

**ITEM 992.1 ALTERATIONS TO BRIDGE NO. M12025; M12027;
M12028; M12029; M12030; M12036; M12039**

The work to be done under this Item shall conform to the relevant provisions of Section 995 and the specific requirements stipulated for component parts of this Item. For those component parts where no specific requirement is stipulated, the Standard Specifications shall apply except for payment.

Description

The work includes the removal and replacement of the existing superstructures for the bridges covered under this contract, according to the plans for each bridge and these specifications.

Structural Steel

The work under these headings shall conform to the applicable provisions of Section 960 of the Standard Specifications and the following.

All welding and the preparation and assembly of material for welding shall conform to the current editions of the Standard Specification for Highways and Bridges, the AASHTO Standard Specifications for Highway Bridges, and the AASHTO/AWS Bridge Welding Code (ANSI/AASHTO/AWS D1.5).

Charpy V-Notch Tests are not required for the following secondary members: stiffener plates and angles, filler plates and utility supports.

Incidental to this item is any work necessary to conduct a field investigation in order to determine all measurements and details necessary for the completion of the work prior to the preparation of shop drawings.

Demolition and work involving painted steel shall conform to the General Requirements for Demolition and Work Involving Painted Steel and the requirements of Section 961 of the Specifications.

4000 PSI – 1½" – 565 CEMENT CONCRETE

4000 PSI – ¾" – 585 HIGH PERFORMANCE CEMENT CONCRETE

5000 PSI – ¾" – 685 HIGH PERFORMANCE CEMENT CONCRETE

High Early Strength Concrete

The work under these headings shall conform to the applicable provisions of Section 901 of the Standard Specifications with the following additions:

The following concrete mixes are to be used:

4000 PSI – 1½" – 565 LB/CY: Highway Guardrail Transition Bases

4000 PSI – ¾" – 585 LB/CY High Performance: Deck and End Diaphragm Encasement at Abutments

5000 PSI – ¾" – 685 LB/CY High Performance (HP): Highway Guard Transition and CF-PL3

Barriers

High Early Strength Concrete: Longitudinal and Transverse Closure Pours

High Early Strength Concrete

The work to be done under this item shall conform to the relevant provisions of Section 901 of the Standard Specifications and the following:

The Contractor shall develop a high early strength concrete mix design for use in the longitudinal and transverse closure pours. This high early strength concrete may also be used in the cast in place concrete work for the modifications to the approach slabs.

The high early strength concrete shall conform to the requirements of M4.00.00, M4.01. and M4.02. and the following criteria:

1. Use Portland cement conforming to AASHTO M 85 with compatible admixtures and air entraining agent.
2. Water-cementitious material ratio shall not exceed 0.4 by weight, including water in the admixture solution and based on saturated surface dry condition of aggregates.
3. Use a maximum size coarse aggregate of $\frac{3}{4}$ ".
4. The amount of entrained air shall be 6.0 +/- 1.5%.
5. A slump test shall be developed as part of the QC plan and shall address changing environmental conditions.
6. High early strength concrete shall achieve a minimum compressive strength of 2,000 psi at 4 hours after the final set. The minimum 28-day compressive strength shall be 4000 psi.
7. A shrinkage reducing admixture shall be added to the concrete mix according to the manufacturer's recommendation such that there will be no cracks at 14 days in the sample tested in AASHTO T334 (see below). A shrinkage reducing admixture shall be tested by an approved testing lab and meet the requirements of ASTM C494-10 Type S, except that in Table 1 length change shall be measured as: Length Change (percent of control) shall be a minimum of 35% less than that of the control. Table 1 Length Change (increase over control) shall not apply. Shrinkage reducing admixtures shall not contain expansive metallic materials.
8. The maximum allowable total chloride content in concrete shall not exceed 0.1% by weight of cement.

Mix Design Requirements

The concrete mix design shall be mitigated per Subsection M4.02.00. Proposed mix design (overdesign factor of 120% of the design strength) with data sheets and trial batches shall be submitted within 15 days from the date of Notice to Proceed to the Research and Materials Section for review and approval. The Engineer shall be notified at least 48 hours prior to the test batching and shall be present to witness the testing.

