

## **SPECIAL PROVISIONS**

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### **TOWN OF WEST NEWBURY BRIDGE No. N-11-007 = W-20-001 (CBR)**

### **PLUMMER SPRING ROAD/MIDDLE STREET OVER ARTICHOKE RESERVOIR**

#### **SCOPE OF WORK**

The work under this contract shall be done in conformance with the Commonwealth of Massachusetts Department of Transportation Standard Specifications for Highways and Bridges Dated 2023, the Supplemental Specifications dated March 31, 2023, the October 2017 Construction Standard Details, the 2015 Overhead Signal Structure and Foundation Standard Drawings, MassDOT Traffic Management Plans and Detail Drawings, the Latest Manual On Uniform Traffic Control Devices for Streets and Highways with Massachusetts Amendments, the 1990 Standard Drawings for Signs and Supports, the 1968 Standard Drawings for Traffic Signals and Highway Lighting, and the Latest Edition of the American Standard for Nursery Stock, and these Contract Documents.

**The project is to be completed by November 30, 2026.**

#### **BRIDGE:**

The bridge spans a surface public water supply and the Owners have obtained permits from various regulatory agencies. The Contractor must and shall comply with the conditions and directives of these Permits at all times. The Contractor shall perform his operations in such a manner as to prevent any amount of contamination, silt, debris from entering the water supply.

No existing drawings of the original structure, bridge No. N-11-007=W-20-001 are known to exist. The existing bridge is a masonry stone arch structure. Based on portions of the structure that could be observed and Inspection Reports, the bridge clear span is approximately 14 feet long and approximately 24 feet wide out-to-out. There are 4 masonry stone wingwalls that are approximately 24 feet long. The entire existing bridge superstructure and substructure will be removed.

The proposed bridge superstructure is spread prestressed concrete box beams with a cast-in-place concrete deck slab supported by cast-in-place integral abutments with H-piles. The span is 45 feet long and 32'-6" wide out-to-out. The integral wingwalls are to be cast-in-place. To provide slope stability and prevent future undermining/scour, designated portions of the streambed, new approach walls & slopes will be armored with protective Riprap.

The work to be performed consists of, but is not limited to, the following: installation of erosion and sediment control, demolition of the existing arch structure and wingwalls, installation of proposed substructure, placement of protective riprap in the stream channel covered with 12 inches

of natural streambed material, installation of precast beams and construction of abutments, wingwalls and new approach walls, bridge rail installation, full depth reconstruction along the approach roadway, installation of guardrail and other incidental work necessary to complete the proposed project.

If the Contractor elects to propose modifications to the project the net result shall be a cost savings to the Town or at the Contractor's expense. All acceptance of proposed project modifications shall be at the discretion of the Town.

For the work specified under this Contract, the Contractor shall be prequalified by the Massachusetts Department of Transportation Highway Division (MassDOT) in - Bridge Construction.

### **MAINTAIN RESERVOIR FLOWS**

**IMPORTANT:** The Contractor shall not impede the flow of water under the bridge at any time during the construction. Upstream of this bridge are two reservoirs that provide a continual flow of water regardless of whether the water is visually flowing over the spillway at the Upper Reservoir Dam, just downstream of this bridge. The dam has outlets below the water surface.

### **SCHEDULE OF OPERATIONS**

Before starting any work under this Contract, the Contractor shall submit a *Schedule of Operations*. The *Schedule of Operations* shall be considered incidental to mobilization. The Contractor shall submit, to and for comment of the Engineer, a schedule of operations within 10 days after the date of the executed Contract to the Contractor. The schedule shall show the proposed methods of construction and sequence of work and the time the Contractor proposes to complete the various items of work within the time specified in the Contract.

If the Contractor's operations are materially affected by changes in the plans or in the quantity of the work, or if he has failed to comply with the submitted and reviewed schedule, the Contractor shall submit a revised schedule if requested by the Engineer within seven days after the date of the Engineer's request. This revised schedule shall show how the Contractor proposes to prosecute the balance of the work, so as to complete the work within the time specified in the Contract. The cost to produce the schedule of operations shall be considered as incidental to the project.

### **PERSONAL PROTECTIVE SAFETY EQUIPMENT FOR CONTRACTOR PERSONNEL**

The Contractor is responsible to ensure that all personnel, including all subcontractors, working on the project are issued and are wearing all necessary personal protective safety equipment while working within the project limits. This equipment shall include, as a minimum, a hardhat and a safety vest, regardless of the type of work being performed. Other safety equipment shall be added as required to perform the work in which they are engaged and in accordance with all local, state and federal requirements in effect. Safety equipment shall be provided at no additional cost to the Town of West Newbury.

### **EXISTING BRIDGE PLANS**

Based on BSC's review there are no existing plans for the original structure available from the City of Newburyport, the Town of West Newbury or MassDOT.

### **APPROVAL OF MATERIALS**

The Contractor shall submit a list of all materials for approval within 15 days of the notice to Proceed. This list shall include kind and type, manufacturer's name, trade name, size, catalog number, and it shall be completed in full text.

The list shall be delivered to the Town's representative. The Town or their representative shall have the right to reject any material or equipment that, in their judgment does not meet these Specifications.

The Contractor shall further provide the Town of West Newbury written evidence within 30 days of receipt of the contract that orders have been confirmed in writing by the manufacturer with delivery dates appropriate for timely completion of the project.

### **STRUCTURAL INTEGRITY**

It is the Contractor's responsibility to maintain the structural integrity of the existing structure during the various work proposed on the project. The bridge spans a surface public water supply. The flow of water shall be maintained at all times, unless otherwise approved by the City of Newburyport Water Division. All work required to maintain the integrity of the structure during construction should be incidental to the bid items. Similarly, the structural integrity of new structures shall be maintained during the various phases of construction.

### **DISPOSAL OF EXCESS MATERIAL**

Surplus materials obtained from any type of excavation, and all existing and other materials not required to be removed and stacked or needed for use on the project, as **determined by the Town** shall become the property of the Contractor and disposed of subject to the regulations and requirements of local authorities governing the disposal of such materials, at no additional compensation.

### **PROTECTION OF UNDERGROUND FACILITIES**

The Contractor's attention is directed to the necessity of making his own investigation in order to assure that no damage to existing structures, drainage lines, traffic signal conduits, etcetera, will occur.

The Contractor shall notify Massachusetts DIG SAFE and procure a Dig Safe Number for each location prior to disturbing existing ground in any way. The telephone number of the Dig Safe Call Center is 811 or 1-888-344-7233.

### **NOTICE TO OWNERS OF UTILITIES**

The Town is not aware of any public or private utilities within the limits of the project. Nonetheless, written notice shall be given by the Contractor to all public service corporations or officials owning or having charge of public or private utilities, of his/her intention to commence operations affecting such utilities at least one week in advance of the start of such operations. The Contractor shall at the same time file a copy of said notice with the Engineer. A list of public and private utilities can be found on the MassDOT website at:

<https://hwy.massdot.state.ma.us/webapps/utilities/select.asp>

Following are the names and addresses of the companies or agencies that may be affected, but the completeness of the list is not guaranteed:

**NEWBURYPORT AGENCIES:**

NEWBURYPORT FIRE DEPT.

Steve Bradbury  
Fire Chief  
0 Greenleaf Street  
Newburyport, MA 01950  
Phone: (978) 465-4427

NEWBURYPORT POLICE DEPT.

Mark Murray  
City Marshall  
4 Green Street  
Newburyport, MA 01950  
Phone: (978) 462-4411

NEWBURYPORT DPS

Wayne Amaral  
Director (Water, Sewer, Highway)  
16A Perry Way  
Newburyport, MA 01950  
Phone: (978) 465-4464

CITY ENGINEER

Jon-Eric White, PE  
16A Perry Way  
Newburyport, MA 01950  
Phone: (978) 465-4464 (1710)

WATER DEPARTMENT

Tom Cusick  
Water Treatment Operator Superintendent  
7 Spring Lane  
Newburyport, MA 01950  
Phone: (978) 465-4466

VERIZON

Karen Mealey  
385 Myles Standish Blvd.  
Taunton, MA 02780  
Phone: (774) 409-3160

NATIONAL GRID

Joe Muraco  
1101 Turnpike Street  
North Andover, MA 01845  
Phone: (978) 551-7741

**WEST NEWBURY AGENCIES:**

WEST NEWBURY FIRE DEPT.

Michael Dwyer  
Chief of Police & Fire  
403 Main Street  
West Newbury, MA 01985  
Phone: (978) 363-1111

WEST NEWBURY DPW

Katelyn Barker  
DPW Business Manager/CPO  
381 Main Street  
West Newbury, MA 01985  
Phone: (978) 363-1100 (x135)

WATER DEPARTMENT

Mark Marlowe  
Manager/Superintendent  
381 Main Street  
West Newbury, MA 01985  
Phone: (978) 363-1100 (x128)

VERIZON

Karen Mealey  
385 Myles Standish Blvd.  
Taunton, MA 02780  
Phone: (774) 409-3160

NATIONAL GRID

Joe Muraco  
1101 Turnpike Street  
North Andover, MA 01845  
Phone: (978) 551-7741

**GENERAL CONTACTS:**

DESIGNER (BSC Group, Inc.)

Micah Morrison, PE, SE  
803 Summer Street  
Boston, MA 02127  
Phone: (617) 896-4356

NEWBURYPORT PM

Jon-Eric White, PE  
City Engineer  
16A Perry Way  
Newburyport, MA 01950  
Phone: (978) 465-4464 (1710)

WEST NEWBURY PM

Angus Jennings  
Town Manager  
381 Main Street  
West Newbury, MA 019  
(978) 363-1100 x111

## **SUBSECTION 5.02 – SHOP DRAWING SUBMITTALS.**

*(Replace Subsection 5.02, 8<sup>th</sup> paragraph)*

The Contractor shall submit full-scale shop drawing prints to the Engineer for approval. If corrections are required, one set of the marked-up drawings will be returned to the Contractor for revision and subsequent re-submittal. No changes shall be made to the approved drawings without the written consent of the Engineer.

## **PREVENTION OF WATER POLLUTION - SANITARY PROVISIONS**

*(Supplementing subsection 7.02)*

During the performance of all Work done under this contract, the Contractor shall adopt such precautions in the conduct of his operations as may be necessary to avoid contaminating the public water supply. All moving of equipment and other operations likely to create silting, shall be so planned and conducted as to minimize pollution in the public water supply. Water used for any purpose by the Contractor, which has been contaminated with soil, bitumen, salt or other pollutants shall not be discharged within 100 feet of the public water supply, or as otherwise directed or addressed in the various permits granted for this construction. Under no circumstances shall the Contractor discharge pollutants directly into the public water supply.

The Contractor shall not use the public water supply for any of his operations.

## **EROSION AND SEDIMENTATION CONTROL**

*(Supplementing Sub-sections 5.01, 7.01, 7.02 & 8.06)*

### Erosion/Sedimentation Controls

All work shall be in strict compliance with the Conservation Commissions' Orders of Conditions. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the Contractor or his/her designee shall inspect erosion controls on a daily basis and shall remove accumulated sediments as needed. An adequate stockpile of erosion control materials shall be kept on site for emergency or routine repairs. The Contractor shall immediately control any erosion problems that occur at the site and shall also immediately notify the Engineer who reserves the right to require additional erosion and/or damage prevention controls he/she may deem necessary.

### Hazardous Spills

Supplies for cleanup of oil, gasoline and other hazardous materials to be used during the project shall be kept onsite at all times. Spills of any kind shall be reported immediately to the Newburyport Water Department. In addition, reportable quantities of hazardous materials shall be reported, as required, to the Massachusetts Department of Environmental Protection (DEP) and cleaned up in compliance with all DEP guidelines.

The Engineer has the authority to limit the surface areas of erodible earth material exposed by excavation, borrow and fill, or any such operations, and to direct the Contractor to provide

immediate, permanent or temporary control measures to prevent contamination of Artichoke Reservoir. Such measures will involve the construction of sediment barriers, sedimentation basins, silt fences or other control devices or methods as necessary to control erosion and sedimentation.

In case of conflict between these specifications and laws, rules, or regulations of local agencies, the more restrictive requirements shall apply.

Dewatering of excavated areas for the bridge substructure, wingwalls, retaining walls, Riprap installation, shall be necessary in order for the installation to be completed "in-the-dry". The contractor shall submit a dewatering plan for approval of the Engineer prior to commencing construction. The following procedures shall be followed during the installation and maintenance of the dewatering plan:

The outlet area for the dewatering operation shall be constructed as to minimize erosion of the area surrounding the outlet, such as through the use of erosion control blankets, stonewalls, etc.

The dewatering operation shall be maintained as follows:

- Inspect at least twice daily during dewatering operations.
- Provide any required repairs immediately.
- Clogged sections should be cleaned daily.
- Remove sediment/filtration systems as needed.
- Dispose of sediment deposits off-site or in an approved manner.

The Contractor shall maintain flow capacity of all watercourses to prevent unnatural flooding due to the Contractor's operations.

If temporary erosion and sediment control measures are required due to the Contractor's negligence or carelessness, the Contractor at his/her own expense shall install and maintain the control measures. Construction of temporary erosion and sediment control measures, which are not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls, will be performed as shown on the Plans and/or as ordered by the Engineer.

Repeated failures by the Contractor to control erosion, pollution, and/or siltation, shall be cause for the TOWN to employ outside assistance or to use their own forces to provide the necessary corrective measures. The cost of such assistance plus project engineering costs will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress estimate.



**CONSTRUCTION STAGING AND STORAGE AREAS**

All demolition/construction staging and storage areas, as well as locations for equipment/vehicle parking/fueling/dumpsters, must comply with the issued environmental permits and be approved by the respective communities.

**ITEM 102.01****SELECTIVE CLEARING AND GRUBBING****LUMP SUM****DESCRIPTION**

The work under this item shall conform to the relevant provisions of Section 101 of the Standard Provisions, and the following:

The work shall include, but is not limited to, the removal of trees, brush, and major roots within the limits of work. Trees and shrubs specifically designated by the Engineer not to be cut, removed, destroyed or trimmed shall be saved from harm and injury, and any replacement will be done at the Contractor's expense. All debris shall be removed and properly disposed from the site.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 102.01 Selective Clearing and Grubbing shall be measured and paid at the contract Lump Sum price, which price shall include all labor, materials, tools, equipment, disposal, and incidental costs required to complete the work.

**ITEM 102.511****TREE PROTECTION – ARMORING & PRUNING****EACH**

The work under this item shall conform to the relevant provisions of Sections 771 and shall be for furnishing and installing temporary tree trunk protection and for minor limb pruning or removal of lower tree limbs to prevent injury to the tree from construction equipment and activities.

Trunk armoring is for instances where construction activity (the use of heavy equipment) comes close enough to potentially damage the tree trunk or limbs. It is to be used where shown on the plans and as directed by the Engineer.

**REFERENCES**

If requested, the Contractor shall provide to the Engineer one copy of the latest edition of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance: Part 1-Pruning and Part 5-Construction Management Standard. Provision of reference shall be incidental to this item.

**MATERIALS**

Trunk armoring shall be such that it prevents damage to the trunk from construction equipment. Selected material shall be such that installation and removal will not damage the trunk.

Acceptable materials include 2x4 wood cladding with wire or metal strapping, or, for instances when duration of construction activities is less than three months, corrugated plastic pipe mounted with duct tape. Height of cladding shall be from base of tree (including root flare) to the bottom of the first branch, eight feet above the ground, or as required by the Engineer. Material and methods shall be approved by the Engineer.

Other materials or methods may be acceptable if approved by the Engineer.

**METHODS OF WORK**

Prior to construction activities, the Engineer, the Contractor, the Town Tree Warden, and the Arborist (if item is included in the contract), shall review trees noted on the plans to be protected. Final decision as to trees armored and/or pruned shall be per the Engineer.

Care shall be taken to avoid damage to the bark during installation and removal of armoring. Trunk armoring shall be replaced and maintained such that it is effective for as long as required and shall be removed immediately upon completion of work activities adjacent to trees.

Pruning of limbs shall conform to the techniques and standards of the most recent ANSI A300 standards.

## DAMAGES & PENALTIES

If trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall, at his own expense obtain an Arborist. The Arborist shall be approved by the Engineer.

If, based on the recommendations of the Arborist, the Engineer determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage will be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Engineer determines that damages are irreparable, the Contractor shall pay for the damages in the amount of \$500.00 per diameter inch at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal will include clean up of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

## METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 102.511 will be measured and paid at the contract unit price per each. This will include full compensation for all labor, equipment, materials, and incidentals for the satisfactory completion of the work and the subsequent removal and satisfactory disposal of the protective materials upon completion of the contract.

In the event of tree damage, cost of Arborist services, of remediation measures, and/or tree removal will be borne by the Contractor.

Payment under this item will be scheduled throughout the length of contract:

- 40% of value shall be paid upon installation of trunk armoring and completion of pruning work, if required.
- 60% shall be paid at the end of construction operations that would damage the tree and after protection materials have been removed and properly disposed of by the Contractor. In the event of repairable damages, payment shall be made after the completion of remediation measures.

In the event of irreparable damage due to lack of proper protective measures being take there will be no compensation in addition to the \$500.00 per diameter inch penalty.

**ITEM 102.521****TREE AND PLANT PROTECTION FENCE****FOOT**

The work under this Item shall conform to the relevant provisions of Sections 644 and 771 of the Standard Specifications and the following:

Work under this item consists of furnishing, installing, removing and resetting, maintaining fence in a vertical and effective position at all times, and final removal of temporary fence.

The purpose of the fence is to prevent damage to tree roots, tree trunks, soil, and all other vegetation within a delineated Tree and Plant Protection Zone (TPPZ) as shown on the plans, as directed by the Engineer, and as described herein.

Protection shall be for the duration of the construction activities unless otherwise directed.

**MATERIALS**

Temporary Fence shall be such that it provides a minimum 48-inch tall barrier that remains vertical and effective (not sagging) for the duration of period required. Fence shall be plastic orange safety fence (recommended where high visibility is necessary), wooden snow fencing, or other approved material.

Per the Engineer, additional posts, deeper post depths, and/or additional attachments will be used if the fabric or fence sags, leans or otherwise shows signs of failing to create a sufficient barrier to access.

**REFERENCES**

If requested, the Contractor shall provide to the Engineer one copy of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance Part 1, Pruning and Part 5, Construction Management Standard. Provision of reference shall be incidental to this item.

**ESTABLISHMENT OF TPPZ**

Fencing shall be used for construction areas, staging areas, and stockpile areas as shown on the plans and as directed by the Engineer to establish the Tree and Plant Protection Zone (TPPZ).

Fence shall be located as close to the work zone limit and as far from the trunk as possible to maximize the area to be protected. Fence shall run parallel and adjacent to construction activity to create a barrier between the work zone and the root zone or designated limit of plants and soils to be protected.

When construction activities surround (or have the potential to surround) trees or plants to be protected, a circular enclosure shall be used. In these instances, the TPPZ limit shall be the Drip Line of each tree or as close as possible to the Drip Line, and as shown on the plans and details. The Drip Line is defined as the limit of tree canopy.

The Contractor shall not engage in any construction activity within the TPPZ without the approval of the Engineer, including: operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets; and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks.

### **METHOD OF WORK**

Fence shall be installed prior to any construction work or staging activities and shall be installed and maintained in a vertical and effective position at all times.

Fence shall be repositioned where and as necessary for optimum effectiveness. Repositioning shall be incidental to this item. Fence shall not be moved without prior approval by the Engineer.

The TPPZ shall be protected at all times from compaction of the soil; damage of any kind to trunks, bark, branches, leaves, and roots of all plants; and contamination of the soil with construction materials, debris, silt, fuels, oils, and any chemicals substance.

After construction activities are completed, or when directed by the Engineer, fence, stakes, and other materials shall be removed and disposed off-site by the Contractor.

### **REQUIRED WORK WITHIN THE TPPZ**

In the event that grading, trenching, utility work, or storage is unavoidable within the TPPZ, the Engineer shall be notified. Measures may be required for tree protection and preservations, including air spading, the use of six-inch depth of wood chips or approved matting for root protection, pruning of branches, and/or trunk protection. These protection measures will be paid under applicable items.

Landscaping work specified within the TPPZ shall be accomplished by hand tools. Where hand work is not feasible, with permission of the Engineer, work shall be conducted with the smallest mechanized equipment necessary.

### **TREE AND PLANT DAMAGES OR LOSS**

If the TPPZ is intruded upon, at the discretion of the Engineer, the Contractor will be required to provide a more durable barrier (e.g., Jersey Barriers) to secure the area. Cost of furnishing and installing additional or more durable barrier shall be borne by the Contractor.

If the Contractor intrudes into a TPPZ without approval, soil will be considered compacted and tree root damage will be assumed. Action will be taken as specified below.

In the event that trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall, at his own expense obtain an Arborist. The Arborist shall be approved by the Engineer.

In the event of spills, compaction or damage, the Contractor shall take corrective action immediately using methods approved by the Engineer in coordination with the Arborist.

If, based on the recommendations of the Arborist, the Engineer determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage will be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Engineer determines that damages are irreparable, the Contractor shall pay for the damages in the amount of \$500.00 per diameter inch at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal will include cleanup of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

Shrubs will be replaced with a plant of similar species and equal size or the largest size plants reasonably available. The Engineer will approve the size and quality of the replacement plant. Replacement will include a minimum of one year of watering and care.

#### **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 102.521 will be measured and paid for payment by the foot of Tree and Plant Protection Fence, complete in place. This includes all labor, materials, equipment, maintenance, final removal and disposal of the protective materials, damages repair, and all incidental cost required to complete the work.

Payment of 40 percent of value will be made upon installation of Fence. The remaining 60 percent will be made when protection materials have been removed and disposed off-site.

No separate payment will be made for costs of remedial actions, including addition of more durable barriers, or arborist services, but all costs in connection therewith shall be included in the Contract unit price bid.

In the event of irreparable damage due to lack of proper protective measures being take there will be no compensation in addition to the \$500.00 per diameter inch penalty.

**ITEM 115.1      DEMOLITION OF BRIDGE NO. N-11-007=W-20-001 (8BC)      LUMP SUM**

**DESCRIPTION**

The work performed under this Item shall conform to Section 112 of the Standard Specifications and the following:

The work shall include the removal and satisfactory disposal of all bridge elements including existing railings, stone headwalls, stone wingwalls/retaining walls, superstructure and substructure components, excess fill, removal of collapsed sections of the bridge within the embankments and/or channel bed and designated existing guardrail within the project limits. Any additional demolition/removal within the project limits shall be considered incidental to Item 115.1.

