ITEM 995.05 BRIDGE STRUCTURE – SUBSTRUCTURE
ITEM 995.06 BRIDGE STRUCTURE - SUPERSTRUCTURE

TEMPORARY PROTECTIVE SHIELDING

The temporary shielding shall protect the roadway and people below the bridge from falling or flying debris during construction of the bridge. The shielding shall prevent any debris, tools or incidental items from falling onto the roadway below.

The Contractor shall submit calculations and detailed drawings of the proposed shielding, stamped by a professional engineer registered in Massachusetts, to the Engineer and for review and approval.

TEMPORARY SUPPORTS

Temporary supports shall be utilized during construction to support the proposed superstructure over Route 2A as shown on the Plans.

The Contractor shall submit calculations and detailed drawings of the proposed temporary supports and their foundation system, stamped by a professional engineer registered in Massachusetts, to the Engineer and for review and approval. The temporary supports shall consist of a pre-engineered system and the design shall conform to the AASHTO LRFD Bridge Design Specifications, the AASHTO Standard Specifications for Highway Bridges, or the AASHTO Guide Specification for Temporary Works.

BRIDGE DECK

In addition to the requirements contained herein, all weather and concrete temperature requirements contained in Subsection 901.64 shall be satisfied. Cement concrete for bridge decks shall not be placed when the ambient air temperature exceeds 85°F or is expected to exceed 85°F during the placement of the deck. When placing concrete, the Contractor must provide suitable equipment and take appropriate actions as approved by the Engineer to limit the evaporation rate of the exposed concrete surface to less than 0.15 $lb/ft^2/hr$. The deck surface evaporation rate shall be determined in accordance with Figure 1 of these Specifications (obtained from "Plastic Cracking of Concrete" by Delmar Bloem for the National Ready Mixed Concrete Association and published in ACI 305R-89) and all data contained in the Bridge Deck Placement Environment table below shall be determined by the Contractor and agreed upon by the Engineer prior to and after casting the bridge deck. To maintain the deck surface evaporation rate below 0.15 $lb/ft^2/hr$ the Contractor shall take one or more of the following actions:

1. Misting the surface of the concrete with pressurized equipment attached to the finishing machine until the curing cover is applied. The water mist shall be distributed at a rate of at least 0.10 gallons/square foot/hour. For example, on a deck that is 30 feet wide, the system must be able to apply at least 3.0 gallons of water per linear foot per hour. The fog spray must be produced from nozzles that produce an atomized fog mist that will maintain a sheen of moisture on the concrete surface without ponding. The atomized

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water droplets shall have an average droplet diameter of 0.003 inches or less. The area of coverage from each nozzle shall overlap all adjacent coverage areas by at least 12 inches. Water that drips from the nozzles shall not be allowed to fall onto the concrete that is being cured.

2. Reduce the temperature of the concrete.
3. Reschedule the placement until such time as the environmental conditions are acceptable, such as at night or during early morning hours.

Bridge Deck Placement Environment						
City/Town:				Date:		
Bridge Number:				Contract Number:		
Start Station:				End Station:		
	Time Measured	Air Temp.	Relative Humidity (%)	Concrete Temp.	Wind Velocity	Evaporation Rate
Prior to Casting						
After Casting						
Signature – Contractor's Authorized Representative:				Printed Name:		
Signature – MASSDOT Resident Engineer:				Printed Name:		

Cement Concrete crack sealing requirements defined herein are for the repair and sealing of cast-in-place cement concrete to prevent water infiltration to the steel reinforcement bars. The width of cracks shall be determined by the Engineer using a width indicating comparator card made of clear plastic with lines of specified width on the cards. The crack width comparator cards shall be held on concrete surfaces to allow the widths of any concrete cracks to be determined by direct visual comparison of the crack width with the widths of the lines marked on the card surface. These cracks are assumed to be non-moving and to have been caused by inadequate control of shrinkage or temperature stresses during curing. Cracks that are of structural concern shall be repaired by other methods determined by the Engineer.

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Cracks shall be sealed after construction movement is substantially stable and before waterproofing, pavement, or other construction covers the cracked surface. Crack sealing materials shall be applied by skilled applicators under a supervisor with proven successful experience in applications with similar scope of work. Crack sealing materials shall be applied when the concrete and the ambient air temperatures are above 40°F. If a heated enclosure is used to accomplish this, the heating units shall be properly vented to the outside of the enclosure to prevent products of combustion from exhausting within the enclosure.

