welding. All welds shall conform to the current ANSI/AASHTO/AWS “Bridge Welding Code”.

6. MEASUREMENT AND PAYMENT

Beam Repair will be measured and paid for at the contract unit bid price per pound for the actual weight of steel installed on the structure, including all bolts, nuts, washers, welds,

replacement members. Payment shall be full compensation for removal of existing steel items, fabrication and installation of new steel items, labor, tools, equipment, incidentals necessary to complete the repair work, access equipment, and any traffic control required. Steel replaced due to damaged caused by the contractor's activities, shall be considered incidental to the cost and no additional payment will be made.

BRIDGE JACKING

(SPECIAL)

1.0 DESCRIPTION

Bridge jacking at end bents and interior bents is to replace bearings, as described on the plans. This work shall consist of furnishing all engineering, labor, equipment, and materials necessary for construction and subsequent removal of jacking support system, including jacks, jack supports, shims and all necessary blocking. Included under this item shall be all work to raise, support the existing structure, and lower the structure once work requiring jacking has completed, as specified on the plans and as noted herein.

2.0 UTILITY COORDINATION

Utility owners with active utilities on the bridge shall be notified by the contractor of the jacking operation 30 days before the operation begins.

3.0 SCOPE OF WORK

Work for bridge jacking includes calculating existing and applied bridge loads, designing proper strength jacking scheme, evaluating stresses imposed on the bridge members, any strengthening measures required to support the bridge on the jacks, setting blocking and jacks, jacking bridge girders, mechanically locking jacks, and lowering bridge spans onto new bearing assemblies. Any bearing reactions or forces required to deflect girders part of structurally-continuous span units provided on the plans are provided for the convenience of the contractor and shall not relieve the contractor of the responsibility to determine jacking loads. The contractor shall have no claim whatsoever against the Department of Transportation or AECOM regarding the loads, reactions, and/or beam deflection forces listed on the plans.

Submit calculations, working drawings, and jacking procedure to the Engineer for review and approval prior to the start of work. Calculations and jacking procedure shall account for all loads expected while bridge is jacked or temporarily supported, including live and construction loads. Calculations and working drawings shall specify imposed loads due to various heights of jacking. Working drawings and all calculations (for determination of all applied loads, for design of the jacking system, to evaluate stresses imposed on the bridge members, any strengthening elements required, and any other necessary calculations) for the required jacking system shall be sealed by an engineer licensed in the State of North Carolina.

Prior to bridge jacking, complete any strengthening measures required to support the bridge on the jacks. While in the raised condition, follow bridge plans for bearing replacement and any other work that may be required. After all repairs requiring bridge jacking are completed, lower the bridge onto the bearing assemblies. Complete repair work, as needed.

Bridge jacking will be designated as one of two jacking arrangements, as follows:

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Type I

Type I Bridge Jacking shall be applicable for jacking at individual beam or bearing locations. On a particular bridge bent or end bent, there might be more than one Type I Bridge Jacking.

When jacking individual beam or bearing locations, all adjacent bearings of beams not being jacked may be loosened to decrease the resistance of the deck slab during jacking. The maximum differential between adjacent beams that are being jacked is $1/8"$. Should the jacking of an individual beam require the jacking of adjacent beams to reduce stresses or damage in the bridge, the jacking of the individual beam and adjacent beams shall be considered one Type I Bridge Jacking. All bearings loosened shall be tightened back after repair operations are completed and the jacks and blocking have been removed.

Type II

Type II Bridge Jacking shall be applicable for jacking an entire span end (i.e., all beams at one time) on a bent or end bent. At a bent or end bent, all beams shall be jacked a uniform amount. Between adjacent beams in a bearing line, the maximum difference in jacking height shall not exceed $1/32"$. Between all bearings in a line, the maximum difference in jacking height shall not exceed $1/8"$. Electronic monitoring shall be employed to measure the jacking heights.

Type I Bridge Jacking shall not be permitted. All jacking operations shall be Type II.

4.0 BRIDGE JACKING REQUIREMENTS

Bridge jacking shall be performed, as required on plans and by other Special Provisions as noted, in such a way as to maintain at least one vehicular traffic lane open on the bridge at all times, with the exception of the time during which the bridge is being raised or lowered. Limit complete closures during raising and lowering operations to a maximum duration of 15 minutes. Coordinate the closure with the Engineer a minimum of 2 weeks prior to the work. If the entire raising or lowering process cannot be achieved in 15 minutes, the jacking sequence must be paused, and the jacks be locked off or the structure supported off the jacks. Traffic shall then be allowed to pass. A subsequent 15 minute closure can then begin.

The contractor shall close the bridge to all public vehicular and pedestrian traffic during the jacking operations at each end bent or bent location. Once the bridge has been raised, the jacks locked off, and the stability of the structure verified, one lane of traffic may resume. Prior to lowering the bridge, vehicular traffic access shall be temporary closed. After the bridge has been lowered, vehicular traffic may resume. The contractor shall make all provision necessary for the temporary closure, and shall be responsible for all advance warning notices to the public of the closure, as directed by the Engineer or Department of Transportation representative, and for following all requirements of a temporary closure as dictated in the Standard Specifications. All costs associated with the

closure shall be considered incidental to the cost of Bridge Jacking.

All jacking operations shall be Type II. At each bent or end bent, jacking heights shall be kept to a minimum. If jacking heights exceed 1/4in at an end bent, shim plates shall be installed on the approach to create a smooth riding transition from approach to the bridge. Such plates shall be positively anchored to the approach and be detailed in working drawings.

Jacking heights shall not exceed 1/2in at any bent or end bent without approval by the Engineer. Jacking operations, including jacking height, shall be within the range detailed in the working drawings and calculations. Deviances from the calculations, including, but not limited to, range of jacking, load patterns, jacking support locations, and other aspects as determined by the engineer, shall not be permitted without specific approval by the Engineer and may require re-submittal of working drawings and calculations.

Control jacking with displacement controlled power operated hydraulic pumps and a single comprehensive computerized control system. Continually measure the pressure in each hydraulic line during operation. Include hydraulic pump, hydraulic circuit, power source, jacking control system, electrical circuit, lifting rate, lowering rate, and jacking falsework details in the jacking plan submittal. Hydraulic circuit information shall include pressure and flow requirements required for each jack to achieve the desired stroke, gauges for measuring pressure, hose configuration, locking mechanisms, valves, and manifolds. Use a hydraulic circuit capable of applying different loads to interior and exterior girders while lifting the girders an equal stroke. Include copies of equipment calibrations with the jacking plan and perform operations prior to the calibration expiration.

Design rigid jacking falsework to prevent deflections during jacking operations.

Shim or block the superstructure to prevent superstructure displacement in the event of a jacking system failure.

Use displacement control during lifting and lowering operations. Measure movements to the nearest 1/32 of an inch. Ensure all jacks reach their target lift height at the same time.

Maintain an electronic history of the jacking operation that includes load, displacement, and hydraulic pressure as a function of time for each jack. Submit the history to the Engineer following the completion of the bearing replacement at each bent.

Use jacks that are rated at 1.5 times the calculated service lifting load.

Care shall be taken to prevent damage to the existing structure during jacking operations. The jacking falsework shall be designed to prevent damage to the cap. Any damage caused to the existing structure shall be repaired to the satisfaction of the Engineer.

5.0 BASIS OF PAYMENT

Bridge Jacking (Type II) will be measured per each bearing location and will be paid for at the contract lump sum price bid for “Design and Construction of Bridge #50”, and shall include the full set-up to complete Type II Bridge Jacking as shown in the contract plans. This will be full compensation for designing proper strength jacking scheme (calculations, working drawings, and jacking procedure), all materials, equipment, tools, labor, and incidentals necessary to complete the work of this scope, including any jacking frames, jacking plates, and concrete repair required due to jacking operations.

CONCRETE FOR DECK REPAIR

(12-18-12)

1. DESCRIPTION

This provision addresses the material requirements of high early strength structural concrete to be used for reconstruction of deck slab, end bent diaphragms, portions of barrier rail to be reconstructed, approach slabs, and barrier on approach slabs, as noted in the plans. The pay item quantity for Concrete for Deck Repair shall be only that for the repair and replacement of the deck and end diaphragm. Concrete for Deck Repair used in the construction of barrier rail, approach slabs, and barrier on approach slab shall be considered incidental to the respective pay items.

2. MATERIALS

Furnish Department approved pre-packaged concrete or bulk concrete materials in a mix proportioned to satisfy provisions for Class AA Concrete detailed in Section 1000-4 of the *Standard Specifications* or as otherwise noted in these provisions. Concrete mix shall meet the following requirements:

Physical Property	Threshold Limitation	Test Method
Compressive Strength (at 3 hrs.)	4500 psi (min.)	ASTM C39/C109
Slump	4 in. (min.) 7 in. (max.)	AASHTO T119
Water to Cement Ratio	0.450 (max.)	N/A
Modulus of Elasticity (at 28	5200 ksi (max.)	ASTM C469
Coefficient of Thermal Expansion (at 28 days)	4.5 in./in./°F (min.) 5.5 in./in./°F (max.)	AASHTO T336
Concrete Setting Times		ASTM C191
Initial Final	30 min. (max.) 40 min. (max)	

Concrete shall be capable of placement on existing concrete substrate surfaces within the

following temperature limitations:

40⁰ F (min.)

100⁰ F (max.)

Measurement for determination of concrete material compositions shall be in accordance with Section 1000-8 of the *Standard Specifications*.

Submit pre-packaged concrete mix contents or concrete mix design, including laboratory compressive strength data, for a minimum of six 4-inch by 8-inch cylinders at an age of 3 hours and 1 day to the Engineer for review. Include test results for the slump and air content of the laboratory mix. Perform tests in accordance with AASHTO T119 and T152

Provide aggregates that are free from ice, frost and frozen particles when introduced into the mixer.

For equipment, proportioning and mixing of concrete compositions, see Section 1000-12 of the *Standard Specifications* and the Special Provision entitled "Volumetric Mixer". Prior to beginning any work, obtain approval for all equipment to be used for joint area preparation, mixing, placing, finishing, and curing the deck repair concrete.

3. MEASUREMENT AND PAYMENT

Concrete for Deck Repair will be measured per cubic yard and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" for the estimated cubic yards of concrete to be incorporated into the completed and accepted structure. Overruns will not be compensated separately. This price and payment will be full compensation for furnishing the required amount of material to complete the deck repair.

CONCRETE REPAIRS

(SPECIAL)

1.0 GENERAL

Work includes removal of concrete in spalled, delaminated and/or cracked areas of the existing structure in reasonably close conformity with the lines, depth, and details shown on the plans, described herein and as established by the Engineer. This work also includes straightening, cleaning, and replacement of reinforcing steel, doweling new reinforcing steel, removing all loose materials, removing and disposing of debris, formwork, applying repair material, and protecting adjacent areas of the bridge and environment from material leakage. The repair material shall be one of the below described materials unless otherwise noted in the plans or provisions.

The location and extent of repairs shown on the plans and described herein are general in nature. The Engineer determines the extent of removal in the field based on an evaluation of the condition of the exposed surfaces. The Contractor shall coordinate removal operations with the Engineer. At a section, no more than 30% of a round or square column or 30% of the bearing area under a beam shall be removed without a temporary support system and approval from the Engineer.

Prepare for horizontal, vertical, and overhead concrete repairs. Notify the Engineer of the materials and methods to be utilized for each repair type in writing. Repair areas shall be formed unless otherwise approved by the Engineer. Overhead repairs shall be formed and material shall be pumped into place.

Repair, to the Engineer's satisfaction, any portion of the structure that is damaged from construction operations. No extra payment will be provided for these repairs.

The work under this item shall conform to the applicable provisions of Section 402 and 420 of the *Standard Specifications* and as specified herein.

2.0 WORKING DRAWINGS

Prior to performing the repair, Contractor shall submit to the Engineer a working drawing of each discrete repair. Working drawings shall show repair location and dimensions; reinforcement sizes, locations, and splice lengths; discrete galvanic anode locations (for Bridge #51 only); and total repair pay item quantities. A plan for containment and disposal of removed concrete shall be provided. A photo of each repair area shall be submitted with the working drawing. The photo shall be taken following demolition and chipping but prior to the application of the repair material or placement of anodes and supplemental reinforcement. Do not perform the repair until the Engineer has approved the working drawing.

3.0 TEMPORARY WORKS

Prior to beginning any repair work, provide details for a sufficiently sized temporary work platform at each repair location. Design steel members to meet the requirements of the

American Institute of Steel Construction Manual, latest edition. Design timber members in accordance with the “National Design Specification for Stress-Grade Lumber and Its Fastenings” (latest edition) of the National Forest Products Association. Submit to the Engineer the platform design and plans for review and approval. The design and plans shall be sealed and signed by a North Carolina registered Professional Engineer. Do not install the platform until the design and plans are approved. Drilling holes in the structure for the purpose of attaching the platform is prohibited.

Contractor shall design all formwork required for the concrete repairs. On Bridge #51, the contractor may drill holes into the arch ribs and arch piers to install formwork, with the approval of the Engineer.

4.0 MATERIALS

Repair mortar, grout for dowels, and bonding agent shall be cementitious material with a resistivity less than 15,000 ohm-cm.

Conform to *Standard Specifications* section 1000-4 and requirements for Class A concrete. Submit mix design to the Engineer for approval.

Utilize discrete galvanic anodes (on Bridge #51 only), bonding agent, and repair mortar from the same manufacturer. Provide written verification from the manufacturer of the compatibility of the materials. Utilize materials that are approved by the NCDOT Materials and Tests Unit.

Reinforcing Steel that is required for the repairs shall conform with materials described in Section 425 of the *Standard Specifications*.

5.0 SUPPLEMENTAL REINFORCEMENT

Contractor shall place supplemental reinforcement where the original reinforcement has corroded with section loss.

After removal of rust and scale from all exposed reinforcing steel, the Engineer shall measure, excluding deformations, the minimum bar diameter (for round bars) or thickness (for square bars) using calipers. The Contractor shall place supplemental reinforcement if the Engineer determines that there is 20% or greater section loss in a single bar or 5% or greater section loss in the total reinforcement at a single section of the member.

Supplemental reinforcement shall be placed so that the steel area (A_s) multiplied by yield strength (f_y) of the remaining original steel plus A_s times f_y of the supplemental steel shall be greater than or equal to the A_s times f_y of the original reinforcement prior to corrosion and section loss. This is shown in the equation below.

Remaining Reinforcement after Corrosion	Supplemental Reinforcement	Original Reinforcement Prior to Corrosion
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$$A_s \cdot f_y + A_s \cdot f_y \geq A_s \cdot f_y$$

Supplemental reinforcement shall extend to the point at which there is zero section loss in the bar and then shall have a full development length beyond these limits on both sides.

6.0 REPAIR PROCEDURE

Complete the repairs using the following procedure.

- A. Mark off the area to be repaired using straight lines between corners. The marked boundaries for the repair area shall be a minimum of 2" outside the perimeter of the defective area. The marked area shall have 90 degree corners with the sides parallel or normal to reinforcement.
- B. Remove all concrete from within the marked perimeter to a near uniform depth. Commence the removal by saw cutting along the marked perimeter to a depth of 1". If existing rebar is encountered, chip out concrete around the rebar to leave a 1" minimum clear space between the rebar and the concrete substrate. Provide the opportunity for the Engineer to sound the remaining concrete within the repair area for delaminations and remove material until sound concrete is reached.
- C. Leave a roughened concrete surface within the cut perimeter with an amplitude of ¼".
- D. Thoroughly clean surfaces to be repaired and remove all loose materials. Remove grease, wax, salt, and oil contaminants by scrubbing with an industrial grade detergent or degreasing compound followed by a mechanical cleaning. Remove weak or deteriorated concrete to sound concrete by bush hammering, gritblasting, scarifying, waterblasting, or other approved methods. Remove dirt, dust, laitance and curing compounds by gritblasting, sanding, or etching with 15% hydrochloric acid. Acid etch only if approved by the Engineer for each location. Follow acid etching by scrubbing and flushing with copious amounts of clean water. Check the cleaning using moist pH paper. Water cleaning is complete when the paper reads 10 or higher.
- E. Sandblast clean rebar to remove rust and scale.
- F. Determine the amount of supplemental reinforcement required for the repair.
- G. Submit the working drawing and a photo of the repair area to the Engineer for approval.
- H. Place supplemental reinforcement, if required.

- I. Install discrete galvanic anodes in accordance with the special provision (Bridge #51 only).
- J. Apply low-resistivity cementitious bonding agent that is compatible with discrete galvanic anodes to all repair areas immediately prior to placing repair mortar.
- K. Form areas to establish the original neat lines of the member being repaired.
- L. Place the repair mortar in a single lift in accordance with the manufacturer's written instructions. Repairs with large surface area may be placed in multiple pours, but the thickness of the repair shall be a single pour. Reinforcement shall be fully developed on both sides of the construction joint.
- M. After applying the repair mortar, remove excessive material and provide a smooth, flush surface.
- N. Cure the repair in accordance with the manufacturer's instructions.

Contractor shall adhere to the following requirements.

- O. Chamfer all exposed corners of concrete with 1" chamfers.
- P. Concrete clear cover to reinforcement shall be 2" unless otherwise noted.
- Q. All rebar splices shall be class "C" tension lap splices in accordance with the current AASHTO LRFD code, unless otherwise noted. Contractor may substitute mechanical couplers instead of lap splices with the approval of the Engineer at no additional cost to the contract.
- R. Overhead repairs shall be formed and pumped into place.
- S. Apply repair mortar to damp surfaces only when approved. In such instances,
- T. remove all free water by air-blasting.
- U. Use aggregate that is washed, kiln-dried, and bagged

7.0 LIMITATIONS OF OPERATION

Removal of unsound concrete and installation of repair shall be done in such a way to prevent debris from falling into the water.

Concrete Repairs shall not be performed over existing (previous) epoxy repairs (on Bridge #50), without first removing all epoxy back to original concrete. If, during surface preparation for a Concrete Repair, unsound concrete is removed up beyond to the limits of a previous epoxy or other repair, the previous repair shall be removed to a minimum of 3 inches beyond the point where sound original concrete is found. In no cases shall a previous repair be removed to the point where any dimension is less than 1ft. If removal of previous repairs results in less than 1ft of the existing repair remaining, the entire existing

repair shall be removed and repaired as described herein. The quantity shall be adjusted on the plans.

8.0 MEASUREMENT AND PAYMENT

Concrete Repairs for Bridge 50 and *Concrete Repairs for Bridge 51* will be measured and paid for at the contract unit price bid per cubic foot for actual material placed under this provision.

For Bridge #50, this payment will be full compensation for removal, containment and disposal off-site of unsound concrete including the cost of materials, reinforcing steel, labor, tools, equipment and incidentals necessary to complete the repair work on Bridge #50. Payment will also include the cost of sandblasting, surface cleaning and preparation, cleaning of reinforcing steel. For Bridge #50 only, fabrication and placement of new reinforcing steel, in accordance with the Supplemental Reinforcing section contained in this provision, will be considered incidental to the work for *Concrete Repairs for Bridge 50* and no separate payment will be made.

For Bridge #51, this payment will be full compensation for removal, containment and disposal off-site of unsound concrete including the cost of materials, labor, tools, equipment and incidentals necessary to complete the repair work on Bridge #51. Payment will also include the cost of sandblasting, surface cleaning and preparation, and cleaning of reinforcing steel. For Bridge #51 only, the cost of *Repair Reinforcing Steel* material and placement will be paid for separately. For Bridge #51, the cost for *Discrete Anodes* shall be paid for under separate Special Provision.

For both bridges, depth will be measured from the original outside concrete face. The Contractor and Engineer will measure quantities after removal of unsound concrete and before application of repair material. For both bridges, payment will also include the cost of temporary work platform, testing of the soundness of the exposed concrete surface, furnishing and installation of repair mortar material, curing and sampling of concrete, and protection/cleaning of adjacent areas from splatter or leakage.