Excavation and removal of material (fill, earth, rock etc.) between the existing arch and the limits of bridge excavation for the proposed bridge abutments shall be incidental to item 115.1, see bridge drawing sheet 16 of 20.

Concrete barriers on the bridge and bridge approaches shall be removed and transported to the Town of West Newbury Department of Public Works facility. This work shall be incidental to Item 115.1.

The stone blocks that comprise the existing bridge/wingwalls shall be stockpiled on site. The Town of West Newbury will inspect the stone blocks to determine if the Town wants them. Any stone blocks that the Town does not want will become the property of the Contractor. The Contractor shall transport the stones to a destination determined by the Engineer but within the Town limits. All costs associated with excavating, transporting, stockpiling and disposing of stone blocks shall be considered incidental to item 115.1. All demolition/excavation is to occur behind a Control of Water System (CWS), Item 991.1. The CWS is the responsibility of the Contractor. A suggested CWS is depicted in the environmental permits that are included in the contract documents.

**CONSTRUCTION METHODS (DEMOLITION)**

The Contractor shall submit for approval a plan indicating their proposed demolition procedures and methods to be used including equipment, tools, devices, crane/excavator capacity and location, schedule of operations, etc. The demolition procedure and any necessary calculations and drawings shall be stamped by a Professional Structural Engineer registered in the Commonwealth of Massachusetts. Work under this item may not commence until the Engineer has given written approval of the method of demolition.

During the prosecution of this work, the Engineer may reject the use of any method or equipment that is not in conformance with the approved demolition procedure. The noise and dust created by demolition operations must be reduced to the maximum extent possible.

The Contractor shall exercise due care not to permit any items of the existing structures to fall into the water during the demolition operation. Any materials that are dropped into the water shall be



removed immediately by the Contractor, without additional compensation. Temporary protective shielding shall be constructed to prevent debris from falling into the Reservoir.

The Town does not guarantee or represent that the bridge materials will actually coincide with any descriptions contained herein or represented on the plans. The Contractor must satisfy themselves by their own investigation and research regarding all conditions and materials affecting the work to be done. No additional compensation, other than the Lump Sum Price Bid for this Item, shall be made if the materials or work proves to be different from that inferred or described herein, or shown on any plans.

### **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 115.1 “Demolition of Bridge No. N-11-007=W-20-001” will be paid for at the Contract Lump Sum. Payment for this item of work shall constitute full compensation for the full removal of the entire existing bridge superstructure, arch, excavation to limits of proposed bridge excavation (see bridge sheet 16 of 20), substructure components (including wingwalls, footings and spandrel walls), previously collapsed portions of the structure, granite curbing and designated exiting guardrail within the project limits, removal from site and proper disposal, submittals, cleaning, materials, labor, equipment including cranes/excavators, tools, and other incidentals necessary to complete the required work, as specified on the Contract Plans and in these Special Provisions.

Temporary Shielding shall be paid for separately under Item 994.01.

**ITEM 144.**

**CLASS B ROCK EXCAVATION**

**CUBIC YARD**

**DESCRIPTION**

The work under this Item shall conform to the applicable provisions of Section 140 of the Standard Specifications and the following:

**The work under this Item shall also include removal of boulders measuring 1 yd<sup>3</sup> or more and/or bedrock encountered within the limits of bridge excavation (not included in Item 115.1 or Item 996.4).**

Unsuitable excavatable materials designated as waste shall be properly removed from the site and become the property of the contractor unless otherwise directed by the TOWN. No additional payment will be provided for disposal of excavated material.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Class B Rock Excavation will be measured and paid for by the CUBIC YARD. Classification of Materials to be removed shall be determined by the Engineer. Class B Rock Excavation will be paid for at the contract unit price which shall include all labor, materials, equipment and incidental costs required to complete the work.

Disposal of the excavated boulder/bedrock shall be incidental to the Item.

**ITEM 153.1**

**CONTROLLED DENSITY FILL –  
NON-EXCAVATABLE**

**CUBIC YARD**

**DESCRIPTION**

The work under this Item shall conform to the relevant provisions of Section 150 of the Standard Specifications, the Plans, and the following:

The work shall consist of the furnishing and installation of controlled density fill (non-excavatable) at the highway guardrail transition bases and precast approach slabs. The contractor shall provide means to hold the highway guardrail transition in place before and during filling until the fill has sufficient capacity to stabilize the highway guardrail transition.

Controlled density fill shall meet the requirements of Section M4.08.0 of the Standard Specifications. The controlled density fill shall be Type 1, very flowable, non-excavatable. The controlled density fill shall be batched at a MassDOT preapproved concrete plant using a preapproved MassDOT mix. The controlled density fill shall require no vibrating.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

This work shall be measured and paid for at the Contract unit price per CUBIC YARD complete in place. This price shall be full compensation for all labor, equipment, materials, and incidental costs required to complete the work.

**ITEM 156.13**

**CRUSHED STONE FOR INTEGRAL  
ABUTMENT PILES**

**TON**

**DESCRIPTION**

The work to be done under this Item shall be performed in accordance with the relevant provisions of Section 150 of the Standard Specifications and the following:

Crushed Stone materials are used to fill in the trench areas near the top of the integral abutment piles, as shown on the Plan, after driving pile. At each abutment, a trench with a depth of 3'-0" and a minimum width 2'-6" shall be excavated below the bottom of the proposed pile cap. The trench shall be filled with uncompacted crushed stone after installing the piles. The crushed stone shall be deposited with as little compaction as possible in the locations shown on the Plans. They shall satisfy the material requirement M2.01.6. The crushed stone shall be placed as shown in the details on the Plans and in conformance with the Standard Specifications.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

This work will be measured for payment by the Ton in place and as accepted by the Engineer.

Item 156.13 Crushed Stone for Integral Abutment Piles will be paid for at the Contract unit price per TON complete in place; which price shall include all labor, materials, equipment and incidental costs required to complete the work.

**ITEM 156.5**

**CRUSHED STONE FOR FILTER BLANKET**

**CUBIC YARD**

**DESCRIPTION**

The work under this Item shall conform to the relevant provisions of Sections 150 and 983 of the Standard Specifications and the following:

The work shall include placing crushed stone for filter blanket to the limits shown on the Plans for use as a bedding/foundation element for Riprap. The crushed stone shall conform to Section M2.01.4 of the Standard Specifications.

The crushed stone shall be placed as shown in the details on the Plans and in conformance with the Standard Specifications.

**METHOD OF PAYMENT AND MEASUREMENT**

Crushed Stone for Filter Blanket will be measured for payment per Cubic Yard, complete in place.

Crushed Stone for Filter Blanket will be paid for at the Contract Unit Price per Cubic Yard, which price shall include the costs of all labor, tools, materials and equipment required to complete the work. The required geotextile fabric for erosion control will be paid for under Item 698.4 Geotextile Fabric for Permanent Erosion Control.

**ITEM 290.**

**DRAINAGE SYSTEM**

**LUMP SUM**

The work under this Item shall consist of the installation of the proposed drainage system and shall conform to the applicable provisions of Sections 150, 200, and 670 of the Standard Specifications and the following:

**WATER QUALITY UNIT**

**DESCRIPTION**

The work shall consist of furnishing and installing hydrodynamic separators as water quality units in conformance with the construction details, and at locations shown on the plans.

The water quality unit shall be Stormceptor Model STC-900 as manufactured by Rinker Materials or approved equal (minimum capacity of 900 gallons). Other acceptable water quality units include, but are not limited to, appropriately sized models of Vortechs and CDS as manufactured by Contech and Downstream Defender as manufactured by Hydro International. Any substitutions must demonstrate that they are capable of providing equivalent total suspended solids (TSS) removal with equivalent scour protection and internal high flow bypass ability.

The water quality units shall be sized to treat runoff from 1/2-inch rainfall intensity and provide 80% TSS removal for the impervious areas indicated below.

The impervious area contributing to each unit is as follows:

Location 1: West Newbury (West of Bridge) – 0.17 acres

Location 2: Newburyport (East of Bridge – 0.03 acres

The Contractor is advised that the proposed locations of the separator units under this item are shown on the drawings in their approximate locations. The Contractor is responsible to coordinate the exact locations and exact elevations of the separator units in the field, and as required by the Engineer, to ensure the proper functional operation of all elements of the proposed stormwater drainage system(s) constructed as part of this project. All separator units under these items and their components shall be installed in accordance with the manufacturer requirements and as required by the Engineer.

The separators shall be capable of trapping silt and clay sized particles, in addition to large particles, and shall be installed underground as part of the stormwater drainage system(s). The separators shall be structurally designed for HS-20 (minimum) traffic loading at the surface, with the storage in the separator vertically oriented. The separator should be maintained from the surface via one access point.

The separator should be equipped with an internal high flow bypass that regulates the flow rate into the treatment chamber and conveys high flows directly to the outlet so the scour and/or resuspension of material previously collected in the separator does not occur. External bypasses are not acceptable. The bypass area must be physically separated from the separation area to

prevent mixing with the separator circular and constructed from either fiberglass or precast concrete risers. The concrete separator shall be designed and manufactured in accordance with ASTM C-478.

The concrete joints shall be oil resistant, watertight and meet the design criteria according to ASTM C-443. A minimum of 12 inches of oil storage should be lined with fiberglass to provide secondary containment of any hydrocarbon materials.

The difference between the separator inlet pipe elevation and the separator outlet pipe elevation must be 1 inch. For configurations consisting of multiple inlet pipes, a 3-inch difference between horizontal inlet pipe inverts and the outlet pipe invert shall occur. The separators shall be capable of being used as a bend structure in the stormwater drainage system(s).

The separator shall be capable of handling floatable substance spills including free oil and shall not be compromised by temporary backwater conditions (i.e. trapped pollutants should not be resuspended and scoured from the separator during backwater conditions). The capabilities of the selected separator shall be documented with scientific studies and reports. Preference will be given to devices that have been verified by a state or federal storm water verification program.

The frame and cover shall include an indented top design with lettering of the unit's name cast into the cover to allow for easy identification in the field.

## **SILT SACK**

### **GENERAL**

The work under this item includes the furnishing, installation, maintenance and removal of a reusable fabric sack to be installed in drainage structures for the protection of wetlands and other resource areas and the prevention of silt and sediment from the construction site from entering the storm water collection system. Devices shall be ACF Environmental (800)-448-3636; Reed & Graham, Inc. Geosynthetics (888)-381-0800; The BMP Store (800)-644-9223; or approved equal.

### **CONSTRUCTION**

Silt sacks shall be installed in retained existing and proposed catch basins and drop inlets within the project limits and as required by the Engineer.

The silt sack shall be as manufactured to fit the opening of the drainage structure under regular flow conditions, and shall be mounted under the grate. The insert shall be secured from the surface such that the grate can be removed without the insert discharging into the structure. The filter material shall be installed and maintained in accordance with the manufacturer's written literature and as directed by the Engineer.

Silt sacks shall remain in place until the graded areas have become permanently stabilized by vegetative growth. All materials used for the filter fabric will become the property of the Contractor and shall be removed from the site.

The Contractor shall inspect the condition of silt sacks after each rainstorm and during major rain events. Silt sacks shall be cleaned periodically to remove and disposed of accumulated debris as required. Silt sacks, which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the TOWN.

When emptying the silt sack, the Contractor shall take all due care to prevent sediment from entering the structure. Any silt or other debris found in the drainage system at the end of construction shall be removed at the Contractor’s expense. The silt and sediment from the silt sack shall be legally disposed of offsite. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

All curb openings shall be blocked to prevent stormwater from bypassing the device.

All debris accumulated in silt sacks shall be handled and disposed of as described in Section 227 of the Standard Specifications.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 290. Drainage System shall be measured and paid at the contract Lump Sum price, which price shall include all labor, excavation, materials, tools, equipment, disposal, and incidental costs required to complete the work.

**BREAKDOWN OF ITEM 290. DRAINAGE SYSTEM (LUMP SUM)**

<u>SUB ITEM</u>	<u>DESCRIPTION</u>	<u>QTY</u>	<u>UNIT</u>
151.2	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	50	CY
201.	CATCH BASIN	5	EA
221.	FRAME AND COVER	2	EA
222.1	FRAME AND GRATE	4	EA
224.12	12 INCH HOOD	4	EA
252.12	12 INCH CORRUGATED PLASTIC PIPE	105	FT
252.112	12 INCH CORRUGATED PLASTIC PIPE FLARED END	2	EA
258.	STONE FOR PIPE ENDS	10	SY
291.	WATER QUALITY UNIT	2	EA
697.1	SILT SACK	4	EA

The Lump Sum breakdown quantities provided above are estimated and not guaranteed.



**DESCRIPTION**

Work to be completed under these items shall conform to the relevant provisions of SUBSECTION 601 of the Standard Specifications and the following:

This work shall consist of the construction of guardrail stiffening applications in accordance with these specifications and in close conformity with the lines and grades shown on the plans, sketch details or established by the Engineer.

**MATERIALS**

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

Guardrail .....	M8.07.0
Guardrail Delineator .....	M9.30.7

The contractor shall provide a detailed list of all system components for maintenance purposes. No work shall commence under these items until the Engineer has received all documentation.

**CONSTRUCTION METHODS**

**Posts**

Posts shall be set plumb, by hand or mechanically dug holes or driven then backfilled with acceptable material placed in layers and thoroughly compacted. Posts shall not be driven in areas where interference with PMB wall geogrid may occur. At locations behind the PMB wall, the posts shall be installed inside of sleeves, as shown in the contract drawings or Engineer approved alternative.

If driven, the posts shall be provided with suitable driving caps and equipment, which will prevent battering or injury of posts. Posts damaged or distorted as result of driving shall be removed and replaced with approved posts.

Posts to be set in areas of proposed hot mix asphalt surfacing shall be erected prior to laying the surrounding finished surface.

**Guardrail Panel**

The rail shall be erected in a smooth continuous rail conforming to the required line and grade. All rail elements and splices shall be per the plans. The rail shall make full contact at each splice. All bolts, except where otherwise required at expansion joints shall be drawn tight. Bolts through expansion joints shall be drawn up as tightly as possible without being too tight to prevent the rail elements from sliding past one another longitudinally.

Guardrail delineators shall be installed. Retroreflective sheeting shall conform to the following colors:

- a. White on the upstream face in the right shoulder.

b. Yellow on the upstream face in the left shoulder.

### **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Guardrail will be measured per foot of stiffening element, including any transition identified on the guardrail stiffening details.

The construction of all guardrail items shall include the assembly and erection of all components, parts and materials complete at the intended locations.

Guardrail will be paid for at the contract price per foot of stiffening element, complete in place, including posts, offset blocks, panels, HDPE sleeve and concrete (4000 PSI,  $\frac{3}{4}$  INCH, 585 HP CEMENT CONCRETE), and connecting hardware.

Guardrail delineators shall be considered incidental to the cost of the guardrail.

The use of special post designs, where necessary or directed by the Engineer, shall be incidental to the work with no additional compensation.

**DESCRIPTION**

Work to be completed under these items shall conform to the relevant provisions of SUBSECTION 601 of the Standard Specifications and the following:

This work shall consist of the construction of guardrail stiffening applications in accordance with these specifications and in close conformity with the lines and grades shown on the plans, sketch details or established by the Engineer.

**MATERIALS**

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

Guardrail .....	M8.07.0
Guardrail Delineator .....	M9.30.7

The contractor shall provide a detailed list of all system components for maintenance purposes. No work shall commence under these items until the Engineer has received all documentation.

**CONSTRUCTION METHODS**

**Posts**

Posts shall be set plumb, by hand or mechanically dug holes or driven then backfilled with acceptable material placed in layers and thoroughly compacted. Posts shall not be driven in areas where interference with PMB wall geogrid may occur.

If driven, the posts shall be provided with suitable driving caps and equipment, which will prevent battering or injury of posts. Posts damaged or distorted as result of driving shall be removed and replaced with approved posts.

Posts to be set in areas of proposed hot mix asphalt surfacing shall be erected prior to laying the surrounding finished surface.

**Guardrail Panel**

The rail shall be erected in a smooth continuous rail conforming to the required line and grade. All rail elements and splices shall be per the plans. The rail shall make full contact at each splice. All bolts, except where otherwise required at expansion joints shall be drawn tight. Bolts through expansion joints shall be drawn up as tightly as possible without being too tight to prevent the rail elements from sliding past one another longitudinally.

Guardrail delineators shall be installed. Retroreflective sheeting shall conform to the following colors:

- a. White on the upstream face in the right shoulder.
- b. Yellow on the upstream face in the left shoulder.

## **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Guardrail will be measured per foot of stiffening element, including any transition identified on the guardrail stiffening details.

The construction of all guardrail items shall include the assembly and erection of all components, parts and materials complete at the intended locations.

Guardrail will be paid for at the contract price per foot of stiffening element, complete in place, including posts, offset blocks, panels and connecting hardware.

Guardrail delineators shall be considered incidental to the cost of the guardrail.

The use of special post designs, where necessary or directed by the Engineer, shall be incidental to the work with no additional compensation.

**ITEM 657.**

**TEMPORARY FENCE**

**FOOT**

**DESCRIPTION**

The work under this Item consists of furnishing, installing and, subsequently, removing a temporary chain link fence to close off a construction work area from the general public, in accordance with the relevant provisions of Section 644, to be located and secured as directed by the Engineer, and the following.

All posts, including end, corner and intermediate brace posts and all gates and gate posts shall be included in the linear foot cost. The fencing height shall be 72 inches minimum. Material need not be new, but shall not be deteriorated nor in any way jeopardize the security purposes intended. All fencing shall meet the approval of the Engineer.

The Contractor shall be responsible for maintenance of the temporary fence; be responsible and cognizant that it remains secure, and that the area is sealed off to the general public at all times. It may be necessary to move sections of temporary fence at times during construction. Fence fabric shall be placed on the face of the post away from the work area. The top edge of the fabric shall be finished with a "Knuckled" selvage.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 657. Temporary Fence shall be measured and paid for at the Contract unit price, per Foot. This price shall be full compensation for all labor, tools, materials, equipment, and incidental cost necessary to complete the work. The removal and stacking of the fence upon the completion of the project shall be included under this item.

**ITEM 698.4****GEOTEXTILE FABRIC FOR PERMANENT  
EROSION CONTROL****SQUARE  
YARD****DESCRIPTION**

The work performed under this Item shall consist of furnishing and installing geotextile fabric below Crushed Stone for Filter Blanket (Item 156.5) for the Riprap slopes as shown on the Plans or as required by the Engineer.

The geotextile fabric shall conform to the requirements of AASHTO M288, Class 2, for fabric used for permanent erosion control and must be on the MassDOT QCML. Construction and installation shall be in accordance with AASHTO M288 including Appendix A and the following. Atmospheric exposure of the geotextile fabric to the elements following lay down shall be a maximum of 14 days.

For seams that are sewn in the field, colored thread must be used. The Contractor shall provide at least a six-foot length of sample sewn seam for the approval of the Engineer before the geotextile fabric is installed. The seams sewn for sampling shall be sewn using the same type of equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams for both directions shall be provided. The seam assembly description shall be submitted by the Contractor along with the seam samples. This description shall include the seam type, stitch type, sewing thread, and stitch density.

Geotextile shall be placed in intimate contact with soils without wrinkles or folds, and shall be anchored on a smooth graded surface approved by the Engineer. The geotextile shall be placed in such a manner that placement of the overlaying materials will not excessively stretch or tear it. Adjacent geotextile sheets shall be joined by either sewing or overlapping. At roll ends, overlapped seams shall overlap a minimum of 12 inches, except when placed under water, where they shall overlap a minimum of 3 feet. Adjacent rolls shall overlap a minimum of 12 inches.

Care shall be taken during installation to avoid damage to the geotextile as a result of the installation process. Should the geotextile be damaged, a geotextile patch shall be placed over the damaged area extending a minimum of 3 feet beyond the limits of the damage.

When stone is placed over geotextile fabric, the stone placement shall begin at the toe of slope and proceed up the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the geotextile. Stone shall not be dropped from a height exceeding 24 inches.

Field monitoring shall be performed to verify that the Stone, Riprap or Rockfill placement does not damage the geotextile. Any geotextile damaged during backfill placement shall be replaced as required by the Engineer, at the Contractor's expense.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Geotextile Fabric for Permanent Erosion Control will be measured per Square Yard, complete in place and accepted, as computed from surface slope area covered. Geotextile fabric placed outside

the specified limits will not be measured or paid for, and the Contractor may be required to remove and dispose of the excess material without cost to the TOWN. No additional measurement shall be made for necessary lap material.

Geotextile Fabric for Permanent Erosion Control will be paid for at the Unit Price per SQUARE YARD, which shall include all labor, materials, equipment and incidental costs required to complete the work. Overlaps and fold-overs are considered incidental to the unit price and shall not be measured separately for cost.

**ITEM 741. ENGINEERS FIELD OFFICE AND EQUIPMENT (TYPE B) MONTH**

Work under this item shall conform to the relevant provisions of Section 740 and the following:

A computer system, printer system, and a digital camera meeting the requirements set forth below including installation, maintenance, power, paper, disks, and other supplies shall be provided at the Resident Engineer's Office:

All equipment shall be UL approved and Energy Star compliant.

The Computer System shall meet the following minimum criteria or better:

Processor:	Intel, 3.5 GHz
System Memory (RAM):	8GB
Hard Drive:	500GB
Optical Drive:	DVD-RW/DVD+RW/CD-RW/CD+RW
Graphics Card:	4GB
Card Reader:	6-in-1 Card Reader, 2 total USB 3.0, audio
Network Adapter:	10/100 Mbit/s
USB Ports:	6 USB 3.0 ports
Keyboard:	Generic
Mouse:	Optical mouse with scroll, MS-Mouse compliant
OS:	Windows Professional with all security updates
Web Browser:	Latest Internet Explorer with all security updates
Applications:	Latest MS Office Professional with all security updates Latest Adobe Acrobat Professional with all security updates Latest Autodesk AutoCAD LT Antivirus software with all current security updates maintained through the life of the contract.
Monitor:	24" LED with built-in speakers, 1920 x 1200 max resolution
Flash drives:	2 - 32GB USB 3.0
Internet access:	High Speed (min. 24 mbps) internet access with wireless router.