All tests necessary to demonstrate the adequacy of the concrete mix shall be performed by the Contractor, including, but not limited to: slump, air content, temperature, initial set and final set (AASHTO T197). Compressive strength tests shall be determined on field cured cylinders (6" X 12" cylinders) at 9 hours, 12 hours, 15 hours, 18 hours, 24 hours, 30 hours, 36 hours, 42 hours, 2 days and 3 days, and standard cured cylinders at 7 days and 28 days. Additionally, a confined

shrinkage test as outlined in the AASHTO T334 - Practice for Estimating the Crack Tendency of Concrete shall be performed by an independent testing company.

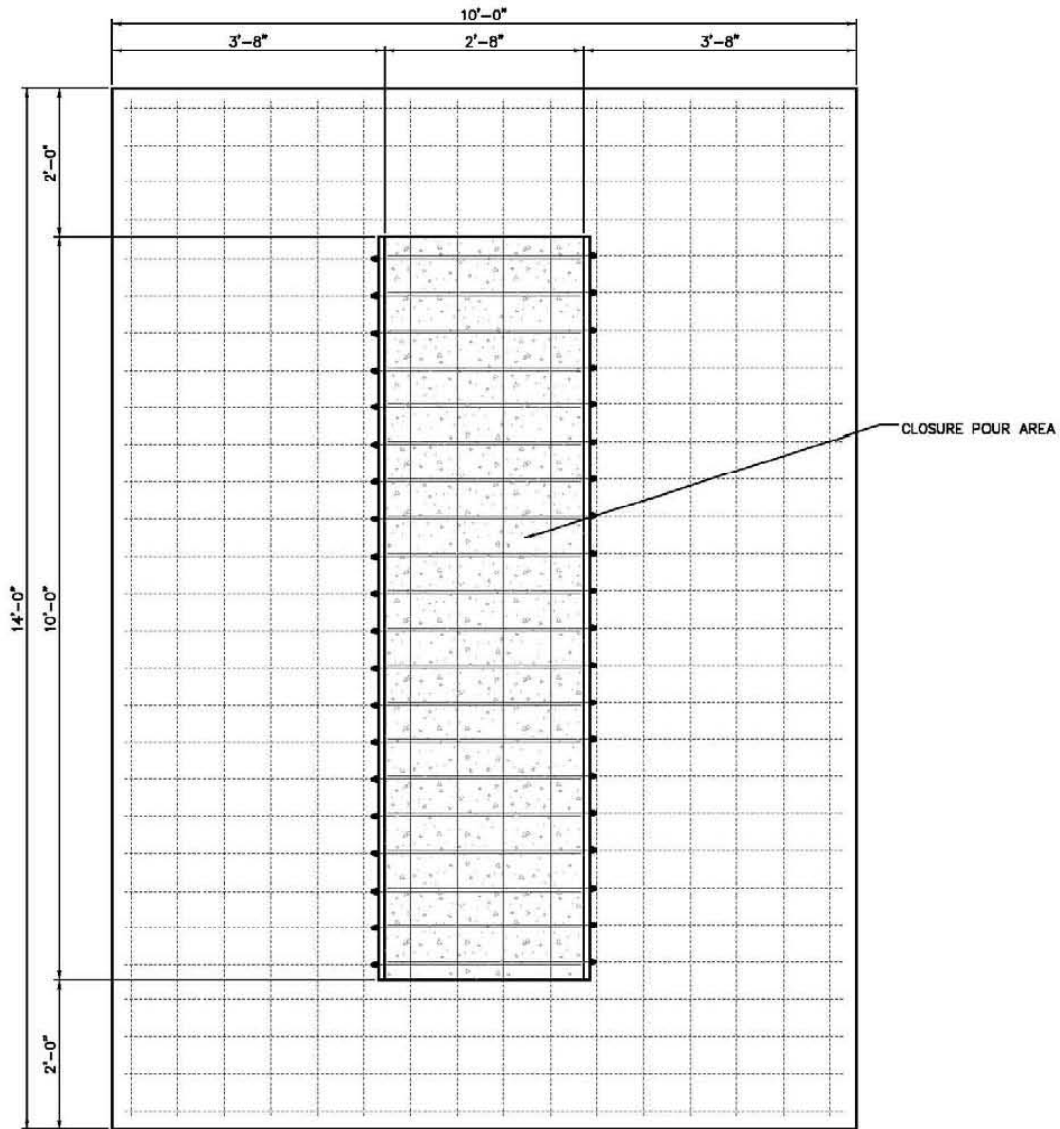
In addition, a trial placement shall be done a minimum of (90) ninety days before the intended date of the initial closure pour placement. The Contractor will be required to demonstrate proper mix design, batching, placement, finishing and curing of the high early strength concrete. The trial placement shall simulate the actual job conditions in all respects including plant conditions, transit equipment, travel conditions, admixtures, forming, the use of bonding compounds, restraint of adjacent concrete, placement equipment, and personnel.