Repair Reinforcing Steel will be measured and paid for at the contract unit bid price per pound for actual reinforcing steel fabricated and placed, in accordance with the Supplemental Reinforcing section contained in this provision and Section 425 of the *Standard Specifications*, on Bridge #51 only.

Payment will be made under:

Pay Item	Pay Unit
Concrete Repairs for Bridge 50	Cubic Feet
Concrete Repairs for Bridge 51	Cubic Feet
Repair Reinforcing Steel	Pounds

DISC BEARINGS

(2-3-14)

1.0 GENERAL

This item consists of removal of existing bearings, furnishing, fabrication and installation of proposed disc bearings in accordance with AASHTO LRFD Bridge Design Specifications, the Standard Specifications, the recommendations of the manufacturer, the details shown on the plans and as specified herein. Disc Bearings consist of a polyether urethane structural element (elastomeric disc) confined by upper and lower steel bearing plates. Equip disc bearings with a shear restriction mechanism (shear pin) to prevent movement of the disc. Supply disc bearings as fixed bearings and guided expansion bearings as designated by the Contract Documents.

Fixed disc bearings allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings consist of a steel sole plate, an elastomeric disc, a shear pin, a steel upper bearing plate, a steel lower bearing plate, a steel masonry plate, a preformed bearing pad, anchor bolts, nuts and washers.

Guided expansion disc bearings allow rotation and only longitudinal movement in the bearing plane. Guided expansion disc bearings consist of a steel sole plate, a polished stainless steel sheet welded to the bottom of the sole plate within the sliding region, a steel upper bearing plate, a layer of virgin polytetrafluoroethylene (PTFE) material bonded to the top and sides of the upper plate within the sliding regions, guide bars welded to the bottom of the sole plate surrounding the sliding region to restrict transverse movement, polished stainless steel sheets welded to the sides of the guide bars within the sliding regions, an elastomeric disc, a shear pin, a steel lower bearing plate, a steel masonry plate, a preformed bearing pad, anchor bolts, nuts, washers, pipe sleeves, a closure plate, grout and various sizes of standard pipe, and any other necessary material as detailed on the plans. Align the stainless steel sheet on the bottom of the sole plate with the PTFE material on the top of the upper bearing plate. Align the PTFE material on the sides of the upper bearing plate with the stainless steel sheets on the sides of the guide bars.

For bearing replacement procedures and considerations, refer to the applicable portions of this provision.

2.0 MATERIALS

Use disc bearings produced by the same manufacturer for all bearing replacements on the bridge.

Use AASHTO M270 Grade 50W (345W) or Grade 50 (345) for all steel plates except the stainless steel sheets in the disc bearings. Clean, coat, and seal the plates in the disc bearing assemblies except for the areas with special facings and the areas that come in contact with the elastomer disc, in accordance with the Special Provision for "Thermal Sprayed Coatings (Metallization)". The surfaces shall be coated to a thickness of 8 mils minimum on all external parts. Repair surfaces that are abraded or damaged after the

application of metallizing in accordance with the Special Provision for “Thermal Sprayed Coatings (Metallization)”.

Provide anchor bolt nuts that will thread over existing anchor bolts (if and where existing anchor bolts retained) and anchor bolts and nuts (if and where new anchor bolts are installed) in accordance with the *Standard Specifications*.

When the maximum plan dimension of the sheet is 12" or less, provide a stainless steel sheet in expansion disc bearings that is at least 16 gage or 1/16". When the maximum plan dimension is greater than 12", provide a stainless steel sheet that is at least 11 gage or 1/8". Ensure that all stainless steel sheets are in conformance with ASTM A240/A167 Type 304 and polished to a minimum #8 mirror surface finish.

Blast clean the surfaces of the steel sole plate and the steel guide bars that will be attached to the stainless steel sheets to a near white condition in accordance with the *Standard Specifications*. Position and clamp the back of the stainless steel sheets in contact with the steel sole plate and the steel guide bars. Apply the stainless steel sheets to the blast cleaned surfaces of the steel sole plate and the steel guide bars as soon as possible after blasting and before any visible oxidation of the blast cleaned surfaces occurs. Weld the stainless steel sheets continuously around the perimeter using a tungsten inert gas, wire-fed welder.

For the PTFE sheets bonded to the top and side sliding surfaces of the steel upper bearing plate, used as mating surfaces for the stainless steel sheets attached to the steel sole plate and the guide bars, provide an unfilled virgin PTFE sheet (recessed) or a glass-fiber filled PTFE sheet, resulting from skiving billets formed under hydraulic pressure and heat. Provide resin that conforms to the requirements of ASTM D4894 or D4895.

To bond the PTFE sheets and the steel upper bearing plate, use heat cured high temperature epoxy capable of withstanding temperature of –320°F to 500°F.

Weld the guide bars in expansion bearings to the bottom of the sole plate. Alternatively, integrate the guide bars and sole plate from the same piece of steel, ensuring that the required dimensions are provided. Provide 1/16" clearances between the stainless steel sheets attached to the side sliding surfaces of the guide bars and the PTFE sheet attached to the side sliding surface of the steel upper bearing plate.

Mold the polyether urethane structural element (elastomeric disc) from a polyether urethane compound. The top and bottom surfaces of the disc shall be roughened. Ensure that the physical properties of the polyether urethane conform to the following requirements:

Physical Property	ASTM Test Method	Requirements	
		Min.	Max.
Hardness, Type D Durometer	D2240	60	64

Tensile Stress psi At 100% elongation At 200% elongation	D412	2000 3700	-----
Tensile Strength psi	D412	5000	-----
Ultimate Elongation %	D412	220	-----
Compression Set % 22 hrs. at 158°F	D395	-----	40

3.0 DESIGN

Design the disc bearings for the loads and movements shown on the contract plans. Design bearings to make use of the existing anchor bolts and to match overall bearing height. Use masonry plate dimensions as shown on plans, with the exception of the thickness, which shall be designed by the manufacturer. Prior to bearing fabrication, each existing bearing shall be field measured for total height (top of cap to underside of bottom flange) and anchor bolt size and locations, including absolute dimensions of the bolts from the centerline of the beam and bearing and the projection of the anchor bolt from the top of cap. The elevation of top of each existing bearing's sole plate shall be surveyed and documented to the nearest 0.01'.

The masonry plate shall be designed and detailed to fit the existing anchor bolts with the tolerances between hole and bolt as shown on the plans. However, at the contractor's option, larger holes may be used and oversize washers used to allow for the same plate used between bearings at a bent if existing anchor bolt patterns between bearing at a bent do not allow for the use of the same plate at each bearing. This option shall not be used to combine masonry plate designations between bents. If this option is selected, the contractor shall submit all working drawings and design calculations for the masonry plate, washers, and welds. The design shall be signed and sealed by a Professional Engineer licensed in the State of North Carolina. Masonry plates shall be sized to provide a minimum of 2 1/8" edge distance from any hole to the nearest edge. If used, oversize washers shall be 1/2" steel plate, AASHTO M270 Grade 50W, shall be designed to provide adequate overlap and shall be welded to the masonry plate all around with a 1/4" fillet weld.

The proposed bearing height shall match the height of the existing bearings. The heights indicated on the plans are based on the best information available for the existing structure. Actual bearings fabricated shall match the field-measured bearing heights such that the elevation of the top-of-bottom-flange at the bearing shall match the value as-surveyed prior to bearing replacement within the following tolerances:

- At any bearing location, the change between existing and final top-of-sole plate elevations shall not exceed 0.06'.
- For any two adjacent bearings, the algebraic differences between the changes of existing to final top-of-sole plate elevations shall be between -0.03' and 0.03'.

- Between exterior bearings, the algebraic differences between the changes of existing to final top-of-sole plate elevations shall be between -0.03' and 0.03'.

The bearing installation shall be performed such that once the beams are lowered onto the new bearings, the final elevations satisfy the above tolerances. The Engineer shall verify the final top-of-sole plate elevations for each bearing prior to any field welding or removal of the jacking system.

Accommodate the differences (if any) of required thickness into the masonry plate. Shim plates shall not be used.

The sole plate and upper bearing plate (for fixed bearings) or the sole plate and guide bars (for expansion bearings) shall be combined or welded together prior to installation. The lower bearing plate and masonry plate shall be separate and not welded prior to installation. The sole plate, sliding plates and guide bars (if expansion bearing), upper bearing plate, shear-resisting mechanism, disc, and lower bearing plate shall be fastened together during shipping and storage. The masonry plate shall be shipped and stored separately. Ensure access and removal of anchor bolt nut is not in conflict with the upper bearing plate, guide bars or sole plate.

Each proposed anchor bolt nut shall be field-verified to thread over the existing anchor bolts prior to jacking. Once that determination has been made, that individual anchor bolt nut shall be marked for the anchor bolt for which it was tested and set aside for final installation.

When designing the bearings, use the following allowable bearing stresses:

- On polyether urethane structural element: 5000 psi
- On PTFE Sliding Surface, filled or unfilled PTFE (recessed): 3500 psi

Submit eight sets of shop drawings and one set of design calculations for review, comments and acceptance. Have a North Carolina Registered Professional Engineer check and seal the shop drawings and design calculations.

After the Engineer reviews the drawings and, if necessary, corrections are made, submit one 22" x 34" reproducible set of the working drawings.

4.0 SAMPLING AND TESTING

A. Sampling

The manufacturer is responsible for randomly selecting and testing sample bearings from completed lots of bearings. The manufacturer is also responsible for certifying that the completed bearings and their components have been tested and are in compliance with the requirements of this Special Provision. The manufacturer shall furnish the results of the tests to the Materials and Tests Engineer prior to installation.

B. Testing

1. Proof Load Test

Load a test bearing to 150% of the bearing's rated design capacity and simultaneously subject it to a rotational range of 0.02 radians (1.146°) for a period of 1 hour.

Have the bearing visually examined both during the test and upon disassembly after the test. Any resultant visual defects, such as extruded or deformed elastomer or PTFE, damaged seals or rings, or cracked steel is cause for rejection.

Keep continuous and uniform contact between the polyether urethane element and the bearing plates and between the stainless steel sheets and the PTFE sheets (for expansion bearings) for the duration of the test. Any observed lift-off or separation is cause for rejection.

2. Sliding Coefficient of Friction

For all guided expansion bearings, measure the sliding coefficient of friction at the bearing's design capacity in accordance with the test method described below, and on the fifth and fiftieth cycles, at a sliding speed of 1 in/min.

Calculate the sliding coefficient of friction as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's vertical design capacity.

The test results are evaluated as follows:

- A maximum measured sliding coefficient of friction of 3%.
- A visual examination both during and after the test. Any resultant visual defects, such as bond failure, physical destruction, cold flow of PTFE to the point of debonding, or damaged components is cause for rejection of the lot.

Using undamaged test bearings in the work is permitted.

3. Test Method

The test method and equipment shall meet the following requirements:

- a. Arrange the test to determine the coefficient of friction on the first movement of the manufactured bearing.
- b. Clean the bearing surface prior to testing.
- c. Conduct the test at maximum working stress for the PTFE surface with the test load applied continuously for 12 hours prior to measuring friction.

- d. Determine the first movement static and dynamic coefficient of friction of the test bearing at a sliding speed of less than 1 in/min, not to exceed:
0.04 unfilled PTFE
0.08 filled PTFE
- e. Subject the bearing specimen to 100 movements of at least 1 inch of relative movement and, if the test facility permits, the full design movement at a speed of less than 1 ft/min. Following this test determine the static and kinetic coefficient of friction again. The specimen is considered a failure if it exceeds the values measured in (d) above or if it shows any signs of bond failure or other defects.

Bearings represented by test specimens passing the above requirements are approved for use in the structure subject to on-site inspection for visible defects.

5.0 REMOVAL OF EXISTING BEARINGS

The existing bearings shall be removed in such a way as to not damage the existing bridge, including anchor bolts, cap, beams, and crossframes. Bearings shall be removed and replaced one bent at a time. The end bent bearings shall be replaced first in accordance with the general scope of work prior to ICT #1. Bent 3 bearings shall be replaced prior to bents 1, 2, 4, and 5. Follow the following removal procedure:

1. Once the bridge is raised and the jacks locked off or the beams blocked in accordance with the Bridge Jacking Special Provision and the plans, grind or cut the sole plate to bottom flange weld.
2. Grind or cut the weld from the existing pot bearing cylinder to the existing masonry plate.
3. Slide out the existing pot bearing cylinder, piston, sliding plates, guide bars, and sole plate.
4. Back the anchor bolt nuts completely off. Raise the masonry plate over the anchor bolts and remove. The extension of the anchor bolt may be partially cut, with specific approval from the Engineer, to allow for the masonry plate to slip past the girder. Any anchor bolt cuts shall be detailed in the working drawings and shall only be made if it can be demonstrated that the new anchor bolt nuts shall fully engage the bolt.
5. Remove any pads below the existing bearing. The Engineer shall inspect the top surface of the cap once a bearing has been removed.

6.0 INSTALLATION OF PROPOSED BEARINGS

Store disc bearings delivered to the bridge site upright and under cover on a platform above the ground surface. Protect the bearings from injury at all times and, before placing the

bearings, dry and clean all dirt, oil, grease or other foreign substances from the bearing. Do not disassemble the bearings during installation, except at the manufacturer's direction. Lift bearing assemblies by their bottom surfaces only, unless lifting brackets that have been designed and approved by the manufacturer are used. Ensure that the polyether urethane disc is not exposed to direct flame or sparks. Place the bearings in accordance with the recommendations of the manufacturer, Contract Drawings, and as directed by the Engineer. If there is any discrepancy between the recommendations of the manufacturer, Special Provisions, and Contract Drawings, the Engineer is the sole judge in reconciling any such discrepancy.

Do not install any bearing before the Engineer approves it.

To accommodate installation around existing anchor bolts within the maximum jacking height allowed, follow the following installation procedure:

1. Place the masonry plate and preformed pad over the anchor bolts onto the cap. Provide preformed bearing pads under the masonry plates in accordance with Article 1079-1 of the Standard Specifications.
2. Slide the lower bearing plate, shear-resisting mechanism, disc, upper bearing plate, guide bars and sliding pad/plate (for expansion bearings), and sole plate under the girder. The bearing shall be positioned under the girder in accordance with the plans considering the temperature at the time of installation.
3. Once all bearings in a line are placed, lower the beams onto the bearings in accordance with the Bridge Jacking Special Provision.
4. Survey the top of sole plate and check for acceptable tolerances as specified above. If bearings are not within tolerance, masonry plates shall be rejected and re-installed, subject to approval by the Engineer.
5. Once tolerances are verified and the bearing heights accepted, field-weld the lower bearing plate to the masonry plate, and the sole plate to the girder.
6. Install anchor bolt nuts, as checked and chosen early, and washers in accordance with the *Standard Specifications* and as specified elsewhere in this provision.

Any movement of the structure or inability to align the fixed bearing with the existing bearing stiffener at any beam (within a 3/4in tolerance) shall be reported to the Engineer prior to installation.

7.0 BASIS OF PAYMENT

Payment for all disc bearings will be at the contract lump sum price bid for "Design and Construction of Bridge 50" which includes full compensation for removal of existing bearings, furnishing all disc bearings, labor, materials, tools, equipment, testing and incidentals required to complete the work in accordance with the *Standard Specifications*, this Special Provision, the manufacturer's requirements and as directed by the Engineer.

EPOXY MORTAR REPAIRS

(12-5-12)

1.0 GENERAL

Use epoxy mortar repairs for repairs that are shallow in nature and do not encounter primary longitudinal reinforcing steel. Feather-edged patching is not allowed with this repair type. The adjacent concrete perimeter shall be sawed at least $\frac{1}{4}$ inch to $\frac{1}{2}$ inch deep and any remaining concrete chipped away to provide a vertical interface between the epoxy mortar and concrete.

The work under this item shall conform to the applicable provisions of Section 420 and 1081 of the Standard Specifications and as specified herein.

2.0 MATERIAL PROPERTIES

Material shall be an NCDOT Materials and Tests Unit Approved Type 1 or Type 2 Epoxy. For vertical and overhead repairs, use a product specifically appropriate for such application as stated in the manufacturer's literature. Use a two-component paste epoxy bonding agent for the epoxy mortar conforming to the following requirements:

Density, lbs/gal	10.5
Specific Gravity	1.3
Minimum Application Temperature, °F	50
Application Temperature Range, °F	60 to 105
Shelf Life	1 year (min.)

	@ 60°F	@ 85°F	@ 105°F
Potlife, hr., 1 gallon	2½	1	½
Open Time ¹ , minimum: hr.	4	1¾	¾
Non-sag Thickness, inches (ASTM D2730)	1	¾	½
Initial Cure ² , days (AASHTO T237)	10	6	3
Cure Time ³ , days (ASTM D695)	20	10	7

Typical Mechanical Properties ⁴	
Tensile Strength, psi Elongation at Break (ASTM D638)	1,500 4%
Compressive Yield Strength, psi Compressive Modulus, psi (ASTM D695)	8,000 4.0 x 10 ⁵
Heat Deflection Temperature ⁵ , °F (ASTM D648)	105
Slant Shear Strength, psi Damp to Damp Concrete (AASHTO T237)	5,000 100% Concrete Failure

1. From start of mixing to completion of repair
2. 5,000 psi minimum
3. Isothermal cure to eliminate effect of exotherm
4. Cure schedule 7 days @ 77°F, test temperature 77°F
5. 128°F after 28 day cure

3.0 SURFACE PREPARATION

Prior to the application of epoxy mortar, thoroughly clean surfaces to be repaired and remove all loose materials. Remove grease, wax, and oil contaminants by scrubbing with an industrial grade detergent or degreasing compound followed by a mechanical cleaning. Remove weak or deteriorated concrete to sound concrete by bush hammering, gritblasting, scarifying, waterblasting, or other approved methods. Remove dirt, dust, laitance and curing compounds by gritblasting, sanding, or etching with 15% hydrochloric acid.

Acid etch only if approved by the Engineer. Follow acid etching by scrubbing and flushing with copious amounts of clean water. Check the cleaning using moist pH paper. Water cleaning is complete when the paper reads 10 or higher.

Areas identified on the plans for Epoxy Mortar Repairs are based on the best available information. If, during surface preparation, main reinforcing is exposed or the depth of loose or delaminated concrete exceeds 1 inch, Epoxy Mortar Repair shall not be used. The Engineer shall be notified, and, at the direction of the Engineer, such areas shall be repaired as a Concrete Repair. The repair quantity adjustment shall be noted on the plans. Epoxy Mortar Repairs to be performed over existing (previous) epoxy repair shall be performed with care. Surface preparation shall thoroughly verify the soundness of the existing epoxy, and the bond strength between new and old epoxy shall be verified prior to the repair, in accordance with the Special Provision for the Preparation for Rehabilitation Work for

Bridge #50. If an area identified on the plans for Epoxy Mortar Repair encroaches on existing unsound epoxy or existing epoxy that does not create sufficient bond, the Engineer shall be notified. As directed by the Engineer, such an area will be repaired as a Concrete Repair and the Engineer shall note the change in quantity in the plans.

Follow all mechanical cleaning with vacuum cleaning.

4.0 APPLICATION

When surface preparation is completed, apply epoxy mortar to the areas specified in the contract plans and established by the Engineer. Repair deep surface irregularities such as severe spalling with a 1:1 sand-epoxy mix. Use graded silica sand that is washed, kiln-dried, and bagged. Repair shallow surface irregularities with the epoxy bonding agent. The finishing of those areas receiving the sand-epoxy mix with the epoxy bonding agent is permitted.

Apply epoxy mortar to damp surfaces only when approved. In such instances, remove all free water by air-blasting.

After applying the epoxy mortar, remove excessive material and provide a smooth, flush surface. Remove the epoxy material in accordance with the supplier's instructions.

5.0 MEASUREMENT AND PAYMENT

Epoxy Mortar Repairs for Bridge 50 will be measured and paid for at the contract unit price bid per square foot for actual epoxy mortar, placed in accordance with this provision, on Bridge #50.