The Multifunction Printer System shall meet the following minimum criteria or better:

Color laser printer, fax, scanner, email and copier all in one with the following minimum capabilities:

- Estimated volume 8,000 pages per month
- LCD touch panel display
- 50 page reversing automatic document feeder (RADF)
- Reduction/enlargement capability
- Ability to copy and print 11" x 17" paper size
- email and network pc connectivity
- Microsoft and Apple compatibility
- ability to overwrite latent images on hard drive
- 600 x 600 dpi capability
- 30 pages per minute print speed (color),
- 4 Paper Trays Standard (not including the bypass tray)
- Automatic duplexing
- Finisher with staple functions
- Standard Ethernet. Print Controller
- Scan documents to PDF, PC and USB
- ability to print with authenticated access protection



**ITEM 741. (Continued)**

The Contractor shall supply a maintenance contract for next day service, and all supplies (toner, staples, paper) necessary to meet estimated monthly usage.

A Digital Camera shall meet the following minimum criteria or better:

Resolution:	12 Megapixel
Optical Zoom:	5x
Internal Memory Included:	Yes
Memory:	8 GB SD Card
Screen:	3 inch Clear Photo LCD
Min Operating Temperature:	14°F
Max Depth of Water Resistant:	30feet
Height of Shock Resistant:	5 feet
Battery Power:	2 rechargeable batteries and a battery charger
Carrying Case:	Rain-proof with shoulder strap

The Engineer's Field Office and the equipment included herein including the computer system, printer and camera shall remain the property of the Contractor at the completion of the project. Disks, flash drives, and card readers with cards shall become the property of the Department. Additionally, a 4' smart level shall be provided for use by the Resident Engineer.

Compensation for this work will be made at the contract unit price per month which price includes full compensation for all services and equipment, and incidentals necessary to provide equipment, maintenance, insurance as specified and as directed by the Engineer.

The work under this item shall conform to the relevant provisions of Subsections 670, 751 and 767 of the Standard Specifications and shall include the furnishing and placement of a sediment control barrier. Sediment control barrier shall be installed prior to disturbing upslope soil.

The purpose of the sediment control barrier is to slow runoff velocity and filter suspended sediments from storm water flow. Sediment barrier may be used to contain stockpile sediments, to break slope length, and to slow or prevent upgradient water or water off road surfaces from flowing into a work zone. Contractor shall be responsible for ensuring that barriers fulfill the intent of adequately controlling siltation and runoff.

Twelve-inch diameter (after installation) compost filter tubes with biodegradable natural fabric (i.e., cotton, jute, burlap) are intended to be the primary sedimentation control barrier. Photo-biodegradable fabric shall not be used.

For small areas of disturbance with minimal slope and slope length, the Engineer may approve the following sediment control methods:

- 9-inch compost filter tubes
- Straw bales which shall be trenched

No straw wattles may be used. Additional compost filter tubes (adding depth or height) shall be used at specific locations of concentrated flow such as at gully points, steep slopes, or identified failure points in the sediment capture line.

When required by permits, additional sediment barrier shall be stored on-site for emergency use and replacement for the duration of the contract.

Where shown on the plans or when required by permits, sedimentation fence shall be used in addition to compost filter tubes and straw bales and shall be compensated under that item.

Sediment control barriers shall be installed in the approximate location as shown on the plans and as required so that no excavated or disturbed soil can enter mitigation areas or adjacent wetlands or waterways. If necessary to accommodate field conditions and to maximize effectiveness, barrier locations may be shifted with approval from the Engineer. Barriers shall be in place prior to excavation work. No work shall take place outside the barriers.

- MATERIALS AND CONSTRUCTION

Prior to initial placement of barriers, the Contractor and the Engineer shall review locations specified on the plans and adjust placement to ensure that the placement will provide maximum effectiveness.

Barriers shall be staked, trenched, and/or wedged as specified herein and according to the Manufacturer's instructions. Barriers shall be securely in contact with existing soil such that there is no flow beneath the barrier.

- Compost Filter Tube

Compost material inside the filter tube shall meet M1.06.0, except for the following: no peat, manure or bio-solids shall be used; no kiln-dried wood or construction debris shall be allowed; material shall pass through a 2-inch sieve; and the C:N ratio shall be disregarded.

Outer tube fabric shall be made of 100% biodegradable materials (i.e., cotton, hemp or jute) and shall have a knitted mesh with openings that allow for sufficient water flow and effective sediment capture.

Tubes shall be tamped, but not trenched, to ensure good contact with soil. When reinforcement is necessary, tubes shall be stacked as shown on the detail plans.

- Straw Bales

Straw bales shall be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

Bales should be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. All bales should be either wire-bound or string-tied. Straw bales should be installed so that bindings are oriented around the sides (rather than along the tops and bottoms) of the bales in order to prevent deterioration of the bindings.

The barrier should be entrenched and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. The trench must be deep enough to remove all grass and other material which might allow underflow. After the bales are staked and chinked (filled by wedging), the excavated soil should be backfilled against the barrier. Backfill soil should conform to the ground level on the downhill side and should be built up to 4 inches against the uphill side of the barrier.

Each bale should be securely anchored by at least 2 stakes or re-bars driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together. Stakes or re-bars should be driven deep enough into the ground to securely anchor the bales. For safety reasons, stakes should not extend above the bales but should be driven in flush with the top of the bale.

The gaps between the bales should be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency. Wedging must be done carefully in order not to separate the bales.

When used in a swale, the barrier should be extended to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale to assure that sediment-laden runoff will flow either through or over the barrier but not around it.

- Sedimentation Fence

Materials and Installation shall be per Section 670.40 and 670.60 of the Standard Specifications and the following:

Sedimentation fence shall only be used if shown on the plans or when specified by Orders of Condition or other permit requirements.

When used with compost filter tubes, the tube shall be placed on a minimum of 8 inches of folded fabric on the upslope side of the fence. Fabric does not need to be trenched.

When used with straw bales, an 8-inch deep and 4-inch wide trench or V-trench shall be dug on the upslope side of the fence line. One foot of fabric shall be placed in the bottom of the trench followed by backfilling with compacted earth or gravel. Stakes shall be on the down slope side of the trench and shall be spaced such that the fence remains vertical and effective.

Width of fabric shall be sufficient to provide a 36-inch high barrier after fabric is folded or trenched. Sagging fabric will require additional staking or other anchoring.

- MAINTENANCE

Maintenance of the sediment control barrier shall be per Section 670.60 of the Standard Specifications or per the Stormwater Pollution Prevention Plan (SWPPP), whichever is more restrictive.

The contractor shall inspect the sediment barrier in accordance with relevant permits. At a minimum, barriers shall be inspected at least once every 7 calendar days and after a rain event resulting in 0.25 inches or more of rainfall. Contractor shall be responsible for ensuring that an effective barrier is in place and working effectively for all phases of the Contract.

Barriers that decompose such that they no longer provide the function required shall be repaired or replaced as directed. If the resulting berm of compost within the fabric tube is sufficiently intact (despite fabric decay) and continues to provide effective water and sediment control, barrier does not necessarily require replacement.

- DISMANTLING & REMOVING

Barriers shall be dismantled and/or removed, as required, when construction work is complete and upslope areas have been permanently stabilized and after receiving permission to do so from the Engineer.

Regardless of site context, nonbiodegradable material and components of the sediment barriers, including photo-biodegradable fabric, plastic netting, nylon twine, and sedimentation fence, shall be removed and disposed off-site by the Contractor.

For naturalized areas, biodegradable, natural fabric and material may be left in place to decompose on-site. In urban, residential, or other locations where aesthetics is a concern, the following shall apply:

- Compost filter tube fabric shall be cut and removed, and compost shall be raked to blend evenly (as would be done with a soil amendment or mulch). No more than a 2-inch depth shall be left on soil substrate.
- Straw bales shall be removed and disposed off-site by the Contractor. Areas of trenching shall be raked smooth and disturbed soils stabilized with a seed mix matching adjacent seeding or existing grasses (i.e., lawn or native grass mix).
- Sedimentation fence, stakes, and other debris shall be removed and disposed off-site. Site shall be restored to a neat and clean condition.
- **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 767.121 will be measured and paid for at the contract unit price per foot of sediment control barrier which price shall include all labor, equipment, materials, maintenance, dismantling, removal, restoration of soil, and all incidental costs required to complete the work.

Additional barrier, such as double or triple stacking of compost filter tubes, will be paid for per foot of tube installed.

Barriers that have been driven over or otherwise damaged by construction activities shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

**ITEM 769.01 PAVEMENT MILLING MULCH UNDER GUARD RAIL**

**SY**

Work to be done shall conform to the relevant provisions of Section 769 of the Standard Specifications and the following: The work consists of earthworks to install pavement millings mulch for shoulders at the edge of pavement. The existing shoulder shall be prepared for pavement milling mulch as necessary and directed by the Engineer. The work shall consist of excavation and leveling shoulder area to be mulched. The excavation and leveling of shoulder shall be pushed back down slope on embankment and/or excavated and disposed of on-site level and compacted as directed by the Engineer. Milling mulch shall be graded and compacted to a width as shown on the contract drawings from the edge of the pavement, or as directed by the Engineer. No geotextile fabric under the pavement millings shall be installed.

**MATERIALS**

Pavement milling mulch shall be smaller than the 1½ inch sieve. The on-site recycling of pavement millings sourced from the project is encouraged. All pavement milling mulch for shoulders will be accepted based on visual inspection by the Engineer. Mulch material greater than 1½ inch shall be removed off-site by the Contractor.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 769.01 will be measured per Square Yard parallel to the edge of road, complete in place.

Item 769.01 will be paid per Foot of material installed which price includes materials, excavation, grading and leveling and disposing on site, compacting and all incidental costs required to complete the work to the satisfaction of the Engineer.

**ITEM 853.22    TEMPORARY BARRIER REMOVED AND STACKED                      FOOT**

The work under this item shall be in accordance with Section 850 and the following:

The work shall include the removing and stacking of existing temporary concrete barriers used to close the roadway.

The contractor shall coordinate with the Town of West Newbury to determine where the concrete barriers shall be relocated to.

**BASIS OF PAYMENT**

Item 853.22 will be measured per Foot of concrete barrier removed and stacked, which shall be considered full compensation for all labor, materials, equipment and incidental costs required to complete the work as specified.

**ITEM 983.12****RIPRAP WITH GRAVEL PACKED VOIDS****CUBIC YARD****DESCRIPTION**

Description, Materials and Construction Methods shall all be in accordance with the relevant provisions of Section 983 of the Standard Specifications and the following:

Riprap shall conform to the requirements of M2.02.0 Materials Specification. Riprap shall be placed on the areas, depths contours and grades designated on the plans in a manner that will produce a well-graded mass of stone with the minimum practicable percentage of voids. Riprap protection shall be placed to its full thickness in one operation in such a manner to avoid displacing the underlying material. Placing of riprap in layers, by dumping into chutes or by placing by similar methods that are likely to cause segregation will not be permitted.

The riprap will be placed in accordance with the relevant provisions of section 983. After the riprap has been placed, gravel will be used to pack any voids that are present. The riprap and gravel will provide a level area for the placement of the streambed materials. Gravel shall conform to M1.03.0 Type B, Gravel Borrow and all costs associated with the material and placement of the material shall be considered incidental to this item.

**CONSTRUCTION METHODS**

Riprap shall be placed upon an approved bed of crushed stone over geotextile fabric to the lines and grades shown on the plans and as directed. Riprap shall have a minimum thickness of 3 feet.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 983.12 Riprap With Gravel Packed Voids will be measured by CUBIC YARD complete in place and paid at the Contract Bid Price per CUBIC YARD, which price shall be the full payment of all labor, materials, equipment, transportation and incident costs necessary to complete the work to the satisfaction of the Engineer.

Excavation for riprap shall be paid for under Item 143. "Channel Excavation". Streambed/Bank Restoration material will be paid for separately under Item 983.521 "Streambed/Bank Restoration". Crushed stone will be paid for separately under Item 156.5 "Crushed Stone for Filter Blanket". Geotextile fabric will be paid for separately under Item 698.4 "Geotextile Fabric for Permanent Erosion Control". Gravel to pack voids shall be included in the bid price for Riprap with Gravel Packed Voids, no additional payment will be provided. Said price shall be considered full compensation for all labor, tools, equipment, and material necessary for the completion of the work.



**ITEM 983.521**

**STREAMBED/BANK RESTORATION**

**CUBIC YARD**

**DESCRIPTION**

The purpose of this item is to provide for the installation of natural streambed material over the proposed Riprap to be left for slope stability/scour protection, to provide a natural streambed for aquatic organisms. Due to the widening of the bridge, there is limited existing natural streambed material that can be reused. Natural streambed material that is removed during excavation shall be stockpiled at a location approved by the TOWN for reuse in Item 983.521. The stockpiling of natural streambed material shall be considered incidental to Item 983.521.

The work to be done under this item shall conform to the relevant provisions of Section 983 of the Standard Specifications and the following:

**MATERIAL**

The streambed/bank construction material is to be placed on top of the Riprap located in front of the proposed abutments and wingwalls as depicted on the Plans. The intent of this item is to ensure a natural streambed and bank in front of the proposed abutments, to provide fisheries and wildlife habitat enhancement.

The streambed material shall be comprised of two primary components.

1. Stone 4 inches and under shall meet the following gradation:

<u>Sieve opening</u>	<u>Percent by Mass Passing Through</u>
4"	95
2"	55 – 65
¾"	30 – 45
#4	0 – 5

2. Stone 6 inches to 2.5 foot in diameter:

<u>Stone Size</u>	<u>Percent Passing</u>
2.0'	80
1.5'	25
0.5'	0

The streambed/bank stone for all two components shall be native cobbles and boulders similar in shape and size of streambed/bank stone adjacent to the work area. Partially angular rock is preferred over round and shall be able to lock together to prevent movement during high flows. Crushed Stone will not be accepted for any of the two components. Any stone excavated from the existing streambed can be stockpiled and reused for streambed restoration, provided the excavated stone is characteristic of the existing stream material upstream and downstream of the work area, or meets the above criteria. The elevations and conditions of the existing streambed shall be maintained to the maximum extent practicable.

## **CONSTRUCTION METHODS**

Components one and two shall be pre-blended outside the project area at a volume ratio of 30% and 70% respectively. The pre-blending shall be done in a way that will prevent the mass from being contaminated by work-place soils. The pre-blended mass shall be placed over areas of proposed Riprap as shown on the plans.

The placement of streambed/bank material under this item shall not begin until the Engineer approves the installed Riprap. The Contractor shall submit to the Engineer for approval prior to the start of operations, his placement plan and method of placement.

Once all material has been placed in the stream channel and approved by the Resident Engineer, the Contractor shall remove the cofferdams in such a way to slowly wet the stream to minimize the initial sediment pulse. Every attempt shall be made to minimize the downstream movement of sediment.

## **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Measurement and payment under this item 983.521, Streambed/Bank Restoration, will be per Cubic Yard of stone complete in place, which price shall be considered full compensation for all labor, tools, equipment, and materials necessary to rebuild the streambed.

**ITEM 991.1**

**CONTROL OF WATER-STRUCTURE**  
**NO. N-11-007 = W-20-001**

**LUMP SUM**

The environmental permits contained in the contract documents depict a suggested control of water system. In addition, the United States Army Corps of Engineers approval states *a minimum of 50% of the channel must be free to flow at all times and safe, timely, and effective downstream fish passage must be maintained.* Any modification of existing or new permits are at the contractor's expense and the contract completion date will not be altered.

**The contractor is alerted to the requirements imposed by the environmental permits contained in the contract documents.**

**The control of water structure depicted in the contract documents is not a closed system and not considered a cofferdam. All excavation items within the control of water system will be paid at the contract unit price with no escalation.**

**DESCRIPTION**

Work under this Item shall conform to the relevant provisions of Section 140 of the Standard Specifications and the following:

This Item includes all dewatering necessary to accomplish the removal and construction of existing and proposed bridge, wingwalls, Prefabricated Modular Block Wall (PMB) retaining walls and installation of the proposed slope protection.

Any pumping and dewatering measures to construct the proposed bridge, demolish the existing bridge, wingwalls, PMB retaining walls and install riprap, crushed stone, geotextile fabric etc. shall be considered incidental to this item.

Channel diversions and dewatering of excavation shall be conducted to ensure that removal and construction of bridge substructure, wingwalls, PMB retaining walls and installation of the proposed slope protection are done *"in the dry."*

As part of the work under this Item, it is the responsibility of the Contractor to determine the need and extent of stream diversions, sedimentation basins and dewatering techniques and sedimentation controls needed to control water and sediment at the site. Prior to starting the excavation and demolition operations, the Contractor shall submit working drawings and the methods and materials they propose to use for the Engineer's approval. These plans shall be in conformance with the Plans and these Specifications. The Contractor shall install all erosion control measures and turbidity barriers prior to proceeding with the approved water control plans. The materials and methods not specifically mentioned under this Item shall comply with the standard specifications where applicable.

Approval of the working drawings does not relieve the Contractor of the responsibility of providing for the safety and successful completion of the work.

The work to be performed under this Item shall include all pumping, sandbagging and sheeting necessary for sufficient water control to accomplish the construction of the proposed bridge, wingwalls, PMB retaining walls and Riprap installation in the dry. Work under this Item shall consist of dewatering within the work limits as shown on the plans. Water within the work area shall be discharged as specified in the contract documents, environmental permits obtained for this project and as directed by TOWN. No direct discharge will be allowed into Artichoke Reservoir, or the adjacent wetlands during the dewatering operations.

## **CONSTRUCTION METHODS**

Plans and Calculations for dewatering measures shall be developed by the Contractor for this Item, prepared and stamped by a Professional Engineer of the appropriate discipline registered in the Commonwealth of Massachusetts and submitted for the review of the Engineer prior to the start of construction.

Stream restrictions shall be conducted in such a manner as to minimize siltation and prevent contamination of the waterway.

Maximum screen sizes on the inlet side of all pumps shall not exceed ½ in (12.7 mm).

Recommended devices to control water at the site include, but are not limited to:

- Sheet Piles.
- Sandbag dams installed at the top of excavation to provide control of water.
- Installation of precast concrete median barriers or blocks covered with sedimentation fabric and sandbags to reduce water infiltration.
- Portable cofferdam system comprised of steel frames covered by an impervious fabric membrane.

The Contractor is advised that the effectiveness of the water control method used will vary based on the field conditions and the time at which the actual excavation work is being performed. The TOWN have the right to order the Contractor to stop all excavation operations when in their judgment the Contractor's water control operations are failing to produce adequate results or are posing a threat to the environment.

The Contractor shall provide the means of removing all sediment from water pumped from the excavation areas; this shall include the use of filter bags, sedimentation basins, check dams, sedimentation fences or tanks.

All dewatering and related earthwork shall be conducted in such a manner as to prevent siltation or contamination of the waterway and wetlands. The pumping discharge shall not be allowed to enter directly into the Artichoke Reservoir or the wetland resource areas. The water from the work areas shall be pumped either to a filter bag, temporary settling tank, forebay basin, or other approved containment structure conforming to MassDOT's "*Guidelines for Soil Erosion & Sediment Control*". The containment structure shall be constructed so as to allow for the pumped water to pass through the structure with sediments settling out before outletting to an area enclosed

by Item 767.121 Sediment Control Barrier. Water filtering thorough the containment structure shall not cause erosion of the surrounding area.

An approved method of controlling erosion, such as an erosion control blanket, stone, etc. shall be used at the outlet.

The control of water containment structure shall be maintained as follows:

1. Inspect at least twice daily during dewatering operations.
2. Repair any damage immediately.
3. Clean containment structure daily. Remove any debris immediately.
4. Remove sediments as needed.

The Contractor shall inspect compost filter tubes and sedimentation fence that surround the outlet daily and shall immediately replace any that are damaged.

Placement of the dewatering containment structure will be as approved by the Engineer based on specific site conditions and staging operations of the Contractor.

#### **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Payment for all water control work, including design for the dewatering operations used to maintain a water free excavation, shall include all labor, tools and equipment materials and installation, piping, pumping, stone ends for pipes, sheeting, maintenance, subsequent removal of all related materials and equipment all as outlined above; and restoration of site shall be included in the lump sum contract price bid under this Item.

Compost filter tubes and sedimentation fence provided specifically for the outlet from the sedimentation containment structure shall be included in the lump sum bid price for this Item.

Partial payments shall be made at the following percentages:

Approval of the Control of Water submittal	10%
Accepted Installation of Control of Water	80%
Satisfactory removal of Control of Water	10%

**ITEM 994.01**

**TEMPORARY PROTECTIVE SHIELDING**  
**BRIDGE NO. N-11-007 = W-20-001**

**LUMP SUM**

**DESCRIPTION**

The work done under this Item consists of designing, furnishing, installing, maintaining, removing, and disposing of a protective shielding system. The shielding shall prevent any debris, tools, or incidental items from falling into the water below.

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

The shielding shall conform to the following:

1. Shielding shall be in place prior to the start of the bridge removal to protect any debris from falling into Artichoke Reservoir below.
2. Shielding shall extend the full length of the bridge and a sufficient distance above and beyond the arch and fieldstone barriers.
3. Shielding shall be in place to protect the reservoir from falling debris during the demolition of the arch and wingwalls.
4. Shielding shall have all spaces along the perimeter and at the seams sealed to prevent dust and debris from escaping and falling below the bridge.
5. Shielding shall be designed to safely withstand all loads that it will be subjected to. The design shall include a complete description of the equipment and construction methods proposed for the arch removal. The shielding shall also be designed to withstand impact of the maximum size of excavated area should it fall during excavation or removal.
6. The shielding shall be maintained and remain in place until the superstructure is completely removed. Shielding shall be removed only upon approval of the Engineer. All materials used in the shielding systems, shall become the property of the Contractor and shall be properly removed from the site at the completion of the project.

**METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 994.01 will be paid for at the contract Lump Sum Bid Price, which price shall include all labor, materials, tools, equipment and incidentals required for the satisfactory installation and subsequent removal of the Temporary Protective Shielding.

Payment of 75% of the Lump Sum Bid Price of this Item will be made upon complete installation to the satisfaction and approval of the Engineer. The remaining 25% of the Lump

Sum Bid Price of this Item will be paid following proper removal and disposal of the shielding.