The details for the trial placement configuration are shown in Figure 1.

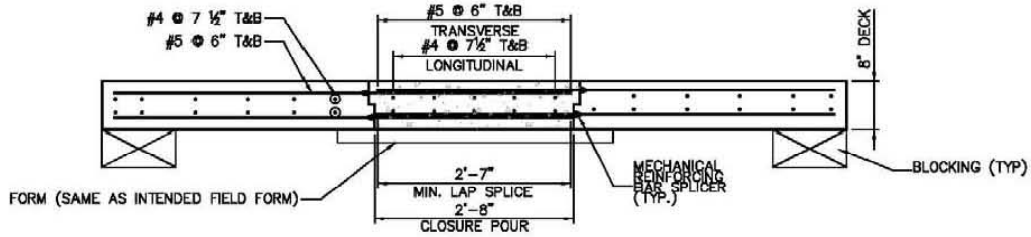
Acceptance criteria for the trial placement shall be as follows:

- The trial placement concrete shall not exhibit cracking or separation from the test panel in excess of 0.016 inches wide
- There shall be no more than one transverse crack in excess of 0.010 inches wide in the 10 foot long pour.
- The evaluation of the trial placement shall take place 14 days after placement.

If the trial placement fails these criteria, the Contractor will be required to submit a corrective action plan on how repairs of these crack sizes will be performed. The Engineer may require the Contractor to conduct more trial batches and trial placements. The requirement for multiple test placements shall not be cause for a time extension.



PLAN



TYPICAL SECTION

FIGURE 1 – TRIAL PLACEMENT TEST SET-UP

The Contractor shall engage an AASHTO accredited laboratory to provide on-site mobile testing facilities which are qualified laboratories under the NETTCP program to perform all Quality Control field testing. All personnel performing tests shall be qualified NETTCP Concrete Technicians and certified ACI Concrete Laboratory Technicians. Anytime the Contractor moves the laboratory, all associated equipment shall be recalibrated. The onsite laboratories should be located and calibrated at each bridge location. On weekends where more than one bridge is being constructed, additional on site laboratories shall be provided so that there is one for each bridge being constructed. This requirement is intended to minimize the movement of test cylinders.

The Contractor is required to perform initial set and final set tests (AASHTO T197) in addition to slump, air content and temperature on concrete from each concrete truck used in the placing of this High Early Strength Concrete. Field cured cylinders (6" X 12" cylinders) will be made from the first and last concrete trucks. A set of three (3) field-cured cylinders shall be made for each informational test associated with early structural loading. The Contractor is advised to fabricate adequate sets of cylinders to allow multiple tests to verify field concrete strength. The Engineer shall be allowed to witness the test and comment on all the tests performed by the Contractor. The Contractor must have a contingency plan established and approved in case compressive strength and other requirements are not met. The Contractor shall not open the roadway to traffic until all of the following conditions have been met:

- At least four hours has elapsed from the last final set time recorded for any concrete. Final set is achieved when the penetration resistance measures 4000 psi by AASHTO T197.
- Field cured cylinder breaks have achieved at least 2000 psi.
- The Engineer has directed that the roadway can be opened to traffic.

All testing and equipment shall conform to AASHTO T-22, and the making and curing of concrete cylinders shall conform to AASHTO T23. All costs associated with the on-site mobile testing facilities, personnel and field testing, equipment calibration and verification to demonstrate the field concrete strength shall be incidental to Item 904.XX.

Verification tests will be performed by MassDOT on field cured cylinders at 3 days and on standard cured cylinders at 7 days and 28 days. Cylinder breaks at 3 days and 7 days must be at least 10% above the approved trial batch results. The Contractor will be notified of any verification tests that do not meet these requirements and will be required to develop a contingency corrective action plan in case final strength is not achieved. Concrete will be accepted based on meeting the 28-day strength requirement of 4000 psi.

Curing Methods

The concrete curing methods shall be developed by the Contractor as part of the QC plan. The curing methods used in the production placements shall be the same as the curing methods used for the trial placement.