Epoxy Mortar Repairs for Bridge 51 will be measured and paid for at the contract unit price bid per square foot for actual epoxy mortar, placed in accordance with this provision, on Bridge #51.

For both bridges, such payment will be full compensation for furnishing all material, labor, tools and equipment necessary for performing this work complete in place and accepted.

For both bridges, the Pay Items shall be measured as follows: For repairs of edge or corner areas, the surface to be measured for payment will be the largest surface and the other surfaces will not be measured. A single discrete location of repair shall be considered to have a minimum area of 0.5 square feet. For larger areas, the repair quantity shall be the actual measured surface area, as measured by the Engineer.

Payment will be made under:

Pay Item	Pay Unit
Epoxy Mortar Repairs for Bridge 50	Square Feet
Epoxy Mortar Repairs for Bridge 51	Square Feet

EPOXY RESIN INJECTION

(SPECIAL)

1.0 GENERAL

For repairing cracks, an approved applicator is required to perform the epoxy resin injection. Make certain the supervisor and the workmen have completed an instruction program in the methods of restoring concrete structures utilizing the epoxy injection process and have a record of satisfactory performance on similar projects.

The applicator furnishes all materials, tools, equipment, appliances, labor and supervision required when repairing cracks with the injection of an epoxy resin adhesive.

The work under this item shall conform to the applicable provisions of Section 1081 of the Standard Specifications and as specified herein.

2.0 SCOPE OF WORK

Using Epoxy Resin Injection, repair all cracks as directed by the Engineer or as indicated on the plans. For Bridge 51, this includes cracks in the arch ribs, arch rib struts, arch piers, end bents, interior bents and underside of deck.

For Bridge 50, this includes cracks in the interior piers, end bents, backwalls, and underside of deck.

Make the underwater repairs when water surface elevation is low and the water is still. For underwater repairs, use manufacturer recommended materials.

Repair any crack, void, honeycomb or spall area unsuitable for repair by injection with other specified repair methodologies in accordance with the plans and special provisions.

3.0 COOPERATION

Cooperate and coordinate with the Technical Representative of the epoxy resin manufacturer for satisfactory performance of the work.

Have the Technical Representative present when the job begins and until the Engineer is assured that his service is no longer needed.

The expense of having this representative on the job is the Contractor's responsibility and no direct payment will be made for this expense by the Department.

4.0 TESTING

The North Carolina Department of Transportation Materials and Tests Unit will obtain cores from the repaired concrete for testing. If the failure plane is located at the repaired crack, a minimum compressive strength of 3000 psi is required of these cores.

5.0 MATERIAL PROPERTIES

Provide a two-component structural epoxy adhesive for injection into cracks or other voids. Provide modified epoxy resin (Component “A”) that conforms to the following requirements:

	Test Method	Specification Requirements
Viscosity @ $40 \pm 3^{\circ}\text{F}$, cps	Brookfield RVT Spindle No. 4 @ 20 rpm	6000 - 8000
Viscosity @ $77 \pm 3^{\circ}\text{F}$, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	400 - 700
Epoxide Equivalent Weight	ASTM D1652	152 - 168
Ash Content, %	ASTM D482	1 max.

Provide the amine curing agent (Component “B”) used with the epoxy resin that meets the following requirements:

	Test Method	Specification Requirements
Viscosity @ $40 \pm 3^{\circ}\text{F}$, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	700 - 1400
Viscosity @ $77 \pm 3^{\circ}\text{F}$, cps	Brookfield RVT Spindle No. 2 @ 20 rpm	105 - 240
Amine Value, mg KOH/g	ASTM D664*	490 - 560
Ash Content, %	ASTM D482	1 max.
* Method modified to use perchloric acid in acetic acid.		

Certify that the Uncured Adhesive, when mixed in the mix ratio that the material supplier specifies, has the following properties:

Pot Life (60 gram mass)

@ $77 \pm 3^{\circ}\text{F}$ - 15 minutes minimum

@ $100 \pm 3^{\circ}\text{F}$ - 5 minutes minimum

Certify that the Adhesive, when cured for 7 days at $77 \pm 3^{\circ}\text{F}$ unless otherwise specified, has the following properties:

	Test Method	Specification Requirements
Ultimate Tensile Strength	ASTM D638	7000 psi (min.)
Tensile Elongation at Break	ASTM D638	4% max.
Flexural Strength	ASTM D790	10,000 psi (min.)
Flexural Modulus	ASTM D790	3.5×10^5 psi
Compressive Yield Strength	ASTM D695	11,000 psi (min.)
Compressive Modulus	ASTM D695	$2.0 - 3.5 \times 10^5$ psi
Heat Deflection Temperature Cured 28 days @ $77 \pm 3^\circ\text{F}$	ASTM D648*	125°F min. 135°F min.
Slant Shear Strength, 5000 psi (34.5 MPa) compressive strength concrete Cured 3 days @ 40°F wet concrete Cured 7 days @ 40°F wet concrete Cured 1 day @ 77°F dry concrete	AASHTO T237	3500 psi (min.) 4000 psi (min.) 5000 psi (min.)
* Cure test specimens so that the peak exothermic temperature of the adhesive does not exceed 77°F.		

Use an epoxy bonding agent, as specified for epoxy mortar, as the surface seal (used to confine the epoxy resin during injection).

Material shall be on the NCDOT Approved Products List before use.

6.0 EQUIPMENT FOR INJECTION

Use portable positive displacement type pumps with interlock to provide positive ratio control of exact proportions of the two components at the nozzle to meter and mix the two injection adhesive components and inject the mixed adhesive into the crack. Use electric or air powered pumps that provide in-line metering and mixing.

Use injection equipment with automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 ± 5 psi and equipped with a manual pressure control override.

Use equipment capable of maintaining the volume ratio for the injection adhesive as prescribed by the manufacturer. A tolerance of $\pm 5\%$ by volume at any discharge pressure up to 200 psi is permitted.

Provide injection equipment with sensors on both the Component A and B reservoirs that automatically stop the machine when only one component is being pumped to the mixing head.

7.0 PREPARATION

The Engineer shall determine cracks to be repaired using this provision, and shall clearly denote on the existing concrete where the repair shall begin and end. Follow these steps prior to injecting the epoxy resin:

- A. Rout out cracks to remove all deteriorated and loose concrete aggregate. Where concrete surfaces adjacent to the crack are deteriorated, “V”-groove the crack until sound concrete is reached.
- B. Clean the crack area with a wire brush, high-pressure water jet, or sandblasting. When using water to clean out the crack, blow out the crack with oil-free, compressed air to accelerate drying, or allow enough time for natural drying to occur before injecting epoxy.
- C. Remove all dirt, dust, grease, oil, efflorescence and other foreign matter detrimental to the bond of the epoxy injection surface seal system from the surfaces adjacent to the cracks or other areas of application. Acids, mechanical grinders, and corrosives are not permitted.
- D. Provide entry ports along the crack at 8” intervals.
- E. Apply surface seal material to the face of the crack between the entry ports. For through cracks, apply surface seal to both faces.
- F. Allow enough time for the surface seal material to gain adequate strength before proceeding with the injection.

8.0 EPOXY INJECTION

Begin epoxy adhesive injection in vertical cracks at the lower entry port and continue until the epoxy adhesive appears at the next higher entry port adjacent to the entry port being pumped.

Begin epoxy adhesive injection in horizontal cracks at one end of the crack and continue as long as the injection equipment meter indicates adhesive is being dispensed or until adhesive shows at the next entry port.

When epoxy adhesive appears at the next adjacent port, stop the current injection and transfer the epoxy injection to the next adjacent port where epoxy adhesive appeared.

Perform epoxy adhesive injection continuously until cracks are completely filled.

If port to port travel of epoxy adhesive is not indicated, immediately stop the work and notify the Engineer.

9.0 FINISHING

When cracks are completely filled, allow the epoxy adhesive to cure for sufficient time to allow the removal of the surface seal without any draining or runback of epoxy material from the cracks.

Remove the surface seal material and injection adhesive runs or spills from concrete surfaces.

Finish the face of the crack flush to the adjacent concrete, removing any indentations or protrusions caused by the placement of entry ports.

10.0 BASIS OF PAYMENT

Epoxy Resin Injection for Bridge 50 will be measured and paid for at the contract unit bid price per linear foot for actual Epoxy Resin Injection, performed in accordance with this provision, on Bridge #50.

Epoxy Resin Injection for Bridge 51 will be measured and paid for at the contract unit bid price per linear foot for actual Epoxy Resin , performed in accordance with this provision, on Bridge #51.

For both bridges, such payment will be full compensation for all materials, tools, equipment, labor, and for all incidentals necessary to complete the work, including, but not limited to, all items described in this section.

For both bridges, the Pay Items shall be measured as the linear foot distance between beginning and end points of the repair work, as marked on the existing structure by the Engineer.

Payment will be made under:

Pay Item	Pay Unit
Epoxy Resin Injection for Bridge 50	Linear Feet
Epoxy Resin Injection for Bridge 51	Linear Feet

JOINT REPAIR

(SPECIAL)

1. DESCRIPTION

This work shall consist of the removal and disposal of the existing modular joints, partial removal and reconstruction of concrete deck slab, partial removal and reconstruction of concrete end diaphragm, partial removal of end bent backwall, placement and finishing of concrete required for reconstructing the deck slab and backwall, new steel reinforcing for deck reconstruction as shown on contract drawings, deck preparations for installing the proposed joint, including staged removal of existing joint system and staged installation of proposed joint system as shown on the contract drawings and testing of the installed joint for water tight seal. All labor, equipment, expansion joint material and incidentals necessary for completing the tasks shall be included. Reconstruction of the approach slabs are covered under separate Special Provision, but the provision contained herein for the surface preparation of the joint bed shall apply to the approach slab reconstruction.

2. EQUIPMENT

Use the following surface preparation equipment:

- Equipment capable of sawing concrete to the required depth(s) as shown on plans. Sawing equipment shall include tracks or guides where straight line cuts are required.
- Hand-held high velocity (4000 psi minimum) water-jet equipment capable of removing rust scale from reinforcing steel and removing small chips of concrete partially loosened by the chipping operation.
- Power driven hand tools for removal of concrete are required that meet the following requirements:
 - Pneumatic hammers, 35 lb class.
 - Pneumatic hammer chisel-type bits that do not exceed the diameter of the shaft in width.
- Hand tools such as hammers and chisels for removal of final particles of unsound concrete.

3. MATERIAL

The proposed expansion joint seal shall be *Watson Bowman Wabo TransFlex reinforced elastomeric molded rubber expansion joint system Model 900* or approved equal. The joint shall be stored in accordance with manufacturer guidelines.

Concrete for the repair of the deck and incidental repairs of the backwall shall be as specified under separate provision. Reinforcing steel (epoxy and plain) shall be as specified in the Standard Specifications.

4. REMOVAL AND PREPARATION

Saw cut the deck using a tracked or guided saw at the location shown in the plans. Depth of cut shall not be less than ½" above the plan reinforcing steel cover. If indications of rebar cutting are present, adjust depth of cut as required to not damage bars that are to be retained. Make additional saw cuts as required for concrete removal.

Remove existing deck slab concrete to the limits shown in the plans. Existing concrete that is deteriorated, cracked or spalled shall be removed to sound material. Do not cut or remove the existing reinforcing steel unless otherwise noted in the plans. Care shall be taken not to disturb any existing reinforcing steel to remain, and any damaged reinforcing or areas where existing reinforcing development into existing concrete has been compromised, as determined by the Engineer, shall be repaired to the satisfaction of the Engineer for no additional cost to the Department.

Remove existing end bent backwall concrete to the limits shown in the plans. Existing concrete that is deteriorated, cracked or spalled shall be removed to sound material. Remove existing reinforcing steel to limits shown on the plans.

Remove the existing modular joint and properly dispose.

The portion of the backwall to remain shall be reconstructed as necessary to achieve a flat, uniform surface. The portion of existing deck to remain shall be roughened to an amplitude of 0.75in below the 1.5" saw cut. This may be performed incidentally through the mechanical removal of concrete or intentionally once the concrete deck removal is complete.

Proof blast and clean the prepared area with a high pressure wash to remove oil, grease, concrete chips, partially dislodged material, and other deleterious material.

Prior to placing concrete at joint repair locations, install a rigid bulkhead at the required grade and profile.

Place reinforcing steel as shown on the plans. Reinforcing steel may be shifted in plan a maximum of 1" as necessary, to allow for the installation of the epoxy anchors for the expansion joint at the locations dictated by the type of joint furnished. The contractor shall prepare and submit working drawings to the Engineer showing the relationship of the anchor bolt locations for the joint and the proposed reinforcing steel.

Secure screed rail guides in position to ensure finishing the surface to the required profile and cross slope. Do not treat screed rails with parting compound to facilitate their removal.

Completely clean all surfaces of grease, oil, curing compounds, acids, dirt, or loose debris within 24 hours of placing concrete. Thoroughly soak and cover with plastic existing

concrete surfaces for a minimum of 2 hours prior to placing concrete. Remove any standing water from the repair area surface prior to placing concrete.

5. PLACING AND FINISHING

Construction joints other than those shown on the plans will not be permitted unless approved by the Engineer.

Prior to placement, the Engineer shall determine the air temperature and wind speed. Do not place concrete if the ambient air temperature is below 45° F or above 85° F, or if the wind velocity is in excess of 10 mph.

If the rate of evaporation of surface moisture exceeds 0.10 pounds per square foot per hour during placement, measures shall be taken to reduce the rate of evaporation. The evaporation rate is calculated using the following formula:

$$E = (T_c^{2.5} - r \cdot T_a^{2.5}) \cdot (1 + 0.4V) \cdot (10^{-6})$$

where,

E = Evaporation Rate,

T_c = Concrete Temp (°F),

r = Relative Humidity (%/100) T_a = Air Temp (°F),

V = Wind Velocity (mph)

Do not place concrete if the predicted air temperature at the site will be less than 35° F within 72 hours after placement. For a predicted air temperature above 35° F but below 50° F, use insulation to protect the concrete for a period of at least 48 hours. Use insulation that meets the requirements of Subarticle 420-7(C) of the *Standard Specifications* and place on fresh concrete surfaces as soon as initial set permits. Do not remove the insulation during the wet curing period unless the ambient air temperature is at least 40° F and rising.

Place the concrete monolithically in one operation per each stage of construction. Concrete shall not be placed in layers. Sections to be reconstructed are to be filled full depth and shall progress horizontally. Deviation from this procedure shall be cause for rejection.

Stop all placement operations during periods of precipitation. Keep an adequate quantity of protective coverings at the worksite and take adequate precautions to protect the freshly placed concrete from precipitation and runoff from adjacent surfaces.

When a tight, uniform surface is achieved and before the concrete becomes non-plastic, finish the top surface of the deck repair by burlap dragging or other approved method that produces an acceptable uniform surface texture.

As soon as the surface supports burlap without deformations, cover the surface with two layers of clean, wet burlap. Drain excess water from the burlap before placement. Other wet cure methods are permitted but must be approved by the Engineer prior to start of placement.

Wet cure the concrete a minimum of 3 hours or until 4500 psi compressive strength is obtained.

After the concrete has hardened sufficiently, test the finished surface with a straightedge that is designed, constructed, and adjusted such that it will accurately indicate or mark all floor areas which deviate from a plane surface by more than 1/8 inch in 10 feet. Remove all high areas in excess of 1/8 inch in 10 feet with an approved grinding or cutting machine. Where variations are such that the corrections extend below the limits of the top layer of grout, seal the repaired surface with an approved sealing agent. Methods for correcting low areas shall be approved by the Engineer.

The surface of the concrete deck and approach slab under the proposed expansion joint shall be finished to create a smooth, uniform surface parallel with the grade of the deck. This surface shall be finished to within tolerances specified by the joint manufacturer. Any such surface that does not meet the requirements of the joint manufacturer shall be repaired at no additional cost to the Department.

6. JOINT INSTALLATION

Temporary steel joint plates shall be installed as shown on the plans when it is anticipated that construction or public traffic will need to cross the joint prior to installation of the final joint. The final joint shall not be installed until after PPC overlay surface preparation, PPC overlay placement, and grooving of the bridge floor. Steel used in the temporary joint plates shall be AASHTO M270 Grade 50 or as approved by the Engineer. The joint plates may contain embedded lifting hooks, provided the hooks do not protrude above the top surface of the top plate, and do not create a gap in the riding surface of greater than 2". The temporary joint plates shall be held-down by high-strength threaded rods and secured with sections of steel angles under the end diaphragm and against the backwall. Prior to opening a portion of the roadway to vehicular traffic, the contractor shall test the temporary plates for bouncing by driving a heavy truck across at a speed of approximately 20mph. Observe the plates for uplift off the joint bed. No uplift of the plates shall be permitted, and any damage caused to the deck, end diaphragm, or backwall by vehicular traffic on the temporary plates shall be repaired prior to installation of the final joint at no additional cost to the Department. The final joint shall be installed according to the joint manufacturer's specifications, and the contractor shall have a qualified representative from the joint manufacturer on-site during all installation processes. The contractor shall install epoxy anchors for the final joint in coordination with the joint details and joint manufacturer guidance. Working drawings of the final joint shall be submitted to the Department for approval prior to installation.

The dimensions shown in the plans are for an installation temperature of approximately 60 degrees Fahrenheit and are based on the best available information of the existing structure. If the existing conditions of the structure indicate joint openings in deviation from those shown on the plans, such deviations shall be reported to the engineer and work shall not commence for the installation of the final joint until necessary adjustments are made and, if needed, a different joint is required. If a joint different to that specified herein is required, it shall be at no additional cost to the Department.

The joint shall be installed to account for the ambient air temperature and any associated thermal expansions or contractions of the bridge deck. Tools, as allowed by the joint manufacturer, shall be utilized to compress or expand the proposed expansion joint to fit the contracted or expanded thermal state of the bridge deck. The contractor shall take special care to allow for this in the installation of the epoxy anchors.

After the joint has been installed in a stage, the joint surfaces shall be sealed to the concrete as specified by the joint manufacturer. Sealant materials and sealant placement shall be considered incidental to the cost of the joint repair and no separate payment will be made.

7. INSPECTION

When concrete is cast, use a non-aluminum, 10 foot, true to line straight edge to check and grade the top of the slab on each side of the joint to ensure smooth transition between deck and approach slab.

8. WATER INTEGRITY TEST

Upon completion of a portion of an expansion joint seal, perform a water test on the top surface to detect any leakage. Cover the roadway section of the joint portion that has been installed (generally from lane edge to curb or barrier, but for whatever portion of the seal that has been installed and completed) with water, either ponded or flowing, not less than 1 inch above the roadway surface at all points. Secure an unnozzled water hose delivering approximately 1 gallon of water per minute to the inside face of the bridge railing, trained in a downward position about 6 inches above the deck, such that there is continuous flow of water across the deck and down the barrier railface of the joint. Where a portion of the installed seal abuts and is spliced to a previously installed portion of the seal, a Watertight Integrity Test shall test that splice.

Maintain the ponding or flowing of water on the roadway and continuous flow across the deck for a period of 2 hours. At the conclusion of the test, the underside of the joint is closely examined for leakage. The expansion joint seal is considered watertight if no obvious wetness is visible on the Engineer's finger after touching a number of underdeck areas. Damp concrete that does not impart wetness to the finger is not a sign of leakage.

If the joint system leaks, locate the place(s) of leakage and take any repair measures necessary to stop the leakage at no additional cost to the Department. Use repair measures recommended by the manufacturer and approved by the Engineer prior to beginning corrective work.

If measures to eliminate leakage are taken, perform a subsequent water integrity test subject to the same conditions as the original test. Subsequent tests carry the same responsibility as the original test and are performed at no extra cost to the Department.

9. LIMITATIONS OF OPERATION

Submit volumetric mixer size and weight data to the Engineer for review. The volumetric mixer may be allowed on the bridge deck with approval from the Engineer.