**ITEM 995.01**

**BRIDGE STRUCTURE,**  
**BRIDGE NO. N-11-007 = W-20-001**

**LUMP SUM**

**DESCRIPTION**

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

The work does not include any items listed separately in the proposal. Payment for materials shown on the Plans as being part of this bridge structure or which may be incidental to its construction and are not specifically included for payment under another Item shall be considered incidental to the work performed under this Item and shall be included in the unit price of the component of which they are a part.

The work under this Item shall include all materials, equipment and labor needed for the construction of the bridge structure including the integral abutments, precast approach slabs, wingwalls, precast highway guardrail transitions, concrete deck slab, safety curb, sidewalk and bridge railings, concrete mixes listed below and the reinforcement for all these concretes, damp-proofing, membrane waterproofing for bridge decks (spray applied), prestressed concrete S36-24 Box Beams, sawing & sealing joints in asphalt pavement at bridges and all items included hereinafter under Basis for Partial Payments.

The work to be done under these headings shall conform to the relevant provisions of Section 901 of the Standard and Supplemental Specifications and the following:

The following items shall be considered as included in the unit price per cubic yard of concrete, as stated by the Contractor and as approved by the Engineer in the respective "Basis for Partial Payments": all water stops, preformed and pre-molded filler, joint sealer, materials complete in place at construction joints, bituminous damp proofing, caulking, closed cell foam, weep holes with stone at ends, all piping and drains, all other work considered as incidental to the work involved in furnishing and placing the concrete, delivery of precast element to the job site, installation of the precast units to the lines and grades on the plans and all other work not covered in the schedule of basis for Partial Payments or for which payment is not provided elsewhere in the Contract.

The contractor will be required to provide an ACI certified field technician to obtain cylinders for verifying the concrete strength. For each concrete placement, the contractor's field technician shall prepare six samples under the direction of the Engineer. The samples shall be field cured and transported to a testing laboratory approved by MassDOT. The results of the test shall be reported promptly and directly to the engineer. The four additional cylinders shall be held for testing at the direction of the engineer. The minimum compressive strength shall be taken as an average of the two-cylinder breaks. The cost for the technician, curing, transportation to the laboratory, and testing results shall be incidental to item 995.01, no additional payment will be provided.



The lump sum payment for work on the Bridge Structure listed above does not include payment for the demolition of the existing bridge and various classes of excavation and other items as listed in these special provisions.

### **SAWING & SEALING JOINTS IN ASPHALT PAVEMENT AT BRIDGES**

The work to be done under this Item consists of making a sealed kerf across the full width of the finished asphalt pavement at bridge abutments where called for on the Plans. The shape, width, and depth of the kerf shall be as shown on the Plans.

Prior to the start of the asphalt pavement operation, the Contractor shall place a mark on each curb or barrier on either side of the paved roadway. These marks shall be aligned with the actual end of the bridge deck and shall be placed so that they will not be covered or otherwise obscured by the asphalt pavement.

After the completion of the paving operation, the Contractor shall snap a straight chalk line on the pavement between these two marks. The Contractor shall then saw cut the pavement along this line to the depth, width and shape as shown on the Plans. The equipment shall be approved by the Engineer prior to commencing work.

After completing the saw cutting, the Contractor shall clean the saw groove of any dust and debris with an oil free air blast. If the groove was wet sawn, the groove shall be cleaned with a water blast to remove any remaining slurry and debris, vacuumed with a Wet-or-Dry vacuum to remove any standing water, and then dried with an air blast from a Hot-Air-Lance.

Once the groove is clean and dry, the Contractor shall fill it completely with a hot-applied bituminous crack sealer meeting the requirements of M3.05.4 in accordance with the manufacturer's application instructions and restrictions regarding ambient and material temperatures. The crack sealer shall be thoroughly cured prior to opening the road to traffic. To reduce tackiness, only boiler slag aggregate (black beauty) shall be scattered over the sealer when required by the Engineer. Conventional sand shall not be used for this purpose.

### **MEMBRANE WATERPROOFING FOR BRIDGE DECKS**

The work under this Item shall conform to applicable sections of Section 965 Membrane Waterproofing for New Bridge Decks of the Standard Specifications

### **STEEL REINFORCEMENT FOR STRUCTURES - EPOXY COATED**

The work under this heading shall conform to relevant provisions of section 901.

## **CAST-IN-PLACE CONCRETE**

The work to be done under this heading shall conform to the relevant provisions of Section 901 and the relevant provisions of Materials Section M4 of the Standard Specifications and amended as follows:

All concrete shall be placed *in the dry*.

The various classes of concrete shall be used as specified on the Plans, and generally described as follows:

### **4000 psi, 1½ inch, 565 CEMENT CONCRETE**

- Shall be used to construct lower (below construction joint) portions of the integral abutments and wingwalls.

### **4000 psi, ¾ inch, 585 HP CEMENT CONCRETE**

- Shall be used to construct the deck slab and upper portions of abutment and wingwalls.

### **4000 psi, ¾ inch, 610 CEMENT CONCRETE**

- Shall be used to construct the beam pedestals at the integral abutments.

### **5000 psi, ¾ inch, 685 HP CEMENT CONCRETE**

- Shall be used to construct the safety curb & sidewalk.

The work under the below headings include furnishing, transporting and installing cast-in-place concrete elements as shown on the plans.

The labor and materials associated with the following items shall be considered as included in the unit price per cubic yard of concrete or per each unit, as stated by the contractor and as approved by the Engineer in the respective "Basis or Partial Payments": all preformed and pre-molded filler, all form liners, joint sealer, methacrylate, materials complete in place at construction joints, caulking, closed cell foam, weep holes and all other work considered as incidental to the work involved in furnishing and placing the concrete to the lines and grades on the plans and all other work not covered in the schedule of basis for Partial Payments or for which payment is not provided elsewhere in the contract.

## **PLACEMENT, FINISHING AND CURING OF CAST IN PLACE CONCRETE DECKS**

The construction of the cast in place concrete deck shall be in accordance with Subsection 901.66 of the Standard Specifications.

## **PRECAST CONCRETE BRIDGE ELEMENTS APPROACH SLABS AND HIGHWAY GUARDRAIL TRANSITIONS**

### **4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE**

- Shall be used to construct the approach slabs.

### **5000 PSI, ¾ INCH, 685 HP CEMENT CONCRETE**

- Shall be used to construct the highway guardrail transitions.

#### **General.**

The work under this Heading consists of fabricating, transporting and installing Precast Concrete Bridge Elements Approach Slabs and Highway Guardrail Transitions and includes all necessary labor, materials, and equipment to complete the work as shown on the Plans. The work shall conform with the MassDOT Standard, Supplemental, and Interim Specifications and the requirements of the current AASHTO LRFD Bridge Construction Specifications, supplemented by the current relevant provisions of the latest edition of PCI MNL-116 (The Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products), except as noted herein.

## **QUALITY ASSURANCE**

#### **General.**

Quality Assurance includes all the planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service. It is an all-encompassing term that includes Quality Control (performed by the Fabricator) and Acceptance by the TOWN. Quality Control is the system used by the Contractor and Fabricator to monitor and assess their production processes at the plant facility and installation activities at the project site to ensure that the final product will meet the specified level of quality..

#### **Fabricator Quality Control.**

Quality Control shall be performed by the Fabricator to ensure that the product is fabricated in conformance with the specifications herein. The Fabricator shall maintain a Quality Control system to monitor, assess, and adjust placement and fabrication processes to ensure the Precast Concrete Bridge Element(s) meet the specified level of quality, through sufficient Quality Control sampling, testing, inspection, and corrective action (where required). The Fabricator's Quality Control system shall address all key activities during the placement and fabrication and shall be performed in conformance with the Fabricator's NPCA or PCI Certification. Quality Control documentation shall meet the requirements of the *Fabricator Quality Control – Documentation* section below. Upon request, Fabricator Quality Control documentation shall be provided to the TOWN.

#### **Plant.**

Prior to the fabrication of Precast Concrete Bridge Elements, the Fabricator's precast concrete plant shall obtain the following:

- (a) Certification by the National Precast Concrete Association (NPCA) Plant Certification Program or Precast/Prestressed Concrete Institute (PCI) Plant Certification Program, for the applicable types of Precast Concrete Bridge Element(s) being fabricated
- (b) MassDOT Prequalification

(c) MassDOT Mix Design Approval

All concrete for a given Precast Concrete Bridge Element shall be produced by a single company and plant.

**Personnel.**

The Fabricator shall provide adequate training for all QC personnel in accordance with NPCA or PCI certification. There shall be sufficient personnel trained and certified to perform the tests listed under Subsection M4.02.13, Part D. At a minimum, the Fabricator's Quality Control Personnel shall maintain the following qualifications and certifications:

- (a) QC Manager with an active NETTCP Field Technician or ACI Concrete Field Testing Technician – Grade I certification or higher, and a minimum of 4 years continuous experience in the manufacture of Precast Concrete Bridge Elements for state transportation departments. The QC Manager shall be on site while the batch plant is producing and placing concrete.
- (b) A Technician/Inspector having the Precast/Prestressed Concrete Institute (PCI) Technician/Inspector Level I or NorthEast Transportation Training and Certification Program (NETTCP) Precast Concrete Inspector, or higher.

The Contractor shall submit to the TOWN a copy of the Fabricator's Quality Control Personnel required qualifications, as specified above.

**Laboratory.**

The Fabricator shall provide a room of sufficient size to house all equipment and to adequately perform all testing. The room shall have either a separate moisture storage room or curing box for concrete cylinders, and it shall be thermostatically controlled to maintain temperatures consistent with AASHTO T 23. It shall include a desk and file cabinet for proper record keeping, and have good lighting and ventilation. This room shall be kept for testing and quality control and not used for any other purpose.

**Testing Equipment.**

At a minimum, the Fabricator's plant facility shall have the following testing equipment:

- (a) Air Content Meter Type A or B: AASHTO T 152
- (b) Air Content Meter Volumetric Method: AASHTO T 196 (Required for Lightweight Concrete)
- (c) Slump Cone: AASHTO T 119
- (d) Cylinder Molds AASHTO M 205
- (e) Concrete Testing Machine: AASHTO T 22
- (f) Screening Sieve: AASHTO T 27, AASHTO T 11
- (g) Curing Box: AASHTO T 23
- (h) Spread Test Base Plate for Self-Consolidating Concrete (SCC): ASTM C1611
- (i) All other equipment prescribed by AASHTO and ASTM standards for the tests to be performed by the Fabricator as specified

**Inspection.**

Quality Control personnel shall monitor and inspect the fabrication of each Precast Concrete Bridge Element. Quality Control personnel shall report all inspection activities on Quality Control Inspection

Reports and non-conformances on Non-Conformance Reports (NCRs) throughout the entire fabrication process, as specified herein.

### **Temperature Monitoring.**

At a minimum, the Fabricator shall monitor, record, and report the temperatures of the form, ambient temperatures surrounding the concrete, and temperatures of the concrete continuously, without interruption as specified below:

- Prior to placement of concrete to verify that  $T_i \geq 50^\circ\text{F}$ .
- Immediately after placement to verify that  $T_i \geq 50^\circ\text{F}$  is maintained.
- Throughout the entire duration of the curing cycle, at regular intervals not to exceed one hour until 100% Design Strength ( $f'_c$ ) is attained and concrete has cooled to within  $40^\circ\text{F}$  of the ambient temperature surrounding the Precast Concrete Bridge Element.

At a minimum, the temperature measuring devices shall record and report the temperature of the concrete to the nearest  $2^\circ\text{F}$ . At least two temperature sensors (thermocouples) shall be positioned to record the maximum and minimum anticipated concrete temperatures. The anticipated minimum temperature shall be measured with one or more thermocouples at a distance no greater than 2 inches from the surface of the thinnest section. The anticipated maximum temperature shall be measured with one or more thermocouples at the center of the thickest section. . Temperature recording devices shall be located within the curing enclosure and calibrated as required by PCI MNL-116 Section 4.18.4. Maximum heat increases and cool down rates shall comply with PCI MNL-116, Section 4.19. The Contractor shall furnish temperature logs recorded at a minimum frequency of once per hour to the TOWN as required, with each post-pour QC inspection report.

### **Sampling and Testing.**

At a minimum, the Fabricator shall perform random Quality Control sampling and testing as specified in *Table 1: Quality Control Sampling and Testing*. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during fabrication. Test Specimens shall conform to the requirements of Section M4.02.13 of the MassDOT Standard and Supplemental Specifications and AASHTO R 60, with the exception of the Stripping (80%  $f'_c$ ) set of cylinders. Stripping (80 %  $f'_c$ ) cylinders shall be cured in the same location and environment as the Precast Bridge Elements they represent.

**Table 1: Quality Control Sampling and Testing**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Lot Size <sup>(c)</sup>	Sublot Size <sup>(d)</sup>	Frequency	Point of Sampling
Slump (in.) <sup>(a)</sup>	AASHTO T 119	Per AASHTO	≤ 8 in.				
Air Content (%)	AASHTO T 152	Per AASHTO	5% ≤ % ≤ 8%				
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F ≤ °F ≤ 90°F				
Compressive Strength (psi)	AASHTO T 22	Stripping Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 80% f <sub>c</sub> at Stripping				
		7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	For Information at 7 days				
		28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% f <sub>c</sub> at 28 days				
		56-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% f <sub>c</sub> at 56 days <sup>(b)</sup>				

**Notes:**

- (a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (b) 56-day Compressive Strength test specimens shall require testing only when 28-day Compressive Strength test specimens have failed to meet Design Strength (f<sub>c</sub>).
- (c) Lot shall be defined as a specific quantity of material from a single source, produced or placed by the same controlled process.
- (d) Sublot shall be defined as an equal division or part of a Lot from which a sample of material is obtained in order to assess the Quality Characteristics of the Lot.

**Certificate of Compliance.**

The Fabricator shall provide a Certificate of Compliance in accordance with Standard Specifications, Division I, Section 6.01, stating that QC test cylinders have achieved the design strength, f<sub>c</sub>. A Certificate of Compliance shall accompany each shipment and shall be presented to the Resident Engineer or designee upon delivery to the site.

**Documentation.**

At a minimum, the Fabricator shall maintain a filing system for the following QC records and documentation. All QC records and documentation shall be made available to TOWN upon the request.

- (a) Current MassDOT Approved Mix Design Sheet(s) and Approval Letter(s)
- (b) PCI or NPCA Certification
- (c) Current Qualifications and Certifications for QC Manager(s) and QC Technician(s)
- (d) Most current set of Approved Shop Drawings
- (e) Approved Placement, Finishing and Curing Plan
- (f) Approved Dunnage Plan
- (g) Fabricator Certificate of Compliance for each fabricated Precast Concrete Bridge Element
- (h) Admixture Manufacturer's Certification of Compliance for each approved Admixture
- (i) Completed QC Inspection Report for each fabricated Precast Concrete Bridge Element
- (j) Identification Number for each fabricated Precast Concrete Bridge Element
- (k) Time and date of casting of each fabricated Precast Concrete Bridge Element
- (l) Date of stripping of each fabricated Precast Concrete Bridge Element
- (m) Batch Ticket Printout reporting the quantity of concrete produced for each batch of concrete produced
- (n) Concrete temperature records for each Precast Concrete Bridge Element fabricated
- (o) QC Test Report Forms for each subplot of concrete produced
- (p) Non-Conformance Reports (NCRs)
- (q) Documentation of Repairs (if applicable)

**Inspection.**

The Fabricator shall complete the following

- (a) Receive approval for all submitted Fabricator cement concrete mix designs from the MassDOT Research and Materials Section for the current year, as specified under the *Mix Design* section and *Table 3: Trial Batch Sampling Testing for New Mix Designs*. Self-consolidating concrete shall meet the requirements of M4.02.17.
- (b) Receive Engineer of Record approved shop drawings.

## MATERIALS

### Materials.

Materials shall meet the following specifications (if applicable):

General	M4.00.00
Portland Cement	M4.01.0
Blended Hydraulic Cements	M4.01.1
Fly Ash	M4.01.2
Cement Concrete	M4.02.00
Cement	M4.02.01
Cement Mortar	M4.02.15
Aggregates	M4.02.02
Lightweight Aggregates	M4.02.03
Water	M4.02.04
Cement Concrete Additives	M4.02.05
Proportioning	M4.02.06
Mixing and Delivery	M4.02.10
Test Specimens	M4.02.13
Mortar for Filling Keyways	M4.04.0
Slag	AASHTO M 302
High Performance Cement Concrete	M4.06.1
Self-Consolidating Concrete (SCC)	M4.02.17
Controlled Density Fill – Non-Excavatable	M4.08.0
Reinforcing Bars	M8.01.0
Epoxy Coated Reinforcing Bars	M8.01.7
Galvanized Reinforcing Bars	M8.01.8
Welded Wire Reinforcement	M8.01.2
Mechanical Reinforcing Bar Splicer	M8.01.9
Lifting Devices	PCI MNL-116
Corrugated Metal Pipe	AASHTO M 36

### Cement Concrete Mix Design.

The cement concrete shall be comprised of specified proportions of water and MassDOT approved aggregates, cement, supplementary cementitious materials (SCMs), and admixtures to form a homogenous composition. Cement concrete for Precast Concrete Bridge Elements shall meet the requirements of M4.06.1 High Performance Cement Concrete, with the exception that the “Total Cementitious Content” specified shall be considered the “Maximum Allowable Cementitious Content”. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

The fabricator shall supply to the TOWN documentation that Mix Design to be used for precast concrete bridge elements is approved by MassDOT Research and Materials and is current.



### **Vertical Adjustment Assembly.**

Vertical Adjustment Assembly details and material requirements shall be as shown on the plans. Alternate devices may be used provided that they are adjustable and can support the anticipated loads. The design of the leveling devices, with necessary calculations, shall be submitted to the Engineer of Record for approval.

### **Grout.**

Grout used for shear keys, vertical adjustment assembly voids, and hand holes shall be in accordance with M4.04.0.

### **Reinforcement.**

All reinforcing steel shall be coated Grade 60 unless otherwise noted on the plans. Mechanical reinforcing bar splicers shall be epoxy coated.

### **Threaded Inserts.**

Threaded inserts are permissible to facilitate forming the keyway pours. Threaded inserts shall be hot dip galvanized or made of stainless steel. The number of threaded inserts shall be minimized, and the inserts shall not come in contact with the reinforcing steel.

### **Corrugated Metal Pipe.**

Corrugated Metal Pipe to be used for forming voids as specified on the plans shall be fabricated from steel and shall have a protective metallic coating of zinc (galvanizing).

## **CONSTRUCTION METHODS – PLANT FABRICATION**

### **Shop Drawings.**

Prior to performing any work under this Section, the Contractor shall receive approval for all shop drawings for the Precast Concrete Bridge Element being worked on and any special Contract requirements, provided that a complete shop drawing package is provided.

Contractor shall review all shop drawings for compliance with the contract documents before submitting them to the Engineer. The Contractor shall stamp all shop drawings that they comply with the contract documents before submitting them to the Engineer.

The Contractor shall not order materials or begin work before receiving approved shop drawings. The Engineer will reject Precast Concrete Bridge Elements that deviate from the approved drawings or are fabricated prior to receiving written approval of the shop drawings. The Contractor shall bear full responsibility and costs for all materials ordered or work performed prior to the approval of the shop drawings or written authorization from the Engineer.

Contractor shall submit scaled shop drawings to the Engineer of Record for review and approval. Resubmittal of “Approved as Noted” shop drawings is not necessary for minor revisions, provided that the correction can be clearly understood and is unambiguous without possibility of misinterpretation.

Shop drawings with questions or comments that require a response and/or additional information from the Fabricator must be resubmitted.

Detailed shop drawings shall be prepared in accordance with the relevant provisions of Subsection 5.02 and shall, at a minimum, contain the following:

- Number and type and/or piece mark of the precast concrete bridge element including overall length, width and height.
- Skew angle.
- Location, size and geometry of all steel reinforcement, including mechanical reinforcing bar splicers to be used for connecting Precast Concrete Bridge Elements together in the field.
  
- Location and details of all inserts, anchors, Vertical Adjustment Assemblies, and any other items required to be cast into the Precast Concrete Bridge Elements (whether detailed on the plans by the Engineer of Record or provided for the Contractor's convenience). Precast Concrete Bridge Elements shall not be fired or drilled into for attachment purposes. All hardware shall be galvanized except as noted.
- Locations and details of the lifting devices, including supporting calculations, type and amount of any additional reinforcing required for lifting. The Fabricator shall design all lifting devices based on the no cracking criteria in Chapter 8 of the PCI Design Handbook (7<sup>th</sup> edition).
- The minimum compressive strength required prior to handling the precast concrete bridge element.

**Fabrication.**

All Precast Concrete Bridge Elements shall be fabricated in accordance with the latest edition of PCI MNL-116 as modified herein.

**Placement, Finishing and Curing Plan.**

At least 30 days prior to start of fabrication, the Contractor shall submit the Fabricator's proposed Placement, Finishing and Curing Plan to the Engineer. This shall be an independent submittal, separate from the fabrication shop drawings. The Placement, Finishing and Curing Plan shall include the following:

- (a) Method of Mixing
- (b) Method of Placement
- (c) Method of Consolidation
- (d) Method of Finishing
- (e) Method of Initial Curing
- (f) Method of Intermediate Curing
- (g) Method of Final Curing
- (h) Moisture Retention Materials and Equipment (water spray equipment, saturated covers, sheet materials, liquid membrane-forming compounds, accelerated curing equipment, etc.)
- (i) Cylinder Curing Methods, Location, and Environmental Control (temperature, humidity, etc.)
- (j) Temperature Monitoring, Recording, and Reporting

**Dunnage Plan Shop Drawings.**

At least 30 days prior to the start of fabrication, the Contractor shall submit proposed Dunnage Plan Shop Drawings to the Engineer of Record for review and approval. The Dunnage Plan shall include the following:

- (a) Proposed layout of the Precast Concrete Bridge Elements for storage in yard and during shipping
- (b) Support and blocking point locations
- (c) Support and blocking materials

**Reinforcement.**

The reinforcing bars shall be installed in accordance with Section 901.62 of the Supplemental Specifications, including tolerances for cover and horizontal spacing of bars. Components of mechanical reinforcing bar splicers shall be set with the tolerances shown on the plans. The reinforcing bars and mechanical reinforcing bar splicers shall be assembled into a rigid cage that will maintain its shape in the form and which will not allow individual reinforcing bars to move during the placement of concrete. This cage shall be secured in the form so that the clearances to all faces of the concrete, as shown on the plans, shall be maintained.

