

## **202560 - CONTAMINATED MATERIAL**

### **Description:**

Contaminated Material is defined as solids or liquids (including soil) potentially contaminated with a hazardous substance, requiring special handling and/or disposal per state or federal regulations.

This work describes the excavation, removal and treatment/disposal of contaminated materials resulting from project construction including utility and other types of excavation activities in accordance with the locations and notes on the Plans, and as directed by the Engineer or the Department's environmental representative. Containment and disposal of spoils developed from micropile construction and any associated excavation is also covered under this Special Provision. The Contractor will be notified of the Department's environmental representative at the pre-construction meeting.

### **Overview of Costs:**

Potential contaminated solids may affect contractor's costs as follows;

Additional cost to normal excavation requirements:

- Cost of 8 mil plastic for placement under and over solid contaminated material,
- Maintaining the segregated contaminated solids staging area.

Reduced cost to normal excavation requirements:

- Not required to, or charged for, transport of contaminated material from site.
- Not required to, or charged for, disposal of contaminated soil.

Potential contaminated liquids will affect contractor's cost as follows;

Additional cost to normal excavation requirements:

- None

Reduced cost to normal excavation requirements:

- None

### **Construction Methods and Responsibilities:**

Contractor's Responsibilities for potential contaminated solids:

The Contractor shall be responsible for providing the appropriate equipment and personnel necessary to excavate, stage, and load contaminated material for off-site disposal, as identified from previous site environmental investigations or identified during construction activities. The work will be performed in accordance with the procedures described in the site specific "Contaminated Material and Water Removal Work Plan" prepared by the Department's environmental representative. A copy of this plan is provided in the bid package at advertisement. The Contractor shall adhere to applicable Occupational Safety and Health standards, Guidelines and/or Laws. This will include compliance with 29 CFR Part 1910.

After award of the Contract, the Contractor shall immediately be responsible for notifying the Department's HAZMAT Coordinator's office (760-2108) for scheduling coordination with the environmental representative. The contractor shall submit a proposed schedule of work to the Department for review and approval prior to any commencement of work on this site. The Contractor is required to perform to a high standard of workmanship to assure protection of workers, local water supplies, and the environment. The Contractor shall coordinate with the utility companies prior to excavation. The Department's environmental representative shall be present during all phases of work

associated with the excavation and removal of potentially contaminated material. Payment will not be made for any work done when a Department approved Inspector or environmental representative is not present to provide environmental oversight.

Specific tasks to be performed by the Contractor will include excavating soil per the project specifications. The Contractor will segregate "contaminated" soil as designated by the Department or their environmental representative, from "clean" soil and place the "contaminated" soil in a designated on-site staging area constructed by the Contractor. At a minimum the staging area needs to be lined with 8-mil plastic and a berm constructed to minimize storm water run-off. The "contaminated" soil will need to be covered by the Contractor at the end of each work day. The Contractor will be responsible for loading contaminated soil onto trucks arranged by the Department's environmental representative on the days the contaminated soil is shipped off-site to a licensed disposal/treatment facility. The Contractor will backfill and compact the excavated area(s) according to the project specifications and payment will be made under that item of the Contract.

### **Department's Responsibilities:**

The Department is responsible for providing and paying; the environmental representative; the transportation of contaminated material for disposal; and the disposal of contaminated material.

The Department's environmental representative shall be responsible for developing and submitting a "Contaminated Material and Water Removal Work Plan" to the Department so it is included in the project specifications prior to going out for bid. The work plan will identify; the procedures to be used to excavate and stage the contaminated material; the licensed treatment/disposal facility where the Department will ship the contaminated material; the method the material will be transported to the treatment/disposal facility; and any additional health and safety requirements for site personnel.

The Department's environmental representative will conduct a health and safety briefing prior to commencement of activities on the sites to insure an understanding of all applicable standards, guidelines, laws, procedures, etc. consistent with the successful completion of this type of activity. The Department's environmental representative will conduct air monitoring during any excavation activities at the site to identify and mitigate fire, explosion and vapor hazards.

The Department's environmental representative shall coordinate the excavation activities with all applicable local, state, and federal environmental regulatory agencies. The Department's environmental representative will also oversee the excavation, removal and treatment/disposal of the material in the designated area(s) and perform such tests as field screening for soil contamination utilizing vapor monitoring techniques and collect soil samples for laboratory analysis to meet the requirements of the treatment/disposal facility, DNREC and/or the USEPA. The Department's environmental representative's personnel will subcontract with the disposal/treatment facility to provide transportation and disposal/treatment of all contaminated materials to be removed as part of the project. The Department's environmental representative is responsible for measuring the quantity of contaminated material removed, via certified scale weights, for the Department's records.

### **Method of Measurement:**

The quantity of contaminated material will not be measured. It will be included in the excavation quantity.

### **Basis of Payment:**

No additional payment will be made for the handling of contaminated material included in the excavation quantities. Contractor's costs for handling contaminated material as described herein are to be included in the standard excavation pay items included in this contract, and will constitute full compensation for excavation, constructing and maintaining the segregated soil staging area, placement of the contaminated soil in the staging area, providing plastic and daily covering of the segregated soil staging area, and loading of contaminated soil for removal by the Department.

This item is a contingency item and the Department reserves the right to delete from the Contract. The Contractor shall make no claims for additional compensation because of deletion of the item.

10/30/16



## 6285XX – RAILROAD PROTECTIVE SHIELD

### **Description.**

This work consists of fabricating, installing, maintaining, and removing a protective shield to be placed over active Amtrak railroad tracks to the limits as shown on the Plans, in accordance with these Special Provisions and as directed by the Engineer. The work also includes developing and submitting a Site-Specific Work Plan for review and approval prior to starting the work.

### **Materials.**

Materials supplied for use in fabricating the railroad protective shield shall meet the requirements of Sections 1039 and 1041 for steel and timber components, respectively. Any other materials supplied by the Contractor in the execution of the work shall also be in accordance with the specific requirements of his Site-Specific Work Plan.

The details for the protective shields as shown on the Plans have been previously reviewed by Amtrak and are approved for use as noted. The Contractor may prepare and submit his own details for the railroad protective shields however he will do so at his own risk with the understanding that this revised and updated design shall be submitted to the Engineer and Amtrak for review and approval. The Contractor is further notified that if an alternate railroad protective shield is submitted for review, there will be no additional calendar days added to the Contract for the time required to receive Amtrak and Department approval on the alternate system. The Department makes no guarantees that an alternate railroad protective shield will be approved by the Department or Amtrak.

### **Construction.**

As a first order of work, the Contractor shall prepare and submit a Site-Specific Work Plan for review and approval by the Department and Amtrak. The Site Safety Plan shall be prepared to demonstrate that the Contractor will adhere to all safety rules, the work is constructible, and that the work minimizes impacts to Amtrak rail operations. The Site-Specific Work Plan shall be in effect for any construction operation(s) within or over the Amtrak railroad right-of-way. The approved Site-Specific Work Plan will provide the basis for all field inspection/verification of the actual work. The Site-Specific Work Plan shall include the Contractor's crane/hoisting work plan. Approval of this plan does not relieve the Contractor from meeting other Department requirements for adequate planning and documentation of the proposed work procedures within the right-of-way of the railroad.

The Site-Specific Work Plan shall be prepared by a qualified Professional Engineer registered in the State of Delaware with expertise designing and detailing temporary protection shield systems. The Contractor shall submit shop drawings and calculations signed and sealed by the qualified Professional Engineer responsible for their preparation and prepare revisions and resubmit plans and calculations as many times as necessary until a complete and correct Site-Specific Work Plan for crane/hoisting operations has been approved. The shop drawings shall include a plan view showing location(s) of cranes, operating radii, with delivery and/or disposal locations shown. Provide all necessary dimensions for locating the elements of the plan including details and computations showing the weight of the pick. Crane rating sheets shall be supplied demonstrating that cranes are adequate for 150% of the calculated pick weight (i.e., the crane can pick 150% of the load, while maintaining normal, recommended factors of safety). For example, if the crane chart is based upon 85% CAP, then for the railroad application, the crane shall be able to safely pick 150% of the 85% chart value. Crane and boom nomenclature is to be indicated. Provide calculations demonstrating that slings, shackles, lifting beams, etc. are adequate for 150% of the calculated pick weight.

Include a location plan showing obstructions, indicating that the proposed swing is possible. Note that the “walking” of a load using two (2) cranes shall will not be permitted. The Contractor shall use multiple picks and repositioning as necessary and permitted to get the load to the needed location for the final pick, if necessary. Include data sheet listing types and sizes of slings and other connecting equipment, copies of catalog cuts for specialized equipment. Detail attachment methods on the plans. Prepare a complete procedure indicating the order of lifts and any repositioning or re-hitching of the crane or cranes. Identify the need for any temporary support of any components or intermediate stages, as may be required. The Contractor shall develop a time schedule for the various stages, as well as a schedule for the entire lifting process.

**Method of Measurement.**

Railroad Protective Shield will not be measured for payment.

**Basis of Payment.**

Price and payment for the Railroad Protective Shield lump sum item will constitute full compensation for furnishing all Materials and performing the Work as detailed and noted in the Contract Documents, for removal and disposal of the protective shield materials, and for all submittals, labor, tools, Equipment, and incidentals necessary to complete the Work as specified. The Site-Specific Work Plan will be incidental to this item.

02/05/2018

**610500 - ULTRA HIGH PERFORMANCE CONCRETE**

**Description:**

This specification consists of mixing, transporting, placing, finishing, curing and grinding of Ultra High Performance Concrete (UHPC) for use in constructing cast-in-place link slabs at specified locations in accordance with the details and notes in the Contract Documents and as directed by the Engineer. UHPC is a cementitious composite material composed of an optimized gradation of granular constituents, a water-to-cementitious materials ratio less than 0.25 and a high percentage of discontinuous internal fiber reinforcement.

**Materials:**

Commonly used materials are as follows. All materials must come from the same batch or lot.

- (a) *Fine Aggregate* - Crushed Quartz with 100 % passing the No. 30 sieve and a maximum of 3% passing the No. 200 sieve.
- (b) *Cementitious Material* - Section 801 - Portland Cement and Blended Hydraulic Cements.
- (c) *Steel Fibers* - ASTM A 820, Type 1, cold drawn high-carbon steel with a minimum tensile strength of 300 ksi. Minimum steel fiber content shall be 2% of the mix’s dry volume.
- (d) *Water* - Section 803 - Water for Mixing Portland Cement.
- (e) *Admixtures* - Only as directed by the manufactures representative.

The UHPC mixture shall meet the conditions listed in Table 1: UHPC Material Properties after 28 days, unless otherwise noted in the Contract Documents or as directed by the Engineer. Material properties listed below shall be verified by the manufacturer and submitted for approval in the Placement Plan.

<b>Table 1: UHPC Material Properties</b>		
<b>Description</b>	<b>Test Method</b>	<b>Acceptance Criteria</b>
Compressive Strength <i>Ends of cylinders must be ground flush prior to testing. Saw cutting, capping, and use of neoprene pads are not permitted.</i>	AASHTO T 22 (3"x6" cylinders) (150 psi/sec loading rate)	≥ 22 ksi after 28 days
Shrinkage	AASHTO T 160 / ASTM C 157	≤ 800 micro-strain
Rapid Chloride Ion Penetrability or Surface Resistivity Testing	AASHTO T 277 / ASTM C 1202 or AASHTO TP 95	≤ 350 coulombs
Chloride Ion Penetrability	AASHTO T 259 (½" depth)	< 0.1183 lbs/yd <sup>3</sup>
Scaling Resistance	ASTM C 672	Y < 3
Freeze-Thaw Resistance	AASHTO T 161 / ASTM C 666A (300 cycles)	Relative Dynamic Modulus of Elasticity > 95%

Alkali-Silica Reaction	ASTM C 1567 (Modified)	≤ 0.08% at 28 days
Slump Flow and Visual Stability	ASTM C1437 / ASTM C 1611	7 inches (Minimum) 10 inches (Maximum) No bleed water Consistent fiber distribution
Modulus of Elasticity, E <sub>c</sub>	N/A	8 ksi, minimum
Concrete Cracking Stress	N/A	1.2 ksi minimum
Modular Ratio, n (E <sub>s</sub> /E <sub>c</sub> )	N/A	~3.625

At least 60 days prior to the placement of UHPC, submit a prepackaged batch of dry ingredients and admixtures sufficient for the Department to make a one cubic foot trial batch of UHPC. Any testing for alkali-silica reaction or permeability will be performed on specimens without steel reinforcement. Batch proportions shall otherwise remain the same per the prepackaged blend and water to cementitious materials ratio (w/cm).

**Construction Methods:**

**(A) Storage:** Assure proper storage of all materials including but not limited to cement, aggregate, steel reinforcement and additives, as required by the supplier’s recommendation in order to protect the integrity of the materials against the loss of physical and mechanical properties.

**(B) Placement Plan:** Submit a Placement Plan with a detailed construction work schedule to the Engineer for review at least 10 days prior to the scheduled UHPC placement pour. The Placement Plan shall address at a minimum:

*The following list is intended as a guide and may not address all of the means and methods the Contractor may elect to use. The Contractor is expected to assemble a comprehensive list of all necessary items for executing the placement of UHPC and shall be reviewed and approved by the Engineer.*

- Responsible personnel and hierarchy.
- Equipment – including but not limited to pumps, hoses, mixers, holding tanks, wheelbarrows, scales, meters, thermometers, floats, screeds, burlap, plastic, heaters, blankets, etc.
- Quality Control of batch proportions - including dry ingredients, steel fibers, water and admixtures.
- Quality Control of mixing time and batch times.
- Batch procedure sequence.
- Form work – including materials and removal.

- Placement procedure – including but not limited to surface preparation (comprised of the exposed existing surface of the concrete end diaphragms and deck and pre-wetting the concrete interface to a saturated-surface-dry (SSD) condition before the placement of UHPC), spreading, finishing, and curing protection. Include provisions for acceptable ambient conditions and batch temperatures and corrective measures as appropriate. Include means and methods to ensure all air is displaced by the UHPC and the void is completely filled.
- Threshold limits for ambient temperature, ambient relative humidity, batch consistency, batch temperature, batch times and related corrective actions.
- Construction joints, if needed, within the UHPC should be detailed and approved by the Engineer.
- Means and methods for water containment and clean up, for pre-wetting and for watertight integrity testing.

Arrange for a meeting between the UHPC manufacturer's representative, the Contractor's staff, and representatives from DelDOT Bridge Design, Construction, and Materials and Research to review the Contractor's Placement Plan. No UHPC pour will be permitted until the aforementioned Placement Plan has been submitted by the Contractor and approved by the Engineer.

Pumping of UHPC is not allowed.

Submit calculations and detailed drawings of the formwork, signed and sealed by a Professional Engineer registered in the State of Delaware. The design and fabrication of forms shall be consistent with the installation drawings and shall follow the recommendations of the UHPC manufacturer. Refer to Section C of the Construction Methods for additional requirements.

Construction loads applied to the bridge during UHPC placement and curing are the responsibility of the Contractor. Submit the weight and placement of concrete buggies, grinding equipment or other significant construction loads for review as part of the proposed Placement Plan.

**(C) Forming, Mixing, Transporting, Placing and Curing:** Design and fabricate formwork to adhere to Section 604.03.2 of the Delaware Standard Construction Specifications and the recommendations of the UHPC manufacturer. Construct forms from nonabsorbent material that are properly sealed and capable of resisting the hydrostatic pressures from UHPC in the unhardened state. Do not remove formwork until a compressive strength of 10 ksi is achieved. Internal vibration of the UHPC is not acceptable. However, rodding may be satisfactory to achieve a suitable blended connection where two successive pours meet.

All UHPC joints shall be covered by a top form with a moisture barrier. Supplemental heat can be provided to the UHPC and surrounding prefabricated elements to reduce initial set times and accelerate strength gain. The proposed method of artificial heating the concrete element shall be included in the installation drawings. Follow the UHPC manufacturer's recommendations for curing to attain the required strength to meet the project schedule.

Once the UHPC reaches a compressive strength of 10 ksi, the top forms of the joint may be removed. Grind the top surface so it reasonably matches the top surface of the exposed deck concrete (prior to overlay placement).