Before containers of sealing materials are opened, the labels shall be checked and the label information shall be documented. If multi-component systems are used, mixing shall be completed prior to application. Manufacturer's instructions shall be followed. An initial crack sealing demonstration application shall be satisfactorily made in the presence of the Engineer before the application is continued.

Before sealing, the concrete must be clean, sound, and free of contaminants and surface moisture. Any curing compounds, sealers, oils, greases, coatings, or other impregnations shall be removed by sandblasting. Once any concrete surface contaminants are removed, the concrete shall be swept clean and blown off using oil free compressed air immediately prior to applying the sealer.

Methacrylate crack sealing shall be performed in accordance with the manufacturer's instructions within the allowable ambient temperature range. The cracks shall be v-notched to a minimum depth of ½" and shall be cleaned with compressed air. The notch shall then be inspected to confirm that the crack was intercepted. If the crack was not intercepted, the notch shall be expanded to intercept, the crack and shall then be re-cleaned with compressed air. Methacrylate shall then be poured into the crack. The crack shall then be observed for seepage of methacrylate and shall be refilled as necessary to ensure the crack is completely filled. If large quantities of methacrylate are used and the crack is not getting filled, the crack should be filled with pre-bagged dried silica sand filler and the crack shall then be re-filled with methacrylate. Methacrylate crack sealer shall consist of a high molecular weight low viscosity methacrylate monomer that when catalyzed will produce a crack-healer/penetrating-sealer that is a rapid-curing, modified-methacrylate resin. The methacrylate material shall, as a minimum, provide the following as applied properties:

Property	Value	Test
Viscosity	< 25 cps	ASTM D2393
Bond Strength	> 1500 psi	ASTM C882
Tensile Elongation	> 3%	ASTM D638

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In addition, the methacrylate material shall demonstrate full penetration of concrete cracks in mock-up testing. Mock-up testing shall consist of preparing the deck surface, applying the methacrylate sealer and removing cores to evaluate the depth and quality of methacrylate sealer penetration. Successful methacrylate penetration of the concrete cracks shall be demonstrated visually in nominal 3 inch deep cores that intersect crack widths in the 7 to 20 mil width range. The cores shall be sliced longitudinally, perpendicular to the crack, and examined in an AASHTO accredited laboratory using ultraviolet light in order to fluoresce the methacrylate to determine the methacrylate penetration depth (the deepest point to which the methacrylate reached) and the sealer-filled crack depth (the depth to which the crack was filled wall-to-wall). The results of mock-up testing shall be documented in a report prepared by the AASHTO accredited laboratory.

Epoxy injection crack sealing shall be performed in accordance with the manufacturer's instructions within the allowable ambient temperature range. Epoxy-Resin for Cement Concrete Crack Injection shall conform to AASHTO M235, Type IV, Grade I. The cracks shall be cleaned with compressed air. Surface mounted injection ports shall then be installed over the centers of the cracks. The spacing of these ports shall be contingent upon the material and the injection equipment chosen. Socket porting shall be allowed provided that a hollow drill bit and vacuum system is used to prevent debris from entering the cracks. Surface ports shall be mounted with rapid setting epoxy material. The crack widths shall be noted during port installation. After the ports are installed, the crack surfaces shall be sealed with high modulus, 100% solids, moisture tolerant epoxy paste adhesive. This material shall be capped with fine sand before it is cured. After the capping material has cured, the cracks shall be injected with an epoxy resin compound. The injection pressure used to seal the cracks shall be based upon a number of factors including crack width, crack depth, and the epoxy material used. Injection shall be accomplished using a metered system. The system shall be equipped with a pressure gauge accurate for the pressures anticipated for this work. Injection shall start at the widest point of the crack and shall continue until the narrowest portions of the crack have been filled. Injection shall continue until refusal. If epoxy is observed at adjacent ports, the adjacent port shall be capped and injection shall continue until refusal occurs. Once refusal occurs, injection shall continue at the next wet port until refusal is reached.