Where reinforcing bars are to protrude from one Precast Concrete Bridge Element in order to mate with reinforcing bar splicers in a second precast concrete element, the fabricator shall set the reinforcing bars and the reinforcing bar splicers with a template in order to ensure proper fit up within the tolerances specified on the plans.

**Tolerances.**

Fabrication shall comply with tolerances specified on the plans. Tolerances for steel reinforcement placement shall be in accordance with 901.62. In the absence of specifications on the plans, tolerances shall comply with the latest version of the PCI MNL 135, Precast Tolerance Manual.

**Forms.**

Concrete shall be cast in rigidly constructed forms, which will maintain the Precast Concrete Bridge Elements within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of the plastic concrete. When wood forms are used, all faces in contact with the concrete shall be laminated or coated with a non-absorbent material. All worn or damaged forms, which cause irregularities on the concrete surface or damage to the concrete during form removal, shall be repaired or replaced before being reused. Any defects or damage of more than "Category 2, Minor Defects" made to the concrete, due to form work, stripping or handling, shall be subject to repair or rejection, as defined in the *Repairs and Replacement* section. If threaded inserts are cast into the elements for support of formwork, the inserts shall be recessed a minimum of 1 inch and shall be plugged after use with a grout of the same color as that of the precast cement concrete.

**Mixing of Concrete.**

The concrete shall be proportioned and mixed in conformance with the Fabricator's MassDOT approved mix design and M4.02.10 Mixing and Delivery Fabrication shall not occur without prior MassDOT mix design approval.

**Placement of Concrete.**

Prior to the placement of concrete, the temperature of the forms shall be greater than or equal to 50°F. Quality Control inspection shall be performed by the Fabricator as specified in the *Fabricator Quality Control* section. The Fabricator shall verify all materials and equipment required for protecting and curing the concrete are readily available and meet the requirements of the *Final Curing Methods* section below. All items encased in the concrete shall be accurately placed in the position shown on the Plans and firmly held during the placing and setting of the concrete. Clearance from the forms shall be maintained by supports, spacers, or hangers and shall be of approved shape and dimension.

During placement, the concrete shall maintain a concrete temperature range between 50°F and 90°F. The Fabricator shall minimize the time to concrete placement (measured from start of mixing to completion of placement). In no event shall time to placement exceed 90 minutes. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during the placement of the concrete as specified in the *Fabricator Quality Control* section above. Delays or shutdowns of over 30 minutes shall not be allowed during the continuous filling of individual forms.

**Consolidation of Concrete.**

Suitable means shall be used for placing concrete to prevent segregation or displacement of reinforcing steel or forms. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both. Vibrators shall not be used to move concrete within the forms. Vibrators shall be used as specified in 901.63C. Concrete shall be placed and consolidated in a way that minimizes the presence of surface voids or bug holes on the formed surfaces. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

**Finishing of Concrete.**

The finish of the Precast Concrete Bridge Elements shall be as indicated on the plans. Where Precast Concrete Bridge Elements have keyways for grout or closure pours, the surfaces of these shear keys shall be abrasive blasted prior to shipment. The Fabricator may utilize a surface retarder with water blast, sandblast, or a combination of both to achieve the desired keyway finish. At a minimum, the profile of the keyway surfaces shall be similar to that of 60 grit sand paper. The exposed reinforcing steel in the precast slab shall be protected from damage during the cleaning of the keyways. Damaged epoxy coating of steel reinforcement shall be repaired, and the reinforcing steel shall be cleaned.

The Fabricator shall permanently mark each precast concrete bridge element with its type and/or piece mark, date of casting, and supplier identification either by stamp markings in fresh concrete, waterproof paint, or other approved means on a surface that will not be exposed after assembly.

**Exposed Surfaces of Precast Concrete Bridge Elements.**

As soon as conditions permit, before the concrete has fully hardened, all dirt, laitance, and loose aggregate shall be removed from the exposed concrete surfaces. Contractor shall not allow foot traffic on the uncured concrete until it has reached sufficient strength to prevent damage.

**Exposed Surfaces of Closure Pour Shear Keys.**

The closure pour shear key cast in the sides of the beam flanges shall have an exposed aggregate finish. The closure pour reinforcing steel and its coating shall not be damaged by the process for creating the

exposed aggregate surface. Fabricator may utilize a surface retarder with water blast, abrasive blast, or a combination of both to achieve the desired shear key finish. The abrasive blast shall use oil free compressed air. The profile of the shear key surfaces shall be similar to that of 60 grit sand paper.

### **Initial Curing Methods.**

After the placement of concrete and prior to concrete finishing, the Fabricator shall initiate initial curing methods when the concrete surface begins to dry, to reduce moisture loss from the surface. Application of one or more of the following initial curing methods shall occur immediately after the bleed water sheen has disappeared.

#### **Fogging.**

Fogging nozzles shall atomize water into a fog-like mist. The fog spray shall be directed and remain visibly suspended above the concrete surface, to increase the humidity of the air and reduce the rate of evaporation. Water from fogging shall not be worked into the surface during finishing operations and shall be removed or allowed to evaporate prior to finishing.

#### **Liquid-applied Evaporation Reducers**

Evaporation reducers shall be sprayed onto the freshly placed concrete surface to produce an effective monomolecular film that reduces the risk of plastic-shrinkage cracking and rate of evaporation of the bleed water from the concrete surface. Evaporation reducers shall be applied in accordance with manufacturer's recommendations.

### **Intermediate Curing Methods.**

The Fabricator shall initiate intermediate curing methods if concrete finishing has taken place prior to the concrete reaching final set. The freshly finished concrete surface shall be protected from moisture loss, by the continuation of initial curing methods (fogging and evaporation reducers) until final curing methods are applied or by the use of liquid membrane-forming curing compounds (see *Liquid Membrane-Forming Compounds for Curing* section).

### **Final Curing Methods.**

The Fabricator shall initiate and apply final curing methods to the concrete immediately after the following conditions are met:

- (a) Completion of concrete finishing
- (b) Final set of concrete
- (c) Concrete has hardened sufficiently enough to prevent surface damage

During fabrication of Precast Concrete Bridge Elements, the Fabricator shall maintain the required concrete temperature ranges throughout the entire duration of the final curing method cycle as specified herein. Controlled and gradual termination of the final curing method shall occur after all specified conditions are met. The concrete temperature shall be reduced at a rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the final curing method

enclosure. The Fabricator shall maintain a minimum concrete temperature of 40°F until 100% f'c is attained (see *Handling and Storage* section below).

**Water Spray Curing.**

All exposed concrete surfaces shall remain moist with a continuous fine spray of water throughout the entire duration of the final curing method cycle (see *Table 4: Final Curing Method Cycle for Water Spray*).

**Table 4: Final Curing Method Cycle for Water Spray**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Five (5) days	≥ 80% f'c

**Saturated Covers for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of saturated covers throughout the entire duration of the final curing method cycle (see *Table 5: Final Curing Method Cycle for Saturated Covers*). Saturated covers shall be allowed to dry thoroughly before removal to provide uniform, slow drying of the concrete surface.

**Table 5: Final Curing Method Cycle for Saturated Covers**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f'c

Saturated covers, such as burlap, cotton mats, and other coverings of absorbent materials shall meet the requirements of AASHTO M 182, Class 3. Saturated covers shall be in good condition, free from holes, tears, or other defects that would render it unsuitable for curing concrete. Saturated covers shall be dried to prevent mildew when storing. Prior to application, saturated covers shall be thoroughly rinsed in water and free of harmful substances that are deleterious or cause discoloration to the concrete. Saturated covers shall have sufficient thickness and proper positioning onto the concrete surface to maximize moisture retention.

Saturated covers shall contain a sufficient amount of moisture to prevent moisture loss from the surface of the concrete. Saturated covers shall be kept continuously moist so that a film of water remains on the concrete surface throughout the entire duration of the final curing method cycle. The Fabricator shall not permit the saturated covers to dry and absorb water from the concrete. Use of polyethylene film (see *Polyethylene Film* section) may be applied over the saturated cover to potentially decrease the need for continuous watering.

**Sheet Materials for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of curing sheet materials throughout the entire duration of the final curing method cycle (see *Table 6: Final Curing Method Cycle for Curing Sheet Materials*).

**Table 6: Final Curing Method Cycle for Sheet Materials**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f <sub>c</sub>

Sheet Materials used for curing, such as polyethylene film, white burlap-polyethylene sheeting, and reinforced paper shall meet the requirements of ASTM C171 and the specifications herein. Sheet materials shall inhibit moisture loss and reduce temperature rise in concrete exposed to radiation from the sun during the final curing method cycle. Adjoining covers shall overlap not less than 12 inches. All edges of the covers shall be secured to maintain a moist environment.

**Polyethylene Film.**

Polyethylene film shall meet the requirements of ASTM C171, consist of a single sheet manufactured from polyethylene resins, be free of visible defects, and have a uniform appearance. Careful considerations shall be taken by the Fabricator to prevent the film from tearing during storage and application, so as to not disrupt the continuity of the film (polyethylene film reinforced with glass or other fibers is more durable and less likely to be torn). The Fabricator shall monitor the application of the film to prevent uneven spots from appearing (mottling) on the concrete surface, due to variations in temperature, moisture content, or both. The Fabricator shall prevent mottling from occurring on the concrete surface by applying additional water under the film or applying a combination of polyethylene film bonded to absorbent fabric to the concrete surface to retain and evenly distribute the moisture.

Immediately following final finishing, polyethylene film shall be placed over the surface of the fresh concrete surface, so as to not damage the surface of the concrete and shall be placed and weighted so that it remains in contact with the concrete throughout the entire duration of the final curing method cycle. The film shall extend beyond the edges of the concrete surface. The film shall be placed flat on the concrete surface, avoiding wrinkles, to minimize mottling. Edges of adjacent polyethylene film shall overlap a minimum of 6 inches and be tightly sealed with the use of sand, wood planks, pressure-sensitive tape, mastic, or glue to maintain close contact with the concrete surface, retain moisture, and prevent the formation of air pockets throughout the entire duration of the final curing method cycle.

**White Burlap-Polyethylene Sheeting**

White burlap-polyethylene sheeting shall meet the requirements of ASTM C171, be securely bonded to the burlap so to avoid separation of the materials during handling and curing of the concrete, and be applied in the same manner as the polyethylene film.

**Reinforced Impervious Paper.**

Reinforced impervious paper shall meet the requirements of ASTM C171, consist of two sheets of kraft paper cemented together with a bituminous adhesive and reinforced with embedded cords or strands of fiber running in both directions, and be white in color. Reinforced impervious paper shall be treated to prevent tearing when wetted and dried.

Reinforced impervious paper can be reused so long as it is effective in retaining moisture on the concrete surface. The Fabricator shall visually inspect the reinforced impervious paper for all holes, tears, and pin

holes from deterioration of the paper through repeated use by holding the paper up to the light. The paper shall be discarded and prohibited from use when the moisture is no longer retained.

After the concrete has hardened sufficiently to prevent surface damage, the concrete surface shall be thoroughly wetted prior to the application of the reinforced impervious paper, and be applied in the same manner as the polyethylene film.

### **Liquid Membrane-Forming Compounds for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of liquid membrane-forming compounds throughout the entire duration of the final curing method cycle (see *Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds*).

**Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Seven (7) days	≥ 80% f <sub>c</sub>

Liquid membrane-forming compounds shall meet the requirements of ASTM C 1315, Type I, Class A and shall exhibit specific properties, such as alkali resistance, acid resistance, adhesion-promoting quality, and resistance to degradation by ultraviolet light, in addition to moisture-retention capabilities. Liquid membrane-forming compounds shall consist of waxes, resins, chlorinated rubber, or other materials to reduce evaporation of moisture from concrete. Liquid membrane-forming compounds shall be applied in accordance with the manufacturer's recommendations.

Liquid membrane-forming compounds shall be applied immediately after the disappearance of the surface water sheen following final finishing. All exposed surfaces shall be wetted immediately after form removal and kept moist to prevent absorption of the compound, allowing the curing membrane to remain on the concrete surface for proper membrane moisture retention. The concrete shall reach a uniformly damp appearance with no free water on the surface prior to the application of the compound.

If patching or finishing repairs are to be performed prior to the application of the compound, the Precast Concrete Bridge Element shall be covered temporarily with saturated covers until the repairs are completed and the compound is applied. Only areas being repaired shall be uncovered during this period. While the saturated covers are removed to facilitate the patching process, the work shall continue uninterrupted. If for any reason the work is interrupted, saturated covers shall be placed onto the uncovered concrete surface, until the work continues and is completed, at which time the curing compound shall be applied to the repaired area.

Careful considerations shall be made by the Fabricator to determine if the evaporation rate is exceeding the rate of bleeding, thus causing the surface to appear dry even though bleeding is still occurring. Under such conditions, the application of liquid membrane-forming compounds to the concrete surface shall be delayed, in order to prevent bleed water from being sealed below the concrete surface and avert map cracking of the membrane films, reduction in moisture-retention capability, and reapplication of the compound. To diagnose and prevent this condition, the Fabricator shall place a transparent plastic sheet over a test area of the uncured and unfinished concrete surface and shall determine if any bleed water accumulates under the plastic.



The compound shall be applied in two applications at right angles to each other to ensure uniform and more complete coverage. On very deeply textured surfaces, the surface area to be treated shall be at least twice the surface area of a troweled or floated surface. In such cases, two separate applications may be needed, each at 200 ft<sup>2</sup>/gal., with the first being allowed to become tacky before the second is applied.

The curing compound shall be applied by power sprayer, using appropriate wands and nozzles with pressures between 25 and 100 psi. For very small areas such as repairs, the compound shall be applied with a wide, soft-bristled brush or paint roller. The compound shall be stirred or agitated before use and applied uniformly in accordance with the manufacturer's recommended rate. The Fabricator shall verify the application rates are in accordance with the manufacturer's recommended rate.

When the concrete surface is to receive paint, finishes, or toppings that require positive bond to the concrete, it is critical that the curing procedures and subsequent coatings, finishes, or toppings be compatible to achieve the necessary bond

After the termination of the final curing method cycle has occurred, liquid membrane-forming compounds shall be removed by blast-cleaning from any concrete surface that is to receive paint, finishes, plastic concrete from secondary pour, grout, or any other toppings that require bonding to the concrete surface. These surfaces shall be further blast-cleaned to remove the cement matrix down to exposed aggregate to ensure proper bonding to the material. The method used to remove the curing compound shall not damage the reinforcement and coating. Compounds are prohibited on any concrete surface that will have a penetrating or coating type treatment such as a sealer, stain, or waterproofing membrane applied to it.

#### **Accelerated Curing.**

Accelerated curing shall use live steam or radiant heat with moisture in accordance with PCI MNL-116 as modified herein. The concrete temperature shall meet the maximum heat increase and cool down rates as specified herein. Concrete temperature monitoring shall meet the requirements of the *Temperature Monitoring* section. Excessive and fluctuating rates of heating and cooling shall be prohibited. The concrete temperature shall not exceed 158°F at any time. The Fabricator shall meet the following accelerated curing sequencing and requirements.

#### **Initial Delay Period.**

The initial delay period shall be defined as the duration immediately following the placement of the concrete and the attainment of initial set of the concrete. The Fabricator shall determine the time of initial set in accordance with AASHTO T 197 specifications. Throughout the entire duration of the preset period, initial curing shall be implemented. The temperature increase period (see *Temperature Increase Period* section) shall not occur until initial set of the concrete is attained. During the initial delay period, the concrete temperature shall meet the following requirements:

- i. Concrete temperature rate of increase shall not exceed 10°F per hour.
- ii. Total concrete temperature increase shall not exceed 40°F higher than the placement concrete temperature or 100°F, whichever is less
- iii.

**Temperature Increase Period.**

The temperature increase period shall be defined as the duration immediately following the completion of the initial delay period (after initial set) and immediately prior to the start of the constant maximum temperature period. Application of steam to the enclosure shall not occur until the initial delay period is complete. After the initial delay period is complete, all exposed concrete surfaces shall be cured in a moist environment where the concrete temperature increases at a rate not to exceed 36°F per hour.

**Constant Maximum Temperature Period.**

The constant maximum temperature period shall be defined as the duration immediately following the completion of the temperature increase period and immediately prior to the start of the temperature decrease period. After the temperature increase period is complete, all exposed concrete surfaces shall be cured in a moist environment at a controlled and constant elevated temperature throughout the entire duration of the constant maximum temperature period. Termination of the constant maximum temperature period and the start of the termination decrease period shall occur after all specified conditions are met (see *Table 8: Constant Maximum Temperature Period*).

**Table 8: Constant Maximum Temperature Period**

Sustained Concrete Temperature	Constant Maximum Temperature Period	Compressive Strength
120°F ≤ °F ≤ 158°F	6 hrs ≤ Time ≤ 48 hrs	≥ 80% f <sub>c</sub>

**Temperature Decrease Period.**

After the constant maximum temperature period is complete, the concrete temperature shall be cured in a moist environment at a controlled and reduced rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the curing enclosure.

**Stripping.**

The Fabricator shall not strip forms or handle the Precast Concrete Bridge Element until Quality Control compressive strength cylinders attain a minimum compressive strength of 80% Design Strength (f<sub>c</sub>) or the value indicated on the approved drawings has been achieved. After removal from the form, all exposed concrete surfaces shall continue to be cured in conformance with the *Final Curing Methods* sections until completion.

**Handling and Storage of Precast Concrete Bridge Elements.**

Precast Concrete Bridge Elements may be exposed to temperatures below freezing (32°F) when the chosen curing cycle has been completed, provided that the following conditions are met:

- (a) Precast Concrete Bridge Elements are protected from precipitation with polyethylene curing covers until 100% f<sub>c</sub> is attained
- (b) Precast Concrete Bridge Elements maintain a minimum concrete temperature of 40°F until 100% f<sub>c</sub> is attained

Precast Concrete Bridge Elements damaged during handling and storage will be repaired or replaced at no cost to the TOWN. Precast Concrete Bridge Elements shall be lifted at the designated points by approved lifting devices embedded in the concrete and in accordance with proper lifting and handling procedures. Storage areas shall be smooth and well compacted to prevent damage due to differential

settlement. Precast Concrete Bridge Elements shall be supported on the ground by means of continuous blocking, in accordance with the approved dunnage plan.

Precast Concrete Bridge Elements shall be loaded on a trailer with blocking as described above, in accordance with the approved dunnage plan. Shock-absorbing cushioning material shall be used at all bearing points during transportation of the Precast Concrete Bridge Elements. Blocking shall be provided at all locations of tie-down straps. Precast Concrete Bridge Elements stored prior to shipment shall be inspected by the Contractor prior to being delivered to the site to identify damage that would be cause for repair or rejection.

### **Repairs and Replacement.**

In the event defects are identified, they shall be classified in the following categories and a non-conformance report (NCR) shall be filed if required. Defects in all categories shall be documented by plant Quality Control personnel and made available to the TOWN upon request. Any required repairs shall utilize materials listed on the MassDOT QCML.

Where noted, defects shall be repaired according to the PCI Northeast Region Guidelines for Resolution of Non-Conformances in Precast Concrete Bridge Elements, Report Number PCINE-18-RNPCBE. Please note that reference to PCINE-18-RNPCBE is made for repair details only. In the case of conflicts with this Special Provision, this Special Provision shall govern.

#### **Category 1, Surface Defects.**

Category 1 defects do not need to be repaired, and an NCR does not need to be filed. Surface defects are defined as the following:

- (a) Surface voids or bug holes that are less than 5/8-inch in diameter and less than 1/4-inch deep, except when classified as Category 4
- (b) Cracks less than or equal to 0.006 inches wide
- (c) Cracks less than or equal to 0.125 inches wide on surfaces that will receive a field-cast concrete overlay

#### **Category 2, Minor Defects.**

Category 2 defects shall be repaired, but an NCR does not need to be filed. Minor defects are defined as the following:

- (a) Spalls, honeycombing, surface voids that are less than 2 inches deep and have no dimension greater than 12 inches
- (b) Cracks less than or equal to 0.016 inches that will not receive a concrete overlay
- (c) Broken or spalled corners that will be covered by field-cast concrete

Minor defects shall be repaired according to PCINE-18-RNPCBE. Cracks shall be sealed according to the PCI Repair Procedure #14 in PCINE-18-RNPCBE.

### **Category 3, Major Defects.**

For Category 3 defects, the Fabricator shall prepare an NCR that documents the defect and describes the proposed repair procedure. The NCR shall be submitted to the Engineer for approval prior to performing the repair. Major defects are defined as the following:

- (a) Spalls, honeycombing and surface voids that are deeper than 2 inches or have any dimension greater than 12 inches, when measured along a straight line
- (b) Concentrated area of defects consisting of four or more Category 2 Defects within a 4-square foot area.
- (c) Exposed reinforcing steel
- (d) Cracks greater than 0.016 inches and less than or equal to 0.060 inches in width that will not receive a concrete overlay
- (e) Bearing area spalls with dimensions not exceeding 3 inches
- (f) Cracks, spalls and honeycombing that will be encased in cast in place concrete need not be repaired, but the limits and location of the defects shall be documented with an NCR

Defects and cracks shall be repaired according to PCINE-18-RNPCBE and this specification. All repairs shall be completed at the expense of the Contractor.

### **Category 4, Rejectable Defects.**

Rejectable defects as determined by the TOWN may be cause for rejection. Fabricator may submit an NCR with a proposed repair procedure, requesting approval. Some rejectable defects are defined as the following:

- (a) Surface defects on more than 5% of the surface area which will be exposed to view after installation
- (b) Minor defects that in total make up more than 5% of the surface area of the unit
- (c) Cracks greater than 0.060 inches in width except as noted in Category 1
- (d) Elements fabricated outside of the specified tolerances
- (e) Compressive strength testing that does not meet the specified Design Strength,  $f'_c$ .

### **Shipping.**

Precast Concrete Bridge Elements shall remain at the Fabricator's plant for a minimum of 7 days after cast date.

### **Delivery.**

Upon Delivery, the following documentation shall be provided to the Resident Engineer or designee:

- (a) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Precast Concrete Bridge Element's representative subplot.
- (b) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (c) QC Inspection Reports signed by the Quality Control Manager.

The Contractor shall inspect Precast Concrete Bridge Elements upon receipt at the site. Precast Concrete Bridge Elements damaged during delivery shall be repaired or replaced at no cost to the TOWN.