No vehicular or construction traffic shall be permitted on finished concrete prior to achieving a compressive strength of 4500 psi.

If working at night, provide approved lighting. No separate payment will be made for portable lighting as the cost of such is incidental to the work being performed.

10. MEASUREMENT AND PAYMENT

Joint Repair will be measured per square foot and paid for at the contract lump sum price bid for “Design and Construction of Bridge 50” and will be full compensation for removal of the existing joint and preparing the deck for new joint installation, including: containment and off-site disposal of unsound concrete or other demolition debris; placement of reinforcing steel; placement and finishing of repair concrete; and shall include the cost of labor, tools, equipment (excluding the volumetric mixer) and incidentals necessary to complete the repair work.

Molded Rubber Segmental Expansion Joints will be paid for at the contract lump sum price bid for “Design and Construction of Bridge 50” and will be full compensation for furnishing all joint materials; all labor, materials, and equipment to install expansion joint hardware and seal and perform water integrity testing.

OVERLAY SURFACE PREPARATION FOR
POLYESTER POLYMER CONCRETE

(SPECIAL)

1. DESCRIPTION

This provision addresses the surface preparation activities required prior to the placement of polyester polymer concrete (PPC).

Work includes: removal of unsound and sound bridge deck concrete and existing patches in deck repair areas; preparation of repair areas prior to placement of PPC bridge deck repair material; bridge deck surface preparation prior to placement of PPC overlay; and any incidentals necessary to prepare the bridge deck for placement of PPC repair material or PPC overlay, as specified or as shown on the plans.

2. DEFINITIONS

Scarification shall consist of the removal of any asphalt wearing surface and concrete surface to the uniform depth and limits shown on the plans.

Shotblasting shall consist of steel beads (or other materials as approved by the Engineer) “shot” out of a machine onto the bridge concrete deck concrete floor to remove soft or deteriorated concrete, and to clean the concrete deck surface for the application of the PPC overlay. Contractor shall vary the speed of the shotblaster or make multiple passes, as necessary, to achieve the required surface preparation for the PPC overlay. Areas inaccessible with shotblasting equipment may require surface preparation with sandblasting equipment and hand equipment.

3. EQUIPMENT

All equipment for cleaning the existing concrete surface and mixing and applying the overlay system shall be in accordance with the System Provider’s recommendations, as approved by the Engineer prior to commencement of any work:

- Scarifying equipment that is a power-operated, mechanical grinder capable of removing a minimum depth of ¼” for each pass.
- Shotblasting and sandblasting equipment to adequately prepare the bridge deck substrate, as required in this provision. Provide equipment to supply oil-free and moisture-free compressed air for final surface preparation.
- Equipment capable of sawing concrete to the specified plan depth.
- Power driven hand tools for removal of unsound concrete are required that meet the following requirements:
 - Pneumatic hammers weighing a nominal 15 lbs. or less.
 - Pneumatic hammer chisel-type bits that do not exceed the diameter of the shaft in width.
- Hand tools, such as hammers and chisels, for removal of final particles of unsound concrete.
- Self-propelled vacuum capable of picking up dust and other loose material from prepared deck surface.
- Equipment to supply oil-free and moisture-free compressed air for final surface preparation.

The equipment must operate at a noise level less than 90 decibels at a distance of 50 feet.

4. MANAGEMENT AND DISPOSAL OF CONCRETE DEBRIS

All concrete debris shall become the property of the Contractor. The contractor shall be responsible for disposing of all debris generated by scarification, shotblasting, sandblasting, and any other surface preparation operations, in compliance with applicable regulations concerning such disposal.

All costs associated with management and disposal of all debris shall be included in the payment of other items.

5. OSP PLAN SUBMITTAL

Prior to beginning surface preparation activities, the Contractor shall submit for review and approval the Overlay Surface Preparation (OSP) Plan. The OSP Plan shall detail the type of equipment that is intended to be used and the means by which the Contractor will achieve the following requirements:

- Estimate depth of reinforcing steel.
- Scarification of deck to depth required.
- Measure depth of scarification to show completed within limits.
- Measure depth of shotblasting to show completed within limits.

6. SURFACE PREPARATION

Prior to any construction, take the necessary precautions to ensure debris from bridge deck preparation and repairs is not allowed to fall below the bridge deck.

Remove all existing asphalt overlays and all loose, disintegrated, unsound or contaminated concrete to the limits shown on the plans with the following requirements.

During surface preparation, precaution shall be taken to assure that traffic is protected from rebound, dust, and construction activities. Appropriate shielding shall be provided as required and directed by the Engineer. During surface preparation, the Contractor shall provide suitable coverings, as needed to protect all exposed areas not to receive overlay, such as curbs, sidewalks, parapets, etc. All damage or defacement resulting from surface preparation shall be repaired to the Engineer's satisfaction at no additional cost.

A. Sealing of Bridge Deck: Seal all expansion joints subject to run-off water from the scarification, shotblasting, and PPC placement process with material approved by the Engineer, prior to beginning any demolition. The expansion joints shall remain sealed until it has been determined that water and materials from the scarification, shotblasting, and PPC placement operations cannot be discharged through them any longer. Take all steps necessary to eliminate the flow of water or materials through the expansion joints, and any other locations water or materials could leak from the deck.

All deck drains in the immediate work area and other sections of the bridge affected by the work being performed shall be sealed prior to beginning scarification. Drains shall remain sealed until it has been determined by the Engineer that water and materials from the scarification, shotblasting, and PPC placement operations cannot be discharged through them any longer.

- B. Scarifying Bridge Deck: Remove any asphalt wearing surface from the bridge deck and scarify the concrete deck to remove the entire concrete surface of the deck to the uniform depth and limits shown on the plans.

It will be the Contractor's responsibility to determine amount of cover for the reinforcing steel. Use a pachometer or other approved device, as approved by Engineer, prior to scarification. Readings shall be read and recorded in the presence of the Engineer. Readings shall be recorded for each span at 1/5 points longitudinally and 1/3 points transversely. The cost for this work will be considered incidental to the cost of surface preparation of the bridge deck.

Cover data for Bridge Number 830050 (values in inches):

Span	1	2	3	4	5	6
No. of Readings	30	30	30	30	30	30
Average	3.11	2.96	2.82	2.92	3.03	3.11
Std. Dev.	0.15	0.15	0.44	0.21	0.18	0.26
Max.	3.46	3.22	3.46	3.33	3.34	3.62
Min.	2.65	2.76	2.07	2.41	2.78	2.60

The above top mat cover dimensions are an estimate based on the best available information. Cover data shown is based on readings taken on one half of the bridge only. Calibrate scarifying equipment in order to avoid damaging the reinforcing steel in the bridge floor or the approach slab. Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel. If reinforcing bars or bridge drainage devices are pulled up or snagged during scarification operations, cease work and consult with the Engineer to determine any necessary adjustments to the roto-milling operation.

Remove and dispose of all concrete and asphalt, and thoroughly clean the scarified surface. In areas where reinforcing steel is located in the depth to be scarified, use another method with the Engineer's approval.

The Engineer will re-inspect after each removal and require additional removals until compliance with plans and specifications are met.

Regardless of the method of removal, the removal operation shall be stopped if it is determined that sound concrete is being removed to a depth greater than required by the plans.

- C. Class II Surface Preparation (Partial Depth): At locations specified on the plans or identified by the Engineer for Class II Surface Preparation, verify the depth of removal achieved by the scarification. Remove by additional scarification or chipping with hand tools all existing patches and unsound concrete. No additional payment will be made for Class II Surface Preparation depths achieved by the initial scarification.

All patches shall be removed under Class II surface preparation. If any patch cannot be removed by means of scarification, the Contractor shall use hand tools to remove the patch. Areas indicated on the plans that require Class II surface preparation, including the locations of existing patches, are from the best information available. The Contractor shall verify prior to surface preparation the location of all existing patches.

Spalled or unsound areas of the deck not removed by scarification shall be removed to sound concrete at locations noted in the contract plans or as directed by the Engineer. Remove existing spalled or unsound areas of the bridge concrete deck by methods approved by the Engineer.

Provide a 1" deep saw cut around the perimeter of areas noted for bridge deck or patch removal. Remove, using the type of tools listed above, all concrete or patch material within the sawcut to a minimum depth of 1" and as necessary to remove unsound concrete. All loose and unsound concrete or patch material shall be removed.

If the condition of the concrete is such that deep spalls or sheer faces result, notify the Engineer for the proper course of action.

Thoroughly clean the newly exposed surface to be free of all grease, oil, curing compounds, acids, dirt, or loose debris in accordance with this special provision.

Dispose of the removed concrete, clean, repair or replace rusted or loose reinforcing steel, and thoroughly clean the newly exposed surface. Care shall be taken not to cut, stretch, or damage any exposed reinforcing steel.

In overhangs, removing concrete areas of less than 0.60 ft²/ft length of bridge without overhang support is permitted unless the Engineer directs otherwise. Overhang support is required for areas removed greater than 0.60 ft²/ft length of bridge. Submit details of overhang support to the Engineer for approval prior to beginning the work.

- D. Preparation of Reinforcing Steel: Remove concrete without cutting or damaging existing steel unless otherwise noted in the plans. Clean, repair, or replace rusted or loose reinforcing steel. Damaged reinforcing steel, such as bars with nicks deeper than 20% of the bar diameter, shall be repaired or replaced. Reinforcing steel which has a cross section reduced to 75% or less shall be replaced with new reinforcing steel of similar cross section area. Loose reinforcing shall be considered reinforcing which is not bonded to the surrounding concrete for a continuous distance of over ½ inch or a total of 3 inches with any 5 inch portion. Replacement bars shall be Grade 60 and meet the material requirements of Section 1070 of the Standard Specifications. Replacement bars shall be spliced to existing bars using either minimum 30 bar diameter lap splices to existing steel with 100% cross sectional area or approved mechanical connectors.

For reinforcing steel left unsupported by the concrete removal process, support and protect the exposed reinforcing steel against displacement and damage from loads, such as those caused by removal equipment and delivery buggies. All reinforcing steel damaged or dislodged by these operations shall be replaced with bars of the same size at the contractor's expense following the replacement criteria outlined above.

Reinforcing steel exposed and satisfactorily cleaned and prepared will not require additional cleaning, if encased in concrete within seven (7) days. Rebar exposed for more than seven (7) days shall be satisfactorily cleaned and prepared, prior to placement of the new concrete. The satisfactory cleanliness and preparation of the reinforcing steel shall be determined by the Engineer.

When large areas of the deck on composite bridges are removed resulting in the debonding of the primary reinforcing bars, the removal shall be performed in stages to

comply with the construction sequence shown on the plans or as directed by the Engineer.

- E. Concrete Deck Repair: Repair and fill the Class II surface preparation areas of the existing bridge concrete deck prior to the final surface preparation and application of the PPC overlay, at locations shown in the plans, or as determined by the Engineer, if necessary. Materials other than PPC may be used for concrete deck repairs, but shall be approved by the PPC System Provider's Technical Representative and shall be applied and prepared as required by the PPC System Provider. For concrete deck repairs with PPC:

- removal and surface preparation of the repair area shall be in accordance with and shall be paid for under pay items in this special provision.
- materials, equipment, placement, and finishing of PPC used for concrete deck repairs shall meet the requirements of and shall be paid for under pay items in the Polyester Polymer Concrete Bridge Deck Overlay special provision.

PPC repair material may be placed up to one (1) hour prior to overlay placement.

All repairs shall be placed and finished to match substrate deck grade prior to PPC placement, in order to provide a uniform overlay thickness.

Concrete deck repairs with PPC may be utilized as a stand-alone item where required on structures not to receive a PPC overlay.

- F. Surface Cleaning: The surface of concrete substrate and repaired areas shall be prepared for application of the overlay by shotblasting in order to remove all existing grease, slurry, oils, paint, dirt, striping, curing compound, rust, membrane, weak surface mortar, or any other contaminants that could interfere with the proper adhesion of the overlay system. The final prepared surface shall adhere to the following requirements:

1. If expansion joints are not being replaced or have been replaced prior to shotblasting they shall be protected from damage from the shotblasting operation. Deck drains and areas of curb or railing above the proposed surface shall be protected from the shotblasting operation.
2. The areas to receive overlay shall be cleaned by shotblasting, or abrasive sandblasting in the event that the shotblaster cannot access areas to be prepared. Do not begin shotblasting until all grinding or milling operations are completed. Cleaning shall not commence until all work involving the repair of the concrete deck surface has been completed and the deck is dry. All contaminants shall be picked up and stored in the vacuum unit and no dust shall be created during the blasting operation that will obstruct the view of motorists in adjacent roadways. The travel speed and/or number of passes of the shotblasting unit shall be adjusted, so as to result in all weak or loose surface mortar being removed, aggregates within the concrete being exposed, and open pores in the concrete exposed, as well as a visible change in the concrete color. Cleaned surfaces shall not be exposed to vehicular traffic unless approved by the Engineer. If the deck becomes contaminated before placing the overlay, the Contractor shall shotblast or abrasive

sandblast the contaminated areas to the satisfaction of the Engineer at no additional cost.

3. Prior to the overlay placement, any loose particles shall be removed by magnets and oil free compressed air and vacuuming, such that no trapped particles remain. Power washing will not be allowed.
 4. The areas to be overlaid shall be blown off with oil and moisture free compressed air just prior to placement of the primer and shall be completely dry.
 5. Cleaning methods other than those detailed by specification may be suggested by the PPC System Provider and approved by the Engineer.
 6. All steel surfaces that will be in contact with the PPC overlay shall be cleaned in accordance with SSPC-SP No. 10, Near-White Blast Cleaning, except that wet blasting methods shall not be allowed.
- G. Safety: Provide a containment system for handling expected and unexpected blow thru of the deck. The containment system shall retain runoff water and debris and protect the area under the bridge deck. The Contractor shall be responsible for any injury or damage caused by these operations. The containment system shall remain in place until the concrete has been cast and attained minimum strength.

Provide adequate lighting when performing deck preparation activities at night. Submit a lighting plan to the Engineer for approval prior to beginning work.

7. BASIS OF PAYMENT

Scarifying Bridge Deck will be measured per square yard and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" and will be full compensation for the milling of existing asphalt wearing surface from the bridge deck or approaches, milling of the entire concrete bridge deck, repairing or replacing any damaged reinforcing steel, and the cleaning and disposal of all waste material generated.

Shotblasting Bridge Deck will be measured per square yard and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" and will be full compensation for the shotblasting and necessary sandblasting and handwork to prepare the entire concrete bridge deck, and removal and disposal of all waste material generated.

Class II Surface Preparation will be measured per square yard and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" and will be full compensation for Class II deck preparation where required by the plans. The cost will also include removal and disposal of unsound and contaminated concrete, removal of all existing patches, cleaning, repairing, or replacing of reinforcing steel, and all materials, labor, tools, equipment and incidentals necessary to complete the work.

PAINTING EXISTING WEATHERING STEEL STRUCTURE

(SPECIAL)

1.0 SCOPE OF WORK

Stanly County Bridge #50: This bridge was built in 1976 with foundation repairs in 1981 and 1987 and carries NC 24/27/73 Eastbound over the Pee Dee River. The structure consists of 6 spans of continuous steel plate girders. There are 5 lines of girders spaced at 9'-0" with steel cross frames. The web is constant at 78" deep and the top and bottom flanges vary between 12" and 18" wide. The bridge has a total length of 1140'-0" with a 42'-10" wide concrete deck. The existing paint system is weathering steel and the estimated area to be cleaned and painted is 2330 sq. ft. Painting is to be performed after bearing replacement at end bents is complete.

2.0 DESCRIPTION

This work shall consist of furnishing all labor, equipment, and materials necessary to clean and paint the ends of the weathering steel girders, zones of excessive corrosion, end bent steel diaphragms and crossframes, and all anchor bolts, of the existing structure. Work includes: removal, containment and disposal of the existing surface protection system; preparation of the surface to be painted and applying the new paint system; a containment enclosure; and any incidentals necessary to complete the project as specified and shown on the plans.

3.0 TWELVE-MONTH OBSERVATION PERIOD

The Contractor maintains responsibility for the coating system for a 12-month observation period beginning upon the satisfactory completion of all the work required in the plans or as directed by the Engineer. The Contractor shall guarantee the coating system under the payment and performance bond (refer to Article 109-10 of the *Standard Specifications*). To complete successfully the observation period, the coating system shall meet the following requirements after 12 months service:

- (A) No visible rust, contamination or application defect is observed in any coated area.
- (B) Painted surfaces have a uniform color and gloss.
- (C) Painted surfaces have an adhesion that meets an ASTM D3359, 3A rating.

Final acceptance is made only after the paint system meets the above requirements.

4.0 SUBMITTALS

Submit all of the following to the Engineer for review and approval before scheduling the pre-construction meeting. Allow at least two (2) weeks for the review process.

- (A) The existing protection systems may include toxic substances such as red lead oxide, which are considered hazardous if improperly removed. The contractor shall be responsible for detremininng of any toxic substances existing in the existing protection

system. The contractor shall be currently Society for Protective Coatings (SSPC) Quality Program (QP) 2, Category A certified, and have successfully completed lead paint removal and field painting on similar structures within 18 months prior to this bid. Lead abatement work completed within the 18 month period shall have been completed in accordance with contract specifications, free of citation from safety or environmental agencies. Lead abatement work shall include, but not be limited to: abrasive blasting; waste handling, storage and disposal; worker safety during lead abatement activities (fall protection, personal protective equipment (PPE), etc.); and containment. This requirement is in addition to the contractor pre-qualification requirements covered by Article 102-2 of the *Standard Specifications*.

The apparent low bidder shall submit a list of projects for which QP 2 work was performed within the last 18 months including owner contact information and submit to the Engineer a "Lead Abatement Affidavit". This form may be downloaded from: <http://www.ncdot.gov/projects/ncbridges/#stats>.

- (B) Work schedule which shall be kept up to date, with a copy of the revised schedule being provided to the Engineer in a timely manner.
- (C) Containment system plans and design calculations in accordance with SSPC Guide 6, Class 3A and other project requirements, signed and sealed by a Professional Engineer licensed by the State of North Carolina.
- (D) Bridge wash water sampling and disposal plan.
- (E) Subcontractor identification.
- (F) Lighting plan for night work in accordance with Section 1413 of the *Standard Specifications*.
- (G) Traffic control plan with NCDOT certified supervisors, flaggers and traffic control devices.
- (H) Health and safety plan addressing at least the required topics as specified by the SSPC QP 1 and QP 2 program and including hazard communication, respiratory health, emergency procedures, and local hospital and treatment facilities with directions and phone numbers, disciplinary criteria for workers who violate the plan and accident investigation. The plan shall address the following: hazardous materials, personal protective equipment, general health and safety, occupational health and environmental controls, fire protection and prevention, signs signals, and barricades, materials handling, storage, use, and disposal, hand and power tools, welding and cutting, electrical, scaffolds, fall protection, cranes, derricks, hoists, elevators, and conveyors, ladders, toxic and hazardous substances, airless injection and high pressure water jet (HPWJ).
- (I) Provide the Engineer a letter of certification that all employees performing work on the project have blood lead levels that are below the Occupational Safety and Health Administration (OSHA) action level.

(J) Provide the Engineer with Competent Person qualifications and summary of work experience.

(K) Environmental Compliance Plan.

(L) Quality Control Plan (Project Specific) with quality control qualifications and summary of work experience.

(M) Bridge and Public Protection Plan (Overspray, Utilities, etc. - Project/Task Specific).

(N) Abrasive Blast Media:

(1) Product Data Sheet.

(2) Blast Media Test Reports in accordance with Article 1080-12 of the *Standard Specification*.

(O) Coating Material:

(1) NCDOT HICAMS Test Reports (testing performed by NCDOT Materials and Tests Unit).

(2) Product Data Sheets.

(3) Material Safety Data Sheets.

(4) Product Specific Repair Procedures.