Forming, batching, placing, and curing shall be in accordance with the UHPC manufacturer's recommendations and as submitted and accepted by the Engineer.

Representatives of the UHPC manufacturer knowledgeable in supplying, mixing, transporting, placing, finishing and curing of the UHPC material must be present during mixing, transporting and placing of the UHPC. The Contractor shall arrange for a minimum of two (2) manufacturer's representatives to be on site for the duration of the UHPC construction; one representative will remain with the mixing operations and the second representative will remain with the placement operations. Do not start mixing or placing UHPC until the manufacturer's representatives are on-site. Place UHPC in accordance with the approved Placement Plan using one continuous pour unless otherwise detailed in the Contract Documents or as approved per the Placement Plan. UHPC should not freeze before attaining a compressive strength of 10 ksi.

Provide a minimum of two portable batching units for mixing of the UHPC. Mixing equipment which is not supplied by the UHPC manufacturer, must be reviewed by the UHPC manufacturer for adequacy. During batching keep the temperature of the UHPC below 90 degrees F; ice may be added to the mix as recommended by the UHPC manufacturer's representative.

The Contractor shall arrange for an on-site meeting with the UHPC manufacturer's representative one day before the start of the actual UHPC placement. The Contractor's staff and representatives from DelDOT Bridge Design, Construction, and Materials and Research, shall attend the meeting. The objective of the meeting will be to clearly outline the procedures for mixing, transporting, finishing and curing of the UHPC.

**(D) Acceptance Testing:** DelDOT Materials and Research will be on site during the placement of UHPC. To schedule a representative, contact DelDOT Materials and Research a minimum of 48 hours prior to the anticipated UHPC placement. A representative from the Materials and Research section will perform a slump flow test according to ASTM C 1437 / ASTM C 1611 on each batch of UHPC. DelDOT Materials and Research will cast 3"x6" cylinders according to AASHTO T 23 at a minimum of once per day. Cylinders shall be cast in a single lift. Compressive strength testing will be performed at 1, 2, 3, 4 and 28 day cure times. Final acceptance will be based upon 4 day and 28 day strengths. Field coring of UHPC for dispute resolution will not be allowed.

Additional specimens will be cast for permeability testing. A minimum of two lots will be selected at random from the permeability specimens and tested in accordance with AASHTO T 277 / ASTM C 1202 and AASHTO TP 95. In the event of a discrepancy between the two methods, results from ASTM C 1202 shall supersede. If one specimen from either lot exceeds the maximum permeability, two additional specimens will be selected and tested in accordance with AASHTO T 277 / ASTM C 1202, the average of which will replace the failed specimen result.

The Contractor is responsible for providing an adequate location to place acceptance specimens for initial curing prior to transport to the lab. Curing boxes will be equipped with supplemental heat or cooling as necessary to cure specimens in accordance with ASTM C 31. Testing performed by the DelDOT

Materials and Research has been summarized in Table 2: DeIDOT M&R UHPC Acceptance Testing. Performance frequencies of each test listed in Table 2, are a minimum value. Tests may be performed at more frequent intervals then described in Table 2, at the discretion of the Engineer or DeIDOT Materials and Research division.

<b>Table 2: DeIDOT M&amp;R UHPC Acceptance Testing</b>			
<b>Description</b>	<b>Test Method</b>	<b>Acceptance Criteria</b>	<b>Frequency</b>
Compressive Strength	AASHTO T 22	$\geq 22$ ksi after 28 days $\geq 14$ ksi after 4 days (3"x6" cylinders) (150 psi/sec loading rate)	At least once per 25 CY or once per 12 hour shift
Rapid Chloride Ion Penetrability or Surface Resistivity Testing	AASHTO T 277 / ASTM C 1202 or AASHTO TP 95	$\leq 350$ coulombs after 28 days	1 per job (Performed prior to field placement)
Slump Flow and Visual Stability	ASTM C1437 / ASTM C 1611	7 inches (Min.) 10 inches (Max.) No bleed water Consistent fiber distribution	1 per batch

**(E) Surface Preparation:** An exposed aggregate finish shall be created on all surfaces existing concrete to be in contact with UHPC to facilitate bond. The exposed adjacent concrete surfaces shall have a minimum 0.25-inch amplitude (the more excessive amplitude resulting from the total surface hydrodemolition operation will be acceptable). In addition, the concrete contact areas shall be wetted to achieve a saturated surface dry (SSD) condition before UHPC placement. Keep wet and remove all surface water just prior to UHPC placement. Submit the procedures for achieving SSD condition as part of the proposed Placement Plan. The procedures may include: continuously wetted burlap in all joints for 12 hours prior to placement of UHPC; supplemental misting of concrete surfaces after burlap is removed if UHPC placement is delayed, etc.

**(F) Surface Profile:** The finished surface of the UHPC field joints shall be flush with adjacent concrete elements to within a tolerance of plus  $\frac{1}{4}$  inch and minus 0 inches. After curing, grind the UHPC surface smooth with adjacent concrete elements in order to match the specified tolerance. Grinding of the UHPC surface can be performed when a minimum strength of 10 ksi is achieved. During grinding operations, if steel fiber pullout is observed, grinding shall be suspended and not resumed until approved by the Engineer.

If deemed as necessary by the Engineer, a watertight integrity test shall be performed on 10% of the link slab joints after grinding has been completed. The test shall consist of continuously applying running water at an approximate rate of 300 gallons per hour along the length of the joints to be tested, for a

duration of 30 minutes. The underside of the joint shall be inspected for water leakage at 30 minutes and at 1 hour. The joint shall be considered watertight if no dripping water or water droplets are visible underneath deck areas along the full length of the joint. If the results of the watertight integrity test are not satisfactory, the Engineer will determine the required corrective action.

Traffic shall not be permitted on the bridge until the UHPC has achieved a minimum compressive strength of 14 ksi or unless otherwise approved by the Engineer.

**Method of Measurement:**

The quantity of Ultra High Performance Concrete will be measured as the number of cubic yards of UHPC placed and accepted. The volume will be computed using the dimensions shown on the plans. The quantity of grinding will not be measured.

**Basis of Payment:**

The quantity of UHPC will be paid at the Contract unit price per cubic yard. Price and payment will constitute full compensation for mixing, transporting, placing, finishing, curing, testing and grinding and for furnishing all equipment, tools, labor, and incidentals required to complete the work.

Additional quantity of material used in the determination of material properties and for acceptance testing as described herein will be furnished at no additional cost to the Department. No additional payment will be made for joint surface preparation or for grinding procedures.

If the UHPC does not meet the minimal material properties as described herein, the UHPC shall be removed and replaced or remediated to the satisfaction of the Engineer at the Contractor's expense. If watertight integrity tests are required by the Engineer, such tests will be performed at no additional cost to the Department. No additional payment will be made for remedial solutions to insufficient bonding of joints.

2/9/2018

## **623500 – BRONZE BEARINGS**

### **Description:**

Work under this item consists of all materials, labor and equipment necessary to remove the existing bearings, furnish and install new bearings as indicated on the Plans, in accordance with these Specifications and as directed by the Engineer. This work shall be performed at Pier 6, Pier 10, and Pier 15.

### **Materials:**

Self-Lubricating Bronze Bearings: Replacement bearings shall be fabricated and installed in accordance with the requirements of Sections 615 of the Standard Specifications, as indicated in the Plans and as noted in these Specifications. Structural steel for the bearings shall conform to AASHTO M270, Grade 50. Steel plates shall meet a flatness requirement of 0.5 percent in the direction being measured (width, length, and diagonals) maximum, but not to exceed 1/8 inch.

The steel used for bearings shall be the same type of steel designated for the steel structure unless otherwise specified. The bearings shall receive one shopcoat of paint in accordance with the requirements of section 616 of the Standard Specifications.

Steel surfaces of the sole plates and bearing plates in contact with other surfaces, shall be machine finished to at least 250 microinches Root-Mean-Square (6.4  $\mu\text{m}$ ). Surfaces of the sole plate and masonry plate in contact with the bronze plate shall have a machine finish of at least 125 microinches Root-Mean-Square (3.2  $\mu\text{m}$ ). The sliding surfaces shall be coated with multipurpose grease before shipment. Prior to erection, the coating shall be removed using a solvent.

The bearing shall be shop assembled and match-marked to ensure proper fit. Bevel the sole plate to match the grade if the grade exceeds 1%. The Contractor will be responsible for measuring the grade of the bridge in the field to determine the appropriate bevel at each bearing location.

Self-lubricating bronze bearing plates shall conform to the requirements of AASHTO M107, Alloy C91100 unless otherwise specified. The sliding surfaces of the plates shall be polished and provided with annular grooves or cylindrical recesses, or a combination thereof, filled with a lubricating compound. The compound shall be free of any material that could cause abrasive or corrosive action upon the metal surfaces and also shall be able to withstand extremely high pressures and the atmospheric elements over long periods of time. The lubricating compound shall be compressed into the recesses under sufficient pressure to form a non-plastic, lubricating inset. The lubricating inset shall comprise not less than 25% of the total area of the plate. The frictional coefficient shall not exceed 0.10 during the first 1000 cycles at the design dead load.

Paint: All paint to be used to touch up the existing coatings on the structural steel damaged while welding and removing plates and painting any bearings assemblies shall be in accordance with the requirements of Section 616 of the Standard Specifications. The color of the finish coat shall match that specified for the remaindered of the structure.

Masonry Products: Grout used for filling annular space around 3" dia. anchor bolts shall be non-shrink, flowable, cementitious type material meeting the requirements of ASTM C1107 having a 5,000 psi compressive strength at 28 days and a maximum aggregate size of 4 mm, or approved equal. Epoxy grout used for anchor bolts for bearing devices and non-shrink mortar used for repairing concrete bearing pads shall be as manufactured by Master Builders, Inc., 23700 Chagrin Boulevard, Cleveland, Ohio 44122 or

as manufactured by Sika Corporation, 201 Polito Avenue, Lundhurst, New Jersey 07071, or approved equal.

**Construction Methods:**

Removal of existing bearing plates from existing girders shall not damage portions of the girder to remain.

Portions of bottom flanges of the existing stringers to receive new bearings shall be cleaned prior to welding. Contractor shall remove existing lead-based paint in accordance with the requirements of Item No. 616003 prior to doing any grinding, cutting, welding, and drilling of the existing structural steel as a part of this work.

All field welding shall be done by the shielded metal-arc process. The Contractor shall not paint welds prior to inspection by the Engineer.

The Engineer will be the sole judge in determining if any additional bearings are to be replaced and any additional bearing pads are to be repaired.

When no longer required, as determined by the Engineer, all materials used for this operation shall become the property of the Contractor and shall be legally disposed of clear of the site.

**Method of Measurement:**

The quantity of "Bronze Bearings" will be measured as the number of bridge bearings replaced and accepted.

**Basis of Payment:**

The "Bronze Bearings" will be paid for at the Contract unit price bid for each bearing replaced. Price and payment will constitute full compensation for the grinding of existing welds, removal and disposal of the existing bearings, furnishing, painting and installing the new bearings, nuts, washers, welding, painting in the repair area and repairing existing concrete bearing pads (if required on the Plans) and for all materials, labor, equipment, tools and incidentals necessary to complete this item of work.

The payment for this item does not include the cleaning of lead-based paint or anchor bolt repairs. Payment for cleaning and painting these items will be made under Item No. 616000 and 616003. Payment for anchor bolt repair will be made under Item No. 623003.

8/22/2017

## **6255xx – ADDITIONAL LATEX-MODIFIED CONCRETE FOR PARTIAL DECK REPAIRS**

### **Description.**

This work consists of furnishing additional latex-modified concrete to perform partial deck repairs in unsound areas of the existing deck slab removed during the hydrodemolition operation. Additional latex-modified concrete for partial deck repairs will be placed concurrently with the installation of the latex-modified concrete overlay work. Work shall be completed as indicated on the Plans, in accordance with these Special Provisions, and as directed by the Engineer.

### **Materials.**

Provide latex-modified concrete materials in accordance with Section 1046.01.

**Construction.** Additional Latex-Modified Concrete for Partial Deck Repairs shall be placed in conformance to applicable portions of Section 625.03. Additional Latex-Modified Concrete for Partial Deck Repairs shall be placed concurrently with the placement of the latex-modified concrete for the proposed overlay work.

**Method of Measurement.** Additional Latex-Modified Concrete for Partial Deck Repairs will be measured as the number of cubic yards furnished.

Additional Latex-Modified Concrete for Partial Deck Repairs will be measured to the nearest 0.1 cubic yards. The quantity of Additional Latex-Modified Concrete for Partial Deck Repairs will be determined by deducting the theoretical volume of material necessary to construct the deck overlay at Plan thickness from the total volume of deck overlay material placed on the deck surface. Measurement for the volume of Additional Latex-Modified Concrete for Partial Deck Repairs will be based on the meter readings on the mixers dispensing the latex modified concrete excluding the calculated volume of any waste. Any volume of material wasted or used to fill depressed areas caused by the Contractor's negligence in milling or concrete removal during the hydrodemolition operation will not be included in this quantity.

### **Basis of Payment.**

Payment for furnishing all Materials for Additional Latex-Modified Concrete for Partial Deck Repairs will be paid for at the Contract Fixed Unit Price specified for Item 6255xx – Additional Latex-Modified Concrete for Partial Deck Repairs. The Contract Fixed Unit Price will be \$600 per cubic yard for the latex-modified concrete furnished including all material, labor and equipment, and any other incidental items necessary to furnish the material.

Labor and equipment costs for placing the additional latex-modified concrete monolithically as part of the partial deck repairs will be incidental in the Contract Unit Price per square yard per inch for Item 625000 – Latex-Modified Concrete Overlay Installation.

2/1/2018

**625XXX – POLYESTER POLYMER CONCRETE OVERLAY INSTALLATION**  
**625XXX – FURNISH POLYESTER POLYMER CONCRETE OVERLAY**

**Description:**

This work shall consist of furnishing and placing a polyester polymer concrete (PPC) overlay with a high molecular weight methacrylate (HMWM) resin prime coat where specified in the Plans. The work shall also include the preparation of all receiving surfaces. All work shall be in accordance with the Plans, System Provider’s recommendations, as directed by the Engineer, and as required by these Special Provisions.

**Materials:**

All material components of the overlay system must be provided by a single System Provider to ensure compatibility of all overlay system components. The System Provider shall be able to demonstrate experience successfully supplying projects of similar size and scope.

Material requirements for the PPC overlay are as follows:

**1. Primer**

The prepared surface shall receive a wax-free low odor, HMWM resin prime coat conforming to the following:

<b>High Molecular Weight Methacrylate (HMWM) Resin</b>		
<b>Property</b>	<b>Requirement</b>	<b>Test Method</b>
Volatile Content*	30 percent, maximum	ASTM D 2369
Viscosity* (Brookfield RVT with UL adapter, 50 RPM at 25 degrees C)	25 cps, maximum	ASTM D 2196
Specific Gravity* (at 77 degrees F)	0.90 - 1.10	ASTM D 1475
Flash Point*	180 degrees F, minimum	ASTM D 3278
Vapor Pressure* (mm Hg at 77 degrees F)	1.0	ASTM D 323
Tack Free Time (minutes at 77 degrees F)	400 minutes, maximum	ASTM C 679
PCC <sup>a</sup> Saturated Surface-Dry Bond Strength (at 24 hours at 70 ± 2 degrees F)	500 psi, minimum	California Test Method 551
Thermal compatibility	No delamination of overlay	ASTM C 884

\*Tested prior to adding initiator

<sup>a</sup> PCC = Portland cement concrete

The prime coat promoter/initiator shall consist of a metal drier and peroxide. If supplied separately from the resin, **at no time shall the metal drier be mixed directly with the peroxide.** The containers shall be stored in a manner that will not allow leakage or spillage from one material to contact

the containers or material of the other.