## CONSTRUCTION METHODS – FIELD CONSTRUCTION

### General.

All of the Contractor's field personnel involved in the erection and assembly of the Precast Concrete Bridge Elements shall have knowledge of and follow the approved Erection Procedure.

Prior to installation, the following documentation shall be reviewed and confirmed by the Resident Engineer or designee:

- (a) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Precast Concrete Bridge Element's representative subplot.
- (b) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (c) QC Inspection Reports signed by the Quality Control Manager.

Field construction staff shall verify that the Resident Engineer has accepted all Precast Concrete Bridge Elements prior to installation.

### Erection Procedure.

Prior to the erection, the Contractor shall submit an Erection Procedure for approval by the Engineer. This submittal shall include computations and drawings for the transport, hoisting, erection and handling of the Precast Concrete Bridge Elements. The Erection Procedure shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts with working knowledge of the Contractor's equipment, approved shop drawings, and materials to build the bridge. The Erection Procedure shall, at a minimum, include the following:

### Erection Procedure

The Erection Procedure shall be prepared to conform to the requirements of 960.61, Erection and the applicable sections in Chapter 8 of the PCI Design Handbook (seventh edition) for handling, erection, and bracing requirements. At a minimum, the Erection Procedure shall provide:

- (a) Minimum concrete compressive strength for handling the Precast Concrete Bridge Elements.
- (b) Concrete stresses during handling, transport, and erection.
- (c) Crane capacities, pick radii, sling geometry, and lifting hardware.
- (d) Verification that the equipment can handle all pick loads and weights with the required factor of safety.
- (e) Evaluation of construction sequence and evaluation of any geometric conflicts in the lifting of the Precast Concrete Bridge Elements and setting them as shown on the plans.
- (f) Design of crane supports including verification of subgrade for support.
- (g) Location and design of all temporary bracing that will be required during erection.

Non-shrink grout and concrete materials, approved by the Engineer, shall be placed as shown on the plans. Fill joints, keyways, and voids, in strict accordance with the specifications and manufacturer's recommendations and instructions.

For footings, approach slabs and highway guardrail transitions, once these Precast Concrete Bridge Elements have been set to the correct horizontal and vertical alignment, the void between them and the

supporting soil shall be filled with Controlled Density Fill – Non-Excavatable to the limits as shown on the plans. Add additional grout ports in the footings to facilitate the bedding process if required.

Joints shall be filled flush to the top with non-shrink grout, and any vertical misalignment between adjacent elements shall be feathered out on a slope of 1 to 12.

Curing of grout or concrete shall be performed in strict accordance with the specifications and manufacturer's recommendations. Filling shall not be completed in cold weather when either the ambient temperature or the precast member's temperature is below the manufacturer's recommendation. No localized heating of either the precast members or of the air surrounding the element will be permitted in an attempt to reach application temperatures.

If the joints or voids are not filled within five days after the Precast Bridge Elements are erected, the Contractor shall cover and protect the openings from weather and debris until they are filled.

### **Survey and Layout.**

Working points, working lines, and benchmark elevations shall be established prior to placement of all elements. The Contractor is responsible for field survey as necessary to complete the work. The TOWN reserves the right to perform additional independent survey. If discrepancies are found, the Contractor may be required to verify previous survey data.

### **Preparation of Closure Pour Keyways.**

Immediately prior to erecting the Precast Concrete Bridge Elements, the closure pour shear keys shall be cleaned at the job site of all dust, dirt, carbonation, laitance, and other potentially detrimental materials which may interfere with the bonding of the closure pour concrete and precast concrete using a high-pressure water blast. The exposed reinforcing steel in the precast concrete shall be protected from damage during the cleaning of the keyways. Damaged epoxy coating of steel reinforcement shall be repaired, and the reinforcing steel shall be cleaned as directed by the Engineer. The surfaces of the shear keys shall be wetted so that the surfaces shall have a Saturated Surface Dry (SSD) condition for at least 24 hours prior to the placement of the closure pour concrete.

### **Erection.**

The elements shall be placed in the sequence and according to the methods outlined in the Erection Procedure. As the erection proceeds, the Contractor shall constantly monitor the assembly to ensure that the precast concrete bridge element is within proper horizontal and vertical location and tolerances prior to releasing it from the crane and setting the next unit. The Contractor may use shims to maintain proper setting tolerances.

The concrete elements shall be lifted only by the lifting devices, and the utmost care shall be taken to prevent distortion of the elements during handling, transportation or storage.

Suitable spreaders shall be used during lifting so that only a vertical pull will be made on the lifting device. A non-vertical lifting force may be permitted if prior written approval is given by the Engineer. This approval will be contingent on the Contractor demonstrating by calculations, prepared by a Professional Engineer registered in Massachusetts, that the elements will not be damaged by the non-vertical lifting

force and by documentation that the capacity of the lifting devices is adequate for the non-vertical lifting force.

Precast components shall be pre-bed with non-shrink grout thicker than shim stacks prior to placing other precast elements on top of them.

After all Precast Concrete Bridge Elements have been placed, the actual overall dimensions of the structure both horizontal and vertical, as laid out shall not deviate from the nominal dimensions shown on the plans beyond a tolerance of +0 inches and -1 inches. Once the layout of Precast Concrete Bridge Elements has been accepted by the Engineer, the Contractor shall cut all lifting devices off below the surfaces of the elements.

**Filling of Blockouts for Lifting Devices and Threaded inserts.**

If the blockouts in the Precast Concrete Bridge Elements where the lifting devices were located will be exposed and visible after assembly is complete, the Contractor shall fill these blockouts with Cement Mortar (M4.02.15) or grout.

After the formwork has been removed, all threaded inserts that have been cast into the precast concrete bridge deck for support of the formwork shall be filled with a grout of the same color as that of the precast concrete.

**COMPENSATION**

**A. Basis of Payment.**

The furnishing, fabricating, and erecting of all Precast Concrete Bridge Elements for the structure shall be paid for at the contract unit price EACH under the Lump Sum Item 995.01, complete in place.

**B. Payment Items.**

Precast Approach Slabs	EA
Highway Guardrail Transitions	EA



## **PRESTRESSED CONCRETE BEAMS BOX BEAMS (B36-24)**

### **General.**

The work under this Heading consists of fabricating, transporting and installing Prestressed Concrete Box Beams (B36-24), and includes all necessary labor, materials, and equipment to complete the work as shown on the Plans. The work shall conform to the MassDOT Standard Specifications and the requirements of the current AASHTO LRFD Bridge Construction Specifications, supplemented by the current relevant provisions of the latest edition of PCI MNL-116 (The Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products), except as noted herein. MassDOT contract documents shall take precedence over the AASHTO LRFD Bridge Construction Specifications and PCI MNL-116. Section 930, M4.02.14, and M4.03.00 through M4.03.14 of the MassDOT Standard Specifications are superseded in their entirety by the requirements specified below.

## **QUALITY ASSURANCE**

### **General.**

Quality Assurance includes all the planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service. It is an all-encompassing term that includes Quality Control (performed by the Fabricator) and Acceptance by the TOWN. Quality Control is the system used by the Contractor and Fabricator to monitor and assess their production processes at the plant facility and installation activities at the project site to ensure that the final product will meet the specified level of quality.

### **Fabricator Quality Control.**

Quality Control shall be performed by the Fabricator to ensure that the product is fabricated in conformance with the specifications herein. The Fabricator shall maintain a Quality Control system to monitor, assess, and adjust placement and fabrication processes to ensure the Prestressed Concrete Beam(s) meet the specified level of quality, through sufficient Quality Control sampling, testing, inspection, and corrective action (where required). The Fabricator's Quality Control system shall address all key activities during the placement and fabrication and shall be performed in conformance with the Fabricator's PCI Certification. Quality Control documentation shall meet the requirements of the *Fabricator Quality Control – Documentation* section below. Upon request, Fabricator Quality Control documentation shall be provided to the TOWN.

### **Plant.**

Prior to the fabrication of Prestressed Concrete Beams, the Fabricator's precast concrete plant shall obtain the following:

- (a) Certification by the Precast/Prestressed Concrete Institute (PCI) Plant Certification Program, for Prestressed Concrete Beam fabrication, Category B3 level or higher
- (b) MassDOT Prequalification
- (c) MassDOT Mix Design Approval

All concrete for a given Prestressed Concrete Beam shall be produced by a single company and plant.

**Personnel.**

The Fabricator shall provide adequate training for all QC personnel in accordance with PCI certification. There shall be sufficient personnel trained and certified to perform the tests listed under Subsection M4.02.13, Part D. At a minimum, the Fabricator's Quality Control Personnel shall maintain the following qualifications and certifications:

- (a) QC Manager with an active Precast/Prestressed Concrete Institute (PCI) Technician/Inspector Level II or higher, and a minimum of 5 years continuous experience in the manufacture of Prestressed Concrete Beams for state transportation departments. The QC Manager shall be on site while the batch plant is producing and placing concrete.
- (b) A Technician/Inspector having the Precast/Prestressed Concrete Institute (PCI) Technician/Inspector Level II or higher

The Contractor shall submit to the TOWN a copy of the Fabricator's Quality Control Personnel required qualifications, as specified above.

**Laboratory.**

The Fabricator shall provide a room of sufficient size to house all equipment and to adequately perform all testing. The room shall have either a separate moisture storage room or curing box for concrete cylinders, and it shall be thermostatically controlled to maintain temperatures consistent with AASHTO T 23. It shall include a desk and file cabinet for proper record keeping, and have good lighting and ventilation. This room shall be kept for testing and quality control and not used for any other purpose.

**Testing Equipment.**

At a minimum, the Fabricator's plant facility shall have the following testing equipment:

- (a) Air Content Meter Type A or B: AASHTO T 152
- (b) Air Content Meter Volumetric Method: AASHTO T 196 (Required for Lightweight Concrete)
- (c) Slump Cone: AASHTO T 119
- (d) Cylinder Molds AASHTO M 205
- (e) Concrete Testing Machine: AASHTO T 22
- (f) Screening Sieve: AASHTO T 27, AASHTO T 11
- (g) Curing Box: AASHTO T 23
- (h) Spread Test Base Plate for Self-Consolidating Concrete (SCC): ASTM C1611
- (i) All other equipment prescribed by AASHTO and ASTM standards for the tests to be performed by the Fabricator as specified

**Inspection.**

Quality Control personnel shall monitor and inspect the fabrication of each Prestressed Concrete Beam. Quality Control personnel shall report all inspection activities on Quality Control Inspection Reports and non-conformances on Non-Conformance Reports (NCRs) throughout the entire fabrication process, as specified herein.

### **Temperature Monitoring.**

At a minimum, the Fabricator shall monitor, record, and report the temperatures of the form, ambient temperatures surrounding the concrete, and temperatures of the concrete continuously, without interruption as specified below:

- Prior to placement of concrete to verify that  $T_i \geq 50^\circ\text{F}$ .
- Immediately after placement to verify that  $T_i \geq 50^\circ\text{F}$  is maintained.
- Throughout the entire duration of the curing cycle, at regular intervals not to exceed one hour until 100% Design Strength ( $f'_c$ ) is attained and concrete has cooled to within  $40^\circ\text{F}$  of the ambient temperature surrounding the Prestressed Concrete Beam.

At a minimum, the temperature measuring devices shall record and report the temperature of the concrete to the nearest  $2^\circ\text{F}$ . At least two temperature sensors (thermocouples) shall be positioned to record the maximum and minimum anticipated concrete temperatures. The anticipated minimum temperature shall be measured with one or more thermocouples at a distance no greater than 2 inches from the surface of the thinnest section. The anticipated maximum temperature shall be measured with one or more thermocouples at the center of the thickest section. Temperature recording devices shall be located within the curing enclosure and calibrated as required by PCI MNL-116 Section 4.18.4. Maximum heat increase and cool down rates shall comply with PCI MNL-116, Section 4.19. The Contractor shall furnish temperature logs recorded at a minimum frequency of once per hour to the TOWN as required, with each post-pour QC inspection report.

### **Sampling and Testing.**

At a minimum, the Fabricator shall perform random Quality Control sampling and testing as specified in *Table 1: Quality Control Sampling and Testing*. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during fabrication. Test Specimens shall conform to the requirements of Section M4.02.13 of the MassDOT Standard and Supplemental Specifications and AASHTO R 60, with the exception of the Stripping (80%  $f'_c$ ) set of cylinders. Stripping (80%  $f'_c$ ) cylinders shall be cured in the same location and environment as the Prestressed Concrete Beam they represent.

**Table 1: Quality Control Sampling and Testing**

Quality Characteristic	Test Method	Sample Size	Specification Limit	Lot Size <sup>(c)</sup>	Sublot Size <sup>(d)</sup>	Frequency	Point of Sampling
Slump (in.) <sup>(a)</sup>	AASHTO T 119	Per AASHTO	≤ 8 in.				
Air Content (%)	AASHTO T 152	Per AASHTO	5% ≤ % ≤ 8%				
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F ≤ °F ≤ 90°F				
Compressive Strength (psi)	AASHTO T 22	Stripping Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 80% f <sub>c</sub> at Stripping				
		7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	For Information at 7 days				
		28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% f <sub>c</sub> at 28 days				
		56-day Cylinders: One (1) set of Three (3) 4 x 8 in.	≥ 100% f <sub>c</sub> at 56 days <sup>(b)</sup>				

**Notes:**

- (a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (b) 56-day Compressive Strength test specimens shall require testing only when 28-day Compressive Strength test specimens have failed to meet Design Strength (f<sub>c</sub>).
- (c) Lot shall be defined as a specific quantity of material from a single source, produced or placed by the same controlled process.
- (d) Sublot shall be defined as an equal division or part of a Lot from which a sample of material is obtained in order to assess the Quality Characteristics of the Lot.

**Certificate of Compliance.**

The Fabricator shall provide a Certificate of Compliance in accordance with Standard Specifications, Division I, Section 6.01, stating that QC test cylinders have achieved the design strength, f<sub>c</sub>. A Certificate of Compliance shall accompany each shipment and shall be presented to the Resident Engineer or designee upon delivery to the site.

**Documentation.**

At a minimum, the Fabricator shall maintain a filing system for the following QC records and documentation. All QC records and documentation shall be made available to the TOWN upon the request.

- (a) Current MassDOT Approved Mix Design Sheet(s) and Approval Letter(s)
- (b) PCI Certification
- (c) Current Qualifications and Certifications for QC Manager(s) and QC Technician(s)
- (d) Most current set of Approved Shop Drawings
- (e) Approved Placement, Finishing and Curing Plan
- (f) Approved Dunnage Plan
- (g) Fabricator Certificate of Compliance for each fabricated Prestressed Concrete Beam
- (h) Admixture Manufacturer's Certification of Compliance for each approved Admixture
- (i) Completed QC Inspection Report for each fabricated Prestressed Concrete Beam
- (j) Identification Number for each fabricated Prestressed Concrete Beam
- (k) Time and date of casting of each fabricated Prestressed Concrete Beam
- (l) Date of stripping of each fabricated Prestressed Concrete Beam
- (m) Batch Ticket Printout reporting the quantity of concrete produced for each batch of concrete produced
- (n) Concrete temperature records for each fabricated Prestressed Concrete Beam
- (o) QC Test Report Forms for each subplot of concrete produced
- (p) Non-Conformance Reports (NCRs)
- (q) Documentation of Repairs (if applicable)

**Inspection.**

The Fabricator shall complete the following:

- (a) Receive approval for all submitted Fabricator cement concrete mix designs from the MassDOT Research and Materials Section for the current year, as specified under the *Mix Design* section and *Table 3: Trial Batch Sampling Testing for New Mix Designs*. Self-consolidating concrete shall meet the requirements of M4.02.17.
- (b) Receive Engineer of Record approved shop drawings.

## MATERIALS

### Materials.

Materials shall meet the following specifications (if applicable):

General	M4.00.00
Portland Cement	M4.01.0
Blended Hydraulic Cements	M4.01.1
Fly Ash	M4.01.2
Cement Concrete	M4.02.00
Cement	M4.02.01
Cement Mortar	M4.02.15
Aggregates	M4.02.02
Lightweight Aggregates	M4.02.03
Water	M4.02.04
Cement Concrete Additives	M4.02.05
Proportioning	M4.02.06
Mixing and Delivery	M4.02.10
Test Specimens	M4.02.13
Mortar for Filling Keyways	M4.04.0
Slag	AASHTO M 302
High Performance Cement Concrete	M4.06.1
Self-Consolidating Concrete (SCC)	M4.02.17
Prestressing Strands	AASHTO M 203
Reinforcing Bars	M8.01.0
Epoxy Coated Reinforcing Bars	M8.01.7
Welded Wire Reinforcement	M8.01.2
Mechanical Reinforcing Bar Splicer	M8.01.9
Strand Chuck	M8.15.0
Lifting Devices	PCI MNL-116

### **Cement Concrete Mix Design.**

The cement concrete shall be comprised of specified proportions of water and MassDOT approved aggregates, cement, supplementary cementitious materials (SCMs), and admixtures to form a homogenous composition. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

The fabricator shall supply the TOWN documentation that the Mix Design to be used for prestressed beams is approved by MassDOT Research and Materials and is current.

The Fabricator is responsible for developing the concrete mix to be used for fabricating prestressed beams and having it prequalified by the MassDOT Research and Materials Section. The mix design compressive strength shall be as shown on the plans and as prequalified by the MassDOT Research and Materials Section.

### **Reinforcement and Prestressing Strands.**

The size and grade of steel reinforcement and prestressing strands shall be as indicated on the plans. All reinforcing steel shall be epoxy coated, Grade 60. All prestressing strands shall be uncoated.

### **Threaded Inserts**

Threaded inserts are permissible in Prestressed Concrete Beams for installing formwork, utility supports, or deck drains. Threaded inserts shall be hot dip galvanized or made of stainless steel and shall not come in contact with the reinforcing steel. The number of threaded inserts installed for the Contractor's convenience shall be kept to a minimum.

## **CONSTRUCTION METHODS – PLANT FABRICATION**

### **Shop Drawings**

Prior to performing any work under this Section, the Contractor shall receive approval for all shop drawings for the Prestressed Concrete Beam being worked on and any special Contract requirements, provided that a complete shop drawing package is provided. The Contractor shall not order materials or begin work before receiving approved shop drawings. The Engineer will reject any prestressed concrete beams that deviate from the approved drawings or are fabricated prior to receiving written approval of the shop drawings. The Contractor shall bear full responsibility and costs for all materials ordered or work performed prior to the approval of the shop drawings or written authorization from the Engineer.

Contractor shall review all shop drawings for compliance with the contract documents before submitting them to the Engineer. The Contractor shall stamp all shop drawings that they comply with the contract documents before submitting them to the Engineer.

The Contractor shall submit scaled shop drawings to the Engineer of Record for review and approval.

Resubmittal of "Approved as Noted" shop drawings is not necessary for minor revisions, provided that the correction can be clearly understood and is unambiguous without possibility of misinterpretation. Shop drawings with questions or comments that require a response and/or additional information from the Fabricator must be resubmitted.

Detailed shop drawings shall be prepared in accordance with the relevant provisions of Subsection 5.02 and shall, at a minimum, contain the following:

- Number and type of Prestressed Concrete Beams including overall length, width and height.
- Skew angle.
- Location and spacing of strands, draped strands and their geometry, and/or location and spacing of strands to be debonded including the length of each strand's debondment.
- Location, size and geometry of all steel reinforcement, and mechanical reinforcing bar splicers if called for on the plans.
- Location and details of all inserts, anchors, and any other items required to be cast into the Prestressed Concrete Beams (whether detailed on the plans by the Engineer of Record or provided for the Contractor's convenience). Prestressed Concrete Beams shall not be fired or drilled into for attachment purposes. All hardware shall be galvanized except as noted.
- Locations and details of the lifting devices, including supporting calculations, type and amount of any additional reinforcing required for lifting. The Fabricator shall design all lifting devices based on the no cracking criteria in Chapter 8 of the PCI Design Handbook (7<sup>th</sup> edition).
- The minimum compressive strength required prior to release of prestressing and prior to handling the Prestressed Concrete Beam.

#### **Fabrication.**

All Prestressed Concrete Beams shall be fabricated in accordance with the latest edition of PCI MNL-116 as modified herein.

#### **Placement, Finishing and Curing Plan.**

At least 30 days prior to start of fabrication, the Contractor shall submit the Fabricator's proposed Placement, Finishing and Curing Plan to the Engineer. This shall be an independent submittal, separate from the fabrication shop drawings. The Placement, Finishing and Curing Plan shall include the following:

- (k) Method of Mixing
- (l) Method of Placement
- (m) Method of Consolidation
- (n) Method of Finishing
- (o) Method of Initial Curing
- (p) Method of Intermediate Curing
- (q) Method of Final Curing
- (r) Moisture Retention Materials and Equipment (water spray equipment, saturated covers, sheet materials, liquid membrane-forming compounds, accelerated curing equipment, etc.)
- (s) Cylinder Curing Methods, Location, and Environmental Control (temperature, humidity, etc.)
- (t) Temperature Monitoring, Recording, and Reporting

#### **Dunnage Plan Shop Drawings.**

At least 30 days prior to the start of fabrication, the Contractor shall submit proposed Dunnage Plan Shop Drawings to the Engineer of Record for review and approval.

- (a) Proposed layout of the Prestressed Concrete Beams for storage in yard and during shipping
- (b) Support and blocking point locations
- (c) Support and blocking materials



### **Reinforcement.**

The reinforcing bars shall be installed in accordance with Section 901.62 of the Supplemental Specifications, including tolerances for cover and horizontal spacing of bars. Components of mechanical reinforcing bar splicers shall be set with the tolerances shown on the plans. The reinforcing bars and mechanical reinforcing bar splicers shall be assembled into a rigid cage that will maintain its shape in the form and which will not allow individual reinforcing bars to move during the placement of concrete. This cage shall be secured in the form so that the clearances to all faces of the concrete, as shown on the plans, shall be maintained.

### **Placing and Tensioning Strands.**

Placing and tensioning strands shall be in accordance with PCI MNL-116. The location of all prestressing strands shall be as indicated on the plans.

### **Tolerances.**

Fabrication shall comply with tolerances specified on the plans. Tolerances for steel reinforcement placement shall be in accordance with 901.62. In the absence of specifications on the plans, tolerances shall comply with the latest version of the PCI MNL 135, Precast Tolerance Manual.