Silane Crack Sealer shall consist of a clear, breathable, high-performance, 100 percent solids by weight silane sealer for protecting new and existing concrete surfaces. It must penetrate deeply, sealing out water, chloride ions, and acids, and prevent damage from freeze/thaw cycles. Silane Crack Sealer material shall, as a minimum, provide the following as applied properties:

Property	Value	Test
Water Weight Gain at 250 ft^2/gal	88% reduction	NCHRP 244 Series II – Cube Test
Absorbed Chloride at 250 ft^2/gal	89% reduction	NCHRP 244 Series II – Cube Test
Absorbed Chloride at 250 ft^2/gal	94% reduction	NCHRP 244 Series IV – Northern Climate

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The type of Cement Concrete crack sealing required shall be determined as a function of the surface type and maximum crack width as follows:

- Cracks less than 0.006" wide shall be ignored;
- Cracks greater than or equal to 0.006" wide and less than 0.012" wide shall be sealed with an approved methacrylate;
- Cracks greater than or equal to 0.012" wide shall be sealed using either epoxy injection or methacrylate with a sand filler.

PRECAST CONCRETE GROUTED JOINTS

The grout to be used for the precast concrete grouted joints shall be a high-strength, non-shrink, flowable grout. The product shall be "FX-228®" as manufactured by Fox Industries, Inc. of Baltimore, Maryland; "Sure-Grip High Performance Grout™" as manufactured by Dayton Superior Corp. of Miamisburg Ohio; or an approved equal. The Engineer shall confer with the Research & Materials Division regarding which products are approved for use on Massachusetts Department of Transportation bridge projects.

STEEL REINFORCEMENT FOR STRUCTURES – EPOXY COATED

Steel reinforcement shall conform to relevant provisions of Section 901 and as follows: Special procedures shall be used during handling, storage, and installation to prevent damaging epoxy coating, as outlined in the Concrete Reinforcing Steel Institute (CRSI) Engineering Data Report No. 19. Any damage to the epoxy coating shall be repaired following the "Guidelines for Inspection and Acceptance of Epoxy Coated Reinforcing Bars" by CRSI. A copy of these reports must be available at the jobsite for reference.

Accessories supporting epoxy coated bars or welded wire fabric shall be epoxy coated. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting a 300-lb load without damage or permanent distortion.

MECHANICAL REINFORCING BAR SPLICERS

Mechanical reinforcing bar splicers shall meet the requirements of M8.01.9 of the MassDOT Supplemental Specifications.

SHEAR CONNECTORS

Shear connectors shall conform to the applicable provisions of Section 960 of the Standard Specifications and the requirements outlined in M8.04.1.

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DRILLED/CORED AND GROUTED DOWELS

The steel dowels/bars shall be standard reinforcing bars and meet the requirements of AASHTO M31 (ASTM A 615) Grade 60 for reinforcement unless otherwise noted. All steel reinforcement dowels shall be either epoxy coated in accordance with AASHTO M284 or ASTM A 934 or galvanized in accordance with AASHTO M 232 (ASTM A 153).

The grout to be used for these dowels shall be "Garonite™ HD" as manufactured by Garon Products, Inc. of Wall, New Jersey; "Quik-Rok®" as manufactured by Ameristar of Tulsa, Oklahoma; "FX-228®" as manufactured by Fox Industries, Inc. of Baltimore, Maryland; "Five Star® Grout" as manufactured by Five Star Products, Inc. of Fairfield, Connecticut; or an approved equal. Epoxy, vinyl, or polyester resin adhesives shall not be utilized. The Engineer shall confer with the Research & Materials Division regarding which products are approved for use on Massachusetts Department of Transportation bridge projects.

All dowel holes shall be air drilled provided that the minimum edge distance of 6 inches is observed. Should, in the Engineer's opinion, air drilling be inappropriate due to questionable strength of the existing concrete or insufficient edge distance, the dowel holes shall be diamond core drilled. The inner surfaces of diamond core drilled dowel holes shall be scored to develop sufficient keying action. The method of scoring of the dowel hole inner surfaces shall be subject to the approval of the Engineer. The diameter of the drilled dowel holes shall be in accordance with the recommendations of the grout manufacturer (generally 1/8 inch larger than the dowel diameter). The holes shall be blown clear of any debris and shall have the approval of the Engineer prior to the placement of any grout material.