High Early Strength Concrete Crack Inspection

The Contractor shall document the location and frequency of cracks on the closure pours (number of cracks per square foot). Cracks greater than 0.016 inches in width shall be repaired as required by

the membrane waterproofing manufacturer The Contractor shall develop repair procedures as part of the QC plan.

The work completed under this Item will be paid for at the contract price per actual number of cubic yards of high early strength concrete that is measured complete in place. Payment under this Item includes full compensation for all testing and approval of the mix design.

SPRAY APPLIED MEMBRANE WATERPROOFING

Description of Work

The work under this Item shall conform to applicable sections of Section 965 of the Standard Specifications and the following:

The work to be performed shall consist of the furnishing and application of an approved cold liquid spray applied, seamless methylmethacrylate or polyurea membrane system and all concrete surface preparation work necessary to install the membrane system. The membrane system shall consist of the primer, the membrane, aggregated keycoat layer, and tack coat.

General

Membrane application shall be in accordance with the manufacturer's instructions. The Manufacturer's representative shall be present during the entire application and shall oversee surface preparation, installation and quality control testing. The handling, mixing, and addition of membrane components shall be performed in a safe manner to achieve the desired results in accordance with the manufacturer's recommendations. All open flames and spark producing equipment shall be removed from the work area prior to commencement of application. No smoking signs shall be posted at the entrances to the work. The Applicator shall be responsible for the protection of equipment and adjacent areas from overspray or other contamination.

The Contractor and the Applicator shall agree upon a schedule for coordination between trades working in the areas that are to receive the membrane system. Before beginning the application, the Contractor shall schedule and conduct a meeting at the site to review the approved submittals, and other pertinent matters related to the application including the schedule for coordination between trades. Present, as a minimum, shall be the Contractor, the Applicator, the Manufacturer's Field Representative and the Engineer.

All components of the membrane system shall be delivered to the site in the manufacturer's original packaging, clearly identified with the products type and batch number. The Contractor shall provide the Applicator with a storage area for all components. The area shall be cool, dry, out of direct sunlight, and complies with relevant health and safety regulations. Copies of material safety data sheets for all components shall be kept on site at the Contractor's field office.

Only products pre-approved by MassDOT will be accepted for use. Product approval shall require the demonstration by the manufacturer that the membrane system meets the material specifications and that the entire membrane system is designed and tested as waterproofing for use on bridge deck

applications. The manufacturer shall demonstrate through testing prior to approval that the system meets material properties and performance requirements stated herein.

Submittals

The Contractor shall submit to the Engineer for approval the membrane system material specifications, installation procedure, application equipment and testing as well as product performance data, storage and protection instructions, handling and mixing instructions, material safety data sheets (MSDS) for all components. An 8 inch square sample of the proposed membrane representing in color, texture and thickness satisfactory field application shall be provided to the Engineer. All submittals shall be certified to be in conformance with the manufacturer's instructions.

Materials

The waterproofing membrane shall consist of a one or two coat rapid curing liquid spray applied methylmethacrylate or polyurea for a total minimum membrane thickness of 100 mils measured over peaks. The membrane shall easily accommodate the need for day joints and patch repairs. The membrane shall be able to bridge live cracks up to 1/8 inch in width and shall conform to the following requirements:

The primer shall promote adhesion of the membrane to the concrete surface. The chemical composition of the primer, membrane, aggregate keycoat and tack coat that make up the membrane system shall conform to the manufacturer's specifications for the material and shall be approved by the manufacture as being compatible for use with the specified membrane. Cleaning solvents shall also be as approved by the manufacturer for use with membrane.

Applicator

The system shall be applied by an Applicator who is approved by the membrane system manufacturer. The Applicator installing the membrane shall have at least 2 years of experience on membrane installation with applicator certified by the membrane manufacturer. The Engineer shall receive manufacturer's written approval of the Applicator's qualifications at least seven days prior to the application of any system component. This approval shall apply only to the named individuals performing the application.