### **Forms.**

Concrete shall be cast in rigidly constructed forms, which will maintain the Prestressed Concrete Beams within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of the plastic concrete. When wood forms are used, all faces in contact with the concrete shall be laminated or coated with a non-absorbent material. All worn or damaged forms, which cause irregularities on the concrete surface or damage to the concrete during form removal, shall be repaired or replaced before being reused. Any defects or damage of more than “Category 2, Minor Defects” made to the concrete, due to form work, stripping or handling, shall be subject to repair or rejection, as defined in the *Repairs and Replacement* section. If threaded inserts are cast into the elements for support of formwork, the inserts shall be recessed a minimum of 1 inch and shall be plugged after use with a grout of the same color as that of the precast cement concrete.

Where applicable, the material used for forming voids in concrete deck beams and box beams shall be sufficiently strong and resistant to water to support the wet concrete, which is to be packed around the void forms, without collapsing. The void forms shall be securely anchored so that no movement will occur during placing and consolidation of the concrete. Void drains shall be installed at the locations shown on the plans and Fabricator shall ensure that the drains are in contact with the void form. After the beams have been cast and removed from the forms, the Fabricator shall check that the drains are still in contact with the void form by inserting a rigid probe into the drain for a distance greater than the thickness of the concrete at the void drain.

### **Mixing of Concrete.**

The concrete shall be proportioned and mixed in conformance with the Fabricator’s MassDOT approved mix design and M4.02.10 Mixing and Delivery. Fabrication shall not occur without prior MassDOT mix design approval.

### **Placement of Concrete.**

Prior to the placement of concrete, the temperature of the forms shall be greater than or equal to 50°F. Quality Control inspection shall be performed by the Fabricator as specified in the *Fabricator Quality Control* section. The Fabricator shall verify all materials and equipment required for protecting and curing the concrete are readily available and meet the requirements of the *Final Curing Methods* section below. All items encased in the concrete shall be accurately placed in the position shown on the Plans and firmly held during the placing and setting of the concrete. Clearance from the forms shall be maintained by supports, spacers, or hangers and shall be of approved shape and dimension.

During placement, the concrete shall maintain a concrete temperature range between 50°F and 90°F. The Fabricator shall minimize the time to concrete placement (measured from start of mixing to completion of placement). In no event shall time to placement exceed 90 minutes. The Fabricator shall perform additional Quality Control sampling and testing on concrete that has been retempered with admixtures or hold-back water during the placement of the concrete as specified in the *Fabricator Quality Control* section above. Delays or shutdowns of over 30 minutes shall not be allowed during the continuous filling of individual forms.

### **Consolidation of Concrete.**

Suitable means shall be used for placing concrete to prevent segregation or displacement of reinforcing steel or forms. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both. Vibrators shall not be used to move concrete within the forms. Vibrators shall be used as specified in 901.63C. Concrete shall be placed and consolidated in a way that minimizes the presence of surface voids or bug holes on the formed surfaces. When used, self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

### **Finishing of Concrete.**

The top of the prestressed concrete beams shall be given a rake finish with a ¼" amplitude applied transversely across the beam to the limits shown on the plans.

### **Exposed Surfaces of Prestressed Concrete Beams.**

As soon as conditions permit, before the concrete has fully hardened, all dirt, laitance, and loose aggregate shall be removed from the exposed concrete surfaces. Contractor shall not allow foot traffic on the uncured concrete until it has reached sufficient strength to prevent damage.

### **Initial Curing Methods.**

After the placement of concrete and prior to concrete finishing, the Fabricator shall initiate initial curing methods when the concrete surface begins to dry, to reduce moisture loss from the surface. Application of one or more of the following initial curing methods shall occur immediately after the bleed water sheen has disappeared.

#### **Fogging.**

Fogging nozzles shall atomize water into a fog-like mist. The fog spray shall be directed and remain visibly suspended above the concrete surface, to increase the humidity of the air and reduce the rate of evaporation. Water from fogging shall not be worked into the surface during finishing operations and shall be removed or allowed to evaporate prior to finishing.

### **Liquid-applied Evaporation Reducers**

Evaporation reducers shall be sprayed onto the freshly placed concrete surface to produce an effective monomolecular film that reduces the risk of plastic-shrinkage cracking and rate of evaporation of the bleed water from the concrete surface. Evaporation reducers shall be applied in accordance with manufacturer's recommendations.

### **Intermediate Curing Methods.**

The Fabricator shall initiate intermediate curing methods if concrete finishing has taken place prior to the concrete reaching final set. The freshly finished concrete surface shall be protected from moisture loss, by the continuation of initial curing methods (fogging and evaporation reducers) until final curing methods are applied or by the use of liquid membrane-forming curing compounds (see *Liquid Membrane-Forming Compounds for Curing* section).

### **Final Curing Methods.**

The Fabricator shall initiate and apply final curing methods to the concrete immediately after the following conditions are met:

- (a) Completion of concrete finishing
- (b) Final set of concrete
- (c) Concrete has hardened sufficiently enough to prevent surface damage

During fabrication of Prestressed Concrete Beams, the Fabricator shall maintain the required concrete temperature ranges throughout the entire duration of the final curing method cycle as specified herein. Controlled and gradual termination of the final curing method shall occur after all specified conditions are met. The concrete temperature shall be reduced at a rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the final curing method enclosure. The Fabricator shall maintain a minimum concrete temperature of 40°F until 100% f<sub>c</sub> is attained (see *Handling and Storage* section below).

### **Water Spray Curing.**

All exposed concrete surfaces shall remain moist with a continuous fine spray of water throughout the entire duration of the final curing method cycle (see *Table 4: Final Curing Method Cycle for Water Spray*).

**Table 4: Final Curing Method Cycle for Water Spray**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Five (5) days	≥ 80% f <sub>c</sub>

### **Saturated Covers for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of saturated covers throughout the entire duration of the final curing method cycle (see *Table 5: Final Curing Method Cycle for Saturated Covers*). Saturated covers shall be allowed to dry thoroughly before removal to provide uniform, slow drying of the concrete surface.

**Table 5: Final Curing Method Cycle for Saturated Covers**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f <sub>c</sub>

Saturated covers, such as burlap, cotton mats, and other coverings of absorbent materials shall meet the requirements of AASHTO M 182, Class 3. Saturated covers shall be in good condition, free from holes, tears, or other defects that would render it unsuitable for curing concrete. Saturated covers shall be dried to prevent mildew when storing. Prior to application, saturated covers shall be thoroughly rinsed in water and free of harmful substances that are deleterious or cause discoloration to the concrete. Saturated covers shall have sufficient thickness and proper positioning onto the concrete surface to maximize moisture retention.

Saturated covers shall contain a sufficient amount of moisture to prevent moisture loss from the surface of the concrete. Saturated covers shall be kept continuously moist so that a film of water remains on the concrete surface throughout the entire duration of the final curing method cycle. The Fabricator shall not permit the saturated covers to dry and absorb water from the concrete. Use of polyethylene film (see *Polyethylene Film* section) may be applied over the saturated cover to potentially decrease the need for continuous watering.

**Sheet Materials for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of curing sheet materials throughout the entire duration of the final curing method cycle (see *Table 6: Final Curing Method Cycle for Curing Sheet Materials*).

**Table 6: Final Curing Method Cycle for Sheet Materials**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Three (3) days	≥ 80% f <sub>c</sub>

Sheet Materials used for curing, such as polyethylene film, white burlap-polyethylene sheeting, and reinforced paper shall meet the requirements of ASTM C171 and the specifications herein. Sheet materials shall inhibit moisture loss and reduce temperature rise in concrete exposed to radiation from the sun during the final curing method cycle. Adjoining covers shall overlap not less than 12 inches. All edges of the covers shall be secured to maintain a moist environment.

**Polyethylene Film.**

Polyethylene film shall meet the requirements of ASTM C171, consist of a single sheet manufactured from polyethylene resins, be free of visible defects, and have a uniform appearance. Careful considerations shall be taken by the Fabricator to prevent the film from tearing during storage and application, so as to not disrupt the continuity of the film (polyethylene film reinforced with glass or other fibers is more durable and less likely to be torn). The Fabricator shall monitor the application of the film to prevent uneven spots from appearing (mottling) on the concrete surface, due to variations in temperature, moisture content, or both. The Fabricator shall prevent mottling from occurring on the

concrete surface by applying additional water under the film or applying a combination of polyethylene film bonded to absorbent fabric to the concrete surface to retain and evenly distribute the moisture. Immediately following final finishing, polyethylene film shall be placed over the surface of the fresh concrete surface, so as to not damage the surface of the concrete and shall be placed and weighted so that it remains in contact with the concrete throughout the entire duration of the final curing method cycle. The film shall extend beyond the edges of the concrete surface. The film shall be placed flat on the concrete surface, avoiding wrinkles, to minimize mottling. Edges of adjacent polyethylene film shall overlap a minimum of 6 inches and be tightly sealed with the use of sand, wood planks, pressure-sensitive tape, mastic, or glue to maintain close contact with the concrete surface, retain moisture, and prevent the formation of air pockets throughout the entire duration of the final curing method cycle.

**White Burlap-Polyethylene Sheeting**

White burlap-polyethylene sheeting shall meet the requirements of ASTM C171, be securely bonded to the burlap so to avoid separation of the materials during handling and curing of the concrete, and be applied in the same manner as the polyethylene film.

**Reinforced Impervious Paper.**

Reinforced impervious paper shall meet the requirements of ASTM C171, consist of two sheets of kraft paper cemented together with a bituminous adhesive and reinforced with embedded cords or strands of fiber running in both directions, and be white in color. Reinforced impervious paper shall be treated to prevent tearing when wetted and dried.

Reinforced impervious paper can be reused so long as it is effective in retaining moisture on the concrete surface. The Fabricator shall visually inspect the reinforced impervious paper for all holes, tears, and pin holes from deterioration of the paper through repeated use by holding the paper up to the light. The paper shall be discarded and prohibited from use when the moisture is no longer retained.

After the concrete has hardened sufficiently to prevent surface damage, the concrete surface shall be thoroughly wetted prior to the application of the reinforced impervious paper, and be applied in the same manner as the polyethylene film.

**Liquid Membrane-Forming Compounds for Curing.**

All exposed concrete surfaces shall remain moist with a continuous application of liquid membrane-forming compounds throughout the entire duration of the final curing method cycle (see *Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds*).

**Table 7: Final Curing Method Cycle for Liquid Membrane-Forming Compounds**

Sustained Concrete Temperature	Final Curing Method Cycle Duration	Compressive Strength
50°F ≤ °F ≤ 90°F	≥ Seven (7) days	≥ 80% f <sub>c</sub>

Liquid membrane-forming compounds shall meet the requirements of ASTM C 1315, Type I, Class A and shall exhibit specific properties, such as alkali resistance, acid resistance, adhesion-promoting quality, and resistance to degradation by ultraviolet light, in addition to moisture-retention capabilities. Liquid membrane-forming compounds shall consist of waxes, resins, chlorinated rubber, or other materials to

reduce evaporation of moisture from concrete. Liquid membrane-forming compounds shall be applied in accordance with the manufacturer's recommendations.

Liquid membrane-forming compounds shall be applied immediately after the disappearance of the surface water sheen following final finishing. All exposed surfaces shall be wetted immediately after form removal and kept moist to prevent absorption of the compound, allowing the curing membrane to remain on the concrete surface for proper membrane moisture retention. The concrete shall reach a uniformly damp appearance with no free water on the surface prior to the application of the compound.

If patching or finishing repairs are to be performed prior to the application of the compound, the Precast Concrete Bridge Element shall be covered temporarily with saturated covers until the repairs are completed and the compound is applied. Only areas being repaired shall be uncovered during this period. While the saturated covers are removed to facilitate the patching process, the work shall continue uninterrupted. If for any reason the work is interrupted, saturated covers shall be placed onto the uncovered concrete surface, until the work continues and is completed, at which time the curing compound shall be applied to the repaired area.

Careful considerations shall be made by the Fabricator to determine if the evaporation rate is exceeding the rate of bleeding, thus causing the surface to appear dry even though bleeding is still occurring. Under such conditions, the application of liquid membrane-forming compounds to the concrete surface shall be delayed, in order to prevent bleed water from being sealed below the concrete surface and avert map cracking of the membrane films, reduction in moisture-retention capability, and reapplication of the compound. To diagnose and prevent this condition, the Fabricator shall place a transparent plastic sheet over a test area of the uncured and unfinished concrete surface and shall determine if any bleed water accumulates under the plastic.

The compound shall be applied in two applications at right angles to each other to ensure uniform and more complete coverage. On very deeply textured surfaces, the surface area to be treated shall be at least twice the surface area of a troweled or floated surface. In such cases, two separate applications may be needed, each at 200 ft<sup>2</sup>/gal., with the first being allowed to become tacky before the second is applied.

The curing compound shall be applied by power sprayer, using appropriate wands and nozzles with pressures between 25 and 100 psi. For very small areas such as repairs, the compound shall be applied with a wide, soft-bristled brush or paint roller. The compound shall be stirred or agitated before use and applied uniformly in accordance with the manufacturer's recommended rate. The Fabricator shall verify the application rates are in accordance with the manufacturer's recommended rate.

When the concrete surface is to receive paint, finishes, or toppings that require positive bond to the concrete, it is critical that the curing procedures and subsequent coatings, finishes, or toppings be compatible to achieve the necessary bond.

After the termination of the final curing method cycle has occurred, liquid membrane-forming compounds shall be removed by blast-cleaning from any concrete surface that is to receive paint, finishes, plastic concrete from secondary pour, grout, or any other toppings that require bonding to the concrete surface. These surfaces shall be further blast-cleaned to remove the cement matrix down to exposed aggregate to ensure proper bonding to the material. The method used to remove the curing compound shall not damage

the reinforcement and coating. Compounds are prohibited on any concrete surface that will have a penetrating or coating type treatment such as a sealer, stain, or waterproofing membrane applied to it.

**Accelerated Curing.**

Accelerated curing shall use live steam or radiant heat with moisture in accordance with PCI MNL-116 as modified herein. The concrete temperature shall meet the maximum heat increase and cool down rates as specified herein. Concrete temperature monitoring shall meet the requirements of the *Temperature Monitoring* section. Excessive and fluctuating rates of heating and cooling shall be prohibited. The concrete temperature shall not exceed 158°F at any time. The Fabricator shall meet the following accelerated curing sequencing and requirements.

**Initial Delay Period.**

The initial delay period shall be defined as the duration immediately following the placement of the concrete and the attainment of initial set of the concrete. The Fabricator shall determine the time of initial set in accordance with AASHTO T 197 specifications. Throughout the entire duration of the initial delay period, initial curing shall be implemented. The temperature increase period (see *Temperature Increase Period* section) shall not occur until initial set of the concrete is attained. During the initial delay period, the concrete temperature shall meet the following requirements:

- i. Concrete temperature rate of increase shall not exceed 10°F per hour.
- ii. Total concrete temperature increase shall not exceed 40°F higher than the placement concrete temperature or 100°F, whichever is less

**Temperature Increase Period.**

The temperature increase period shall be defined as the duration immediately following the completion of the initial delay period (after initial set) and immediately prior to the start of the constant maximum temperature period. Application of steam to the enclosure shall not occur until the initial delay period is complete. After the initial delay period is complete, all exposed concrete surfaces shall be cured in a moist environment where the concrete temperature increases at a rate not to exceed 36°F per hour.

**Constant Maximum Temperature Period.**

The constant maximum temperature period shall be defined as the duration immediately following the completion of the temperature increase period and immediately prior to the start of the temperature decrease period. After the temperature increase period is complete, all exposed concrete surfaces shall be cured in a moist environment at a controlled and constant elevated temperature throughout the entire duration of the constant maximum temperature period. Termination of the constant maximum temperature period and the start of the termination decrease period shall occur after all specified conditions are met (see *Table 8: Constant Maximum Temperature Period*).

**Table 8: Constant Maximum Temperature Period**

Sustained Concrete Temperature	Constant Maximum Temperature Period	Compressive Strength
120°F ≤ °F ≤ 158°F	6 hrs ≤ Time ≤ 48 hrs	≥ 80% f <sub>c</sub>

### **Temperature Decrease Period.**

After the constant maximum temperature period is complete, the concrete temperature shall be cured in a moist environment at a controlled and reduced rate not to exceed 36°F per hour until the concrete temperature is within 20°F of the ambient temperature outside of the curing enclosure.

### **Release.**

The Fabricator shall not release strands or handle the Prestressed Concrete Beam until Quality Control compressive strength cylinders attain a minimum compressive strength of 80% Design Strength ( $f'_c$ ) or the specified detensioning compression strength as indicated on the approved shop drawings has been achieved. All exposed concrete surfaces shall continue to be cured in conformance with the *Final Curing Methods* sections until completion.

### **Handling and Storage of Prestressed Concrete Beams.**

Prestressed Concrete Beams may be exposed to temperatures below freezing (32°F) when the chosen curing cycle has been completed, provided that the following conditions are met:

- (a) Prestressed Concrete Beams are protected from precipitation with polyethylene curing covers until 100%  $f'_c$  is attained
- (b) Prestressed Concrete Beams maintain a minimum concrete temperature of 40°F until 100%  $f'_c$  is attained

Prestressed Concrete Beams damaged during handling and storage will be repaired or replaced direction at no cost to the TOWN. Prestressed Concrete Beams shall be lifted at the designated points by approved lifting devices embedded in the concrete and in accordance with proper lifting and handling procedures. Storage areas shall be smooth and well compacted to prevent damage due to differential settlement. Prestressed Concrete Beams shall be supported on the ground by means of continuous blocking, in accordance with the approved dunnage plan.

Prestressed Concrete Beams shall be loaded on a trailer with blocking as described above, in accordance with the approved dunnage plan. Shock-absorbing cushioning material shall be used at all bearing points during transportation of the Prestressed Concrete Beams. Blocking shall be provided at all locations of tie-down straps. Prestressed Concrete Beams stored prior to shipment shall be inspected by the Contractor prior to being delivered to the site to identify damage that would be cause for repair or rejection.

### **Repairs and Replacement.**

In the event defects are identified, they shall be classified in the following categories and a non-conformance report (NCR) shall be filed if required. Defects in all categories shall be documented by plant Quality Control personnel and made available to the TOWN upon request. Any required repairs shall utilize materials listed on the MassDOT QCML.

Where noted, defects shall be repaired according to the PCI Northeast Region Guidelines for Resolution of Non-Conformances in Prestressed Concrete Beams, Report Number PCINE-18-RNPCBE. Please note that reference to PCINE-18-RNPCBE is made for repair details only. In the case of conflicts with this Special Provision, this Special Provision shall govern.



### **Category 1, Surface Defects.**

Category 1 defects do not need to be repaired, and an NCR does not need to be filed. Surface defects are defined as the following:

- (a) Surface voids or bug holes that are less than 5/8-inch in diameter and less than 1/4-inch deep, except when classified as Category 4
- (b) Cracks less than or equal to 0.006 inches wide
- (c) Cracks less than or equal to 0.125 inches wide on surfaces that will receive a concrete overlay or spray-applied membrane waterproofing

### **Category 2, Minor Defects.**

Category 2 defects shall be repaired, but an NCR does not need to be filed. Minor defects are defined as the following:

- (a) Spalls, honeycombing, surface voids that are less than 2 inches deep and have no dimension greater than 12 inches
- (b) Cracks less than or equal to 0.016 inches that will not receive a concrete overlay or spray-applied membrane waterproofing
- (c) Broken or spalled corners that will be covered by field-cast concrete

Minor defects shall be repaired according to PCINE-18-RNPCBE. Cracks shall be sealed according to the PCI Repair Procedure #14 in PCINE-18-RNPCBE.

### **Category 3, Major Defects.**

For Category 3 defects, the Fabricator shall prepare an NCR that documents the defect and describes the proposed repair procedure. The NCR shall be submitted to the Engineer for approval prior to performing the repair. Major defects are defined as the following:

- (a) Spalls, honeycombing and surface voids that are deeper than 2 inches or have any dimension greater than 12 inches, when measured along a straight line
- (b) Concentrated area of defects consisting of four or more Category 2 Defects within a 4-square foot area
- (c) Exposed reinforcing steel
- (d) Cracks greater than 0.016 inches and less than or equal to 0.060 inches in width that will not receive a concrete overlay or spray-applied membrane waterproofing
- (e) Bearing area spalls with dimensions not exceeding 3 inches
- (f) Cracks, spalls and honeycombing that will be encased in cast in place concrete need not be repaired, but the limits and location of the defects shall be documented with an NCR

Defects and cracks shall be repaired according to PCINE-18-RNPCBE and this specification. All repairs shall be completed at the expense of the Contractor.

### **Category 4, Rejectable Defects.**

Rejectable defects as determined by the TOWN may be cause for rejection. Fabricator may submit an NCR with a proposed repair procedure, requesting approval. Some rejectable defects are defined as the following:

- (a) Surface defects on more than 5% of the surface area which will be exposed to view after installation
- (b) Minor defects that in total make up more than 5% of the surface area of the unit
- (c) Cracks greater than 0.060 inches in width except as noted in Category 1
- (d) Elements fabricated outside of the specified tolerances
- (e) Compressive strength testing that does not meet the specified Design Strength,  $f'_c$

**Shipping.**

Prestressed Concrete Beams shall remain at the Fabricator's plant for a minimum of 7 days after cast date.

**Delivery.**

Upon Delivery, the following documentation shall be provided to the MassDOT Resident Engineer or designee:

- (a) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Prestressed Concrete Beam's representative subplot.
- (b) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (c) QC Inspection Reports signed by the Quality Control Manager.

The Contractor shall inspect the Prestressed Concrete Beams upon receipt at the site. Prestressed Concrete Beams damaged during delivery shall be repaired or replaced at no cost to the TOWN.

## CONSTRUCTION METHODS – FIELD CONSTRUCTION

### **General.**

All of the Contractor's field personnel involved in the erection and assembly of the Prestressed Concrete Beams shall have knowledge of and follow the approved Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly.

Prior to installation, the following documentation shall be reviewed and confirmed by the MassDOT Resident Engineer or designee:

- (a) QC Compressive Strength Test Report Forms attaining Design Strength,  $f'_c$  for the Prestressed Concrete Beam's representative subplot.
- (b) Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
- (c) QC Inspection Reports signed by the Quality Control Manager.

Field construction staff shall verify that the Resident Engineer has accepted all Prestressed Concrete Beams prior to installation.