**NOTE:** Mixing the metal drier directly with the peroxide will result in a violent exothermic reaction.

## 2. Aggregate

Aggregate for polyester polymer concrete and abrasive finishing sand shall conform to the following gradation requirements:

Combined Aggregate		
Sieve Size	3/8" Max. Percent Passing	#4 Sieve Max. Percent Passing
1/2"	100	100
3/8"	83-100	100
#4	65-82	62-85
#8	45-64	45-67
#16	27-48	29-50
#30	12-30	16-36
#50	6-17	5-20
#100	0-7	0-7
#200	0-3	0-3

Aggregate retained on the #8 sieve shall have a maximum of 45 percent crushed particles when tested in accordance with AASHTO Test Method T 27. Fine aggregate shall consist of natural sand only.

The minimum Mohs scale hardness of the silica sand shall be 7.0, and all aggregates retained in the No. 8 sieve shall have a minimum hardness of 7.0.

Aggregate absorption shall not exceed one percent (1%) as determined by AASHTO Test Methods T 84 and T 85.

At the time of mixing with the resin, the moisture content of the aggregate, as determined by AASHTO Test Method T 255, shall not exceed one half of the aggregate absorption.

Sand for abrasive sand finish shall be commercial quality blast sand having at least 95 percent passing the No. 8 sieve and at least 95 percent retained on the No. 20 sieve and conform to the dryness requirements for polyester concrete aggregate as specified in this special provision.

### 3. Polyester Resin Binder

The polyester polymer concrete shall consist of polyester resin binder and dry aggregate. The resin shall be an unsaturated isophthalic polyester-styrene co-polymer conforming to the following:

Polyester Resin Binder		
Property	Requirement <sup>a</sup>	Test Method
Viscosity* (RVT No. 1 Spindle, 20 RPM at 25 degrees C)	75 to 200 cps	ASTM D 2196
Specific Gravity*	1.05 to 1.10 at 77 degrees F	ASTM D 1475
Elongation	35 percent, minimum Type I at 0.45"/minute Thickness = 0.25" ± 0.03"	ASTM D 638
	Sample conditioning: 18/25/50 + 5/70	ASTM D 618
Tensile Strength	2500 psi, minimum Type I at 0.45"/minute Thickness = 0.25" ± 0.03"	ASTM D 638
	Sample conditioning: 18/25/50 + 5/70	ASTM D 618
Styrene Content*	40 percent to 50 percent (by weight)	ASTM D 2369
Silane Coupler	1.0 percent, minimum (by weight of polyester styrene resin)	
PCC <sup>b</sup> Saturated Surface Dry Bond Strength	500 psi, minimum at 24 hours and 70 ± 2 degrees F	California Test Method 551
Thermal Compatibility (mixed with aggregate)	No delamination of overlay	ASTM C 884

\*Tested prior to adding initiator

<sup>a</sup> Values are based on specimens or samples cured or aged at 77 degrees F unless otherwise indicated.

<sup>b</sup>PCC = Portland cement concrete

The silane coupler shall be an organosilane ester, gamma-methacryloxypropyltrimethoxysilane. The promoter shall be compatible with methyl ethyl ketone peroxide (MEKP) and cumene hydroperoxide (CHP) initiators. The promoter shall be compatible with suitable peroxide initiators.

### 4. Samples

Samples of materials for all components of the overlay system shall be submitted by the System Provider to the Materials and Research Section a minimum of five (5) days prior to the overlay application. Samples shall be representative of the materials to be used in the overlay application and shall consist of a one gallon (1 gal.) sample for each liquid component (HMWM resin primer and polyester resin binder) and a five pound (5 lb.) sample for each dry component. Appropriate amounts of catalysts and promoters shall be supplied with the one gallon samples.

### 5. Packaging and Shipment

A Material Safety Data Sheet shall be furnished prior to use for each shipment of polyester resin

binder and HMWM resin. All components shall be shipped in strong, substantial containers, bearing the System Provider's label specifying date of manufacture, batch number, brand name, quantity, and date of expiration or shelf life. In addition, the mixing ratio shall be printed on the label of at least one (1) of the system components. If bulk resin is to be used, the Contractor shall notify the Engineer in writing ten (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.

## **6. Basis of Acceptance**

Project acceptance of the PPC overlay materials will be based on the following:

1. Delivery of the PPC overlay materials to the project site in acceptable containers bearing all the label information as required above in Packaging and Shipment.
2. Receipt of a Manufacturer's certification stating the primer, aggregate and polyester resin binder meet the material requirements of items 1 through 3 above.
3. Approval by the Materials and Research Section based on conformance with the material requirements above.

### **Submittals:**

Prior to construction of the PPC overlay, the Contractor shall submit to the Department a Work Plan for constructing the PPC overlay. The Work Plan shall include, but not be limited to, the following:

1. A schedule and sequence of all overlay work
2. Technical literature from the System Provider including requirements for storage, handling, mixing, application, cleanup, and disposal of materials and containers
3. Description of materials and test reports for all overlay system materials to be used
4. Description of equipment for applying HMWM resin
5. Description of equipment for measuring, mixing, placing, and finishing PPC overlay material
6. Method for isolating bridge joints
7. Location of proposed cold joints in PPC overlay
8. Cure time for PPC overlay
9. Description of equipment for applying sand
10. Procedures for surface preparation, application, curing, and finishing

In addition, the System Provider's technical representative who will be on site shall also review and approve the plan. Any deviations from the approved Work Plan shall be approved by the Engineer.

### **Construction:**

#### **A. General**

The System Provider's technical representative shall be made available on the job site for a minimum of two (2) working days to make recommendations to facilitate the PPC overlay installation. This shall include, but not be limited to, surface preparation, PPC overlay application, and PPC overlay curing.

During surface preparation and PPC overlay application, precautions 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 Department.

During PPC overlay application, the Contractor shall provide suitable coverings (e.g. heavy duty drop cloths) to protect all exposed areas not to be overlaid, including, but not limited to, curbs, sidewalks, parapets, etc. All damage to the existing structure to remain as a result of the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Engineer and the Department at no additional cost to the Department.

## **B. Storage of Materials**

All materials shall be stored and handled in accordance with the System Provider's recommendation to ensure their preservation. Applicable fire codes may require special storage facilities for some components of the PPC overlay system.

## **C. Equipment**

Equipment shall be fitted with suitable traps, filters, drip pans, or other devices to prevent oil, fuel, grease, or other deleterious material from being deposited on the deck

1. Surface Preparation. All equipment to be used for surface preparation shall be as specified by the PPC overlay System Provider and approved by the Engineer. Unless otherwise specified, the Contractor shall use automatic shot blasting units to clean pavement surfaces. In those areas not accessible to this machinery, the surface may, with the Engineer's approval, be cleaned with blast cleaning equipment.

Automatic shot blasting units shall be self propelled and include a vacuum to recover spent abrasives. The abrasive shall be steel shot. Magnetic rollers shall be used to remove any spent shot remaining on the deck after vacuuming.

2. Application. Polyester polymer concrete shall be mixed in mechanically operated mixers. Mixer size shall be sufficient for complete mixing of batch and shall be approved by the System Provider's technical representative and the Engineer. The binder shall be initiated and thoroughly blended just prior to mixing with aggregate. The polyester polymer concrete shall be mixed a minimum of two (2) minutes prior to placement.

A continuous mixer employing an auger screw/chute device with self-contained, separate aggregate, resin, and peroxide compartments may be used. The continuous mixer shall 1) be equipped with a metering device that automatically measures and records the aggregate volumes and the corresponding resin volumes and 2) have a readout gage, visible to the Engineer at all times, that displays the volumes being recorded. The volumes shall be recorded at no greater than five (5) minute intervals along with the time and date of each recording. A printout of the recordings shall be furnished to the Engineer at the end of each work shift.

A minimum of four (4) Class B fire extinguishers, five pound (5 lb.) minimum, in good working order shall be mounted approximately equidistant around the perimeter of each mixer unit. The capacity, operating speed, and all mix control constants shall be clearly and prominently mounted on the unit by the System Provider in a durable metal plate or plates.

3. Finishing and Texturing. Finishing shall be performed using a vibratory-type mechanical screed riding on preset forms/rails or through the use of a PPC paver.

Texturing shall be performed in accordance with DelDOT Standard Specifications Subsection

602.20(c)(1) Mechanical Grooving.

#### **D. Surface Preparation**

All structural slab, curb and parapet surfaces that will be in contact with the overlay shall be prepared as follows:

1. The Contractor shall determine the size of shot, flow of shot, forward speed of shot blast machine and number of passes necessary to provide a surface capable of a tensile bond strength greater than or equal to 250 psi or a failure area, at a depth of 0.25" or more into the base concrete, greater than 50% of the test area. The acceptance testing shall be performed by the Department per ACI 503R-93, Appendix A of the *ACI Manual of Concrete Practice*. The Engineer will designate the location of the test patches. A test result shall be the average of three (3) tests on a test patch of not less than 4.5 square feet. A minimum of one (1) test result shall be obtained for each bridge. Additional test patches may be required, up to one (1) in each bridge span, as specified by the Materials and Research Section. The test patches shall be located to provide for the evaluation of the range of surface conditions on the bridge, and one or more patches shall be placed on deck repairs. Test patches shall be installed at the same thickness, and with the same materials, equipment, personnel, timing, sequence of operations, and curing period that will be used for the installation of the overlay. The cleaning practice, materials, and installation procedure will be approved if one passing test result is obtained from each test area when tested at an age of 24 hours or more. Tensile adhesion tests shall not be performed at surface temperatures above 80degrees F.

Before application of the primer, the entire deck surface shall be cleaned by shot blasting and other means using the approved cleaning practice to remove any epoxy resins, asphaltic material, oils, dirt, rubber, curing compounds, paint, carbonation, laitance, weak surface mortar and other potentially detrimental materials, which may interfere with the bonding or curing of the overlay.

If the Engineer determines that an approved cleaning practice has changed prior to the completion of the PPC overlay application, the Contractor must return to the approved cleaning methods and re-clean the suspect areas or verify through tests at no additional cost to the Department that the practice is acceptable.

All patching and cleaning operations shall be inspected and approved prior to placing the PPC overlay. Any contamination of the deck after initial cleaning shall be removed. The entire PPC overlay system shall be applied following the cleaning and prior to opening the bridge to traffic.

Cleaned pavement surfaces shall not be exposed to vehicular or pedestrian traffic other than that required by the PPC overlay operation. If the pavement is contaminated before being overlaid it shall be re-cleaned by abrasive blasting to the satisfaction of the Engineer. No additional payment will be made for re-cleaning work.

The concrete shall be dry at the time of application of the HMWM primer. If deemed necessary, the Department shall test for the presence of deck moisture in accordance with ASTM D 4263. The Contractor's means and methods shall allow for placement of the primer within 24 hours of surface cleaning. Dryers shall be used, as necessary, to facilitate the timely placement of the HMWM primer and PPC overlay materials.

2. All steel surfaces that will be in contact with the overlay shall be cleaned in accordance with SSPC-SP No. 10, Near-White Blast Cleaning, except that wet blasting methods shall not be allowed.

After the cleaning operation is completed there shall be no visible evidence of oil, grease, dirt, rust, loose particles, spent abrasives or other foreign material on any of the surfaces to be overlaid.

## **E. Application**

1. Prime Coat

Prior to applying the prime coat, the area shall be dry and shall be blown clean with oil-free compressed air. The surface temperature during application and curing shall satisfy the System Provider's requirements.

The prime coat shall be uniformly applied to completely cover the surface to receive the PPC overlay. The rate of spread shall be approximately 1.4 ounces per square foot of deck surface or as recommended by the System Provider. The prime coat shall be allowed to cure a minimum of 15 minutes before placing polyester polymer concrete.

2. Polyester Polymer Concrete

### **Test Patches**

Prior to constructing the PPC overlay, one (1) or more trial overlays shall be placed on a previously constructed concrete base to determine initial set time and to demonstrate the effectiveness of the mixing, placing, and finishing equipment proposed as well as curing period. Each trial overlay shall be the same width as the normal single-lane paving width, at least six feet (6 ft.) long and the same thickness as the PPC overlay to be constructed. Conditions and equipment used during the construction of the trial overlay shall be similar to those expected and to be used for the construction of the permanent PPC overlay. If the cleaning practice, materials and installation procedure are not acceptable, the Contractor must remove the failed test patches and make the necessary adjustments and retest all test areas at no additional cost to the Department until satisfactory test results are obtained.

The test patch shall have minimum bond strength of 250 psi as determined by ACI 503R-93, Appendix A to assure that the overlay adheres to the prepared surface. Adhesion testing required for acceptance shall be performed by the Department.

All material used in the trial overlay, including the test patches, shall become the property of the Contractor and shall be removed (if required) and disposed of at the Contractor's expense.

Calibration and general mixer operation shall be demonstrated on-site a minimum of five (5) working days prior to anticipated use. The calibration will consist of a weight/volume determination made in a 0.25 cubic yard container, filled with the polyester polymer concrete to be used, struck off, and the volume compared to the mixer output record or reading. When no longer required, as determined by the Engineer, the container and contents shall become the property of the Contractor and shall be disposed of at the Contractor's expense.

The polyester polymer concrete shall be placed within 120 minutes after the prime coat has been applied.

The polyester polymer concrete shall contain approximately 12 percent polyester resin by weight of dry aggregate; the exact percentage is dependent on the aggregate chosen and will be determined by the System Provider's technical representative during placement to enable proper finishing and texturing of the overlay surface.

The target nominal thickness for the polyester polymer overlay shall be as shown in the Plans with a minimum final in-place overlay thickness as shown in the Plans over all finished deck surfaces receiving an overlay.

Termination edges of the overlay may require application and finishing by hand trowel due to obstructions such as a curb. All hand troweling shall be followed by broadcasting aggregate or surface texturing while the resin is still wet to provide acceptable surface friction characteristics.

When multiple passes of the screed or paver are required to overlay the full bridge width, longitudinal termination edges shall be located at the edge of travel lane(s) and/or within two feet (2 ft.) of the curblines.

All expansion joints shall be adequately isolated prior to overlaying.

The amount of initiator used in the polyester polymer concrete shall be sufficient to produce an initial set time between 20-120 minutes during placement. The initial set time will be determined by using an initial-setting time Gillmore needle in accordance with the requirements of ASTM C 266. Accelerators or inhibitors may be required to achieve proper set times and shall be used as recommended by the resin System Provider.

The resin binder shall be initiated and thoroughly blended just prior to mixing with aggregate. The polyester polymer concrete shall be mixed a minimum of two (2) minutes prior to placing.

Polyester polymer concrete shall be placed prior to gelling and within 15 minutes following the addition of the initiator, whichever occurs first. Polyester polymer concrete that is not placed within this time shall become the property of the Contractor and shall be disposed of at the Contractor's expense. Placing includes the broadcasting of finish sand, see below.

The surface temperature of the area to receive polyester concrete shall be the same as specified above for the prime coat and shall satisfy the System Provider's recommendations.

The finishing equipment used shall strike off the polyester polymer concrete to the established grade and cross section. Finishing equipment shall be fitted with vibrators or other means of consolidating the polyester polymer concrete to the required relative compaction of not less than 97 percent in accordance with California Test Method 552. Compaction testing required for acceptance shall be performed by the Department as deemed necessary by the Department.

The surface shall be textured with an abrasive sand finish. The finish sand shall be applied by either mechanical means or hand broadcasting immediately after strike-off, before gelling

occurs, at a minimum rate of 2.75 ounces per square foot.

**F. Surface and Thickness Requirements**

The smoothness of the polyester polymer concrete surface will be tested with a straightedge. The surface shall not vary more than 0.25” from the lower edge of a 12.0 ± 0.2 foot long straight edge placed in any direction. Any surfaces which fail to conform to the required tolerances shall be removed by grinding.

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 to the Department.

The minimum thickness of the PPC overlay as shown in the Plans shall be checked prior to its initial set using a ruler. If the Engineer determines that the minimum thickness has not been attained, the limits of the deficient area shall be documented and an additional layer of PPC shall be applied after the deficient area of PPC overlay hardens. The thickness of this additional layer of PPC shall be as specified by the System Provider and as required to achieve the minimum total PPC overlay thickness specified in the Plans. Any additional PPC overlay needed to satisfy the minimum thickness requirement shown in the Plans shall be applied by the Contractor at no additional cost to the Department.