(5) Acceptance letters from paint manufacturer's for work practices that conflict with special provisions and/or paint manufactures product data sheets.

5.0 PRE-CONSTRUCTION MEETING

Submittals shall be reviewed and approved by the Engineer prior to scheduling the pre-construction meeting. Allow no less than two (2) weeks for a review process. When requesting a pre-construction meeting, contact the Engineer at least seven (7) working days in advance of the desired pre-construction date. The contractor's project supervisor, Competent Person, quality control personnel and certified traffic control supervisor shall be in attendance at the pre-construction meeting in order for the Contractor and NCDOT team to establish responsibilities for various personnel during project duration and to establish realistic timeframes for problem escalation.

6.0 CONTAINMENT SYSTEM

Prior to performing any construction or painting operations on the structure, the Contractor shall furnish the Engineer with plans and design calculations for a sufficiently designed containment system, which will provide access for any repairs on structural steel members,

cleaning and surface preparations for structural steel members, and coating operations for structural steel members of the bridge. The containment system shall not be installed, and no work shall begin, until the Engineer has reviewed and approved, in writing, the submitted containment system plans and design calculations. Containment system plans and design calculations shall be prepared, sealed, and signed by a Professional Engineer licensed by the State of North Carolina. Allow a minimum of two (2) weeks for review of the containment plans and calculations.

The containment system shall meet or exceed the requirements of Class 3A containment in accordance with SSPC Guide 6. The Contractor shall determine the required capacity of the containment system, which, at a minimum, shall include loads due to wind, repair materials and repair operations, equipment, and tools; however, the capacity shall not be less than that required by Federal or State regulations. Design steel members to meet the requirements of the *American Institute of Steel Construction Manual*. Design timber members in accordance with the *National Design Specification for Stress-Grade Lumber and Its Fastenings* of the National Forest Products Association. The containment system shall be constructed of materials capable of withstanding damage from any of the work required on this project and shall provide a two (2) hour resistance to fire.

In the containment system plans, describe how debris is contained and collected. Describe the type of tarpaulin, bracing materials, and the maximum designed wind load. Design wind loads shall be in accordance with the Falsework and Formwork special provision. Describe the dust collection system and how a negative pressure of 0.03 inches of water column is maintained inside the enclosure, while blasting operations are being conducted. Describe how the airflow inside the containment structure is designed to meet all applicable OSHA Standards. Describe how water run-off from rain will be routed by or through the enclosure. Describe how wash water will be contained and paint chips separated. Describe what physical containment will be provided during painting application to protect the public and areas not to be painted.

Drilling holes in the superstructure for the purpose of attaching the containment system is prohibited.

The Contractor will be responsible for certifying the containment system has been constructed in accordance with the approved plans.

The containment system shall be cleaned after each workday.

Upon completion of work, remove all anchorages in the substructure and repair the substructure at no additional cost to the Department.

Protect non-metallic parts of bearings from blasting and painting (i.e.: Pot Bearings, Elastomeric Pads, and Disc Bearings).

7.0 WASH WATER SAMPLING AND DISPOSAL PLAN

All wash water shall be collected and sampled prior to disposal. Representative sampling and testing methodology shall conform to North Carolina Administrative Code

15A NCAC 02B.0103, “Analytical Procedures”. Wash water shall be tested for pollutants listed in 15A NCAC 02B.0211(3), 15A NCAC 02T.0505(b)(1) and 15A NCAC 2T.0905(h). Depending on the test results, wash water disposal methods shall be described in the disposal plan. Wash water shall be disposed of in accordance with all current Federal and State regulations. See link for NCDOT Guidelines for Managing Bridge Wash Water: <http://www.ncdot.gov/projects/ncbridges/#stats>.

8.0 WASTE HANDLING OF PAINT AND ABRASIVES

Comply with all Federal, State, and local regulations. Failure to comply with the regulations could result in fines and loss of qualified status with NCDOT.

Comply with the Resource Conservation and Recovery Act (RCRA - 40 CFR 261 - 265) and the Occupational Safety and Health Act (OSHA - 29 CFR 1910 - 1926) regulations for employee training, and for the handling, storage, labeling, recordkeeping, reporting, inspections and disposal of all hazardous waste generated during paint removal.

A summary of Generator Requirements is available at the above NCDOT web link, which cites the specific regulations for each Generator category. Quantities of waste by weight and dates of waste generation shall be recorded. Waste stored at the project site shall be properly labeled. All waste, hazardous or non-hazardous, requires numbered shipping manifests.

The North Carolina Department of Environmental Quality (NCDEQ) have adopted RCRA as the North Carolina Hazardous Waste Management Rules and are responsible for enforcement. The *Hazardous Waste Generator Compliance Manual* is published by the Compliance Branch of the Division of Waste Management of NCDEQ, and can be found at:

<https://files.nc.gov/ncdeq/Waste%20Management/DWM/HW/Compliance/Generator%20Compliance%20Manual.pdf>

Immediately after award of the contract, arrange for waste containers, sampling, testing, transportation, and disposal of all waste. No work shall begin until the Contractor furnishes the Engineer with a written waste disposal plan. Any alternative method for handling waste shall be pre-approved by the Engineer. Use an approved waste management company from the following link:

<https://www.ebs.nc.gov/VendorDirectory/results.html?sap-params=cD0xJTlwJmN1cnJlbnRfc2VhcmNoX3BhZ2U9d2Mmc2VsZWNOaW9uX2Zpcm1fbmFtZT0mc2VsZWNOaW9uX2NlcQ9JnNlbGVjdGlubl9maXJtdHlwZT0meXNjX2Zpc m10eXBIPSzZwXlY3Rpb25fd29ya2xvY2F0aW9uPSZ5c2Nfd29ya2xvY2F0aW9uPSZz ZWxlY3Rpb25fYWRRkcN0YXRIPSZ5c2NfYWRRkcN0YXRIPSZzZWxlY3Rpb25fYWRR kcmNvdW50eT0meXNjX2FkZHJjb3VudHk9JnNlbGVjdGlubl93a2NvZGU9MDAzMDQ wJnlzY193a2NvZGU9MDAzMDQwJTlwQ09OVEFNUS5BVEVEJTIwTUUFURVJJQUxT JTIwUkVNT1ZBTCZzZWxlY3Rpb25fZGZlYz0meXNjX2Rpc2M9JnNlbGVjdGlubl9uY Wljcz0meXNjX25haWNzPSZzZWxlY3Rpb25fY3R5cGU9MA%3d%3d>

All removed paint and spent abrasive media shall be tested for lead following the SW-846 Toxicity Characteristic Leaching Procedure (TCLP) Method 1311 Extraction, as required in 40 CFR 261, Appendix 11, to determine whether it shall be disposed of as hazardous waste. Furnish the Engineer certified test reports showing TCLP results of the paint chips stored on site, with disposal in accordance with “Flowchart on Lead Waste Identification and Disposal” at:

<https://ncdenr.s3.amazonaws.com/s3fs-public/document-library/Lead%20Disposal.pdf>

All sampling shall be done in presence of the Engineer’s representative.

The Competent Person shall obtain composite samples from each barrel of the wash water and waste generated by collecting two or more portions taken at regularly spaced intervals during accumulation. Composite the portions into one sample for testing purposes. Acquire samples after 10% or before 90% of the barrel has accumulated. The intent is to provide samples that are representative of widely separated portions, but not the beginning and end of wash water or waste accumulation.

Perform sampling by passing a receptacle completely through the discharge stream or by completely diverting the discharge into a sample container. If discharge of the wash water or waste is too rapid to divert the complete discharge stream, discharge into a container or transportation unit sufficiently large to accommodate the flow and then accomplish the sampling in the same manner as described above.

Comply with the NCDEQ *Hazardous Waste Compliance Generator Manual*. Record quantities of waste by weight and dates of waste generation. Until test results are received, store all waste, and label as “NCDOT Bridge Paint Removal Waste - Pending Analysis” and include the date generated and contact information for the Engineer. Store waste containers in an enclosed, sealed, and secured storage container protected from traffic from all directions. Obtain approval for the protection plan for these containers from the Engineer. If adequate protection cannot be obtained by use of existing guardrail, provide the necessary supplies and equipment to maintain adequate protection. Once test results are received and characterized, label waste as either “Hazardous Waste - Pending Disposal” or “Paint Waste - Pending Disposal”.

Once the waste has been collected, and the quantities determined, prepare the appropriate shipping documents and manifests and present them to the Engineer. The Engineer will verify the type and quantity of waste and obtain a Provisional Environmental Protection Agency (EPA) ID number from:

Melodi Deaver

Division of Waste Management/Hazardous Waste Section

North Carolina Department of Environmental Quality

1646 Mail Service Center

Raleigh, NC 27699

Phone: (919) 707-8204, Email: melodi.deaver@ncdenr.gov

At the time of shipping, the Engineer will sign, date, and add the ID number in the appropriate section on the manifest. The maximum on-site storage time for collected waste shall be 90 calendar days. All waste whether hazardous or non-hazardous will require numbered shipping manifests. The cost for waste disposal (including lab and Provisional EPA ID number) is included in the bid price for this contract. Note NC Hazardous Waste Management Rules (15A NCAC 13A) for more information. Provisional EPA ID numbers may be obtained at:

<https://deq.nc.gov/about/divisions/waste-management/hw/provisional-notification>

Testing labs shall be certified in accordance with North Carolina State Laboratory Public Health Environmental Sciences. List of certified laboratories may be obtained at:

<https://slphreporting.ncpublichealth.com/Certification/CertifiedLaboratory.asp>

All test results shall be documented on the lab analysis as follows:

(A) For leachable lead:

(1) Soils/Solid/Liquid- EPA 1311/200.7/6010

Area sampling will be performed for the first two (2) days at each bridge location. The area sample will be located within five (5) feet of the containment and where the highest probability of leakage will occur (access door, etc.). Results from the area sampling will be given to the Engineer within 72 hours of sampling (excluding weekends). If the results of the samples exceed $20 \mu\text{g}/\text{m}^3$ corrective measures shall be taken and monitoring shall be continued until two (2) consecutive sample results are less than $20 \mu\text{g}/\text{m}^3$.

Time Weighted Average (TWA) may suspend the work if there are visible emissions outside the containment enclosure or pump monitoring results exceeding the level of $30 \mu\text{g}/\text{m}^3$.

Where schools, housing and/or buildings are within 500 feet of the containment, the Contractor shall perform initial Total Suspended Monitoring (TSP) Lead monitoring for the first ten (10) days of the project during abrasive blasting, vacuuming and

containment removal. Additional monitoring will be required during abrasive blasting two (2) days per month thereafter. Results of the TSP monitoring at any location shall not exceed $1.5 \mu\text{g}/\text{m}^3$.

9.0 EQUIPMENT MOBILIZATION

The equipment used in any travel lanes and paved shoulder shall be mobile equipment on wheels that has the ability to move on/off the roadway in less than 30 minutes. All work conducted in travel lanes shall be from truck or trailer supported platforms and all equipment shall be self-propelled or attached to a tow vehicle at all times.

10.0 QUALITY CONTROL INSPECTOR

Provide a quality control (QC) inspector in accordance with the SSPC QP guidelines to ensure that all processes, preparation, blasting and coating application are in accordance with the requirements of the contract. The inspector shall have written authority to perform QC duties to include continuous improvement of all QC internal procedures. The presence of the engineer or inspector at the work site shall in no way lessen the contractor's responsibility for conformity with the contract.

11.0 QUALITY ASSURANCE INSPECTOR

The quality assurance inspector which may be a Department employee or a designated representative of the Department shall observe, document, assess, and report that the Contractor is complying with all of the requirements of the contract. Inspectors employed by the Department are authorized to inspect all work performed and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. The inspector is not authorized to alter or waive the requirements of the contract. Each stage in preparing the structure to be coated which includes but not limited to washing, blasting, coating testing and inspection shall be inspected and approved by the Engineer or an authorized representative.

12.0 SUBLETTING OF CONTRACT

Only contractors certified to meet SSPC QP 2, Category A, and have successfully completed lead paint removal and field painting on all similar structures within 18 months prior to this bid are qualified for this work. Work is only sublet by approval of the Engineer.

13.0 LIMITS OF ZONE PAINTING

If any girder has excessive corrosion along its bottom flange, beyond the distance of 1.5 times the depth of the beam or girder, at the bearing, the area of the affected girder indicated on the plans, and other girders as directed by the Engineer, shall be cleaned in accordance with the requirements of System 5 painting system. The horizontal limits of zone painting shall extend 12" beyond the maximum horizontal extent of web/flange corrosion. The vertical limits of zone painting shall extend 3" beyond the maximum vertical extent of web corrosion.

Areas designated for zone coating shall be primed and coated in accordance with System 5 as outlined in Article 442-8 of the *Standard Specifications*.

System 5 is one coat of primer, one intermediate acrylic coat, one stripe coat of paint, and one topcoat of paint and over non-weathering steel surfaces cleaned to an SSPC SP-6 finish.

Painting shall be performed in accordance with Section 442 and Section 1080 of the *Standard Specifications*, and/ or these special provisions; the more restrictive requirement shall apply. Perform all mixing operations over an impervious surface with provisions to prevent runoff to grade of any spilled material.

14.0 PREPARATION OF SURFACES

Before any other surface preparation is conducted, all surfaces shall be power washed to remove dust, salts, dirt, and other contaminants. All wash water shall be contained, collected, and tested in accordance with the requirements of NCDOT Guidelines for Managing Bridge Wash Water. Obtain approval of the Engineer and allow all cleaned surfaces to dry to the touch and without standing water before beginning surface preparation or painting activities.

Surface preparation is done with materials meeting Article 1080-12 of the *Standard Specifications*. No silica sand or other silica materials are permitted for use. The profile shall be between 1.0 and 3.0 mils when measured on a smooth steel surface. Conduct and document at least two (2) tests per beam/girder and two (2) tests per span of diaphragms/cross bracing.

Spread tarpaulins over all pavements and surfaces underneath equipment used for abrasive blasting as well as equipment and containers used to collect abrasive media. This requirement will be enforced during activity and inactivity of equipment.

Before the Contractor departs from the work site at the end of the workday, collect all debris generated during surface preparation and all dust collector hoses, tarps or other appurtenances containing blasting residue in approved containers.

Clean a 3" x 3" area at each structure to demonstrate the specified finish, and the inspector will preserve this area by covering it with tape, plastic or some other suitable means so that it can be retained as the Dry Film Thickness (DFT) gauge adjustment standard. An acceptable alternative is for the Contractor to provide a steel plate with similar properties and geometry as the substrate to be measured.

The contractor and or quality assurance representative shall notify the Engineer of any area of corroded steel that has lost more than 50% of its original thickness.

All parts of the bridges not to be painted and the travelling public shall be protected from overspray. Submit a plan to protect all parts of bridge that are not required to be painted and a plan to protect the traveling public and surrounding environment while applying all coats of paint to a structure.

Ensure that chloride levels on the surfaces are 7 µg/cm² or lower using an acceptable sample method in accordance with SSPC Guide 15. The frequency of testing shall be two (2) tests per span after all surface preparation has been completed and immediately prior to painting. Select test areas representing the greatest amount of corrosion in the span as determined by the Engineers' representative. Additional testing may be required if significant amounts of chloride are detected.

All weld splatter, slag or other surface defects resulting in a raised surface above the final paint layer shall be removed prior to application of primer coat.

15.0 PAINTING OF STEEL

Paint System 5, as specified in these special provisions and Article 442-8 of the *Standard Specifications*, is to be used for this work. System 5 is one coat of primer, one intermediate acrylic coat, one stripe coat of paint, and one topcoat of paint over non-weathering steel surfaces blast-cleaned surfaces in accordance with SSPC-SP-6 (Commercial Blasting). Perform all mixing operations over an impervious surface with provisions to prevent runoff to grade of any spilled material. The contractor is responsible for reporting quantities of thinner purchased as well the amounts used. No container with thinner shall be left uncovered, when not in use.

Apply 2" stripe coat, by brush or roller only, to all exposed edges of steel including fasteners before applying the finish coat. Locate the edge or corner in the approximate center of the paint stripe.

Any area where newly applied paint fails to meet the specifications shall be repaired or replaced by the Contractor, at no additional cost to the Department. The Engineer approves all repair processes before the repair is made. Repaired areas shall meet the *Standard Specifications*. The Contractor applies an additional finish coat of paint to areas where the tape adhesion test is conducted.

16.0 MATERIALS

Only paint suppliers that have a NCDOT qualified inorganic zinc primer may furnish paints for this project. All paints applied to a structure shall be from the same supplier. Before any paints are applied the Contractor shall provide the Engineer a manufacturer's certification that each batch of paint meets the requirements of the applicable Section 1080 of the *Standard Specifications*.

Color of the paint shall be that approved for use on weathering steel beams and girders and shall be a uniform dark brown. The paint color shall be submitted to the Engineer for approval prior to ordering materials.

The inspector randomly collects a one pint sample of each paint product used on the project. Additional samples may be collected as needed to verify compliance to the specifications.

Do not expose paint materials to rain, excessive condensation, long periods of direct sunlight, or temperatures above 110°F or below 40°F. In addition, the Contractor shall place a device that records the high, low, and current temperatures inside the storage location. Follow the manufacturer's storage requirements if more restrictive than the above requirements.

17.0 INSPECTION

Surface Preparation for System 5 shall be in accordance with SSPC SP-6. Any area(s) not meeting the requirements of SSPC SP-6 shall be remediated prior to application of coating. Surface inspection is considered ready for inspection when all blast abrasive, residue and dust is removed from surfaces to be coated.

(A) Quality Assurance Inspection

The Contractor furnishes all necessary OSHA approved apparatus such as ladders, scaffolds and platforms as required for the inspector to have reasonable and safe access to all parts of the work. The contractor illuminates the surfaces to be inspected to a minimum of 50-foot candles of light. All access points shall be illuminated to a minimum of 20-foot candles of light.

NCDOT reserves the right for ongoing Quality Assurance (QA) inspection to include but not limited to surface contamination testing, adhesion pull testing, and DFT readings as necessary to assure quality.

Inform the Engineer and the Division Safety Engineer of all scheduled and unannounced inspections from SSPC, OSHA, EPA and/or others that come on site. Furnish the Engineer a copy of all inspection reports except for reports performed by a third party and or consultant on behalf of the Contractor.

(B) Inspection Instruments

At a minimum, furnish the following calibrated instruments and conduct the following quality control tests:

- (1) Sling Psychrometer - ASTM E337 - bulb type
- (2) Surface Temperature Thermometer
- (3) Wind Speed Indicator
- (4) Tape Profile Tester - ASTM D4417 Method C
- (5) Surface Condition Standards - SSPC VIS-1 and VIS-3
- (6) Wet Film Thickness Gage - ASTM D4414
- (7) Dry Film Thickness Gage - SSPC-PA2 Modified

- (8) Solvent Rub Test Kit - ASTM D4752
- (9) Adhesion Test Kit - ASTM D3359 Method A (Tape Test)
- (10) Adhesion Pull test - ASTM D4541
- (11) Surface Contamination Analysis Kit or (Chloride Level Test Kit) SSPC Technology Guide 15

(C) Quality Control

Maintain a daily quality control record in accordance with Subarticle 442-12(D) of the *Standard Specifications* and make such records available at the job site for review by the inspector and submit to the Engineer as directed. In addition to the information required on Form M&T-610, submit all Dry Film Thickness (DFT) readings on a form equivalent to Form M&T-611. These forms can be found at:

<https://connect.ncdot.gov/resources/Materials/Pages/Materials-Manual-by-Material.aspx?Order=MM-03-02>

- (1) Measure DFT at each spot on the attached diagram and at the required number of locations as specified below:
 - (a) For span members less than 45 feet; three (3) random locations along each girder in each span.
 - (b) For span members greater than 45 feet; add one additional location for each additional ten (10) feet in span length.

DFT measurements for the prime coat shall not be taken for record until the zinc primer has cured in accordance with ASTM D4752 (MEK Rub Test) with no less than a four (4) resistance rating.