PROPERTY	TEST	REQUIREMENTS
Minimum Thickness		100 mils minimum measured over peaks
Water Vapor Transmission	ASTM E 96-00 Method A	$<1.66 \times 10^{-3}$ lb/ft ² /day
Adhesion to concrete	ASTM D 4541	100 psi minimum. Failure in concrete will require additional concrete preparation
Tensile	ASTM D 638 Method A, Die C	> 1,700 psi

PROPERTY	TEST	REQUIREMENTS
Elongation at Break	ASTM D 638 Method A, Die C	130 % Typical
Crack Bridging	ASTM C 836- 00	Pass 10 cycles at -14.8°F no failure at 1/8 inch

Application Procedure

The application procedure shall consist of concrete surface preparation, applying primer, applying membrane, applying aggregated keycoat layer, applying Polymer Modified tack coat. Special attention shall be paid to the bridge deck surface preparation prior to the membrane system application. A representative from the membrane manufacturing company shall be present for the entire duration of the membrane application. The manufacturer's representative shall be responsible for the field testing, required documentation and reporting.

The membrane system shall not be applied in either wet, damp or foggy weather, or when the ambient temperature is 40° F or below or is forecast to fall below 40° F during the application period.

The membrane waterproofing on bridge decks shall not be placed until the Contractor is ready to follow within 24 hours with the first layer of Hot Mix Asphalt pavement; a longer period of time will be allowed only with the approval of the Engineer.

Where the areas to be waterproofed are bound by a vertical surface including, but not limited to, a curb or a wall, the membrane system shall be continued up the vertical as necessary. A neat finish with well defined boundaries and straight edges shall be provided.

1. CONCRETE SURFACE PREPARATION: Concrete surfaces which are to be waterproofed shall be screeded to the true cross section, sounded and all spalls and depressions shall be repaired prior to the application of the prime coat. Depressions shall be filled to a smooth flush surface with 1:2 mortar (1 part cement to two parts sand) or an approved rapid setting patching mortar that is compatible with the waterproofing system. Other surfaces shall be trimmed free of rough spots, projections or other defects which might cause puncture of the membrane so that the surface profile of the prepared concrete surface shall not exceed a ¼ inch amplitude, peak to valley.

The use of resin or wax-based deck curing membranes is not acceptable.

Immediately prior to the application of the primer, the concrete to which the membrane is to be applied shall be cleaned of all existing bond inhibiting materials using an abrasive blast. Dust or loose particles shall be removed using clean, dry oil-free compressed air or industrial vacuums. The surface preparation shall insure that the concrete surface shall be free of bituminous product, surface laitance, oil staining, soiling, and dust and produce a clean dry surface.

Random tests for adequate tensile bond strength of the membrane shall be conducted on the concrete in accordance with ASTM D 4541 using the membrane manufacturer's primer and

membrane to achieve minimum bond strength of 100 psi with failure in the concrete. Additional preparation of the concrete shall be required if a bond strength of a least 100 psi is not demonstrated in the concrete-membrane interface.

2. APPLYING PRIMER: The primer shall only be applied when the temperature of the concrete deck surface exceeds the dew point and when the concrete deck surface has moisture content of 5.5% or less as confirmed by a portable electronic surface moisture meter supplied by the Contractor. The primer shall be applied to ensure full coverage. The concrete to which the membrane is to be applied shall have cured a minimum of 7 days prior to the application of the primer. A second coat of primer shall be required if first coat of primer is absorbed by the concrete. The primer shall be over sprayed with the membrane for up to the manufacture allowed re-coat drying time but in no case it shall exceed 24 hours. Beyond this period, the surface shall be prepared again and re-primed following the manufacturer's recommendations prior to membrane application.

3. APPLYING MEMBRANE: The waterproofing membrane shall be applied in a methodical manner. The Applicator shall follow the approved mixing and application procedure. Unless approved by the Engineer, the membrane shall be spray applied, with the mixing of the two components taking place at the nozzle, and shall be applied to the primed deck in accordance with the manufacturer's instructions. The spray equipment shall be computer controlled, monitoring mixing ratios and quantities applied, and the latter allowing coverage rates to be checked. Following the application of membrane system and before holiday testing, the cured surface shall be visually inspected. If any defects or pinholes are found, an appropriate quantity of membrane shall be mixed by hand and repairs effected by touch-in with a putty-knife hand tool, ensuring in all cases that the thickness of the repair is sufficient to bring the area up to the specified thickness and that the thickness of the repair patch is a minimum 100 mils.

4. APPLYING AGGREGATED KEYCOAT: Following the membrane application, a layer of resin, compatible with the membrane shall be spray applied to a thickness of 30 to 40 mils into which a crushed basalt aggregate approved by the membrane manufacturer shall be broadcast ensuring minimum 80% coverage.