**G. Curing**

Traffic and equipment shall not be permitted on the PPC overlay for a minimum of four (4) hours following final finishing. The PPC overlay shall be protected from moisture for not less than four (4) hours after finishing. The PPC overlay shall be allowed to reach sufficient cure, as specified by the System Provider, before subjecting it to traffic loads. Cure time is dependent upon the ambient and deck temperatures. Actual degree of cure and suitability of the PPC overlay for traffic shall be as determined by the Engineer.

**Method of Measurement:**

Polyester Polymer Concrete overlays will be paid separately at the Contract Unit Price for furnishing and installation of the respective overlay.

**Basis of Payment:**

A. Payment will be made for accepted quantities at the Contract Unit Price as follows:

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
625XXX	POLYESTER POLYMER CONCRETE OVERLAY INSTALLATION	SY-IN
625XXX	FURNISHING POLYESTER POLYMER CONCRETE OVERLAY	CY

B. Price and payment for furnishing all Materials is to be paid separately.

C. Price and payment for installation of the overlay Material constitutes full compensation for the preparation of the area to receive overlay including scarifying, shot- or grit-blasting, removal of rust, oil, and other contaminants, protecting the area, placing the bonding grout or primer coat,

| placing of PPC overlay, consolidating, curing, texturing, constructing, and removing test patches,  
| and for all labor, Equipment, tools, and incidentals necessary to complete the Work.

10/28/2016

**6285xx – REMOVAL OF EXISTING DECK REPAIRS**

**Description.**

This work consists of selective removal of unsound concrete that is part of existing deck repairs of variable depths within the structural deck slabs as indicated on the Plans, in accordance with these Special Provisions, and as directed by the Engineer.

**Materials.**

Not applicable.



**Construction.** Following milling of the deck, and prior to hydrodemolition, the Engineer will visually inspect and perform a sounding test on all existing deck repairs. Existing deck repairs are defined as any repairs made to the original deck previous to this project. Any existing deck repairs that are loose, partially delaminated, or otherwise unsound, will be measured by the Engineer and marked for removal. The Contractor shall remove the existing unsound deck repairs in accordance with applicable portions of Section 628.03(F). The removal shall not include any unsound original bridge deck concrete. Following removal of unsound existing deck repairs, all debris shall be removed from the deck prior to hydrodemolition.

**Method of Measurement.**

Removal of Existing Deck Repairs will be measured by the square foot for the removal of existing deck repairs made prior to the hydrodemolition operation.

**Basis of Payment.**

Removal of Existing Deck Repairs will be paid for at the Contract Unit Price per square foot for Item 6285xx – Removal of Existing Deck Repairs. All equipment, labor and materials necessary to perform the operation, including the cost of cleaning and repairing reinforcement and cleaning the removal area shall be included in the cost of Item 6285xx – Removal of Existing Deck Repairs, along with any other incidental work necessary to complete this item.

2/1/2018

**6285XY - FRP JACKET AND EPOXY GROUT CONCRETE PIER ENCASEMENT**

**Description:**

This work consists of furnishing all materials and constructing a protective pier encasement. The encasement shall consist of a fiber reinforced plastic (FRP) outer jacket with the space between the jacket and pier filled with a pourable epoxy grout.

**Materials:**

1. Jackets - The FRP jackets shall have interlocking joints. The jackets shall be fabricated from fiberglass and polyester resins and shall be a minimum thickness of 1/8 inch (3 mm), unless otherwise shown on the Plans. The inside face of the jacket shall be textured similar to a sandblasted surface and the surface shall have no bond-inhibiting agents that will come into contact with the epoxy grout. The jackets shall be provided with non-corrosive standoffs, which will maintain the jackets in the required positions (away from the face of the pier) to provide the specified void. The jacket shall be capable of being opened, placed around a pier and then returned to its original shape without damaging the jacket. Compressible sealing strips shall be installed at the bottoms of the jackets to seal the annular space between the pier and the jacket.

The jacket shall meet the following physical-characteristics:

- (a) Water Absorption (ASTM D570) . . . . . 1% Max.
- (b) Ultimate Tensile Strength (ASTM D638) Longitudinal,  
transverse and diagonal. . . . . 15,000 psi Min.
- (c) Flexural Strength (ASTM D796) . . . . . 25,000 psi Min.
- (d) Flexural Modulus of Elasticity (ASTM D790) . . . . . 700,000 psi Min.
- (e) Barcol Hardness (ASTM D2583) . . . . . 45 ± 5
- (f) Color . . . . . Grey or Translucent as noted in the Plans

2. Pourable Epoxy Grout - The epoxy grout shall be a 100% solids pourable epoxy grout. The epoxy grout shall consist of an epoxy binder and epoxy extender as follows:

Binder - The binder shall be a two (2) component 2:1 ratio 100% solids pourable epoxy material. It shall be moisture insensitive for application both above and below water and it shall adhere to wet wood, steel, concrete and the FRP jacket.

Epoxy Extender - The filler shall be an epoxy extender compatible with and supplied by the manufacturer of the epoxy.

Mixing - The binder shall be mechanically mixed in strict accordance with manufacturer's instructions. One 3-gallon unit of the mixed binder shall be combined with the designated volume of epoxy extender to achieve the following consistencies:

Pourable. (3) gallons epoxy plus (3) – 48 pound bags epoxy extender

Mortar Strength - When mixed on a ratio of one part binder to one part epoxy extender, 2 inch cubes of this material at seven (7) days [curing at 66° F to 74° F] shall be 8,000 psi when tested according to ASTM C 109 Modified.

3. Trowelable Epoxy Mortar - The trowel grade epoxy shall be composed of 100% solids trowel grade epoxy binder and epoxy extender as follows:

Binder - The binder shall be a two (2) component 2:1 ratio trowel grade epoxy material. It shall be moisture insensitive for application both above and below water. It shall adhere to wet concrete, steel and the FRP jacket.

Epoxy Extender - The epoxy extender shall be an epoxy extender compatible with and supplied by the manufacturer of the epoxy.

Mixing - The binder shall be machine mixed in strict accordance with manufacturer's instructions. One part of binder shall be combined with a maximum of one part of epoxy extender.

Mortar Strength - When mixed on a ratio of one-part binder to one-part filler, 2 inch cubes of this material at seven (7) days [curing at 60° F to 74° F] shall be 8,000 psi when tested according to ASTM C 109 Modified.

All materials shall be compatible and shall be supplied from a single source.

### **Construction Methods:**

Shop drawings, showing location of stand-off spacers, method of fastening jacket form to pier surface, sealing the jacket after installation and bracing during placement of materials in the annular space between the jacket and the pier, shall be prepared by the Contractor and submitted for approval prior to any field installations.

The surface of the pier shall be prepared in accordance with manufacturer's recommendations. All surfaces to be covered with protective jackets shall be thoroughly cleaned of oil, grease, dirt, broken and unsound concrete, marine growth, and any other deleterious material, which would prevent proper bonding of filled jacket or seating of the non-filled jacket. Cleaning may be accomplished by high pressure blasting, wire brushing, or water laser. Sandblasting is not permitted. In addition to the above surface preparation, any exposed reinforcing steel shall be cleaned using similar methods to remove all rust and scale prior to installation of the protective jacket. If the Contractor elects to use an alternative method, they will be responsible for amending the permit at no additional time or cost to the Department. No placement of the jackets will be allowed until the surface preparation has been approved.

The Contractor shall submit, for approval, a method for cleaning the piers (as per manufacturer's recommendations) and for the collection and proper disposal of all material removed. Cleaning the piers may be done under wet or dry conditions. If under wet conditions, the area must be contained to collect all removed materials. Under dry conditions, all removed materials shall be collected prior to entering the stream or soil.

The FRP jacket shall be spread open by disengaging the interlocking joint. Then placed in position around the pier and fitted together and the bottom of the jacket form shall be sealed against the pier surface. Filling of the annular void between the pier and the pier jacket shall be done in accordance with the material manufacturer's instructions. External bracing materials shall be removed after completion of the work and the exterior surfaces of the jackets shall be cleaned of any filler material or other extraneous material deposited on the FRP jackets. Around the top of the jacket a bevel shall be constructed with the trowel grade epoxy mortar to prevent water from ponding on the FRP jacket tops.

### **Method of Measurement:**

The quantity of FRP jacket and epoxy grout pier encasement will be field measured as the total number of square feet of pier surface encased and accepted.

**Basis of Payment:**

The quantity of FRP jacket and epoxy grout pier encasement will be paid for at the Contract unit price per square foot. Price and payment will constitute full compensation for furnishing and placing all materials as described in this specification, for cleaning and preparing the piers, collecting and disposing of material removed during the pier cleaning process, for excavating and backfilling streambed material, and for all labor, equipment, tools and incidentals required to complete the work.

**6285XX – REHABILITATION OF EXISTING CONCRETE STRUCTURE, FIBER  
REINFORCED POLYMER WRAP**

**6XX.01 Description.**

Design, furnish and install an externally bonded fiber reinforced polymer (FRP) composite system to strengthen the concrete piers at the locations as shown on the plans.

**6XX.02 Materials.**

- A. Provide a unidirectional, high-strength fiber fabric fully saturated with compatible epoxy resin per manufacturer's recommendations.
  - 1. The FRP provided shall meet or exceed the minimum requirements in the AASHTO guide specification "Design of Bonded FRP Systems for Repair and Strengthening of Concrete Bridge Elements", for the tensile modulus, stress and strain as determined from independent laboratory testing in accordance with ASTM D3039 test procedure requirements.
  - 2. The epoxy resin provided shall create a bond strength between the concrete substrate and FRP composite system that meets or exceeds the minimum requirements set forth in the AASHTO guide specification "Design of Bonded FRP Systems for Repair and Strengthening of Concrete Bridge Elements", as determined using direct pull-off tests performed in accordance with ASTM D7522 test procedure requirements.
- B. Provide a flexible, waterproofing, non-vapor barrier protective top coating compatible with the FRP manufacturer's recommendations to protect the FRP from ultraviolet radiation and heavy abrasion with a design life of 50 years. This protective top coating shall closely match the color and texture appearance of the adjacent concrete.

**6XX.03 Construction.**

- A. Pre-Installation
  - 1. Submit contractor and manufacturer qualifications.
    - a. Contractor qualifications shall include a manufacturer's certification of technical training, FRP composite system selected, project supervisor, and documentation showing the contractor has been certified or approved by the manufacturer of the FRP composite system. Additionally, the contractor shall document a minimum of 2 years of experience or 5 similar field applications with acceptable reference letters from respective Owners.
    - b. Qualifications of the manufacturer shall include documentation demonstrating that the manufacturer of the proposed FRP composite system has a program of training and certifying potential installers or contractors, and can provide technical support personnel.
  - 2. Arrange for a technical representative from the composite system manufacturer to be present during the surface preparation and application of the FRP composite system, as directed by the Engineer. A trained project supervisor with a manufacturer's letter of certification as an approved installer may be accepted in lieu of having a technical representative onsite. The technical representative or trained project supervisor will be required to remain onsite at all times to instruct and monitor all activities related to the FRP application procedures.

3. Provide the manufacturer's product data, including physical and chemical characteristics, material specifications for each component, limitations on use of the system, construction or application specifications, maintenance instructions and general manufacturer's recommendations regarding each system. Include product data on the proposed primer, putty, resin, saturant, and carbon or glass fiber.
4. Provide certifications by the producers of the materials that all materials supplied are in accordance with all the requirements and standards of the appropriate ASTM and other agencies. Provide testing information on the combination of the proposed carbon or glass fiber reinforcement and epoxy when used together as a system.
5. Supply a copy of the manufacturer's Material Safety Data Sheets (MSDS) for all materials to be used on site and certification that the materials conform to local, state, and federal environmental and worker safety laws and regulations.
6. Prepare and submit working drawings that detail the number, thickness, geometry, placement and orientation of the fiber reinforcement layers, and locations of splices and corresponding lap lengths to meet the coverage shown on the drawings. Include a work plan documenting necessary preparations of the existing structure, the time schedule for various steps in the work, and identify the environmental conditions that may affect the application and curing of the FRP composite system. Provide complete design calculations for the FRP composite system stamped by a Professional Engineer, registered in the State of Delaware. Design the FRP composite system in accordance with the AASHTO guide specification "Design of Bonded FRP Systems for Repair and Strengthening of Concrete Bridge Elements" to achieve the structural performance shown in the plans for required factored tensile forces.
7. Follow the submittal procedures outlined in Section 105.04 of the Standard Specifications.

**B. Delivery, Storage and Handling**

1. Deliver all components of the FRP composite system in the original factory-sealed packaging or containers with the manufacturer's labels intact and legible (including brand, system identification number and batch number) with verification of date of manufacture and shelf life.
2. Store materials in a protected area at a temperature between 35°F [2°C] and 100°F [38°C]. Catalysts and initiators should be stored separately. Protect all components from dust, moisture, chemicals, direct sunlight, physical damage, fire, and temperature outside the range specified in the system data sheets. If manufacturer requires additional measures for storage of materials, those should be followed accordingly.
3. Handle all components of the FRP composite system, especially fiber sheets, according to the manufacturer's recommendations. Protect them from damage and avoid misalignment or breakage of the fibers by pulling, separating or wrinkling, or by folding the sheets. After cutting, stack sheets dry or with separators, or rolled gently at a radius no tighter than 300 mm, or as recommended by the manufacturer.
4. Dispose of any component of the FRP composite system that has exceeded its shelf or pot life, that has not been properly stored, and any unused or excess material that is deemed waste.

### C. Concrete Repairs and Surface Preparation

1. Remove spalled and loose concrete and restore concrete surfaces to their original dimensions using concrete repair and rehabilitation in accordance with Section 628.03(E). The new concrete in the repair areas shall cure for a minimum of 28 days before the FRPP is applied.
2. Epoxy inject all cracks in the concrete surface wider than 0.01 in. [0.3 mm] using concrete repair and rehabilitation in accordance with Section 628.03(A).
3. Grind uneven surfaces, protrusions, and sharp edges on the concrete such that localized out-of-plane variations do not exceed 1/32" or the tolerances recommended by the FRP manufacturer. Round or chamfer all inside and outside corners or sharp edges by grinding or forming the system's epoxy mortar to a minimum radius of 1", or as recommended by the manufacturer.
4. Remove any dust, laitance, grease, paint, curing compounds, waves, impregnations, foreign particles, and other bond inhibiting materials from the surface by blast cleaning or equivalent mechanical means. Vacuum clean all concrete surfaces to a dust-free condition. If water pressure is used to clean surfaces, allow surface to dry thoroughly before installing the FRP composite system. Protect the cleaned surface against redeposit of any bond-inhibiting materials. Cover any newly repaired or patched surfaces that have not cured a minimum of 7 days with a water-based epoxy prior to installation of the FRP composite system.

### D. Installation of FRP System

1. Do not begin applying FRP composite system until all surface preparation work is complete and has been approved by the Engineer or technical representative/project supervisor.
2. Apply the FRP composite system when the concrete surface and ambient temperature are between 45° F and 100° F, and are forecast to remain in that window until the system has cured. If the manufacturer's recommended temperature range is more stringent, the manufacturer's requirements shall govern.
3. Mix all resin components, including main agent and hardener, at the proper temperature, using the appropriate weight ratio and for a duration specified by the manufacturer, until uniform color and consistency is achieved. Do not dilute resins with any organic solvents such as thinner. Mix components using methods permitted by the manufacturer and perform as instructed by the manufacturer. Mix resin quantities sufficiently small to ensure that it can be used within its pot life. Dispose of mixed resin that begins to generate heat or show signs of increased viscosity.
4. Apply primer on the concrete surface in accordance with manufacturer's recommendations. Primer may be applied with a brush or roller. Apply second coat as necessary after first coat has penetrated into concrete. Follow manufacturer's recommendations pertaining to time between priming and application of FRP. Allow no more than 24 hours between the application of primer and covering the primer with FRP. If the 24-hour window is exceeded due to unforeseen circumstances, the primed surfaces must be solvent wiped with a fast flashing solvent or roughened with sandpaper to break the amine blush. Grind surface irregularities caused by the primer application by way of disc sanding. Fill surface depressions with approved epoxy filler.