The Contractor shall strictly follow the recommendations of the manufacturer for mixing and placing the grout material prior to the placement of the dowels. The Contractor shall, at a minimum, adhere to the ACI code requirements regarding minimum and maximum temperatures while placing the grout. Any excessive grout around the hole after placement of the dowel shall be struck off smooth while the grout is still fresh.

Two test dowel bars of each dowel size shall be installed in the existing concrete substructure and tested by the Contractor for pullout. The tension test shall conform to ASTM E488 and the pullout force shall correspond to 125% of the yield strength of the bar. If any of the tested bars pull out or if the surrounding concrete shows signs of cracking, the Contractor must adjust the hole diameter, embedment length, and/or grouting material to meet this test requirement. All holes or cracks caused by testing shall be repaired by the Contractor.

LAMINATED ELASTOMERIC BEARING W/O ANCHOR BOLTS

Elastomeric bearings shall meet the requirements of M9.14.5.

ITEM 996.003 **PRECAST BRIDGE COMPONENTS (PRECASTING AND DELIVERY)**

Precast concrete shall be fabricated in accordance with the dimensions shown on the plans and the applicable provisions of M4.02.14 of the Standard Specifications. Precast components shall be lifted by handling hooks or slings. The utmost care shall be taken to prevent distortion of the components during handling, transporting, and storing. The precast components shall be free from cracks, spalls, and other defects to the satisfaction of the Engineer.

Specifications for steel reinforcement for structures and mechanical reinforcing bar splicers shall be the same as given under Items 995.05 & 995.06.

The Contractor shall prepare and submit to the Engineer, for approval, a plan indicating the proposed erection procedures and methods to be used including, but not limited to, equipment, tools, devices, lifting connections, equipment location, and schedule of operations. The requirements for equipment and all procedures utilized shall be in conformance with the intent of Subsection 960.61D, Erection, of the Standard Specifications for Highway Bridges and the Supplemental Specifications. The procedure and any necessary calculations and drawings shall be stamped by a Professional Engineer registered in the Commonwealth of Massachusetts.

ITEM 999.009 **SELF PROPELLED MODULAR TRANSPORTER (SPMT)/HEAVY LIFT/CRANE/ OTHER BRIDGE MOVING TECHNOLOGY**

The proposed superstructure shall be built on temporary supports in a location approximately 130 feet north of the existing bridge and then moved into place on the existing abutments as shown on the plans.

The Contractor shall prepare and submit to the Engineer, for approval, a plan indicating the proposed superstructure move procedures and methods to be used including, but not limited to, equipment, tools, devices, lifting connections, equipment location, and schedule of operations. The requirements for equipment and all procedures utilized shall be in conformance with the intent of Subsection 960.61D, Erection, of the Standard Specifications for Highway Bridges and the Supplemental Specifications unless otherwise modified herein. The superstructure move procedure and any necessary calculations and drawings shall be stamped by a Professional Engineer registered in the Commonwealth of Massachusetts.

The Contractor shall include a contingency plan as a part of the superstructure move procedures. The contingency plan shall identify potential events which could disrupt the schedule and identify mitigating actions that will be taken.

The design of all supports, shoring, jacking/lifting systems, blocking, and header beams used during the bridge move shall conform to the AASHTO LRFD Bridge Design Specifications, the AASHTO Standard Specifications for Highway Bridges, or the AASHTO Guide Specification for Temporary Works. The loads on the heavy lift equipment and any supports associated with it shall receive an additional factor of 1.15 to account for dynamic effects during the move.

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The superstructure shall be moved from the temporary shoring and placed on the proposed abutments as shown on the plans. The placement tolerance in the bridge's longitudinal direction shall be 1/2" and the placement tolerance in the bridge's transverse direction shall be 1/2".

The superstructure shall be monitored for damage during the lifting, moving, and placing procedures. Prior to lifting and after the span is set on the final abutments, the Contractor shall catalog all of the cracks in the concrete deck, as seen from above and below, and in the concrete barrier. The catalogs from before and after the move shall be compared to identify possible locations of damage induced by the lifting and moving procedure. Cracks equal to or greater than 0.006" shall be sealed by the methods described under Items 995.05 & 995.06 of this document. Any concrete spalls that occur shall be patched as outlined in Item 115.1 of this document.