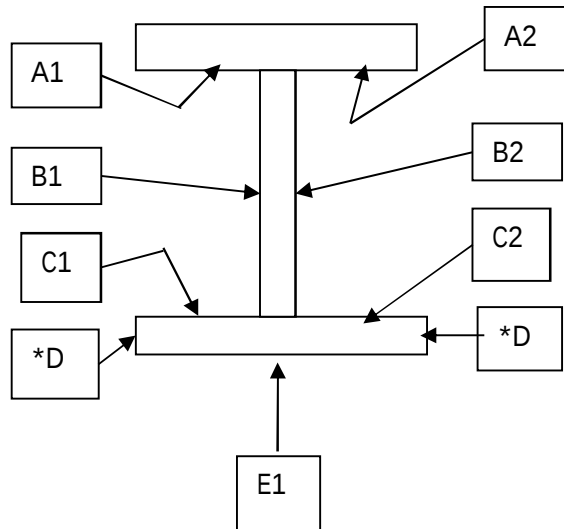
Stiffeners and other attachments to beams and or plate girders shall be measured at no less than five (5) random spots per span. Also, dry film thickness is measured at no less than six (6) random spots per span on diaphragms/cross frames.

Each spot is an average of three (3) to five (5) individual gage readings as defined in SSPC PA-2. No spot average shall be less than 80% of minimum DFT for each layer applied; this does not apply to stripe coat application. Spot readings that are non-conforming shall be re-assessed by performing additional spot measurements not to exceed one-foot intervals on both sides of the low areas until acceptable spot averages are obtained. These non-conforming areas shall be corrected by the Contractor prior to applying successive coats.

Less than 36" in height and/or bottom flanges less than 16" in width.

7 Spot Areas

21 Individual DFT Readings

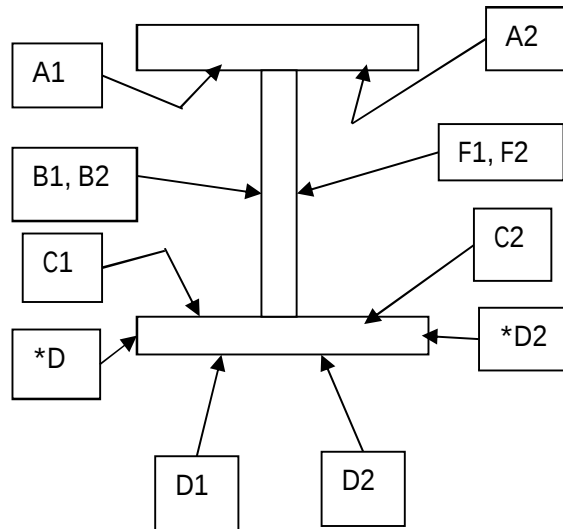


*D areas are only included when flange thickness is one inch (1") or greater.

36" in height or greater and/or bottom flanges greater than 16" in width.

10 Spot Areas

30 Individual DFT Readings



*D areas are only included when flange thickness is one inch (1") or greater.

- (2) Two (2) random adhesion tests (1 test = 3 dollies) per span are conducted on interior surfaces in accordance with ASTM D4541 (Adhesion Pull Test) after the prime coat has been properly cured in accordance with ASTM D3363 (Pencil Hardness) with no less than 2H, and will be touched up by the Contractor. The required minimum average adhesion is 400 psi.
- (3) Cure of the intermediate and stripe coats shall be accessed by using the thumb test in accordance with ASTM D1640 (Curing Formation Test) prior to the application of any successive layers of paint.
- (4) One random Cut Tape adhesion test per span is conducted in accordance with ASTM D3359 (X-Cut Tape Test) on interior surface after the finish coat is cured. Repair areas shall be properly tapered and touched up by the Contractor.

18.0 ZONE PAINTING

If any girder has excessive corrosion along its bottom flange, beyond the distance of 1.5 times the depth of the beam or girder, at the bearing, the area of the affected girder indicated on the plans, and other girders as directed by the Engineer, shall be cleaned in accordance with the requirements of System 5 painting system. The horizontal limits of zone painting shall extend 12" beyond the maximum horizontal extent of web/flange corrosion. The vertical limits of zone painting shall extend 3" beyond the maximum vertical extent of web corrosion.

Areas designated for zone coating shall be primed and coated in accordance with System 5 as outlined in the *Structural Steel Shop Coatings Program*.

System 5 is one coat of primer, one intermediate acrylic coat, one stripe coat of paint, and one topcoat of paint and over non-weathering steel surfaces cleaned to an SSPC SP-6 finish.

Painting shall be performed in accordance with Section 442 and Section 1080 of the *Standard Specifications*, and/ or these special provisions; the more restrictive requirement shall apply. Perform all mixing operations over an impervious surface with provisions to prevent runoff to grade of any spilled material.

19.0 SAFETY AND ENVIRONMENTAL COMPLIANCE PLANS

Personnel access boundaries are delineated for each work site using signs, tape, cones, or other approved means. Submit copies of safety and environmental compliance plans that comply with SSPC QP 2 Certification requirements.

20.0 HEALTH AND SAFETY RESPONSIBILITIES

This project may involve toxic metals such as arsenic, lead, cadmium and hexavalent chromium. It is the contractor's responsibility to test for toxic metals and if found, comply with the OSHA regulations, which may include medical testing.

Ensure a "Competent Person" as defined in OSHA 29 CFR 1926.62; one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them; is on site during all surface preparation activities and monitors the effectiveness of containment, dust collection systems and waste sampling. Before any work begins, provide a written summary of the Competent Person's safety training.

Comply with Subarticle 442-14(B) of the *Standard Specifications*.

Comply with Subarticle 442-14(D) of the *Standard Specifications*. Ensure employee blood sampling test results are less than 50 micrograms per deciliter. Remove employees with a blood sampling test of 50 or more micrograms per deciliter from work activities involving any lead exposure.

An employee who has been removed with a blood level of 50 micrograms per deciliter or more shall have two (2) consecutive blood sampling tests spaced one week apart indicating that the employee's blood lead level is at or below 40 micrograms per deciliter before returning to work activities involving any lead exposure.

All OSHA recordable accidents that occur during the project duration are to be reported to the Engineer within twenty-four (24) hours of occurrence. In addition, for accidents that involve civilians or property damage that occurs within the work zone the Division Safety Engineer shall be notified immediately.

Prior to blasting operations, the Contractor shall have an operational OSHA approved hand wash station at each bridge location and a decontamination trailer at each bridge or between bridges unless the work is on the roadway, or the Contractor shall show reason why it is not feasible to do so and provide an alternative site as approved by the Engineer. The Contractor shall assure that all employees whose airborne exposure to lead is above the Permissible Exposure Limit (PEL) shall shower at the end of their work shift.

21.0 STORAGE OF PAINT AND EQUIPMENT

Provide a location for materials, equipment, and waste storage. Spread tarpaulins over all pavements and surfaces underneath equipment used for abrasive recycling and other waste handling equipment or containers. All land and or lease agreements that involve private property shall disclose to the property owner that heavy metals may be present on the Contractor's equipment. Prior to storing the Contractor's equipment on private property, provide a notarized written consent signed by the land owner received by the Engineer at least forty-eight (48) hours before using property. All storage of paint, solvents, and other materials applied to structures shall be stored in accordance with Subarticle 442-9(C) of the *Standard Specifications* or the manufacturers' requirements. The more restrictive requirements will apply.

22.0 UTILITIES

Protect all utility lines or mains that may be supported on, under, or adjacent to bridge work sites from damage and paint overspray.

23.0 MEASUREMENT AND PAYMENT

Cleaning and Painting of Existing Weathering Steel includes the work and cost of inspection, surface preparation and repainting the existing structure, and is paid for at contract lump sum price bid for "Design and Construction of Bridge 50". This price is full compensation for furnishing all inspection equipment, all paint, cleaning abrasives, cleaning solvents and all other materials; preparing and cleaning surfaces to be painted; applying paint in the field; protecting work area, traffic and property; furnishing blast cleaning equipment, paint spraying equipment, brushes, rollers, any other hand or power tools and any other equipment.

Pollution Control will be paid at the contract lump sum price bid for “Design and Construction of Bridge 50” which will be full compensation for all collection, handling, storage, air monitoring, and disposal of debris and wash water, all personal protective equipment, and all personal hygiene requirements, and all equipment, material and labor necessary for the daily collection of the blast debris into specified containers; and any measures necessary to ensure conformance to all safety and environmental regulations as directed by the Engineer.

Painting Containment will be paid at the contract lump sum price bid for “Design and Construction of Bridge 50” and will be full compensation for the design, materials, installation, maintenance, and removal of the containment system.

POLYESTER POLYMER CONCRETE BRIDGE DECK OVERLAY

(SPECIAL)

1.0 DESCRIPTION

This work consists of furnishing and placing a Polyester Polymer Concrete (PPC) overlay system with a High Molecular Weight Methacrylate (HMWM) resin primer on concrete surfaces. The surface of the concrete shall be prepared and the PPC overlay system shall be applied in accordance with this provision in conformity with the lines, grades, thickness, and typical cross-sections shown on the plans or as approved by the Engineer.

Work includes: placement of HMWM primer; placement of PPC surface patching and/or overlay; and any incidentals necessary to complete the project as specified or as shown on the plans.

The System Provider is the manufacturer that will provide the PPC system for the PPC overlay. System shall include the necessary and appropriate PPC components, including but not limited to polyester resin binder, aggregate, and primer, as well as the necessary and appropriate HMWM resin primer components. Contractor shall not change System Provider during project, without approval from the Engineer.

2.0 QUALIFICATIONS AND SUBMITTALS

The Contractor shall submit the following requested items and any other relevant documents at least two weeks prior to the PPC Overlay Pre-placement Conference. These submittals are for approval and shall be directed to the Engineer.

- A. Overlay System: The Contractor shall submit two copies of the System Provider's material information, written installation instructions, safety data sheets, and independent test results for approval.
- B. System Provider Qualifications: The Contractor shall install an overlay system with all components provided through a single System Provider with documented experience successfully supplying at least 5 PPC overlay projects of similar size and scope within the past 5 years. The Contractor shall submit documentation of the System Provider's project experience including the following:
 - 1) Project Location
 - 2) Owner Agency
 - 3) Project construction date
 - 4) Overlay quantities
 - 5) Reference name and contact information for owner representative
- C. Contractor Qualifications: The Contractor shall submit documentation of successful projects placing structural concrete bridge decks, modified concrete bridge deck overlays, or PPC overlay systems to finished grade using similar equipment as specified herein within the past 5 years. A minimum of two (2) employees on site must have the equivalent work experience qualifications of the Contractor. The documentation of Contractor's qualifications shall include the following:
 - 1) Project Location
 - 2) Owner Agency
 - 3) Project construction date

- 4) Overlay quantities
- 5) Reference name and contact information for owner representative

D. System Provider Technical Representative Qualifications: The System Provider Technical Representative shall have a minimum of 5 years of experience with PPC and be completely competent in all aspects of the work, including surface preparation, mixing, placement, curing, and testing of the PPC Overlay System. The Technical Representative shall have experience on a minimum of 5 successful projects of similar size and scope. The Contractor shall submit documentation of the System Provider Technical Representative's experience including the following:

- 1) Years of Experience with PPC
- 2) Project location
- 3) Project construction date
- 4) Overlay quantities
- 5) Reference name and contact information for owner representative

The Technical Representative shall be available on site, for a minimum of three (3) days per project, to give the installer advice and guidance on the installation of PPC. This includes, but not limited to deck concrete surface preparation, PPC application, and PPC cure.

E. Overlay Placement Plan: The Contractor shall submit an Overlay Placement Plan that includes the following:

- 1) Schedule of overlay work and testing for each bridge
- 2) Anticipated concrete deck repair locations and repair method
- 3) Staging plan describing overlay placement sequence including:
 - a) Construction joint locations. Longitudinal construction joints between passes shall be located along the centerline or edge of final travel lanes.
 - b) Sequence of placement
 - c) Placement widths
 - d) Anticipated placement lengths
 - e) Placement direction
 - f) Joint locations
 - g) Location of proposed trial overlay(s)
- 4) Description of equipment used for:
 - a) Surface preparation including grinding and shotblasting
 - b) Applying HMWM Primer resin
 - c) Measuring, mixing, placing, and finishing the PPC
 - d) Applying surface finish sand
- 5) Method of protecting and finishing inlets and bridge drains
- 6) Method for isolating expansion joints
- 7) Method for measuring and maintaining overlay thickness and profile
- 8) Cure time for PPC based on range of temperatures expected during construction
- 9) Storage and handling of HMWM resin and PPC components
- 10) Procedure for disposal of excess HMWM resin, PPC, and containers
- 11) Procedure for cleanup of mixing and placement equipment

F. Equipment: The Contractor shall submit documentation of current certification that mixing equipment has been calibrated (Caltrans California test CT 109 or similar

accepted). The Contractor shall submit a documented history of the use of the placement equipment to successfully place PPC overlays on bridge projects for review and approval by the Engineer.

3.0 MATERIALS

The PPC shall consist of polyester resin binder and aggregate as specified below. It shall also include a compatible primer which when mixed with other specified ingredients and applied as specified herein, is capable of producing a PPC meeting the requirements of this specification.

- 1) Verification. The Contractor shall submit a Certified Test Report from independent labs for all of the materials associated with the PPC overlay in accordance with this special provision.
- 2) Packaging and Shipment. All components shall be shipped in strong, substantial containers, bearing the manufacturer's label specifying batch/lot number, brand name, and quantity. If bulk resin is to be used, the contractor shall notify the Engineer in writing 10 days prior to the delivery of the bulk resin to the job site. Bulk resin is any resin that is stored in containers in excess of 55 gallons.
- 3) Sampling. NCDOT reserves the right to retain and test samples of components of the PPC Overlay system. This includes requiring submittal of samples prior to the first installation or on-site sampling during construction.
- A. Polyester Resin Binder: Polyester resin binder shall have the following properties:
 - 1) Be an unsaturated isophthalic polyester-styrene co-polymer. The resin content shall be 12% +/-1% of the weight of the dry aggregate.
 - 2) Contain at least 1 percent by weight gamma-methacryloxypropyltrimethoxysilane, an organosilane ester silane coupler.
 - 3) Be used with a promoter that is compatible with suitable methyl ethyl ketone peroxide and cumene hydroperoxide initiators.
 - 4) Meet the required values for the material properties shown in Table 1, below.

Accelerators or inhibitors may be required to achieve proper setting time of PPC. They shall be used as recommended by the overlay System Provider.

Table 1
POLYESTER RESIN BINDER PROPERTIES
(Each lot sent to job shall be tested)

Property	Test Method	Requirement
Viscosity*	ASTM D 2196	75 – 200 cps (RVT No.1 Spindle, 20 RPM at 77 °F)
Specific Gravity*	ASTM D 1475	1.05 to 1.10 at 77 °F
Elongation	ASTM D 638	35 percent, minimum Type I specimen, thickness 0.25 ± 0.03” at Rate = 0.45 inch/minute.
	ASTM D 618	Sample Conditioning: 18/25/50+5/70

Tensile Strength	ASTM D 638	2,500 psi, minimum Type I specimen, thickness 0.25 ± 0.03" at Rate = 0.45 inch/minute.
	ASTM D 618	Sample Conditioning: 18/25/50+5/70
* Test shall be performed before adding initiator.		

- B. High Molecular Weight Methacrylate (HMWM) Primer: Primer for the substrate concrete surface shall be a wax-free, low odor, high molecular weight methacrylate primer, and consist of a resin, initiator, and promoter. The primer shall conform to requirements indicated in Table 2, below, and all components shall be supplied by the System Provider.

Initiator for the methacrylate resin shall consist of a metal drier and peroxide. If supplied separately from the resin, the metal drier shall not be mixed with the peroxide directly; a VIOLENT EXOTHERMIC REACTION will occur. The containers and measuring devices shall not be stored in a manner that allows leakage or spilling to contact the containers or materials of the other.

Table 2
HIGH MOLECULAR WEIGHT METHACRYLATE RESIN PROPERTIES
(Tested yearly)

Property	Test Method	Requirement
Viscosity**	ASTM D 2196	25 cps maximum (Brookfield RVT with UL adapter, 50 RPM at 77 °F)
Volatile Content**	ASTM D 2369	30 percent, maximum
Specific Gravity**	ASTM D 1475	0.90 minimum at 77 °F
Flash Point	ASTM D 3278	180 °F minimum
Vapor Pressure**	ASTM D 323	1.0 mm Hg, maximum at 77 °F
PCC Saturated Surface-Dry Bond Strength (Adhesive)	California Test 551, part 5	700 psi, minimum at 24 hours and 70 ± 1°F (with PPC at 12% resin content by weight of the dry aggregate), primed surface
**Test shall be performed before initiator is added		

- C. Aggregates: PPC aggregate shall have the following properties:

- 1) No more than 45 percent crushed particles retained on the No. 8 sieve when tested in accordance with AASHTO Test Method T335.
- 2) Fine aggregate consists of natural sand only.
- 3) Weighted-average aggregate absorption of no more than 1.0 percent when tested under AASHTO Test Methods T84 and T85.
- 4) At the time of mixing with resin, have moisture content of not more than one-half of the weighted-average aggregate absorption when tested under AASHTO Test Method T255.
- 5) Moh's hardness of 7 or greater.
- 6) Comply with the requirements for the aggregate gradation indicated in Table 3, below:

Table 3
AGGREGATE GRADATION
(Tested yearly)

Sieve Size	Percent Passing
3/8"	100
No. 4	60-85
No. 8	55-65
No. 16	29-50
No. 30	16-36
No. 50	5-20
No. 100	0-7
No. 200	0-3

Sand for abrasive sand finish shall have the following properties:

- 1) Commercial-quality blast sand.
- 2) Not less than 95 percent pass the No. 8 sieve and not less than 95 percent retained on the No. 20 sieve when tested under AASHTO Test Method T27.
- 3) Shall be dry at the time of application.

D. Composite system: The composite PPC system shall have the following properties indicated in Table 4, below:

Table 4
COMPOSITE PROPERTIES
(Tested every 2 years)

Property	Test Method	Requirement
PCC Saturated Surface Dry Bond Strength	CT 551	500 psi minimum at 24 hrs. and 70° F (without primer, at 12% resin content by weight of the dry aggregate, on Saturated Surface Dry Specimen)
Abrasion Resistance	CT 550	<2g weight loss (at 12% resin content by weight of the dry aggregate)
Modulus of Elasticity	ASTM C 469	1,000,000 psi to 2,000,000 psi (at 12% resin content by weight of the dry aggregate)

4.0 CONSTRUCTION REQUIREMENTS

- A. PPC Overlay Pre-placement Conference: A Pre-placement Conference shall be held before any overlay operations begin. Attendees shall include representatives from all parties involved in the work. If necessary, teleconferencing of attendees may be approved by the Engineer.
- B. Trial Application: Prior to constructing the overlay, one or more trial applications shall be placed on a previously constructed concrete base to demonstrate proper initial set time and the effectiveness of the mixing, placing, and finishing equipment proposed. The set time can be determined as the time elapsed from resin catalyzation until the in-place PPC cannot be deformed by pressing with a finger, indicating the resin binder is no longer in a liquid state. Each trial application shall be the planned paving width, at least 10 feet long, and the same thickness as the specified overlay. Conditions, including but not limited to temperature and humidity, during the construction of the trial application(s) and equipment used shall be similar to those to be used for construction of the overlay. The location of the trial application(s) shall be approved by the Engineer. Trial applications shall be properly disposed of off-site by the Contractor, if removal is necessary.

The number of trial applications required shall be as many as necessary for the Contractor to demonstrate the ability to construct an acceptable trial overlay section and competency to perform the work. However, the installer or proposed equipment/techniques may be rejected if not shown to be acceptable after three (3) trials.