5. Saturate fiber sheet using a method approved by the manufacturer. Use saturant with sufficiently low viscosity to ensure full impregnation of the fiber sheets prior to curing. Viscosity may be adjusted by means of gradual heating. Once the fabric is saturated, it may then either be spooled for easy handling, or cut to specified lengths and booked for handling. Care must be taken not to damage the fibers. The fiber may then be applied to the surface with no delay. Work from one end to the other, taking care to place and orient the fibers as specified in the approved shop drawings. Lap splices shall be a minimum of 6" end-to-end and 2" parallel to the direction of the fibers. Stagger lap splices on multiple plies and adjacent strips. Remove any air entrapped in the fabric using a method approved by the manufacturer. Limit the number of plies applied in a single day to that that can be supported by the previously applied system without sloughing or sliding.
6. Protect finished installation of FRP composite system from rain, dust, etc. using protective sheeting or other barriers. Do not allow protective sheeting to come in contact with finished application. Curing of finished application shall be a minimum of 24 hours, or as directed by the manufacturer's recommendations.
7. Apply protective coating in accordance with the manufacturer's recommendations. The final top coating shall match the color and texture appearance of the adjacent concrete.
8. Uncured saturants may be cleaned from tools with an approved solvent and properly disposed. Cured saturants shall be removed by mechanical means and properly disposed.

#### E. Inspection and Quality Assurance

1. During construction, submit Daily Construction Logs documenting the following information: weather and temperature at application times; amount of product used and square footage/linear footage of substrate covered; batch numbers of all products used; names of all crew members; any bond-strength tests, noting location quantity and the name of the crew members who performed the tests.
2. Perform and submit test results for all material lots prior to application to verify material properties. Perform tests in accordance with ASTM D3039 testing procedures and manufacturer's published testing methods. Testing may be performed as part of the manufacturer's QC program or by the contractor before applying. The testing shall provide average values for the ultimate tensile strength, tensile modulus, and percent elongation. The material lot will be deemed unacceptable if the average modulus is less than 90% of the value specified in the Contract Documents and Plans.
3. After the initial resin has cured for at least 24 hours, perform the following tests:
  - a. Visually inspect the FRP composite system for any defects, particularly any swelling, bubbles, voids or delaminations. Perform an acoustic tap test inspection to any regions of the layered surface suspected to contain air pockets. Defects smaller than 1/4" [6 mm] in diameter do not require corrective action, unless they occur next to edges or when there are more than five such defects in an area of ten square feet. Defects larger than 1/4" [6 mm] in diameter should be repaired in accordance with this specification.
  - b. Before applying the protective coating, perform a direct pull-off test in the presence of the Engineer or technical representative/project supervisor and in accordance with ASTM D7522 to verify the tensile bond between the FRP composite system and the concrete. At

a minimum, perform three pull-off tests for each day of production, with at least one test per pier face or one test per 150 square feet of the FRP composite system. Perform pull-off tests on an adjacent area representative to the area being strengthened. Tests shall be performed on each type of substrate or for each surface preparation technique used. The minimum acceptable value for a single tension test is 175 psi. The average of the tests at a single location shall not be less than 200 psi. Additional tests may be performed to qualify the work. The tension adhesion tests shall exhibit failure of the substrate indicated by a layer of concrete or masonry on the underside of the test specimen following the test. If the pull-off tests find that the adhesion between the FRP composite system and the concrete is inadequate, the work will be rejected and repaired.

4. In the event that material testing determines a sample batch to possess insufficient material properties, remedial measures shall be taken. If the tested composite system has material properties below the minimum specified values, install additional layers until the final composite thickness is increased by the same percentage as the deficiency of the material's elastic modulus. Additional payment will not be made for any required additional material.

#### F. Repair of Defective Work

1. Repair the defective work after the minimum cure time for the FRP composite system. Repair all defects in a manner that will restore the system to the designed level of quality in accordance with the Manufacturer's recommendations. Obtain approval for procedures and conditions that are not specifically addressed in this specification. Make all repairs and touch ups to the satisfaction of the Engineer or technical representative/project supervisor.
2. Acceptable repair procedures are as follows:
  - a. Small entrapped air pockets and voids or surface discontinuities less than 1/4" [6 mm] in diameter naturally occur in mixed resin system and do not require repair or treatment unless they occur next to edges or when there are more than five such defects in an area of ten square feet.
  - b. Repair small defects between 1/4" [6 mm] and 1" [25 mm] in diameter using a low-pressure epoxy injection, as long as the defect is local and does not extend through the complete thickness of the composite layer, in the case of multi-ply FRP systems. If any delamination growth is suspected between the FRP plies due to injection, stop the injection procedure and repair the area in accordance with the medium defect repair.
  - c. Repair medium defects between 1" [25 mm] and 6" [150 mm] in diameter by first removing the area surrounding the defect to an extent of at least 1" [25 mm] on all sides. Next, wipe the area clean and allow to dry thoroughly. Lastly, complete the repair by adding an FRP patch of the same type and orientation as the removed section, and place over the defective section, extending at least 1" [25 mm] beyond the removed area on all sides.
  - d. Repair large defects greater than 6" [150 mm] by first scarifying the defective area out to at least 1" [25 mm] on all sides. For multi-ply FRP systems, scarify progressively through the layers until past the defective area. If the defect extends to the first ply adjacent to the concrete, remove the entire thickness of FRP and primer. Prepare the concrete and apply the primer after ensuring that the surface and FRP are clean and dry. Follow procedures for a new system when applying in the scarified area, except add an additional layer

extending a minimum of 6" [150 mm] on all sides of the scarified area as a patch. After curing, apply the protective coating over the entire area.

- e. Defects in the protective coating consist of small hairline cracks, blistering and/or peeling. For cracks in the protective coating, lightly sand the local surface and apply a new coating with the appropriate primer over an area extending 1" [25 mm] on either side of the defect. For blisters in the protective coating, carefully scrape clean the entire area of blisters extending 12" [300 mm] beyond the extent of the defect, completely remove the existing coating, wipe the area clean, and allow the area to thoroughly dry before applying a primer coat and the protective coating over the area. For peeling of the protective coating, scrape off the entire coating, lightly sand, clean and thoroughly dry before applying a new protective coating

**6XX.04 Method of Measurement.**

- A. The quantity of Rehabilitation of Existing Concrete Structure, Fiber Reinforced Polymer Wrap will not be measured.

**6XX.05 Basis of Payment.**

- A. Payment will be made for accepted quantities at the Contract Unit Price as follows:

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
6285XX	REHABILITATION OF EXISTING CONCRETE STRUCTURE, FIBER REINFORCED POLYMER WRAP	LS

- B. Price and payment for Rehabilitation of Existing Concrete Structure, Fiber Reinforced Polymer Wrap will be made at the Contract Lump Sum price and will constitute full compensation for design of the FRP composite system; providing a manufacturer's representative; furnishing and installing all Materials for the composite system including surface preparation of the substructure members, installation of the FRP composite system, repair of defective work and application of the final coating system; providing all Contractor Submittals; furnishing and removing scaffolding as required; providing protection against damage during system installation; inspection and testing of the final product; and for all labor, Equipment, tools and all necessary incidentals required to complete the Work.
- C. Price and payment for deep spall repairs (defined in Section 628 as patches that extend below the top mat of reinforcement) that are within the proposed limits of the FRP composite system will be paid for under Item No. 628041, in accordance with Section 628.05(F).
- D. Price and payment for rehabilitation of P.C.C. masonry (defined in Section 628 as deep-spall patches that exceed 0.5 cubic yard in a single area) that are within the proposed limits of the FRP composite system will be paid for under Item No. 628042, in accordance with Section 628.05(F).
- E. Price and payment for shallow spall repairs (defined in Section 628 as patches that do not extend below the top mat of reinforcement) that are within the proposed limits of the FRP composite system will be incidental to the work performed under this specification, in accordance with Section 628.05(F).
- F. Price and payment for epoxy injection of all cracks within the proposed limits of the FRP composite

system will be paid for under Item No. 628001, in accordance with Section 628.05(B).

DRAFT

## 7205xx – DRILLING ROCK FOR GUARDRAIL POST INSTALLATION

### **Description.**

This work consists of drilling rock to permit the installation of guardrail posts which would otherwise be in conflict with rock.

**Materials.** Provide Materials as specified in:

Galvanizing Repair Paint	Section 1039.10.B
Del. Stone No. 57	Section 1004

### **Construction.**

When rock is encountered, drill a 12 inch diameter hole to accommodate the length of the specified guardrail post, or drill into the rock 20 inches in depth, whichever is less. The 12 inch diameter hole shall be located such that the guardrail post will be placed in the center of the hole. When the 20 inch depth is reached prior to the depth required to accommodate the full post length, cease drilling and cut the post to the appropriate length and paint the cut edge with galvanizing repair paint. Backfill with No. 57 stone. Place backfill in horizontal layers not exceeding 6 in. depth and thoroughly compact. Do not use concrete or grout material.

### **Method of Measurement.**

The Engineer will measure Work acceptably completed as specified in Section 109.01 and as follows:

- A. The length of guardrail requiring drilling for post installation will be measured along the face of guardrail, from the center of the first post requiring rock drilling to the center of the last post requiring rock drilling. If two or more sequential posts do not require drilling between a series of posts requiring drilling, the measured lengths of guardrail requiring drilling shall omit guardrail between the posts for which drilling is not required.
- B. The depth of drilling, quantity of backfill, and work associated with cutting and painting posts as needed, will not be measured for payment.

### **Basis of Payment.**

The Department will pay for accepted quantities at the Contract Unit Price per linear foot for Item 7205xx – Drilling Rock for Guardrail Post Installation. Price and payment will constitute full compensation for furnishing all Materials, Equipment, labor, and incidentals for drilling, removing debris, cutting and painting guardrail posts, backfilling and compacting the post cavity with No. 57 stone, and all other activities required to install guardrail in the area of rock and complete the work. Installation of the guardrail shall be paid separately, under the applicable guardrail item. No additional payment shall be paid for detection of rock, whether it be by test hole, probe, or interruption to post driving, and no additional payment shall be made for re-driving due to the presence of rock or reduced production due to encountering rock. No additional payment shall be made for damaged posts due to presence of rock.

1/05/2018

**7215xx – END ANCHORAGE 31, DOUBLE FACE**

**Description.**

This work consists of furnishing and installing a double-face End Anchorage in accordance with the contract documents.

**Materials.** Furnish guardrail end anchorage components and associated Materials in accordance with Section 720.02.

**Construction.**

Install guardrail end anchorages in accordance with the construction documents at the locations indicated on the Plans. Construct end anchorages using applicable construction methods provided in Section 720.

**Method of Measurement.**

Measure the quantity of guardrail end anchorages as the number of guardrail end anchorages furnished, assembled, installed, complete-in-place and accepted.

**Basis of Payment.**

The quantity of Item 721xxx – End Anchorage 31, Double Face will be paid for at the Contract Unit Price per Each. Price and payment will constitute full compensation for furnishing all Materials, fabrication and installation and for all Materials, labor, Equipment, tools and incidentals required to complete the Work.

1/04/2018

## 7275XX –DECORATIVE BARRIER

### **Description.**

This work shall consist of fabricating, furnishing, and installing new aluminum decorative panels within the limits shown on the Plans, in accordance with these Special Provisions, and as directed by the Engineer. This work shall also include removing and restoring the existing aluminum posts and installing them back onto the new reconstructed parapets at the locations shown on the plans, in accordance with these Special Provisions, and as directed by the Engineer.

### **Materials.**

Any new structural posts or plates required to replace damaged posts shall be aluminum alloy 6063-T6 or 6061-T6.

The new coating to be applied to the existing decorative barrier aluminum posts shall be a shop-applied polyvinylidene fluoride (PVDF) resin with color selected to best match the existing barrier. The Contractor shall prepare and submit a product data sheet with descriptive data and test results for the specified finish and a 2" by 3 1/2" coating sample on aluminum backing that shows the proposed color (to closely match the existing color).

The provided coating shall meet the requirements of American Architectural Manufacturers Association (AAMA) 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels.

For the new decorative panels, channels and angles shall be aluminum alloy 6063-T6 or 6061-T6.

Anchor bolts shall be fabricated from stainless steel conforming to the applicable requirements of A276, Type 304, Condition A; nuts and washers shall conform to the applicable requirements of ASTM A320, Series 300; and all anchor bolts, nuts and washers shall be passivated in accordance with Federal Specification QQ-P-35.

Neoprene Pads, Bumpers and Flaps shall be manufactured from 100% virgin chloroprene (not reprocessed) meeting the requirements of Table B in Section 25 of AASHTO Standard Specifications for Highway Bridges, dated 1983. The Durometer Hardness of the neoprene shall be 50±5.

Aluminum Sandwich Panels shall meet the following requirements:

Face and Back Sheets: Each sheet shall be fabricated in one piece from .063" aluminum sheet of Alclad alloy 6061-H-12 with an alloy 1230 cladding of approximately 5% on both sides. The aluminum sheets shall be specially prepared for porcelain enameling by the use of an immersion type metal treatment with all pretreatment to be performed in tanks of sufficient size to accommodate the complete panel. Pretreatment shall include deoxidizing and alkaline-chromate solutions. The exposed side of each sheet shall be porcelain enameled a minimum of .002" in thickness. To insure uniformity, porcelain enamel shall be applied by automatic spray equipment to conform to current Porcelain Enamel Institute Specifications and have a gloss reading of 50 to 70 units at an angle of 45 degrees when measured on the Photovolt meter. Reference Test ASTM Designation C346-59.

Porcelain enamel color samples shall initially be submitted to the Department for selection and approval. Color shall match existing decorative barriers as close as possible. Testing of the Porcelain Enamel shall be

performed by the manufacturer as follows:

Adherence: Adherence of the porcelain enamel coating shall be checked by accelerated spall test in accordance with current Porcelain Enamel Institute Specifications ADS-105(69). Tests shall be performed on samples processed with the production run. Test samples shall be run every 1,000 square feet of production cycle or total of order, whichever occurs first.

Acid Resistance: The porcelain enamel shall have a weight loss of less than 20 mg./sq. inch in the boiling 6% citric test when tested in accordance with ASTM C283.

Visual: The porcelain enamel on all surfaces exposed to weathering shall be free of blemishes in the coating that may impair serviceability or detract from the general appearance of the panel when viewed from a distance of 25 feet.

Each panel section shall be provided with a perimeter frame. All perimeter framing shall be channel section fabricated from aluminum alloy 6063-T6. The perimeter frame shall be assembled by means of self-tapping hex head stainless steel screws in accordance with the manufacturer's standard and the approved shop drawings. An approved sealant shall be used at the contact faces of the corners to prevent moisture penetration.

Core Material shall be 2-1/2" thick phenolic impregnated paper honeycomb. Core material shall meet Military Specification MIL-D-5272 for resistance to fungus. The cell size shall be 1/2", weight of Kraft paper 80 lbs. and impregnation 18 percent by weight minimum.

The laminating adhesive shall produce a permanent oil and water-resistant bond. Adhesives shall be of the thermo-setting type. Bonding of panels shall be done in a heated flat platen press of sufficient size to contain the entire panel at one time with capabilities of 10 psi over the entire platen area. Face and back panels shall be cleaned, prior to laminating, in tanks of sufficient size to accommodate the complete panel.

All adhesively bonded panels shall have an exterior face of such flatness that when measured at normal room temperature of 70 degrees to 80 degrees F, the maximum wave slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1%. Flatness will be considered satisfactory if tolerance requirement is met with readings taken in sun or shade. Wave slope shall be computed in the following manner. Measure the distance between high points (dimension A) and then place a straight edge across the points and measure the depth of slope (dimension B). Divide one-half of A into B to determine percentage of wave slope.

The manufacturer shall furnish certification as to prior testing of the adhesive laminate according to test methods ASTM C-297-61 and ASTM C-481-62; the minimum tensile strength of the honeycomb laminate construction shall be 50 psi. Test to be performed in accordance with ASTM Test Methods C297-61 and ASTM C481-62 Cycle A. All testing shall be performed by an independent testing laboratory at the Contractor's expense.

1/8" in diameter weep holes shall be drilled in the perimeter frame at the bottom of each panel. Holes shall be located to clear the neoprene bumpers at the bottom of the panels.