5. APPLYING POLYMER MODIFIED TACK COAT: The manufacturer's tack coat shall be applied in accordance with the membrane manufacturer's recommendations after a minimum of three hours from initial membrane application. Polymer modified tack coat shall be heated and melted in a kettle at a temperature between 375°F-400°F and applied at a coverage rate of between 25-35 Square Feet/Gallon. The Tack Coat shall be allowed to cool for a minimum of 1 hour prior to the application of the hot rolled asphalt.

During paving, a light soap spray should be applied to the paving equipment wheels to prevent removal of the tack coat

6. REPAIRS: If an area of membrane requires repair or if the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the membrane system. The damaged area shall be cut back to sound materials and wiped with a solvent up to a width of at least 6 inches

beyond the periphery of the damaged area, removing contaminants. The concrete shall be primed as necessary, followed by the application of the membrane. A continuous layer shall be obtained over the concrete with a 6 inch overlap onto the existing membrane. The solvent shall be as approved by the membrane waterproofing manufacturer. Repairs shall comply with the manufacturer's guidelines for any over-coating times.

Where the membrane is to be joined to existing cured material and at day joints, the new application shall overlap the existing membrane/day joint by at least 4 inch. The existing membrane/day joint shall be cleaned of all contamination including tack coat material or dirt to an edge distance of a least 6 inch and wiped with a solvent as approved by the membrane waterproofing manufacturer.

7. FIELD QUALITY CONTROL: The following tests shall be conducted by the manufacturer's representative and recorded on a test report form to be submitted to the Engineer. All test reports shall be submitted to the Engineer within 5 working days of the test completion.

a. Temperature and Moisture: Concrete deck temperature and dew point readings shall be taken prior to commencing the primer application. Air temperature shall be recorded every 4 hours during the application process.

b. Film Thickness: Wet film thickness shall be checked every 300 square feet using a gauge pin or standard comb type thickness gauge or a magnetic gauge. Film thickness checks shall be carried throughout the application process. During the Final Review, the cured membrane film thickness shall be checked by a dial thickness gauge.

c. Pin Hole/Holidays: The entire surface of the membrane shall be holiday tested in accordance with ASTM D 4787 using an approved holiday tester. All holidays shall be located, marked for repair, documented, and repaired in accordance with the approved repair procedure. The holiday testing equipment shall be independently calibrated with valid certification. The spark tester shall be adjusted to suit the conductivity of the in-place concrete substrate prior to testing in accordance with ASTM D-4787. Tester certification shall be provided to the Engineer prior to commencing the application process. The Engineer shall oversee the holiday testing.

d. Adhesion Tensile Bond: Random tests for adequate tensile bond strength shall be conducted in accordance with ASTM D 4541 using the membrane manufacture's primer and membrane. The test shall be conducted using the membrane as the adhesive to the test dolly. Minimum bond strength of 100 psi will be required for acceptance. Failure in the concrete will require additional surface preparation of the concrete. Tester Model 106, or approved similar equipment shall be used. A frequency of 1 test per 5,000 square feet or fraction thereof shall be conducted. Areas smaller than 5,000 square feet shall receive a minimum of 3 tests.

e. Visual inspections shall be conducted throughout the application process. The Manufacturer's Field Representative shall take progress photos for incorporation with his final review report to the Engineer.

Final Review

The final review visual inspection shall be conducted jointly by the Applicator, Contractor, Manufacturer's Field Representative and Engineer. Irregularities or other items that do not meet the

requirements of the Special Provisions and the Plans shall be addressed/repared at this time, at no additional cost to the MassDOT.

Strip Seal Bridge Joint System

The work under this heading shall conform to the applicable provisions of Section 960 and 972 of the Specification with the following additions:

Supplying and installing materials for the strip seal bridge joint system, including, steel extrusions, strip seals, headed anchors, and expansion anchor bolts for leveling, shall be included under this heading.

Shop drawings shall be prepared in accordance with the applicable requirements of Subsection

960.60. The joints shall be fabricated with the proper skews and cross slope of the deck.

Concrete Coating for Existing Substructures

After all substructure repairs have been completed a colored protective coating will be applied, color to be determined by MassDOT, over the entire above grade substructure of each bridge. The material shall be either Conpro Lastic by Conproco Corporation, Sikaguard 550W Elastocolor by Sika Corporation and Thorolastic by BASF