Overlay tensile bond testing shall be performed in accordance with the acceptance testing herein. Vertical axis pull bond tests shall be performed after 24 hours by the Contractor in accordance to ACI 503R-30. At a minimum, 2 pull bond tests shall be performed on each Trial Application. Acceptable test results shall be achieved on a Trial Application before the installation may proceed on the bridge. Tensile bond testing shall be performed by an independent testing firm and shall be arranged by the Contractor, cost to be included in bid price for *Placing and Finishing PPC Overlay* item.

- C. Equipment: All equipment for cleaning the existing concrete surface and mixing and applying the overlay system shall be in accordance with the System Provider's recommendations, as approved by the Engineer prior to commencement of any work.
 - 1) Surface Preparation Equipment: Provide appropriate scarifying, shotblasting, sandblasting and other equipment to adequately prepare the bridge deck substrate, as required in the Overlay Surface Preparation for Polyester Polymer Concrete special provision.
 - 2) Mixing Equipment: A continuous automated mixer shall be used for all PPC overlay applications. The continuous mixer shall:
 - a. Employ an auger screw/chute device capable of sufficiently mixing catalyzed resin with dry aggregate.
 - b. Employ a plural component pumping system capable of handling polyester binder resin and catalyst while maintaining proper ratios to achieve set/cure times within the specified limits. Catalyzed resin shall flow through a static mix tube for sufficient duration to completely mix the liquid system.

- c. Be equipped with an automatic metering device that measures and records aggregate and resin volumes. Record volumes at least every five minutes, including time and date. Submit recorded volumes at the end of the work shift to the Engineer.
- d. Have a visible readout gage that displays volumes of aggregate and resin being recorded.
- e. Produce a satisfactory mix consistently during the entire placement.

A portable mechanical mixer of appropriate size for proposed batches, as recommended by the System Provider and approved by the Engineer, may be used for all PPC patching applications and for smaller area overlay applications if approved by the Engineer.

- 3) Finishing Equipment: Finishing may be accomplished with a Self-Propelled Slip-Form Paving Machine.

Self-Propelled Slip-Form Paving Machine

A self-propelled slip-form paving machine, which is modified or specifically built to effectively place the PPC overlay in a manner that meets the objectives and requirements of the project, shall be used for major PPC overlay applications. The paving machine shall:

- a. Employ a vibrating pan to consolidate and finish the PPC.
- b. Be fitted with hydraulically controlled grade automation to establish the finished profile. The automation shall be fitted with substrate grade averaging devices on both sides of the new placement; the device shall average 15 feet in front and behind the automation sensors; or the sensor shall be constructed to work with string-line control. It is acceptable to match grade when placing lanes adjacent to previously placed PPC.
- c. Have sufficient engine power and weight to provide adequate vibration of the finishing pan while maintaining consistent forward placement speed.
- d. Be capable of both forward and reverse motion under its own power.

Vibratory Screed

A vibratory screed may be used for finishing PPC on smaller projects (generally less than 6000 ft² of bridge deck area), but must be approved by the Engineer at least two weeks prior to PPC placement.

- D. Concrete Deck Repairs and Surface Preparation: All areas that require removal of existing patches or unsound concrete shall be removed and prepared in accordance with the requirements of the Overlay Surface Preparation for Polyester Polymer Concrete special provision. Placement of concrete deck repair material shall be in accordance with this special provision. Prepare all concrete deck and repaired deck surfaces in accordance with the requirements of the Overlay Surface Preparation for Polyester Polymer Concrete special provision.
- E. Application of Overlay: Methods indicated in this specification are typical of general installations and may be modified per the System Provider's recommendations as approved by the Engineer. The application of the overlay shall not begin until the concrete deck is completely surface dry in accordance with ASTM D4263, with a wait

time revised from 16 hours to 2 hours, or as directed by the System Provider's Technical Representative. The concrete surface temperature shall be between 40° and 100° F. Night work may be required when temperatures cannot be met during the day.

During overlay application, precaution shall be taken to assure that traffic is protected from rebound, dust, and construction activities. Appropriate shielding shall be provided as required and directed by the Engineer.

During overlay application, the Contractor shall provide suitable coverings (e.g. heavy duty drop cloths) as needed to protect all exposed areas not to receive overlay, such as curbs, sidewalks, parapets, etc. All damage or defacement resulting from this application shall be cleaned and/or repaired to the Engineer's satisfaction at no additional cost.

- 1) HMWM Primer Application: Immediately before placing primer, all exposed surfaces shall be completely dry and blown clean with oil-free compressed air. Exposed surfaces shall be protected from precipitation and heavy dew during and after the application of the primer.

After the exposed surfaces have been prepared and are dry, primer shall be applied in accordance with the System Provider's recommendations. Primer shall be placed within 5 minutes of mixing at approximately 90 ft²/ gal or the rate acceptable to the Engineer.

Primer shall be applied by flooding and uniformly spread to completely cover surfaces to receive overlay. Care shall be taken to avoid heavy application that results in excess puddling. Excess material shall be removed or distributed to meet the required application rate. Primer shall be reapplied to any areas that appear dry prior to overlay placement.

Primer shall not be allowed to leak onto areas that have not received surface preparation.

- 2) PPC Application: The PPC shall be applied during the interval between 15 minutes and 2 hours after the primer has been applied. The PPC shall be placed prior to gelling and within 15 minutes following addition of initiator, unless otherwise recommended by the System Provider's Technical Representative.

The polyester resin binder shall be initiated and blended completely. Aggregate shall be added and mixed sufficiently when a portable mechanical mixer is used.

PPC shall have an initial set time of at least 30 minutes and at most 90 minutes. The set time can be determined in the field when the in-place PPC cannot be deformed by pressing with a finger, indicating that the resin binder is no longer in a liquid state. If the initial set is not within 30 to 90 minutes, the material shall be removed and replaced in a manner recommended by the System Provider.

The overlay shall be consolidated and finished to the required grade and cross-section using PPC placement equipment as defined herein.

If a vibratory screed is used, prior to placing the PPC, place and fasten screed rails in position to ensure finishing the new surface to the required profile. Do not treat screed rails with parting compound to facilitate their removal. Prior to placing the

overlay, attach a filler block to the bottom of the screed and pass it over the overlay area to check the thickness. The filler block thickness shall be equal to the design overlay thickness as shown in the plans. Remove all concrete that the block does not clear.

Place the PPC in one operation. Provide a minimum overlay thickness as shown in the plans.

Although the paver or screed may yield a finished or nearly finished surface, additional finishing may be necessary. PPC shall be finished, as necessary, through traditional concrete finishing methods, producing a slight resin bleed indicating complete consolidation of aggregates.

Finishing of PPC used as patching of an existing deck surface or overlay shall be completed and finished using traditional concrete hand finishing methods and hand concrete finishing tools. Such patches shall be placed flush with the top of the existing deck surface.

Resin content shall be as specified in the Materials section of this special provision and to yield a PPC consistency that requires surface applied consolidation and finishing to consolidate aggregates and yield a slight sheen of bleed resin on top surface, yet does not yield excess bleed resin.

A surface friction sand finish of at least 2.2 lbs/ yd² shall be broadcast onto the glossy surface immediately after sufficient finishing and before resin gelling occurs. To ensure adequate pavement friction, the completed PPC overlay surface shall be free of any smooth or "glassy" areas such as those resulting from insufficient quantities of surface aggregate. Any such surface defects shall be repaired by the Contractor in the manner recommended by the System Provider and approved by the Engineer at no additional cost.

After application of surface friction sand, unless otherwise indicated on the plans, groove the bridge floor in accordance with Article 420-14(B) of the Standard Specifications. Vehicular traffic may travel across a deck surface that has not been grooved; however, the entire deck area shall be grooved after the PPC overlay achieves design strength and no later than seven days after completion of the overlay unless otherwise approved by the Engineer.

Before completion of the project, all deck joints shall be sawcut, prepared, and sealed according to the details in the plans.

After the PPC material has set, if final sawcutting for joint seals will not be done within 6 hours, a single sawcut, at minimum, shall be made at the approximate midpoint of each joint. The sawcut shall be made within 6 hours or prior to opening of PPC placement to traffic, if traffic will be allowed within 6 hours. Two sawcuts may be made, but final saw cutting for the joints shall be done in accordance with the special provisions for the installation of the joint seals.

If traffic is to be returned to the site, but the overlay is not completed within the allowable lane closure time and is more than $\frac{3}{4}$ inch higher in elevation than the adjacent pavement, the PPC overlay edges shall be tapered. Tapered edges transverse to the direction of traffic and on the leading edge of the overlay shall be

at a 4:1 (horizontal: vertical) slope. Tapered edges transverse to the direction of traffic and on the trailing edge of the overlay and tapered edges longitudinal to the direction of traffic shall be at a 45 degree slope. Tapers of 45 degrees may remain, and PPC overlay may be placed adjacent. Tapers with a slope gentler than 45 degrees shall be sawcut square to the overlay surface, prior to placing adjacent PPC overlay.

The Contractor shall collect a ticket for each pass or portion of a pass that is provided by each mixer, and ensure that the following information is shown on each ticket:

- a. Project Number
- b. Bridge Number
- c. Date and Time
- d. Location of Placement (Lane and Station Limits or location and length of placement along the length of the bridge)
- e. Aggregate Weight
- f. Polyester Resin Binder Weight

The tickets shall be available on site for Inspection personnel to use in tabulating quantities.

Curing: The Contractor shall allow the overlay to cure sufficiently before subjecting it to loads or traffic of any nature that may damage the overlay. Cure time depends upon the ambient and deck temperatures as well as initiator/accelerator levels.

The overlay shall be considered cured to a traffic ready state when a minimum reading of 25 on a properly calibrated Swiss hammer is achieved. Other rebound hammers may be use as approved by the Engineer.

F. Acceptance Testing: Acceptance of the deck repairs, surface preparation, and PPC overlay will be determined by the Engineer based on vertical axis bond tests, and smoothness quality testing performed by the Engineer, assisted by the Contractor.

- 1) Overlay Direct Tension Bond Testing: Vertical axis pull bond tests shall be performed after 24 hours by the Contractor in accordance to ACI 503R-30. At a minimum, 2 pull bond tests shall be performed on each bridge overlay. For bridges with deck areas greater than 25,000 square feet, additional tests shall be performed at a frequency of one test per 25,000 square feet of additional deck area, rounded up. Additional testing may be required as directed by the Engineer.

The test result shall be the average of the tests for each structure. Test cores shall be drilled a minimum of 0.25" but no greater than 0.50" below the bond line.

The minimum bond strength of the PPC overlay system on normal weight concrete shall be 250 psi. An acceptable test will demonstrate that the overlay bond strength is sufficient by producing a concrete subsurface failure area greater than 50% of the test surface area. The Contractor shall repair all bond test locations with PPC overlay in accordance with this specification.

- 2) Smoothness Quality Testing: As soon as practical after the PPC has hardened sufficiently, test the finished surface with an approved rolling straightedge that is

designed, constructed, and adjusted, so that it will accurately indicate or mark all deck areas which deviate from a plane surface by more than 1/8" in 10'. Remove all high areas in the hardened surface in excess of 1/8" in 10' with an approved grinding or cutting machine. Additionally, the final PPC deck surface shall not deviate from the line and elevation indicated on the plans by more than 0.3" over any 50' length. If approved by the Engineer, correct low areas in an acceptable manner in accordance with this provision and the System Provider recommendations.

G. Corrective Work

- 1) Repair of Surface Defects: The repair materials and finishing methods for surface defects in the overlay shall be in accordance to those used for the application of the overlay. All surface defects shall be repaired to the satisfaction of the Engineer before acceptance of the work is made.
- 2) Correction for Smoothness: Areas showing high spots of more than 1/8 inch in 10 feet shall be marked and diamond ground until the high spot does not exceed 1/8 inch in 10 feet. Ground surface may be sawcut grooved to restore the texture if ordered by the Engineer. Areas showing low spots of more than 1/8 inch in 10 feet shall be marked and prepared with shot blasting or sandblasting, primed, and filled with either catalyzed resin and broadcast sand or mixed PPC slurry material. The use of resin or mixed slurry material shall be as recommended by the System Provider and approved by the Engineer.
- 3) Replacement of Defective Overlay: A defective overlay, or portion thereof, resulting in failing overlay pull bond test results shall be removed and replaced at the Contractor's expense. The Contractor shall submit a written corrective work proposal to the Engineer, which shall include the methods and procedures that will be used. The Contractor shall not commence corrective work until the methods and procedures have been approved in writing by the Engineer. The Engineer's approval shall not relieve the Contractor of the responsibility of producing work in conformity with the Contract.
- 4) Repair of Cracking: After a one-week cure period, if cracks are in the overlay, the Contractor shall fill the cracks with properly catalyzed and mixed HMWM primer material at his own expense. Care shall be taken to fill the cracks only, and ensure minimal HMWM primer is left on the finished surface of the overlay.

5.0 MEASUREMENT AND PAYMENT

Concrete Deck Repair for PPC Overlay will be measured per square yard and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" and will be full compensation for placement of concrete deck repair material and shall include the cost of labor, tools, equipment and incidentals necessary to complete the work.

PPC Materials will be measured per cubic yard as the actual volume of PPC material complete-in-place. The volume shall include material used for overlay, patching of existing unsound concrete deck surface or overlays, and bridge deck concrete repairs as directed by the Engineer. Tickets provided to the project inspector, showing quantities of

PPC produced, shall be sufficient to calculate volume of material placed. Materials placed for Trial Overlay shall be included in Pay Quantity if placed and remaining on the bridge deck as part of the permanent overlay. *PPC Materials* will be paid for at the contract lump sum price bid for “Design and Construction of Bridge 50” and will be full compensation to furnish the PPC material, including HMWM primer, freight to the project site, receiving, storage, and disposal of any unused PPC overlay material.

Placing and Finishing PPC Overlay will be measured per square yard as the quantity of final surface finishing. Payment will be full compensation for all labor, equipment, and all incidentals necessary to complete the PPC overlay placement and will be paid for at the contract lump sum bid price for “Design and Construction of Bridge 50”. Construction and removal (if required) of Trial Overlay, including concrete base surfaces, will be considered incidental to the work and no separate payment will be made.

PREPARATION FOR THE REHABILITATION WORK FOR BRIDGE #50 (SPECIAL)

DRAFT

1.0 GENERAL

Complete rehabilitation work using qualified personnel with adequate preparation for performing the repairs.

Prepare an appropriate mockup for each specific repair type to the satisfaction of the Engineer prior to executing the work. Demonstrate the ability to perform the repairs on the mockups prior to performing the repairs on the structure members that will be rehabilitated.

Clear vegetation from the bridge superstructure and substructure. Care shall be taken to not damage the structure during vegetation removal.

Perform bond-strength tests on mock repairs, as described herein.

Take 1 concrete core from each pier below the waterline to test for compressive strength.

Use materials that are approved for use for the specific intended application by the NCDOT Materials and Tests Unit.

2.0 MOCKUPS

Prior to executing the repair work, prepare a mockup for each repair type using test samples fabricated by the contractor to simulate the actual defects on the bridge. Mockups may be created using damaged concrete from this bridge. Damage shall be of similar type and extent to the damage that will be repaired in the structure. Perform a mockup for each of the following repair types:

- A. Epoxy Resin Injection
- B. Epoxy Mortar Repair
- C. Concrete Repair
- D. Underwater Repair
- E. Silane Coating, one for each of barrier, deck (if silane material used is different), and substructure
- F. Structural Epoxy Grout Jacket
- G. Epoxy Coating of Substructure

The contractor shall submit repair materials and methodology for horizontal, vertical, and overhead concrete repairs to the Engineer. Only one repair is required for the mockup, but

the contractor shall demonstrate to the satisfaction of the Engineer that adequate preparation has been made to perform all three repair types.

Each mockup shall be repaired in full accordance with the plans and special provisions documented for the repair. Follow all manufacturer's written recommendations.

3.0 SILANE TREATMENTS FOR DECK AND BARRIER

Test treatment areas shall be developed for the silane treatments to be applied to the bridge deck soffit at the overhang and on the barrier rail. These tests shall demonstrate the adhesion and construction process to be used prior to actual application of the treatments.

For the Silane Treatments for Deck, a 2ft x 2ft portion of the underside of the overhang at and end bent shall be identified for the test treatment area. For the Silane Treatments for Barrier, a 2ft long test section of the barrier end block at each end bent. The test shall be performed on the outside (non-traffic) face of the barrier.

The Engineer shall be permitted to observe the treatment area and comment on its selection prior to the test treatment. The test area shall be protected and surrounding areas, including vegetation and traffic, shall be protected from the test work in accordance with the special provision. The test area shall be prepared to receive the respective Silane Treatments in accordance with each's special provision, and the Silane Treatment shall be applied and allowed to dry in accordance with material manufacturer guidelines. Once completed and allowed to dry a minimum of 5 days, the test area shall demonstrate even application of the silane treatment, as demonstrated with a water test. Water shall be sprayed at a rate of 5 gal/minute uniformly over the treated area for 1 minute. Observe that the water is repelled by the treated concrete uniformly. Nonuniformity shall be cause for rejection, and the test shall be repeated until the method can provide for uniform coverage.

4.0 SILANE TREATMENTS FOR SUBSTRUCTURE AND REPAIRED AREAS

For silane treatments applied to the substructure, it shall be demonstrated that the silane treatment bonds with Concrete Repair and Concrete Jacket Repair materials. This shall be accomplished by performing a Silane Treatment application test on mockups of Concrete Repair areas and Concrete Jackets. These tests shall be performed prior to any Concrete Repairs, Concrete Jackets, or Silane Coatings.

For Concrete Repairs, a mockup may be constructed or an actual defect on an End Bent Cap or Backwall may be selected to serve as the mockup. The minimum mockup size shall provide for a 2ft x 2ft treatment area. If an actual defect is selected to serve as the mockup, the Concrete Repair shall be performed and completed at that location prior to the Silane Treatment test. Concrete Repair materials shall be tested prior for Bond Strength, as described in Section 5.0, and the Concrete Repair material used in the test shall be that selected for the repairs throughout the bridge. The mockup shall be prepared in accordance with the Silane Treatment for Substructure Special Provision.

For Concrete Jacket Repairs, a test specimen shall be constructed of like materials used for the Concrete Jacket Repair to a minimum size of that provides a 2ft x 2ft treatment area. The Concrete Jacket Repair test shall be allowed to fully cure prior to conducting the test. The test shall be prepared to receive the Silane Treatment in accordance with the applicable portion of the Silane Treatment for Substructure Special Provision.

For both test specimens, the Silane Treatment shall be applied and allowed to dry in accordance with material manufacturer guidelines. Once completed and allowed to dry a minimum of 5 days, the test area shall demonstrate even application of the silane treatment, as demonstrated with a water test. Water shall be sprayed at a rate of 5 gal/minute uniformly over the treated area for 1 minute. Observe that the water is repelled by the treated concrete uniformly and with complete coverage. Nonuniformity shall be cause for rejection, and the test shall be repeated until the method can provide for uniform coverage.

5.0 TEST OF BOND STRENGTH

Epoxy Mortar Repairs, Concrete Repairs, and Epoxy Coating (Substructure) repairs that will be applied to the substructure (original concrete and previously epoxy-coated areas) shall be tested for appropriate bond strength to the substrate concrete. This shall be accomplished by performing Bond Strength Tests in accordance with ASTM C1583 on select locations of actual repairs.

For bond strength tests, the following scenarios shall be evaluated:

1. Epoxy Mortar Repairs on Original Substructure Concrete and on Previously-Epoxy-Coated Concrete.
2. Concrete Repairs on Original Substructure Concrete.
3. Epoxy Coating (Substructure) on Original Substructure Concrete and on Previously-Epoxy-Coated Concrete.

For each scenario, a location of this type of repair shall be selected on the bridge to evaluate the bond strength between the repair material and the substrate. For repairs performed over Previously-Epoxy-Coated concrete, a Bond-Strength test shall be performed at a minimum of one location for each bent and end bent. For repairs performed on original substructure concrete, a Bond-Strength test shall be performed at minimum of one location on the bridge. The test location(s) shall be coordinated with the Engineer and all tests performed prior to any additional repair work involving these types of repairs.