On the perimeter of the finished panel, a 1/8" tolerance from flush between the sheets and frame will be allowed and all edges shall be straight within 1/8" from a straight plane. All sharp edges that would present a hazard in handling shall be smoothed.

At each corner on the face of each panel, one 1/8" self-plugging rivet shall be used to fasten the sheet to the

perimeter panel. Rivets appearing on the face side shall be of a color matching the color of the face of the panel.

Apply inorganic zinc rich primer and vinyl top coat for coating all carbon steel components of the Decorative Barrier installation, except for areas where the neoprene pads are to be bonded to the steel surface. Coatings shall conform to the requirements of Section 616 of the Standard Specifications.

Adhesive for bonding neoprene pads to steel posts and neoprene flaps to panels shall be of type specially formulated for such purpose and shall be approved by the Engineer. The adhesion of the neoprene, using this adhesive, to steel and aluminum surfaces shall be tested by the manufacturer on the actual neoprene proposed to be used in this installation. Strip tests to meet the requirements specified below shall be performed by the epoxy manufacturer and the result of such tests submitted to the Engineer prior to the approval of the adhesive.

Grout for grouting the anchor bolts in the drilled holes shall be an epoxy or non-shrink grout of a type and quality suitable for the use intended and approved by the Engineer.

### **Construction.**

Detailed shop drawings of the new decorative panel and refurbished aluminum posts installation shall be submitted to the Engineer for approval.

The decorative barrier shall be mounted on the reconstructed concrete parapets and elsewhere as shown on the Plans.

Anchor bolts shall be cast to a depth as shown on the Plans.

Posts and aluminum sandwich panels shall be installed as shown on the Plans, in accordance with the approved shop drawings and as ordered by the Engineer.

Welding of aluminum components shall be performed in accordance with the applicable requirements of Section 1044.03 of the Standard Specifications.

Aluminum posts shall be properly cleaned, prepared and tested for bonding the neoprene pads. Adhesive cement, specially formulated for bonding neoprene to carbon steel and aluminum shall be applied to the cleaned and prepared metal surface. Neoprene shall be totally bonded to the metal. Bond between the neoprene and metal shall meet the following Rubber Manufacturers' Association's criteria:

Table 8, Method B, page 21 of RMA Handbook - RMA "Class 3", Drawing Designation "Grade 3";  
Minimum Bond Destructive Value "15 lbs./in. width".

After the neoprene is fully bonded, the surface of the neoprene shall be temporarily masked, then the posts, base plates and joint closure plates shall be prepared and painted, with the specified inorganic zinc rich primer and vinyl top coat in accordance with the requirements of Section 616 of the Standard Specifications. All other steel components (except stainless steel) of the installation shall be similarly painted with inorganic zinc rich primer and vinyl top coat

### **Method of Measurement.**

Reinstalling the decorative barrier will be measured by the linear feet of barrier placed and accepted at the locations specified on the Plans. Measurement shall be taken from center to center of end posts. Replacement of damaged posts will not be measured.

**Basis of Payment.**

Reinstalling the decorative barrier to the locations shown on the Plans will be paid for at the Contract Unit Price per linear foot for Item 7275XX – Decorative Barrier. All equipment, labor and materials necessary to perform the work, including the cost to transport, clean, coat, and reinstall the aluminum posts and fabricate and install the new decorative panels will be included in the cost of Item 7275XX – Decorative Barrier, along with any other incidental work necessary to complete this item. Replacement of damaged posts will be incidental to this item.

The removal and salvage of the existing decorative barrier will not be measured for payment. Cost for this work will be incidental to Item 21100 – Removal of Structures and Obstructions.

02/12/2018

## 7275XY –RAILROAD PROTECTIVE BARRIER

### **Description.**

This work shall consist of fabricating, furnishing, and installing a new railroad protective barrier over active Amtrak railroad tracks at the locations shown on the Plans, in accordance with these Special Provisions, and as directed by the Engineer.

### **Materials.**

Structural posts, plates, channels and angles shall be aluminum alloy 6063-T6 or 6061-T6.

Anchor bolts shall be fabricated from stainless steel conforming to the applicable requirements of A276, Type 304, Condition A; nuts and washers shall conform to the applicable requirements of ASTM A320, Series 300; and all anchor bolts, nuts and washers shall be passivated in accordance with Federal Specification QQ-P-35.

Neoprene Pads, Bumpers and Flaps shall be manufactured from 100% virgin chloroprene (not reprocessed) meeting the requirements of Table B in Section 25 of AASHTO Standard Specifications for Highway Bridges, dated 1983. The Durometer Hardness of the neoprene shall be 50 $\pm$ 5.

Aluminum Sandwich Panels shall meet the following requirements:

Face and Back Sheets: Each sheet shall be fabricated in one piece from .063" aluminum sheet of Alclad alloy 6061-H-12 with an alloy 1230 cladding of approximately 5% on both sides. The aluminum sheets shall be specially prepared for porcelain enameling by the use of an immersion type metal treatment with all pretreatment to be performed in tanks of sufficient size to accommodate the complete panel. Pretreatment shall include deoxidizing and alkaline-chromate solutions. The exposed side of each sheet shall be porcelain enameled a minimum of .002" in thickness. To insure uniformity, porcelain enamel shall be applied by automatic spray equipment to conform to current Porcelain Enamel Institute Specifications and have a gloss reading of 50 to 70 units at an angle of 45 degrees when measured on the Photovolt meter. Reference Test ASTM Designation C346-59.

Porcelain enamel color samples shall initially be submitted to the Department for selection and approval. Color shall match existing decorative barriers as close as possible. Testing of the Porcelain Enamel shall be performed by the manufacturer as follows:

Adherence: Adherence of the porcelain enamel coating shall be checked by accelerated spall test in accordance with current Porcelain Enamel Institute Specifications ADS-105(69). Tests shall be performed on samples processed with the production run. Test samples shall be run every 1,000 square feet of production cycle or total of order, whichever occurs first.

Acid Resistance: The porcelain enamel shall have a weight loss of less than 20 mg./sq. inch in the boiling 6% citric test when tested in accordance with ASTM C283.

Visual: The porcelain enamel on all surfaces exposed to weathering shall be free of blemishes in the coating that may impair serviceability or detract from the general appearance of the panel when viewed from a distance of 25 feet.

Each panel section shall be provided with a perimeter frame. All perimeter framing shall be channel section

fabricated from aluminum alloy 6063-T6. The perimeter frame shall be assembled by means of self-tapping hex head stainless steel screws in accordance with the manufacturer's standard and the approved shop drawings. An approved sealant shall be used at the contact faces of the corners to prevent moisture penetration.

Core Material shall be 2-1/2" thick phenolic impregnated paper honeycomb. Core material shall meet Military Specification MIL-D-5272 for resistance to fungus. The cell size shall be 1/2", weight of Kraft paper 80 lbs. and impregnation 18 percent by weight minimum.

The laminating adhesive shall produce a permanent oil and water-resistant bond. Adhesives shall be of the thermo-setting type. Bonding of panels shall be done in a heated flat platen press of sufficient size to contain the entire panel at one time with capabilities of 10 psi over the entire platen area. Face and back panels shall be cleaned, prior to laminating, in tanks of sufficient size to accommodate the complete panel.

All adhesively bonded panels shall have an exterior face of such flatness that when measured at normal room temperature of 70 degrees to 80 degrees F, the maximum wave slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1%. Flatness will be considered satisfactory if tolerance requirement is met with readings taken in sun or shade. Wave slope shall be computed in the following manner. Measure the distance between high points (dimension A) and then place a straight edge across the points and measure the depth of slope (dimension B). Divide one-half of A into B to determine percentage of wave slope.

The manufacturer shall furnish certification as to prior testing of the adhesive laminate according to test methods ASTM C-297-61 and ASTM C-481-62; the minimum tensile strength of the honeycomb laminate construction shall be 50 psi. Test to be performed in accordance with ASTM Test Methods C297-61 and ASTM C481-62 Cycle A. All testing shall be performed by an independent testing laboratory at the Contractor's expense.

1/8" in diameter weep holes shall be drilled in the perimeter frame at the bottom of each panel. Holes shall be located to clear the neoprene bumpers at the bottom of the panels.

On the perimeter of the finished panel, a 1/8" tolerance from flush between the sheets and frame will be allowed and all edges shall be straight within 1/8" from a straight plane. All sharp edges that would present a hazard in handling shall be smoothed.

At each corner on the face of each panel, one 1/8" self-plugging rivet shall be used to fasten the sheet to the perimeter panel. Rivets appearing on the face side shall be of a color matching the color of the face of the panel.

Apply inorganic zinc rich primer and vinyl top coat for coating all carbon steel components of the Railroad Protective Barrier installation, except for areas where the neoprene pads are to be bonded to the steel surface. Coatings shall conform to the requirements of Section 616 of the Standard Specifications.

Adhesive for bonding neoprene pads to steel posts and neoprene flaps to panels shall be of type specially formulated for such purpose and shall be approved by the Engineer. The adhesion of the neoprene, using this adhesive, to steel and aluminum surfaces shall be tested by the manufacturer on the actual neoprene proposed to be used in this installation. Strip tests to meet the requirements specified below shall be performed by the epoxy manufacturer and the result of such tests submitted to the Engineer prior to the approval of the adhesive.

Grout for grouting the anchor bolts in the drilled holes shall be an epoxy or non-shrink grout of a type and

quality suitable for the use intended and approved by the Engineer.

### **Construction.**

Detailed shop drawings of the complete Railroad Protective Barrier installation shall be submitted to the Engineer for approval.

The Railroad Protective Barrier shall be mounted on the reconstructed concrete parapets and elsewhere as shown on the Plans.

Anchor bolts shall be cast to a depth as shown on the Plans.

Posts and aluminum sandwich panels shall be installed as shown on the Plans, in accordance with the approved shop drawings and as ordered by the Engineer.

Welding of aluminum components shall be performed in accordance with the applicable requirements of Section 1044.03 of the Standard Specifications.

Aluminum posts shall be properly cleaned, prepared and tested for bonding the neoprene pads. Adhesive cement, specially formulated for bonding neoprene to carbon steel and aluminum shall be applied to the cleaned and prepared metal surface. Neoprene shall be totally bonded to the metal. Bond between the neoprene and metal shall meet the following Rubber Manufacturers' Association's criteria:

Table 8, Method B, page 21 of RMA Handbook - RMA "Class 3", Drawing Designation "Grade 3";  
Minimum Bond Destructive Value "15 lbs./in. width".

After the neoprene is fully bonded, the surface of the neoprene shall be temporarily masked, then the posts, base plates and joint closure plates shall be prepared and painted, with the specified inorganic zinc rich primer and vinyl top coat in accordance with the requirements of Section 616 of the Standard Specifications. All other steel components (except stainless steel) of the installation shall be similarly painted with inorganic zinc rich primer and vinyl top coat.

### **Method of Measurement.**

Furnishing the Railroad Protective Barrier will be measured by the linear feet of barrier placed and accepted at the locations specified on the Plans. The linear feet of Railroad Protective Barrier to be paid for under this Section shall be the number of linear feet of installation of barrier conforming to the requirements of these Specifications and the Plans, installed complete in place. Measurement shall be taken from center to center of end posts.

### **Basis of Payment.**

The footage of the installation of Railroad Protective Barrier measured in linear feet as specified above, will be paid for at the Contract unit price bid per Linear Foot for the Item 7275XY – Railroad Protective Barrier. Price and payment shall constitute full compensation for furnishing and placing all materials, placing anchor bolts, and all related hardware, neoprene components, aluminum sandwich panels, painting, testing and for all labor, equipment, tools, and incidentals necessary to complete the item.

The removal and disposal of the existing railroad protective barrier will not be measured for payment. Cost for this work will be incidental to Item 21100 – Removal of Structures and Obstructions.

02/08/2018

**7605xx – TOTAL SURFACE HYDRODEMOLITION**  
**7605xy – DEEP CUT HYDRODEMOLITION**

**Description.**

This work consists of surface preparation of the specified existing bridge decks using the hydrodemolition method to provide a highly rough and bondable surface including select removal of all unsound concrete in the structural bridge deck prior to the placement of the proposed Latex-Modified Concrete (LMC) overlay. This item of work shall also include water control, shielding, all removal and disposal of concrete and debris, additional trim work, cleaning and other preparatory work at each bridge site to prepare individual bridge decks for the placement and finishing of the LMC overlay, and all work as indicated on the Plans, in accordance with these Special Provisions, and as directed by the Engineer.

Deck cores and an impact echo survey were taken in November/December 2014 and January/February 2015 on all project bridges. The coring report and the results of the impact echo survey are included as part of the Contract documents and are available upon request.

**Materials.**

Not applicable.



**Construction.**

A. Environmental Compliance

Prior to the start of any work, the Contractor shall submit an Environmental Compliance Plan (ECP) to the Engineer for review and approval. The ECP shall follow all Federal, State, and Local environmental laws and regulations. The ECP shall include specific details of the Contractor's plan for containment, filtering, and disposal of water, slurry, and other debris, including all best management practices (BMPs) that the Contractor plans to utilize to prevent environmental pollution and protect the waters of the State. All drains, joints, and other locations where discharge water could exit the deck shall be blocked to direct runoff to a central collection and filtering location, as designed by the Contractor. When runoff can be dispersed adjacent to the bridge, BMPs shall be utilized to contain and filter the slurry to prevent the discharge of slurry or other contaminants.

B. Mechanical Milling

1. Prior to milling, the depth of the deck reinforcing steel shall be verified in the field. The original thickness of the existing LMC overlay shall be milled to a depth as specified on the Plans using a mechanical milling machine in conformance with applicable portions of Section 760.03.01 capable of accurately and automatically establishing profile grades. The entire existing LMC overlay thickness on each deck slab shall be removed including additional depth into the original deck slab as specified. Areas adjacent to scuppers or joints (or other locations inaccessible to the milling machine such as the temporary PCC safety barriers for MOT) shall be hand chipped using pneumatic hammers no heavier than the nominal 35-pound class operating at no more than a 45-degree angle from the horizontal. When removing LMC overlay having a variable thickness within a section of the deck, the Contractor shall provide a uniform transition as shown on the Plans. If mechanical milling results in the snagging of reinforcing

steel, the operation shall be stopped immediately, and the depth of removal adjusted. Damaged or dislodged reinforcing steel resulting from Contractor negligence during the operation shall be repaired or replaced at the Contractor's expense. All construction debris, wearing surface material, or residual materials from the milling process shall be completely removed from the bridge deck prior to the commencement of hydrodemolition.

2. Following milling of the deck, and prior to hydrodemolition, the Engineer will visually inspect and perform a sounding test on all existing deck repairs in accordance with Item 6285xx – Removal of Existing Deck Repairs.

#### C. Total Surface Hydrodemolition

1. This work shall consist of providing a highly rough and bondable surface including select removal of all unsound concrete in the structural bridge deck during the initial pass of the hydrodemolition equipment. The work shall include the removal and disposal of all concrete and debris as created by the process and includes shielding, deck washing, water control, and any other incidental concrete removal that may be required to prepare the deck for the placement of the LMC overlay.
2. For this Special Provision, a 'highly rough and bondable surface' is defined as a surface having a 1" amplitude between the peaks and valleys after the hydrodemolition is complete and as shown on the Plans.

#### D. Deep Cut Hydrodemolition

This work shall consist of providing a deep cut of the existing deck to the limits shown on the Plans. The minimum amount of removal shall extend from the bottom of the top layer of transverse reinforcement plus an additional 1" amplitude below that layer of existing deck reinforcement as show on the Plans and shall include providing a highly rough and bondable surface as well as select removal of all unsound concrete in the structural bridge deck in this region during the initial pass of the hydrodemolition equipment. The work shall include the removal and disposal of all concrete and debris as created by the process and includes shielding, deck washing, water control, and any other incidental concrete removal that may be required to prepare the deck for the placement of new deck concrete.

#### E. Hydrodemolition Equipment

1. The hydrodemolition equipment shall consist of a water supply system, a high-pressure water pumping system, and a demolition type unit. The demolition unit shall be a robotic, computerized, and self-propelled unit, utilizing a high-pressure water jet stream that can remove concrete to the desired depths specified with a single pass of the unit, including the selective removal of all unsound concrete. It shall also be capable of cleaning rust and concrete particles from all exposed reinforcing steel. The resulting concrete surface profile shall be one that is highly rough and bondable. All water used in conjunction with the hydrodemolition process shall be potable water, except that stream or lake water may be used if properly filtered prior to use.
2. Only individuals who have experience on bridge deck overlay construction projects of comparable type within the past five (5) years shall operate the hydrodemolition equipment.
3. The demolition unit shall provide shielding to ensure containment of all dislodged concrete

within the removal area to protect the traveling public, adjacent properties, and work crews from flying debris on, adjacent to, and/or below the work site.

#### F. Vacuum Clean-up Equipment

The vacuum equipment shall be equipped with fugitive dust control devices that can remove wet and dry debris, along with standing water, in the same pass.

#### G. Water Control Plan

1. Prior to the beginning of hydrodemolition, the Contractor shall prepare and submit a water control plan to the Engineer for the control and filtering of all water discharged by the operation. All scuppers, joints, and other locations where discharge water could exit the deck shall be blocked (e.g., drainage openings in temporary PCC safety barriers), to direct runoff to a central collection and filtering location, as designed by the Contractor. The Contractor shall be responsible for compliance with all environmental laws and regulations regarding the discharge of runoff water into the environment. Specific information shall be provided by the Contractor detailing the method of water and debris collection, filtering, treatment, and legal disposal.
2. The Contractor is responsible for the disposal of all concrete and debris, and securing any applicable permits which may be required.

#### H. Removal Requirements

Removal requirements beyond the use of hydrodemolition equipment shall be in accordance with applicable portions of Section 628.03(F) as specified, except that only pneumatic hammers no heavier than the nominal 35-pound class will be allowed, operating at no more than a 45-degree angle from the horizontal, and in areas that are inaccessible to hydrodemolition equipment, or in previously patched or debonded concrete areas that require removal.

#### I. Equipment Calibration

1. The robotic hydrodemolition equipment shall be calibrated on a representative sample of sound deck concrete, as directed by the Engineer, to demonstrate the ability to cut to the desired depth, as indicated on the Plans. The minimum allowable water pressure shall be 13,000 psi and the maximum water pressure shall not exceed 20,000 psi. The minimum water usage shall be 20 gallons per minute. The calibration shall accomplish the desired surface roughness, profile, and cutting depth as indicated on the Plans. The equipment shall then be moved to an area of deteriorated deck, as directed by the Engineer, to demonstrate the ability to remove all unsound material. The equipment shall selectively remove all unsound concrete, avoid the removal of unnecessary sound concrete, and provide a highly rough and bondable surface. Calibration shall be required on each bridge, or when different equipment is brought to the site for use.
2. Upon approval by the Engineer that the equipment settings do selectively remove all unsound concrete and provide a highly rough and bondable surface, the calibration will be approved, and the settings recorded. If the equipment does not demonstrate the ability to produce the desired result, as determined by the Engineer, the equipment shall be removed from the project and the Contractor shall provide other equipment for calibration. No additional contract time or compensation will be allowed for the mobilization of different equipment to the work site. The operating parameters shall be recorded as follows:

Water Pressure Gauge, PSI	
Machine Staging Control (Step), IN	
Nozzle Size, IN	
Nozzle Type	
Nozzle Travel Speed, FPS	
Water Usage Rate, GPM	

J. Operational Requirements

Upon approval of the calibration, the Contractor shall perform total surface hydrodemolition or deep cut hydrodemolition over the entire top surface of the bridge deck within the limits specified on the Plans with a single pass of the unit. The calibration and production settings shall be maintained and provided in writing to the Engineer. The settings shall be maintained throughout the operation, unless the desired results are not being attained, in which case re-calibration shall be performed. The quality of the cut shall be verified in the field for every 30 linear feet of cutting path per construction stage (i.e., Stages 2, 3A, and 3B). The Engineer may require re-calibration if the appropriate cut and profile as specified on the Plans is not being met. The Contractor shall take steps to prevent damage to existing reinforcing steel. All equipment shall be operated in a manner that does not damage the slab, reinforcing steel or superstructure components to remain. Any damage caused by the Contractor's equipment or negligence shall be repaired at the Contractor's expense. The operator shall minimize the overlap of the individual hydrodemolition passes to limit the amount of sound concrete removal. When the hydrodemolition process is taking place above an area of concern, the Contractor shall take measures to protect that area from hydro blasting through the deck, falling debris, water runoff, or any other action that the Engineer considers a risk to public safety or a risk of property damage. An area of concern shall include, but not be limited to, vehicular traffic, pedestrian traffic, parking areas, basketball courts, parks, private property, railroad property, or any other area of concern as determined by the Engineer. Only those vehicles directly required to perform the hydrodemolition work and clean-up, or corresponding overlay construction equipment, shall be allowed on the bridge deck. Contamination of the deck by construction equipment or any other source shall be prevented.

K. Removal of Slurry and Debris

The Contractor shall clean up the slurry and rubble from the hydrodemolition operations in a timely manner, and before it dries on the deck and reinforcing steel. Vacuum clean up shall follow as closely as possible behind the hydrodemolition process. The deck shall then be blown dry to remove excess water. Following the cleaning, the surface shall be free of all debris, loose material, slurry, or cement paste.

L. Reinforcing Steel

Any reinforcing steel damaged by the Contractor's operation shall be replaced at no additional cost. Replacement may include the removal of additional concrete to adequately anchor reinforcing steel to the appropriate lap splice length. Where the bond between exposed reinforcing steel and sound

concrete has not been compromised as determined by the Engineer, the clearance requirement around existing reinforcing steel will be waived. Partially exposed reinforcing steel is acceptable if, as determined by the Engineer, the bond between exposed reinforcing steel and sound concrete has not been compromised.

M. Sounding

After the initial pass of hydrodemolition and appropriate cleaning, sounding will be done after the deck is clean, dry and frost free. Any unsound deck concrete that remains shall be removed at the Contractor's expense with the use of pneumatic hammers, except that only pneumatic hammers no heavier than the nominal 35-pound class will be allowed, operating at no more than a 45-degree angle from the horizontal.

N. Removal of Remaining Unsound Material

Where existing patches have debonded, or previous unsound overlay material is found below the top mat of reinforcing steel, that material shall be removed with the use of pneumatic hammers or hydrodemolition, except that only pneumatic hammers no heavier than the nominal 35-pound class will be allowed, operating at no more than a 45-degree angle from the horizontal.

O. Full Depth Repair

This work shall consist of localized full depth removal and replacement of the bridge deck in the required areas as identified on the Plans or as determined in the field. Predetermined areas of full depth repair may be done prior to or after hydrodemolition as additional areas may require full depth repair following hydrodemolition as directed by the Engineer. Full depth deck repair shall be completed in accordance with applicable portions of Section 628.03(F) except that the concrete deck repair material used for the full depth repairs shall be placed to an elevation that is approximately one-half of the original slab thickness as shown on the Plans. Full depth deck repairs will be covered under Item 628053 – Deck Repair, Full Depth.

P. Final Cleaning Prior to Placement of New LMC Overlay

After completion of hydrodemolition and associated clean-up of debris, but not more than 24 hours prior to placement of the overlay, the entire deck surface shall be thoroughly cleaned by either abrasive blasting or high-pressure water blasting (7,500 psi minimum). All horizontal and vertical surfaces to which the overlay is to bond, including exposed reinforcing steel, shall be blasted clean. Upon cleaning, the deck surface shall be thoroughly saturated to the point that the surface does not dry out, and any excess water removed with compressed air. Clean polyethylene sheeting shall then be used to cover the deck completely until the overlay is poured. If the deck is allowed to dry out it shall be re-blasted at the Contractor's expense.

Q. LMC Overlay Surface Requirements with Hydrodemolition

1. Installation of the LMC overlay shall be in conformance with applicable portions of Section 625 – Concrete Overlays. The overlay shall not be placed on areas of full depth concrete deck repairs until the repair material has reached a minimum of 3,000 psi strength. Where hydrodemolition has left variable depth areas below the plan elevation of the overlay, the entire area shall be poured monolithically with the overlay material. Any standing water on the deck shall be removed prior to placement of concrete overlay material. Hand vibrators shall be used

in areas where concrete is being placed around reinforcement, deeper areas within the pour, and along scuppers, parapets, transverse joints, and construction joints.

2. See applicable portions of Section 625.03(A) for more details regarding surface preparation, materials, equipment, and other details related to the LMC overlay surface installation.

**Method of Measurement.**

- A. Mechanical milling to remove the existing LMC overlay material, including scarification of the existing deck to the depth specified, will be measured as specified in Section 760.04, for the entire surface area of the deck to remain as shown on the Plans.
- B. Total Surface Hydrodemolition of the bridge deck will be measured by the square yard to the limits shown on the Plans.
- C. Deep Cut Hydrodemolition of the bridge deck will be measured by the square yard to the limits shown on the Plans.
- D. Full depth patching to repair the existing bridge deck will be measured as specified in Section 628.04 (G). The volume of patching material used in Item 628053 – Deck Repair, Full Depth will not be measured for payment. Areas of the deck that do not require full depth patching, such as removing any existing deck repairs (i.e., completed during previous contracts and/or maintenance work) and/or areas of deck deterioration that are found after the hydrodemolition operations, will be paid for under other items specified in the contract. Reference the Special Provisions for the Removal of Existing Deck Repairs and Additional Latex-Modified Concrete for Partial Deck Repairs for measurement and payment.

**Basis of Payment.**

- A. The milling operation for the scarification into the existing bridge deck, and removal of the existing overlay, if applicable, shall be paid for at the Contract Unit Price per square yard per inch for Item 760013 – Pavement Milling, Portland Cement Concrete Pavement, based on the depth as specified on the Plans. The cost of removal in areas adjacent to parapets, joints, etc. or otherwise inaccessible areas to the power operated mechanical milling machine will be included in the Contract Unit Price. All equipment, labor and materials necessary to perform the work in accordance with the specifications shall be included in the cost of Item 760013 – Pavement Milling, Portland Cement Concrete Pavement, plus any other incidental work, including saw cutting, necessary to complete this item.
- B. Hydrodemolition of the bridge deck will be paid for at the Contact Unit Price per square yard for Item 7605XX – Total Surface Hydrodemolition, regardless of the number of passes of the equipment. The cost for all equipment, labor and materials necessary to perform the work, including blocking scuppers and roadway joints, initial equipment calibration, any re-calibration, filtering of discharge water, equipment shielding, hand chipping along inaccessible areas, removal of remaining unsound concrete, deck washing, and clean-up, collection and disposal of all debris, slurry, and water produced by the operation, will be incidental to the cost of Total Surface Hydrodemolition, along with any other incidental work necessary to complete this item. Payment for preparation and submittal of the ECP and the water control plan, including its implementation, will not be paid but will be incidental to the Total Surface Hydrodemolition item.

- C. Deep Cut Hydrodemolition of the bridge deck will be paid for at the Contract Unit Price per square yard for Item 7605XY – Deep Cut Hydrodemolition, regardless of the number of passes of the equipment. The cost for all equipment, labor and materials necessary to perform the work, including blocking scuppers and roadway joints, initial equipment calibration, any re-calibration, filtering of discharge water, equipment shielding, hand chipping along inaccessible areas, removal of remaining unsound concrete, deck washing, and clean-up, collection and disposal of all debris, slurry, and water produced by the operation, will be incidental to the cost of Deep Cut Hydrodemolition, along with any other incidental work necessary to complete this item. Payment for preparation and submittal of the ECP and water control plan, including its implementation, will not be paid but will be incidental to the Deep Cut Hydrodemolition item.
  
- D. Full depth patching will be paid for at the Contract Unit Price per square foot for Item 628053 – Deck Repair, Full Depth. All equipment, labor and materials necessary to perform the operation, including the cost of cleaning the removal area and the patching material used for full depth patching, shall be included in the cost of Item 628053 – Deck Repair, Full Depth, along with any other incidental work necessary to complete this item.

Removal of Existing Deck Repairs and Additional Latex-Modified Concrete for Partial Deck Repairs will be paid for under their respective items.

2/1/2018

## **763501 - CONSTRUCTION ENGINEERING**

### **1) Description:**

This work consists of construction lay out including; stakes, lines and grades as specified below. Subsection 105.10 Construction Stakes, Lines and Grades of the Standard Specifications is voided.

Based on contract plans and information provided by the Engineer, the Contractor shall stake out right-of-way and easements lines, limits of construction and wetlands, slopes, profile grades, drainage system, centerline or offset lines, benchmarks, structure working points and any additional points to complete the project.

The Engineer will only establish the following:

- (a) Original and final cross-sections for borrow pits.
- (b) Final cross-sections: Top and bottom pay limit elevations for all excavation bid items that are not field measured by Construction inspection personnel. The Contractor shall notify the Engineer when these pay limit elevations are ready and allow for a minimum of two calendar days for the Engineer to obtain the information.
- (c) Line and grade for extra work added on to the project plans.

**2) Equipment.** The Contractor shall use adequate equipment/instruments in a good working order. He/she shall provide written certification that the equipment/instrument has been calibrated and is within manufacturer's tolerance. The certification shall be dated a maximum of 9 months before the start of construction. The Contractor shall renew the certification a minimum of every 9 months. The equipment/instrument shall have a minimum measuring accuracy of [3mm+2ppmxD] and an angle accuracy of up to 2.0 arc seconds or 0.6 milligons. If the Contractor chooses to use GPS technology in construction stakeout, the Contractor shall provide the Engineer with a GPS rover and Automatic Level for the duration of the contract. The GPS rover shall be in good working condition and of similar make and model used by the Contractor. The Contractor shall provide up to 8 hours of formal training on the Contractor's GPS system to a maximum of four Engineer's appointees (DELDOT Construction Inspectors). At the end of the contract, the Engineer will return the GPS rover to the Contractor. If any of the equipment/instruments are found to be out of adjustment or inadequate to perform its function, such instrument or equipment shall be immediately replaced by the Contractor to the satisfaction of the Engineer. Choosing to use GPS technology does not give the contractor authority to use machine control.- Construction Engineering (GPS) Machine Control Grading shall only be used if noted in the General Notes in the plan set outlining the available files that will be provided to the Contractor and "the Release for delivery of documents in electronic form to a contractor" are signed by all parties prior to delivery of any electronic files. Only files designated in the General Notes shall be provided to the contractor. If machine control grading is allowed on the project see the "machine control" section of this specification. GPS technology and machine control technology shall not be used in the construction of bridges.

**3) Engineering/Survey Staff.** The Contractor shall provide and have available for the project an adequate engineering staff that is competent and experienced to set lines and grades needed to construct the project. The engineering personnel required to perform the work outlined herein shall have experience and ability compatible with the magnitude and scope of the project. Additionally, the Contractor shall employ an engineer or surveyor licensed in the State of Delaware to be responsible for the quality and accuracy of the work done by the engineering staff. When individuals or firms other than the Contractor perform any professional services under this item, that work shall not be subject to the subcontracting requirements of Subsection 108.01 of the Standard Specifications. The Contractor shall

assume full responsibility for any errors and/or omissions in the work of the engineering staff described herein. If construction errors are caused due to erroneous work done under Construction Engineering the Contractor accepts full responsibility, no matter when the error is discovered. Consideration will not be given for any extension of contract time or additional compensation due to delays, corrective work, or additional work that may result from faulty and erroneous construction stakeout, surveying, and engineering required by this specification.