For Epoxy Mortar Repairs and Concrete Repairs on original concrete, Bond-Strength tests shall be performed in accordance with ASTM C1583. At each test location, 3 tests shall be performed as directed in the Standard. Each test shall be conducted over sound original (substrate) concrete, and clearly identified and numbered for that test location. The Engineer shall verify that the locations selected represent a consistent quality of original concrete. Reinforcement shall be located at each test location and clearly identified on the concrete, in such a way that the reinforcing location can be clearly determined after the repair is made. The location with respect to the individual test spot and cover depth of reinforcement shall be recorded. Tests may not be performed within 1 inch of a located rebar. The center-to-center spacing of tests within a location shall be at least 2 disk diameters, and shall be at least 2 disk diameters from the edge of the repair. Epoxy Mortar Repairs and Concrete Repairs shall be performed in accordance with their respective Special Provisions. Once the repair is complete, the Bond-Strength test shall be set-up and performed, and the results for the 3 tests at each location recorded. The failure mechanism shall be the tensile failure of the substrate concrete. If the failure occurs in the Repair material or at the bond interface to the substrate concrete, the Repair shall be rejected and the repair shall be removed and reconstructed.

For Epoxy Mortar Repairs on previously-epoxy-coated concrete, Bond-Strength tests shall be performed in accordance with ASTM C1583. At each test location, 3 tests shall be performed as directed in the Standard. Each test shall be conducted over sound existing epoxy, and clearly identified and numbered for that test location. The Engineer shall verify that the locations selected represent a consistent quality of existing epoxy. Reinforcement shall be located at each test location and clearly identified on the concrete, in such a way that the reinforcing location can be clearly determined after the repair is made. If, at a repair location, the reinforcement cannot be located or readings indicate deteriorated reinforcing, that area shall have all existing epoxy removed and the repair be performed as a "Concrete Repair" in accordance with the Special Provision. The test location with respect to the individual test spot and cover depth of reinforcement shall be recorded. Tests may not be performed within 1 inch of a located rebar. The center-to-center spacing of tests within a location shall be at least 2 disk diameters, and shall be at least 2 disk diameters from the edge of the repair. Epoxy Mortar Repairs and Concrete Repairs shall be performed in accordance with their respective Special Provisions. Once the repair is complete, the Bond-Strength test shall be set-up and performed, and the results for the 3 tests at each location recorded. In this case, the "Substrate" for purposes of the test shall be the original concrete, not the existing epoxy coating. The circular cut shall extend a minimum of 0.5in into the original concrete. The failure mechanism shall be the tensile failure of the substrate concrete. If the failure occurs in the Repair material, existing epoxy, or at the bond interfaces between the Repair Material, existing epoxy or original concrete, the Repair

shall be rejected, the existing epoxy removed, and the repair re-done as a Concrete Repair on original concrete.

In all cases, care shall be taken to minimize disturbance outside of the test location. Following tests, the core hole shall be repaired with Epoxy Mortar and finished to match the surrounding finished repair. This work shall be considered incidental to the various repair items.

For vertical tests, care shall be taken to restrain the testing apparatus. Drilling into the existing concrete shall not be permitted to hold-down the apparatus. Clamps and other means to secure the apparatus shall be described in the plan of work and submitted to the Engineer prior to performing the tests.

6.0 COOPERATION

The contractor shall appoint a Foreman for each repair type. The name and qualifications of the Foreman shall be submitted prior to performing the mockup. The Foreman shall perform the work utilizing the repair crews that will be performing the structure repairs on the bridge.

The Foreman shall direct the fabrication of the mockups in the presence of the Engineer and the Technical Representative of the material manufacturer for satisfactory performance of the work.

7.0 TESTING

Following acceptance of the mockups by the Engineer, the contractor shall make the mockups available to The North Carolina Department of Transportation Materials and Tests Unit for evaluation. Within 30 days of acceptance of the mockups by the Engineer, the Materials and Tests Unit shall notify the contractor in writing of its desire to evaluate the mockups. If the Materials and Tests Unit does not provide written notification within the allotted schedule, the rights to the mockups shall be waived and the contractor may dispose of the mockups.

8.0 DISPOSAL

Dispose of all mockup members and materials not claimed by the Materials and Tests Unit in accordance with Section 402-2 of the Standard Specifications.

9.0 BASIS OF PAYMENT

No separate payment shall be made for the work noted in this section. Payment for the preparation to perform each rehabilitation item shall be included in the cost of "Design and Construction of Bridge 50."

REPLACEMENT OF NAVIGATION SIGNS ON COLUMNS

(SPECIAL)

1. DESCRIPTION AND SCOPE OF WORK

This provision addresses replacing the navigation signs on the bent columns in the water. Place signs on the north and south faces of Piers 1 through 5 columns following completion of the rehabilitation work for the piers.

2. COORDINATION AND DESIGN OF SIGNS

Navigation signs shall be diamond shaped Danger signs. The size, content, color, reflectivity, materials, locations from waterline, and any other design consideration shall be in accordance with United States Coast Guard requirements.

3. ATTACHMENT OF SIGNS TO THE COLUMNS

At all locations designed for a sign, signs shall be permanently affixed to the columns by use of epoxy anchors at the conclusion of all substructure rehabilitation work. Signs shall be installed in coordination with the operator of the lake. Concrete substrate shall be sound, and no sign shall be installed over a repaired area. Four anchors shall be used, one anchor at each corner of the sign. The contractor shall submit plan for the attachment for approval a minimum of two weeks prior to installation. The submittal shall include, at a minimum, physical and graphical design of the sign, locations, type and quantity of anchors, and installation methods. Anchors shall be suitable for the size of the sign, and shall be designed to each withstand a minimum of 500lbs of tension. Care shall be taken to not damage any repairs or existing concrete, and any damaged areas shall be repaired to the satisfaction of the Engineer at no additional cost. The Engineer shall inspect and approve each sign installation.

4. MEASUREMENT AND PAYMENT

Replacement of Navigational Signs on Columns will be measured and paid for at the contract lump sum bid price for "Design and Construction of Bridge 50" and will be full compensation for coordination and design of signs, fabrication of signs, installation hardware, and installation.

SILANE TREATMENTS

(SPECIAL)

1.0 DESCRIPTION

This work consists of preparation of bent column, barrier rail, and deck overhang soffit surfaces and the furnishing and application of alkylalkoxysilane (silane) penetrant sealers, with 100% solids, to seal those surfaces and cracks. Prepare the surfaces and apply the silane treatments in accordance with this special provision and as indicated on the plans, or as approved by the Engineer.

Work includes: substructure surface preparation, placement of silane penetrant sealer, appropriate removal and disposal of excess and waste material, and any incidentals necessary to complete the project, as specified or as indicated on the plans.

2.0 SUBMITTALS

Submit for approval the following requested items and any other relevant documents:

- A safety data sheet (SDS) for each shipment of the silane materials.
- Silane material information and manufacturer's written preparation and application instructions.
- Certification from an independent testing laboratory that the materials meet the requirements of these provisions. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material.
- The dates of manufacture of the silane materials, their lot numbers and date of shelf-life expiration for each lot number.
- A table indicating the likely cure time, in minutes, to allow vehicular traffic on the bridge where the concrete barrier rail surface has been treated. Provide time for the allowable ambient temperature range, in increments of 10° F.
- A work plan for each structure that includes estimated times for surface preparation and silane application.

3.0 MATERIAL DELIVERY AND STORAGE

Store at the site sufficient quantities of silane materials to perform the entire application.

Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Ensure that each container is clearly marked by the manufacturer with the following information:

- a. Manufacturer's name and address.
- b. Product name.
- c. Date of manufacture.
- d. Expiration date.
- e. LOT identification number.
- f. Container serial number.

Provide the Engineer a certification from the manufacturer, confirming that the silane materials meet the requirements of this special provision. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material. Submit such certification for each LOT of material delivered to the project. In each certification, identify the serial or LOT numbers of the containers certified.

The Engineer may require samples from each LOT or container of materials delivered to the project or from containers at the point of use. When samples are required, furnish samples in accordance with the Engineer's instructions.

Store silane materials in unopened containers in a clean, dry area between 40° F and 90° F. Store containers in a manner that prevents leakage or spillage.

4.0 MANUFACTURER'S REPRESENTATIVE

Provide a manufacturer's representative on site for the duration of the surface preparation and silane application work, to provide expert assistance on surface preparation, storage, mixing, application, clean-up, and disposal of materials.

5.0 MATERIALS

Provide silane from a single manufacturer, and provide silane that conforms to requirements indicated in Table 1, below.

**Table 1
SILANE PROPERTIES**

Property	Test Method	Requirement
Silane Content		100%
VOC content	EPA method 24	Less than 350 g/l
Surface Appearance after Application		Unchanged
Flash Point	ASTM D3278	140° F, minimum
Resistance to Chloride Ion Penetration	AASHTO T259 and T260	Less than: 0.52 pounds/yd ³ (criteria of 1.5) at 1/2 inch level; 0.00 pounds/yd ³ (criteria of 0.75) at 1 inch level
Water absorption test	ASTM C 642	0.50% maximum/48 hours; 1.5% maximum/50 days
Scaling resistance	ASTM C 672	(non-air-entrained concrete) 0 rating "No Scaling" (100 cycles)
NCHRP 244		

Water weight gain	Series II - cube test	85% reduction, minimum
Absorbed chloride		87% reduction, minimum
Absorbed chloride	Series IV - Southern climate	95% reduction, minimum

6.0 SURFACE PREPARATION

Prepare the bridge concrete barrier rail surfaces for application of the silane in order to remove all existing grease, slurry, oils, paint, dirt, striping, curing compound, rust, membrane, weak surface mortar, or any other contaminants that could interfere with the proper adhesion, penetration, and the curing of the silane material.

Prepare a final surface that adheres to the following requirements:

- 1) For areas to receive silane treatment, clean by sandblasting or shotblasting. Select the size of shot or sand, and travel speed of the equipment to provide a uniformly clean surface with a uniform profile. Do not expose cleaned surfaces to vehicular or construction traffic unless approved by the Engineer. If the treatment surfaces become contaminated before placing the silane treatment, shotblast or abrasive sandblast the contaminated areas to the satisfaction of the Engineer, at no additional cost. Provide a containment system that will prevent blasting material from entering the water, surrounding environment, or vehicular areas
- 2) Powerwashing of surfaces will not be allowed.
- 3) Prior to silane application, protect cracks on treatment surfaces from materials that can interfere with the penetration and the curing of the silane material. Just prior to placement of the silane, remove, by magnets and oil-free compressed air and vacuuming, any loose particles, such that no excess particles remain.
- 4) Prior to silane application, treatment areas shall be completely dry.
- 5) The silane manufacturer may suggest cleaning and preparation methods other than those detailed by this special provision. The Engineer must approve such alternative methods prior to implementation.
- 6) The joints and deck surface, beams, and adjacent substructure areas not to receive treatment shall be protected during all preparation and silane application activities. Any damage caused to the deck or expansion joint shall be repaired to the satisfaction of the Engineer at no additional cost to the Department.

7.0 SILANE APPLICATION

Test Area

- For each location to be treated (barrier, deck soffit, and substructure), test a small area of the surface (minimum 5 ft. by 5 ft.) before general application to ensure desired performance results, aesthetics, and application rates and to verify

application technique. Allow 5–7 days for the product to react fully before evaluating. Application rates may vary depending on field conditions.

- Conduct at least one absorption test in the test area, using a Rilem Tube Test. Acceptable results are no loss of water in the Rilem tube over a period of 20 minutes. Adjust application to achieve required repellent performance.
- The manufacturer's representative shall assist the Contractor in determining the application rates. Use test applications on actual surfaces to determine accurate application rates. Extremely porous surfaces may require two coats of silane. This determination shall be made by the Engineer, and no additional compensation for a second coat will be paid.
- Do not begin production application of silane until Engineer has approved the test area, including approval of aesthetics, color, texture, and appearance.

Application Environment Requirements

- The surface, air, and material temperatures shall be between 40°F and 90°F during application.
- Do not apply silane materials during cold, hot, or wet weather conditions or when adverse weather conditions are forecasted within twelve (12) hours of the completion of the silane application. Correct any coating damaged by rain or moisture by an additional application or as required by the silane manufacturer.
- Application of sealant by spray methods will not be permitted when wind speeds are 20 mph or more, or if in the opinion of the Engineer, unsatisfactory results will be obtained. Other application methods or rescheduling will be required.
- Apply silane during the lowest temperature period of the day, typically between 1:00 a.m. and 9:00 a.m., when the cracks are open to the greatest extent.
- The surface to receive the treatment shall be dry for at least 48 hours before treatment and shall be free from sand, surface dust and dirt, oil, grease, chemical films, and other contaminants prior to application of the silane.

Protection of Surroundings

- Pick up and store all blast media and contaminants in a vacuum unit. Do not create dust during the blasting operation that will obstruct the view of motorists in roadways adjacent, above, below, or surrounding the silane treatment area. Store, handle, and dispose of blast media and contaminants in accordance with all applicable local, state, and federal requirements.
- Cover deck joint seal and elastomeric material, plug deck drain scuppers, seal cracks larger than 1/8in wide on underside of deck, barrier, or substructure, and use other necessary protective measures to prevent leakage of silane below the concrete deck and beyond the concrete barrier rail, to protect waterways, bridge components, pedestrians, vehicles, roadway, vegetation, and any other items or areas below or near the bridge.
- Protect traffic from rebound, dust, overspray, and construction activities. Provide appropriate shielding, as required and/or directed by the Engineer. Damages that occur due to the Contractor's operations shall be the responsibility of the Contractor.
- The Contractor shall provide suitable coverings (e.g. heavy-duty drop cloths, suspended canopies, etc.) as needed to protect all exposed areas not to receive

surface preparation and silane treatment. The contractor shall submit the plans to the Engineer for such measures prior beginning work.

Treatment Surface Conditions

- Immediately before placing silane, all exposed surfaces shall be completely dry and blown clean with oil-free compressed air to remove any loose dust and debris. Apply silane as soon as practical after the exposed surfaces have been properly prepared and conditions are satisfactory.
- Prior to application of any silane sealer, cure concrete, epoxy mortar repairs, and concrete repairs a minimum of 7 days or as required by the silane manufacturer. Surface repairs (epoxy coatings, and structural epoxy grout jacket) adjacent to silane treatments shall be completed and allowed to cure such that the silane will not damage them if overspray occurs.
- Protect prepared surfaces from precipitation and heavy dew during and after the application of the silane.

Application, Cleanup, and Incidentals

- Do not use silane material after the shelf life date.
- Do not return unused material in opened containers to storage for later use. Either apply such material to appropriate areas on barrier rail surfaces or remove and appropriately dispose of it at offsite locations provided by the Contractor.
- Avoid application with hand pump sprayers. For small areas of silane application, the use of hand pump sprayers might be allowed, but must be approved by the Engineer.
- Clean and/or repair all damage or defacement resulting from Contractor's operations to the Engineer's satisfaction at no additional cost to the Department.
- The equipment used for silane application must be clean of foreign materials and approved by the Engineer before use.
- Maintain operating pressures in sprayers used for application of the silane sealer material sufficiently low, so that atomization or misting of the material does not occur.
- Apply even distribution of silane. Avoid ponding of silane; take care when applying the silane, so that running or puddling does not occur.
- Apply silane in a single application to the treatment surface with enough material to saturate the surface. For decks and barriers, this shall apply to each span. For substructure, this shall apply to a face of bent column. Remove excess material with a roller or brush and dispose of excess material appropriately. If a second coat is required, it should be applied "wet on wet" before first coat dries.
- Conduct the work in a continuous operation, with the silane application as soon as practical following surface preparation.
- Clean up, dispose of any surplus material, and restore any disturbed areas unless otherwise directed.

Safety

- 100% Silane is a combustible liquid; take appropriate precautions during handling, storage, and operations. KEEP AWAY FROM OPEN FLAME.

- Work crews should wear appropriate personal protection equipment and follow manufacturer's recommendations when applying silane. Refer to the SDS and all applicable local, state, and federal laws, and rules and regulations of authorities having jurisdiction over the project, for specific guidance for personal and environmental protection and safety requirements.

8.0 MEASUREMENT AND PAYMENT

Surface Preparation for Silane will be measured per square foot and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" and will be full compensation for the shotblasting, sandblasting, or other necessary surface preparation and handwork to prepare the entire bridge concrete barrier rail and removal and disposal of all blast media and waste material generated, including protection and containment.

Silane Treatments will be measured per square foot and paid for at the contract lump sum price bid for "Design and Construction of Bridge 50" and will be full compensation for silane treatments to bridge concrete barrier rail, deck soffit, and substructure; including all silane materials; removal and disposal of excess and waste material generated; for protection of waterways, bridge, and other nearby surfaces, vehicles, and pedestrians; and for all labor, tools, and incidentals necessary to complete the work.

VOLUMETRIC MIXER

(12-18-12)

1.0 DESCRIPTION

This provision addresses the requirements for batching deck repair concrete at the point of delivery using a Mobile High Performance Volume Mixer (MHPVM). Work shall be in accordance with the general requirements of Section 1000-12 of the *Standard Specifications* and as amended by these provisions.

2.0 MATERIALS

Produce high early strength concrete with MHPVM equipment. Furnish project site storage facilities that will provide protection of materials in accordance with the *Standard Specifications* and all material suppliers' recommendations.

3.0 EQUIPMENT

MHPVM devices shall have prominently displayed stamped metal plate(s) from the Volumetric Mixers Manufacturers Bureau stating that the equipment conforms to the requirements of ASTM C685.

Hydraulic cement concrete shall be mixed at the point of delivery by a combination of materials and mixer unit conforming to the following:

- 1.) The unit shall be equipped with calibrated proportioning devices for each ingredient added to the concrete mix. The unit shall be equipped with a working recording meter that is visible at all times and furnishes a ticket printout with the calibrated measurement of the mix being produced. If at any time the mixer fails to discharge a uniform mix, production of concrete shall be suspended until such time that problems are corrected.
- 2.) Each unit shall have prominently displayed stamped metal plate(s) attached by the manufacturer on which the following are plainly marked: the gross volume of the transportation unit in terms of mixed concrete, the discharge speed and the mass calibrated constant of the machine in terms of volume.
- 3.) MHPVMs shall be calibrated by a Department approved testing agency in accordance with the manufacturer's recommendations at an interval of every 6 months or a maximum production of 2500 cubic yards, whichever comes first prior to use on the project. The yield shall be maintained within a tolerance of +/- 1% and verified using a minimum 2 cubic feet container every 500 cubic yards or a minimum of once per week.
- 4.) The three cubic feet initially discharged from the truck shall be discarded and not used for concrete placement. Acceptance of the concrete shall comply with the *Standard Specifications* except that the sample secured for acceptance testing will be taken after four cubic feet is discharged from the delivery vehicle. During

discharge, the consistency as determined by ASTM C143 on representative samples taken from the mixer discharge at random intervals shall not vary by more than 1 inch. Acceptance tests shall be performed on each load. If test data demonstrates that acceptable consistency of concrete properties is being achieved, the Engineer may reduce testing requirements.

- 5.) MHPVM equipment shall be operated by a person who is a certified operator by the equipment manufacturer. Any equipment adjustments made during the on-site production of concrete shall be done under the direct on-site supervision of the producer's NCDOT Certified Concrete Batch Technician.

4.0 UNIFORMITY AND ACCEPTANCE

The contractor is responsible for providing a Certified Concrete Plant Technician during batching operations, and a Certified Concrete Field Technician during placing operations

5.0 MEASUREMENT AND PAYMENT

Volumetric Mixer will be paid for at the contract lump sum bid price for "Design and Construction of Bridge 50" and will be full compensation for furnishing the certified MHPVM devices and calibration of the equipment.