### **Construction Methods:**

#### **4) Performance Requirements:**

- (a) Construction Engineering shall include establishing the survey points and survey centerlines; finding, referencing, offsetting the project control points; running a horizontal and vertical circuit to verify the precision of given control points. Establishing plan coordinates and elevation marks for culverts, slopes, subbase, subsurface drains, paving, subgrade, retaining walls, and any other stakes required for control lines and grades; and setting vertical control elevations, such as footings, caps, bridge seats and deck screed. The Contractor shall be responsible for the preservation of the Department's project control points and benchmarks. The Contractor shall establish and preserve any temporary control points (traverse points or benchmarks) needed for construction. Any project control points (traverse points) or benchmarks conflicting with construction of the project shall be relocated by the Contractor. The Contractor as directed by the Engineer must replace any or all stakes that are destroyed at any time during the life of the contract. The Contractor shall re-establish centerline points and stationing prior to final cross-sections by the Engineer. The Vertical Control error of closure shall not exceed 0.035 ft times [Square root of number of miles in the level run] (0.01 m times [square root of number of kilometers]). The Horizontal Control precision ratio shall have a minimum precision of 1:20,000 feet (1 meter per 20,000 meters or 1:20,000) of distance traversed prior to adjustment.
- (b) The Contractor shall perform construction centerline layout of all roadways, ramps and connections, etc. from project control points set by the Engineer. The Contractor using the profiles and typical sections provided in the plans shall calculate proposed grades at the edge of pavement or verify information shown on Grades and Geometric sheets.
- (c) The Contractor shall advise the Engineer of any horizontal or vertical alignment revisions needed to establish smooth transitions to existing facilities. The Contractor must immediately bring to the attention of the Engineer any potential drainage problem within the project limits. The Engineer must approve any proposed variation in profile, width or cross slope.
- (d) The Contractor shall establish the working points, centerlines of bearings on bridge abutments and on piers, mark the location of anchor bolts to be installed, check the elevation of bearing surfaces before and after they are ground and set anchor bolts at their exact elevation and alignment as per Contract Plans. Before completion of the fabrication of beams for bridge superstructures, the Contractor shall verify by accurate field measurements the locations both vertically and horizontally of all bearings and shall assume full responsibility for fabricated beams fitting and bearing as constructed. After beam erection and concurrently with the Department project surveyors or their designated representative, the Contractor shall survey top of beam elevations at a maximum of 10-ft (3.0-meter) stations and compute screed grades. These shall be submitted to the Engineer for review and approval before the stay in place forms are set. Construction stakes and other reference control marks shall be set at sufficiently frequent intervals to assure that all components of the structure are constructed in accordance with the

lines and grades shown on the plans. The Contractor will be responsible for all structure alignment control, grade control and all necessary calculations to establish and set these controls.

- (e) The Contractor, using contract plans, shall investigate proposed construction for possible conflicts with existing and proposed utilities. The Contractor shall then report such conflicts to the Engineer for resolution. All stakes for utility relocations, which will be performed by others, after the Notice to Proceed has been given to the Contractor, shall be paid for under item 763597 - Utility Construction Engineering.
- (f) The Contractor shall be responsible for the staking of all sidewalk and curb ramp grades in accordance with the plans and the Departments Standard Construction Details. The Contractor shall review the stakeout with the Engineer prior to construction. The Engineer must approve any deviation from plans, Department Standard Construction Details and Specifications in writing. The Contractor shall be responsible for any corrective actions resulting from problems created by adjustments if they fail to obtain such approval.
- (g) If wetland areas are involved and specifically defined on the Plans the following shall apply:
  - i. It is the intent of these provisions to alert the Contractor, that he/she shall not damage or destroy wetland areas, which exist beyond the construction limits. These provisions will be strictly enforced and the Contractor shall advise his/her personnel and those of any Subcontractor of the importance of these provisions.
  - ii. All clearing operations and delineation of wetlands areas shall be performed in accordance with these Special Provisions. Before any clearing operation commences the Contractor shall demarcate wetlands at the Limits of Construction throughout the entire project as shown on the Plans labeled as Limits of Construction or Wetland Delineation to the satisfaction of the Engineer.
  - iii. The material to be used for flagging the limits of construction shall be orange vinyl material with the wording "Wetland Boundary" printed thereon. In wooded areas, the flagging shall be tied on the trees, at approximate 20-foot (6.1 meter) intervals through wetland areas. In open field and yard areas that have been identified as wetlands, 3 foot (one meter) wooden grade stakes shall be driven into the ground at approximate 20 foot (6.1 meter) intervals and tied with the flagging.
  - iv. If the flagging has been destroyed and the Engineer determines that its use is still required, the Contractor shall reflag the area at no cost to the Department. If the Contractor, after notification by the Engineer that replacement flagging is needed, does not replace the destroyed flagging within 48 hours, the Engineer may proceed to have the area reflagged. The cost of the reflagging by the Engineer will be charged to the Contractor and deducted from any monies due under the Contract.
  - v. At the completion of construction, the Contractor shall remove all stakes and flagging.
  - vi. The Contractor shall be responsible for any damages to wetlands located beyond the construction limits, which occurs from his/her operations during the life of the Contract. The Contractor shall restore all temporarily disturbed wetland areas to their preconstruction conditions. This includes restoring bank elevations, streambed and wetland surface contours and wetlands vegetation disturbed or destroyed. The expense for this restoration shall be borne solely by the Contractor.
- (h) Whenever the Engineer will be recording data for establishment of pay limits, the Contractor will be invited to obtain the data jointly with the Engineer's Survey Crew(s) in order to agree with the information. If the Contractor's representative is not able to obtain the same data, then the

information obtained by the Engineer shall be considered the information to be used in computing the quantities in question.

**5) Submittals.** All computations necessary to establish the exact position of all work from the control points shall be made and preserved by the Contractor. All computations, survey notes, electronic files, and other records necessary to accomplish the work shall be made available to the Department in a neat and organized manner at any time as directed by the Engineer. The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be made as soon as possible. The Contractor shall furnish the Engineer with such assistance as may be required for checking all lines, grades, and measurements established by the Contractor and necessary for the execution of the work. Such checking by the Engineer shall not relieve the Contractor of his/her responsibility for the accuracy or completeness of the work. Copies of all notes must be furnished to the engineer at the completion of the project.

The Contractor shall submit any of the following at the Engineer's request:

- (a) Proposed method of recording information in field books to ensure clarity and adequacy.
- (b) A printout of horizontal control verification, as well as coordinates, differences and error of closure for all reestablished or temporary Control Points.
- (c) A printout of vertical control verification, with benchmark location elevation and differences from plan elevation.
- (d) Sketch of location of newly referenced horizontal control, with text printout of coordinates, method of reference and field notes associated with referencing control - traverse closure report.
- (e) Description of newly established benchmarks with location, elevation and closed loop survey field notes - bench closure report
- (f) All updated electronic and manuscript survey records.
- (g) Stakeout plan for each structure and culvert.
- (h) Computations for buildups over beams, screed grades and overhang form elevations.
- (i) A report showing differences between supplied baseline coordinates and field obtained coordinates, including a list of preliminary input data.
- (j) Any proposed plan alteration to rectify a construction stakeout error, including design calculations, narrative and sealed drawings.
- (k) Baseline for each borrows pit location.
- (l) Detailed sketch of proposed overhead ground mounted signs or signals showing obstructions that may interfere with their installation.
- (m) Copies of cut sheets.

### **Machine Control Grading**

**This Section of the specification shall only be used if machine control is authorized for use on the project.**

#### **Description:**

This specification contains the requirements for grading operations utilizing Global Positioning Systems (GPS).

Use of this procedure and equipment is intended for grading the subgrade surface; it is not intended for the use in constructing final surface grades.

The Contractor may use any manufacturer's GPS machine control equipment and system that results in achieving the grading requirements outlined in section 202 of the standard specifications. The Contractor shall convert the electronic data provided by the Department into the format required by their system. The Department will only provide the information outlined in this document and no additional electronic data will be provided.

The Contractor shall perform at least one 500 foot test section with the selected GPS system to demonstrate that the Contractor has the capabilities, knowledge, equipment, and experience to properly operate the system and meet acceptable tolerances. The engineer will evaluate and make the determination as to whether additional 500 foot test sections are required. If the Contractor fails to demonstrate this ability to the satisfaction of the Department, the Contractor shall construct the project using conventional surveying and staking methods.

**Materials:**

All equipment required to perform GPS machine control grading, including equipment needed by DelDOT to verify the work, shall be provided by the Contractor and shall be able to generate end results that are in accordance with the requirements of Division 200 - EARTHWORK of the Standard Specifications.

**Construction:**

**a. DelDOT Responsibilities:**

1. The Department will set initial vertical and horizontal control points in the field for the project as indicated in the contract documents, (plans set). If the Contractor needs to establish new control points they shall be traversed from existing control points and verified to be accurate by conventional surveying techniques.
2. The Department will provide the project specific localized coordinate system.
3. The Department will provide data in an electronic format to the Contractor as indicated in the General Notes.
  - a. The information provided shall not be considered a representation of actual conditions to be encountered during construction. Furnishing this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered including, but not limited to site visits, and basing the bid on information obtained from these investigations, and the professional interpretations and judgments of the Contractor. The Contractor shall assume the risk of error if the information is used for any purpose for which the information is not intended.
  - b. Any assumption the Contractor makes from this electronic information shall be at their risk. If the Contractor chooses to develop their own digital terrain model the Contractor shall be fully responsible for all cost, liability, accuracy and delays.

- c. The Department will develop and provide electronic data to the Contractor for their use as part of the contract documents in a format as indicated in the General Notes. The Contractor shall independently ensure that the electronic data will function in their machine control grading system.
  4. The Files that are provided were originally created with the computer software applications MicroStation (CADD software) and INROADS (civil engineering software). The data files will be provided in the native formats and other software formats described below. The contractor shall perform necessary conversion of the files for their selected grade control equipment. The Department will furnish the Contractor with the following electronic files:
    - a. CAD files
      - i. Inroads -Existing digital terrain model (.DTM)
      - ii. Inroads -Proposed digital terrain model (.DTM)
      - iii. Microstation -Proposed surface elements - triangles
    - b. Alignment Data Files:
      - i. ASCII Format
  5. The Engineer shall perform spot checks of the Contractor's machine control grading results, surveying calculations, records, field procedures, and actual staking. If the Engineer determines that the work is not being performed in a manner that will assure accurate results, the Engineer may order the Contractor to redo such work to the requirements of the contract documents, and in addition, may require the Contractor to use conventional surveying and staking, both at no additional cost to the Department.

#### B. Contractor's Responsibilities

1. The Contractor shall provide the Engineer with a GPS rover and Automatic Level, for use during the duration of the contract. At the end of the contract, the GPS rover and Automatic Level will be returned to the Contractor. The Contractor shall provide a total of 8 hours of formal training on the Contractor's GPS machine control system to the Engineer and up to three additional Department appointees per rover.
2. The Contractor shall review and apply the data provided by the Department to perform GPS machine control grading.
3. The Contractor shall bear all costs, including but not limited to the cost of actual reconstruction of work, that may be incurred due to application of GPS machine control grading techniques. Grade elevation errors and associated corrections including quantity adjustments resulting from the contractor's use of GPS machine control shall be at no cost to the Department.
4. The Contractor shall convert the electronic data provided by the Department into a format compatible with their system.
5. The Contractor's manipulation of the electronic data provided by the Department shall be performed at their own risk.

6. The Contractor shall check and if necessary, recalibrate their GPS machine control system at the beginning of each workday in accordance with the manufacturer's recommendations, or more frequently as needed to meet the requirements of the project.
7. The Contractor shall meet the accuracy requirements as detailed in the Standard Specifications.
8. The Contractor shall establish secondary control points at appropriate intervals and at locations along the length of the project. These points shall be outside the project limits and/or where work is performed. These points shall be at intervals not to exceed 1000 feet. The horizontal position of these points shall be determined by conventional survey traverse and adjustments from the original baseline control points. The conventional traverse shall meet or exceed the Department's Standards. The elevation of these control points shall be established using differential leveling from the project benchmarks, forming a closed loop. A copy of all new control point information including closure report shall be provided and approved by the Engineer prior to construction activities. The Contractor shall be responsible for all errors resulting from their efforts and shall correct deficiencies to the satisfaction of the Engineer and at no additional cost to the Department.
9. The Contractor shall provide stakes at all alignment control points, at every 500 foot stationing, and where required for coordination activities involving environmental agencies and utility companies at the Contractor's expense. Work that is done solely for utility companies and that is beyond the work performed under item 763501 - Construction shall follow and be paid for under item 763597 -Utility Construction Engineering.
10. The Contractor shall at a minimum set hubs at the top of finished grade at all hinge points on the cross section at 500 foot intervals on the main line and at least 4 cross sections on side roads and ramps as directed by the engineer or as shown on the plans. Placement of a minimum of 4 control points outside the limits of disturbance for the excavation of borrow pits, Stormwater Management Ponds, wetland mitigation sites etc. These control points shall be established using conventional survey methods for use by the Engineer to check the accuracy of the construction.
11. The Contractor shall preserve all reference points and monuments that are identified and established by the Engineer for the project. If the Contractor fails to preserve these items the Contractor shall reestablish them at no additional cost to the Department.
12. The Contractor shall provide control points and conventional grades stakes at critical points such as, but not limited to, PC's, PT's, superelevation points, and other critical points required for the construction of drainage and roadway structures.
13. No less than 2 weeks before the scheduled preconstruction meeting, the Contractor shall submit to the Engineer for review a written machine control grading work plan which shall include the equipment type, control software manufacturer and version, and proposed location of the local GPS base station used for broadcasting differential correction data to rover units.
14. The Contractor shall follow the guidelines set forth in the "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques" and follow a minimum of Second Order Class 1, (2-1) classification standards.

Automated equipment operations have a high reliance on accurate control networks from which to take measurements, establish positions, and verify locations and features. Therefore, a strong contract control

network in the field which is the same or is strongly integrated with the project control used during the design of the contract is essential to the successful use of this technology with the proposed Digital Terrain Model (DTM). Consistent and well designed site calibration for all machine control operations (as described below under *Contract Control Plan*) are required to ensure the quality of the contract deliverables. The Contract Control Plan is intended to document which horizontal and vertical control will be held for these operations. Continued incorporation of the Base Station(s) as identified in the Contract Control Plan is essential to maintaining the integrity of positional locations and elevations of features. The Contract Control Plan shall be submitted to the Department for review and approval by the Departments Survey Section 3 weeks prior to the start of any machine control work. The Contractor shall operate and maintain all elements of the Machine Grade Control continuously once the operations begin until otherwise approved by the Engineer.

### **Contract Control Plan:**

The Contractor shall develop and submit a Contract Control Plan for all contracts which use Machine Control Grading. Contract control includes all primary and secondary horizontal and vertical control which will be used for the construction contract. Upon the Contractor's completion of the initial survey reconnaissance and control verification, but prior to beginning primary field operations, the Contractor shall submit a Contract Control Plan document (signed and sealed by the Delaware licensed Land Surveyor or Delaware Professional Engineer who oversees its preparation) for acceptance by the Engineer, which shall include the following:

1. A control network diagram of all existing horizontal and vertical control recovered in the field as contract control.
2. Include a summary of the calculated closures of the existing control network, and which control has been determined to have been disturbed or out of tolerance from its original positioning.
3. An explanation of which horizontal and vertical control points will be held for construction purposes. If necessary include all adjustments which may have been made to achieve required closures.
4. An explanation of what horizontal and vertical control (including base stations) was set to accomplish the required stakeout or automated machine operation. Include how the position of these new control points was determined.
5. Describe the proposed method and technique (technology and quality control) for utilizing the control to establish the existing and/or proposed feature location and to verify the completed feature location and/or measured quantity.
6. A listing of the horizontal and vertical datums to be used and the combined factor to be used to account for ellipsoidal reduction factor and grid scale factor.
7. If the Contractor chooses to use machine control as a method of measuring and controlling excavation, fill, material placement or grading operations as a method of measuring and controlling excavation, fill, material placement or grading operations, the Contractor Control Plan shall include the method by which the automated machine guidance system will initially be site calibrated to both the horizontal and vertical contract control, and shall describe the method and frequency of the calibration to ensure consistent positional results.

8. Issues with equipment including inconsistent satellite reception of signals to operate the GPS machine control system will not result in adjustment to the "Basis of Payment" for any construction items or be justification for granting contract time extension.

**Method of Measurement:**

The quantity of Construction Engineering will not be measured.

**Basis of Payment:**

Payment will be made at the Lump Sum price bid for the item "Construction Engineering". The price bid shall include the cost of furnishing all labor, equipment, instruments, stakes and other material necessary to satisfactorily complete the work as herein described under this item for all roads and structures that are a part of the contract. Adjustment in payment will be made for the deletion or addition of work not shown in the contract documents.

Monthly payment will be made under this item in proportion to the amount of work done as determined by the Engineer.

10/5/16