### **Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly.**

Prior to the erection, the Contractor shall submit an Erection Procedure and a Quality Control Plan for Prestressed Concrete Beam Assembly for approval by the Engineer. This submittal shall include computations and drawings for the transport, hoisting, erection and handling of the Prestressed Concrete Beams. The Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts with working knowledge of the Contractor's equipment, approved shop drawings, and materials to build the bridge. The Erection Procedure and Quality Control Plan for Prestressed Concrete Beam Assembly shall, at a minimum, include the following:

#### **Erection Procedure**

The Erection Procedure shall be prepared to conform to the requirements of 960.61, Erection and the applicable sections in Chapter 8 of the PCI Design Handbook (seventh edition) for handling, erection, and bracing requirements. At a minimum, the Erection Procedure shall provide:

- (a) Steel reinforcing details, and location and details of lifting devices
- (b) Minimum concrete compressive strength for handling the Prestressed Concrete Beams.
- (c) Concrete stresses during handling, transport, and erection.
- (d) Crane capacities, pick radii, sling geometry, and lifting hardware.
- (e) Verification that the equipment can handle all pick loads and weights with the required factor of safety.
- (f) Evaluation of construction sequence and evaluation of any geometric conflicts in the lifting of the Prestressed Concrete Beams and setting them on the abutments and piers.
- (g) Design of crane supports including verification of subgrade for support.
- (h) Location and design of all temporary bracing that will be required during erection.

### **Quality Control Plan for Prestressed Concrete Beam Assembly**

The Quality Control Plan for Prestressed Concrete Beam Assembly is a document prepared and submitted by the Contractor prior to the start of work which requires the Contractor to identify and detail the sequence of construction in accordance with the project schedule and which clearly identifies all stages of field construction. The assembly procedures for the Prestressed Concrete Beams shall be submitted on full size 24"x36" sheets. This document will be treated as a Construction Procedure and will be reviewed by both the Designer and the District Construction Office.

At a minimum, the Quality Control Plan for Prestressed Concrete Beam Assembly shall include the following:

- (a) Listing of the equipment, materials, and personnel including their assigned responsibilities that will be used to erect and assemble the Prestressed Concrete Beams on site.
- (b) Documentation of all preparatory work necessary for moving personnel, equipment, supplies, and incidentals to the project site before beginning work.
- (c) Detailed schedule showing the sequence of operations that the Contractor will follow to complete the field construction from setting working points and working lines to the casting of closure pours and the curing of the closure pour concrete, as described below and as called for on the plans.
- (d) For NEDBT and NEXT D beams, Contractor's means for ensuring that the Prestressed Concrete Beam shall align to the roadway profile and cross slope and means for adjusting the final deck slab elevation.
- (e) Timeline and descriptions of Quality Control activities to be followed throughout the field construction operations including methods and procedures for controlling tolerance limits both horizontally and vertically.

#### **Survey and Layout.**

Working points, working lines, and benchmark elevations shall be established prior to placement of all elements. The Contractor is responsible for field survey as necessary to complete the work. The TOWN reserves the right to perform additional independent survey. If discrepancies are found, the Contractor may be required to verify previous survey data.

#### **Beam Layout and Erection.**

Prestressed concrete beams shall be installed to the line and grade shown on the plans in accordance with the Contractor's approved Erection Procedure and Assembly Plan.

As the beams are being erected, the Contractor shall monitor the width of the closure pours and the out-to-out width of the beams top flanges so that, after all beams are erected, the actual overall width of the bridge deck shall not deviate from the dimension shown on the plans beyond a tolerance of +0 inches and -1 inches. In order to achieve this, the Contractor may vary the width of the closure pours within the tolerances specified on the plans.

#### **Concrete Deck Slab Placement.**

Prior to casting the deck, the abutments shall be prepared for the placement of the deck concrete as called for on the plans and the Contractor shall cut the lifting devices off below the top of the beam.

The top of the beam shall be clean and free of all laitance. Deck concrete shall be placed against the beam concrete without the use of any bonding agents.

After the formwork has been removed, all threaded inserts that have been cast into the beams for support of the formwork shall be plugged with a grout of the same color as that of the precast concrete.

## **COMPENSATION**

### **Basis of Payment.**

The furnishing, fabricating, and erecting of all Prestressed Concrete Box Beams shall be paid for at the contract unit price per FT under the Lump Sum 995.01, complete in place.

### **Payment Items.**

Prestressed Concrete Box Beams (B36 - 24)                      FT

## **RUBBER-COTTON DUCK BEARING PAD**

The Rubber-Cotton Duck bearing pads used as erection pads for integral abutment bridges shall conform to MassDOT Standard M9.16.1.

The Contractor shall submit to the Engineer a representative 12"x12" sample of the bearing pad material taken from the same Lot for approval.

### **Basis of Payment**

The item shall be paid at the contract unit price per SF under Item 932.1, Rubber-Cotton Duck Bearing Pad, complete in place.

### **Payment Items.**

Rubber-Cotton Duck Bearing Pad                                      SF

**BRIDGE STRUCTURE NO. N-11-007 = W-20-001**

<u>SUB-ITEM NO.</u>	<u>ITEM DESCRIPTION</u>	<u>QTY.</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>TOTAL</u>
482.31	SAWING & SEALING JOINTS IN ASPHALT PAVEMENT AT BRIDGES	48	FT		
901.	4000 PSI, 1.5 INCH, 565 CEMENT	98	CY		
904.	4000 PSI, 3/4 INCH, 610 CEMENT CONCRETE	1	CY		
904.3	5000 PSI, 3/4 INCH, 685 HP CEMENT CONCRETE	18	CY		
904.4	4000 PSI, 3/4 INCH, 585 HP CEMENT CONCRETE	76	CY		
910.1	STEEL REINFORCEMENT FOR STRUCTURES - EPOXY COATED	36,400	LB		
916.001	PRECAST CONCRETE APPROACH SLAB	6	EA		
916.002	PRECAST HIGHWAY GUARDRAIL TRANSITION	4	EA		
930.410	PRESTRESSED CONCRETE BOX BEAMS (B48-24)	233	FT		
965.	MEMBRANE WATERPROOFING FOR BRIDGE DECKS	1,320	SF		
970.	DAMP-PROOFING	1,640	SF		
975.1	METAL BRIDGE RAILING (3 RAIL), STEEL (TYPE S3-TL4)	142	SY		

TOTAL LUMP SUM FOR ITEM 995.01 =

The Lump Sum breakdown quantities provided above are estimated and not guaranteed.

**ITEM 996.4**

**PREFABRICATED CONCRETE MODULAR  
BLOCK WALL (WITH GEOGRID  
REINFORCEMENT)**

**LUMP SUM**

The environmental permits contained in the contract documents depict a Prefabricated Modular Block Wall (PMB) Wall system and layout. If the contractor varies significantly from the system and layout contained in the permits, modification of the permits may be required. Any modification of the permits are at the contractor's expense and the contract completion date will not be altered. The work under this Item shall conform to the relevant provisions of Sections 140, 150, 260, 685, and 901 of the Standard Specifications and the following:

This work shall consist of the construction of reinforced concrete prefabricated modular block walls in accordance with these specifications and in reasonably close conformance with the lines and grades shown on the plans or established by the Engineer. Included in the scope for the PMB Wall construction is all grading necessary for wall construction, excavation, **removal of unsuitable material, such as peat, and or the installation of ground improvements**, installation of gravel borrow, crushed stone, drainage, geotextile, support of excavation, drainage), backfill, construction of leveling pads, segmental unit erection and miscellaneous items necessary for a complete installation. **The issued environmental permits, contained in the bid documents, are for less than 100-cubic yards of dredge and fill for the entire project. The existing permits include the excavation/dredge/fill quantities required to install the PMB walls and bridge's substructure (98-cubic yards), but they do not include the removal quantities of unsuitable material below the PMB walls. If the contractor elects to remove unsuitable material through excavation, permit modification/additional permits will be required. Any modification of the permits/additional permits are at the contractor's expense and the contract completion date will not be altered.**

The PMB Wall design shall follow the general dimensions of the wall envelope shown in the contract plans. The top of the leveling pad shall be located at or below the theoretical leveling pad elevation. The minimum wall embedment shall be at or below the elevation shown on the plans.

**The contractor is directed to the geotechnical report regarding available information on the potential location of unsuitable material. The geotechnical report also contains recommendations on ground improvements. At a minimum, peat and other organic material are considered unsuitable, and shall be excavated and replaced with suitable material and or ground improvements installed. The Contractors methods to excavate the unsuitable material and or install ground improvements shall be included in the PMB wall submission. The PMB wall submission shall be prepared and stamped by a professional engineer licensed in the Commonwealth of Massachusetts and designed in accordance with MassDOT and AASHTO requirements. Partial payments for removal of unsuitable material/ground improvements shall be per each of the 4 PMB Walls installed.**

The Contractor shall require the design-supplier to supply an on-site, qualified experienced

technical representative to advise the Contractor concerning proper installation procedures. The technical representative shall be on-site during initial stages of installation and thereafter shall remain available for consultation as necessary for the Contractor or as required by the Engineer. The cost associated with the representative is incidental to this item.

## **QUALITY ASSURANCE**

PMB Wall's shall be designed and constructed as specified herein. The design shall be subject to review and acceptance by the Engineer. The acceptability of a Prefabricated Modular Block Wall design shall be at the sole discretion of the Engineer. Any additional design, construction, or other costs arising as a result of rejection of a retaining wall design by the Engineer shall be borne by the Contractor.

All calculations and Shop Drawings shall be signed and stamped by a Professional Engineer that is registered in the Commonwealth of Massachusetts.

The PMB Wall system considered appropriate for this project are:

The Redi-Rock Positive Connection (PC) System with limestone texture color natural, or approved equal. Contractor to confirm texture and color with TOWN prior to ordering. This system (28" block), including wall caps and top of wall finishes, were used as the basis of the design/detailing shown on the Drawings. The Contractor may propose an equal alternative (with similar color, texture and aesthetic) for review and approval by the TOWN, but shall be responsible for any adjustment to the geometry, elevations, and details shown on the Drawings to accommodate the selected system.

A geogrid, or geotextile, reinforcement (sub item 694.4) satisfying the design requirements, specifically manufactured for use as soil reinforcement and compatible with the selected units, shall be furnished by one of the following manufacturers:

1. TenCate Geosynthetics.;
2. Strata Systems, Inc.;
3. Tensar Earth Technologies, Inc.; or
4. Engineer-approved equal.

The contractor installing the PMB Wall's shall have demonstrated experience constructing PMB Wall's and shall use personnel having demonstrated experience in the installation procedures recommended by the manufacturers and as specified herein.

All PMB Wall's shall be built in accordance with the Plans and accepted Shop Drawings for the proposed wall systems.

## **ADMINISTRATIVE REQUIREMENTS**

**Preconstruction Meeting.** The General Contractor shall schedule a preconstruction meeting at the project site prior to commencement of retaining wall construction.



Participation in the preconstruction meeting shall be required of the General Contractor, Retaining Wall Design Engineer, Retaining Wall Installation Contractor, Grading Contractor and Resident Engineer. The General Contractor shall provide notification to all parties at least 10 calendar days prior to the meeting.

1. Preconstruction Meeting Agenda:
  - a. The Retaining Wall Design Engineer shall explain all aspects of the retaining wall construction drawings.
  - b. The Retaining Wall Design Engineer shall explain the required bearing capacity of soil below the retaining wall structure and the shear strength of in-situ soils assumed in the retaining wall design to the Resident Engineer.
  - c. The Retaining Wall Design Engineer shall explain the required shear strength of fill soil in the reinforced, retained and foundation zones of the retaining wall to the Resident Engineer.
  - d. The Retaining Wall Design Engineer shall explain any measures required for coordination of the installation of utilities or other obstructions in the reinforced or retained fill zones of the retaining wall.
  - e. The Retaining Wall Installation Contractor shall explain all excavation needs, site access and material staging area requirements to the General Contractor and Grading Contractor.

## **DESIGN REQUIREMENTS**

The PMB Wall's shall be designed to provide the grade separation shown on the Plans with a service life of not less than 75 years.

Concrete used to manufacture PMB Wall's units shall have a minimum 28-day compressive strength of 4,000 psi, as determined in accordance with ASTM C140, and a maximum moisture absorption rate, by weight, of eight (8) percent, as determined in accordance with ASTM C1372/C1776, as applicable.

The PMB Wall's units shall have an integral shear key connection and shall be offset to the minimum wall batter per manufacturer Specification.

Work includes furnishing and installing concrete modular block retaining wall units to the lines and grades designated on the Contract Drawings and as specified herein. Base of footing elevation shall be as shown on the Plans. All wall elements shall be within the right-of-way limits shown on the Plans. The units shall be placed so as not to interfere with drainage or other utilities, or other potential obstructions.

In general, the prefabricated modular block wall system shall be designed in accordance with the manufacturer's requirements, as specified herein and shown on the Plans, and in accordance with latest AASHTO LRFD Standard Specification for Highway Bridges. Where conflicting requirements occur, the more stringent shall govern.

Facing units shall have tongue and groove, ship lap or similar approved connections along all joints, both vertical and horizontal.

Concrete prefabricated modular blocks shall be installed on cast-in-place concrete leveling pads.

All appurtenances behind, in front of, under, mounted upon, or passing through the wall such as guardrail, drainage structures, utilities, fences, concrete parapet wall or other appurtenances shown on the Plans shall be accounted for in the stability design of the wall.

Walls or wall sections which intersect at an angle of one hundred thirty (130) degrees or less shall include a special corner element to cover the joint formed by the abutting walls or wall sections and to permit relative movement. Corner elements shall not consist of connected standard facing units.

A minimum live load surcharge of 250 psf should be applied to account for vehicular traffic and construction equipment (AASHTO Article 3.11.6.4). The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height of soil in accordance with AASHTO Tables 3.11.6.4-1 and 2. **The prefabricated modular block retaining wall shall be designed in accordance with design criteria from the 2020 MassDOT LRFD Bridge Manual Section 3.3.2.4.** The proposed retaining walls should be designed to drain, and therefore, be analyzed assuming hydrostatic pressure will not be applied to the retaining wall. Passive pressure shall be ignored. The PMB Wall's shall be designed for all applicable loading for the guardrail posts located as shown on the contract drawings.

## **MATERIALS**

The Contractor shall be responsible for the purchase or manufacture of the precast concrete modular blocks, geotextile fabric, unit/reinforcement connections, bearing pads, joint filler, and all other necessary components. The Contractor shall furnish to the Engineer the appropriate Certificates of Compliance certifying that the applicable wall materials meet the requirements of the project specifications.

### **Concrete Prefabricated Modular Block Units**

The units shall be fabricated in accordance with Section M4 and Section 901, with the following exceptions and additions:

- A. Precast units may be subject to rejection on account of failure to conform to this specification. Individual units may be rejected because of any of the following:
  1. Variations in the exposed face that substantially deviate from the approved architectural model as to color, texture, relief, and reveals in accordance with precast concrete industry standards.
  2. Dimensions not conforming to the following tolerances:
    - a. Position of unit connection devices within 1", except for coil and loop imbeds which shall be 3/16". All other dimensions within 3/16".
    - b. Unit squareness as determined by the difference between the two diagonals

shall not exceed 1/2".

- c. Surface defects on smooth-formed surfaces measured over a length of five feet shall not exceed 1/8". Surface defects on textured-finished surfaces measured over a length of 5' shall not exceed 5/16".
3. Defects indicating honeycombed or open texture.
  4. Defects which would affect the structural integrity of the unit including cracked or severely chipped units.
- B. Unless otherwise indicated on the plans, the concrete surfaces shall be finished in accordance with Section 901.65 and as modified herein. The units shall be cast on a flat area. The coil embeds, tie strip guide, and other galvanized devices shall not contact or be attached to the face unit reinforcement steel.
  - C. The date of manufacture, production lot number, and the piece mark shall be clearly scribed on an unexposed face of each unit.
  - D. All units shall be handled, stored, and shipped in such a manner as to eliminate the dangers of chipping, discoloration, cracks, fractures, and excessive bending stresses. Units in storage shall be supported in firm blocking to protect the unit connection devices and the exposed exterior finish.
  - E. Reinforcing steel for precast units shall be plain uncoated reinforcing bars in accordance with Section M8.
  - F. Quality assurance and testing will be modified by the following:

Product Data. At least 28 days prior to construction, the General Contractor shall submit retaining wall product submittal package to the Engineer for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:

1. Precast Modular Block System brochure
2. Precast Modular Block concrete test results
  - a. 28-day compressive strength
  - b. Air content
  - c. Slump or Slump Flow (as applicable)
3. Drainage Pipe
4. Geotextile
5. Geosynthetic Soil Reinforcement. The contractor shall provide certified manufacturer test reports for the geosynthetic soil reinforcement material in the manufactured roll width specified. The test report shall list the individual roll numbers for which the certified material properties are valid.

### **Joint Materials**

Cover all joints between units on the back side of the wall with a geotextile fabric. The geotextile fabric shall conform to the requirements of Section M9.50.0, Type II. Slit film and multifilament woven and resin bonded non-woven geotextile fabrics are not allowed for this application. The minimum width of the fabric shall be 12 inches. Lap fabric at least 4 inches where splices are required.

### **Backfill Material (sub item 151.4)**

All backfill materials used in the concrete modular block wall volume shall conform to Gravel Borrow M1.03.0(b), or similar material, and the following additional requirements:

- A. Soundness - The material shall be substantially free of shale or other soft, poor durability particles. The materials shall have a magnesium sulfate soundness loss, as determined by AASHTO T104 (ASTM C88), of less than 30 percent after four cycles.

### **Leveling Pad**

The leveling pad shall be constructed of 4000 psi, 1-1/2 inch, 565-pound cement concrete as specified in Section M4. Leveling pad shall have minimum dimensions of 8 inches thickness and 46 inches width and be placed at the design elevation shown on the plans within a 1/8-inch tolerance. However, the leveling pad can be modified based upon the elected wall system.

### **Acceptance Of Material**

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the above materials comply with the applicable contract specifications. A copy of all test results performed by the Contractor necessary to assure contract compliance shall also be furnished to the Engineer. Acceptance will be based on the Certificate of Compliance, accompanying test reports, and visual inspection by the Engineer.

## **SUBMITTALS**

- A. Design computations and shop drawings demonstrating compliance with the criteria specified herein and shown on the Plans, prepared and signed and stamped by a registered professional engineer licensed in the Commonwealth of Massachusetts. The design calculations shall include:**
  - 1. Statement of all assumptions made and copies of all references used in the calculations.
  - 2. Analyses demonstrating compliance with all applicable earth, water, surcharges, seismic, or other loads, as specified herein and required by the latest AASHTO LRFD Bridge Design Specifications.
  - 3. Analyses or studies demonstrating durability and corrosion resistance of retaining wall systems for the proposed location and environment. The designers shall provide all corrosion protection devices necessary for the retaining wall to

have a minimum service life of 75 years in the proposed location and environment.

- B. A detailed listing of prefabricated modular block walls that the contractor has constructed, including a brief description of each project and a listing of personnel who will construct the walls, demonstrating their experience in construction of prefabricated modular block walls. A reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, address, and current phone number.
- C. Manufacturer's product data for the prefabricated modular block wall system, including material, manufacture, erection specifications, all specified erection equipment necessary, details of buried prefabricated modular block wall elements, structures design properties, type of backfill, and details for connections between facing units.
- D. Shop Drawings showing the configuration and all details, dimensions, quantities, and cross-sections necessary to construct the prefabricated modular block wall, including but not limited to the following:
  - 1. A plan view of the wall which shall include Contract limits, stations and offsets, and the face of wall line shown on the Plans.
  - 2. An elevation view of the wall which shall include the elevations at the top of the wall, at all horizontal and vertical break points, and all steps in the leveling pads. The elevation view shall also show designation as to the type of retaining wall system(s), and an indication of the final ground line and maximum calculated bearing pressures.
  - 3. A typical cross section or cross sections showing the elevation relationship between existing ground conditions and proposed grades, and the proposed wall configuration, including details for the proposed methods for connecting to proposed conditions. The sections shall also indicate the location of the face of wall shown on the Plans.
  - 4. General notes pertaining to design criteria and wall construction.
  - 5. A listing of the summary of material quantities for each wall.
  - 6. Details of sleeves and pipes and other embedded items to be installed through the walls.
  - 7. Clearly indicated details for construction of walls around foundations or any other potential obstructions.
  - 8. Details of the architectural treatment of facing units (smooth flat finish)
  - 9. Drainage design detail and design scheme.
  - 10. Location of utilities.
  - 11. Sequence and schedule of construction, including overall construction schedule.
  - 12. Methods of excavation and requirements for proper backfill.
  - 13. Method of maintaining stability of excavated trenches.
  - 14. Method of monitoring plumbness and deviation of wall.
  - 15. Excavation support system, if any.
  - 16. Any acceptance testing and frequency.

17. Details and location of all necessary construction and expansion joints.
18. Connection details at the interface of the wall and any adjacent proposed abutment structure.
19. Details of impermeable membrane connection to facing units and to runoff collection system.

**E. The Contractors methods to excavate the unsuitable material and or install ground improvements**

## **CONSTRUCTION**

### **Delivery, Storage, And Handling**

The Contractor shall check the material upon delivery to assure that the proper material has been received. A product certification should be provided with each shipment.

All wall materials and modular block units shall be stored elevated from the ground and protected to prevent all mud, wet cement, epoxy, and like substances from affixing themselves to the units or materials. The units shall be supported during storage to prevent excessive bending stress. For storage exceeding 30 days in duration, all materials shall be stored in or beneath a trailer or covered with a colored tarpaulin to prevent long-term exposure.

### **Wall Excavation**

Earth excavations shall be in accordance with the requirements of Section 120 and in close conformity to the limits and construction stages shown on the Plans. Sections 120.80, 120.81, and 120.82 do not apply to the work covered in this section. Payment for excavation and incidentals to complete the excavation are included in the Prefabricated Concrete Modular Block Wall Item.

### **Foundation Preparation**

Unsuitable soils such as organics, peat, clay, soft or yielding materials, if encountered, shall be excavated to firm and stable ground within the footprint of the PMB Wall and replaced with Compacted Structural Fill. Structural Fill may consist of either Gravel Borrow, Type b, M1.03.0), Crushed Stone (3/4 or 1 1/2 inch Crushed Stone, M2.01.1 or M2.01.4)

The foundation for the structure shall be graded level for a width equal to the length of base unit elements plus 1 foot. Prior to wall construction the foundation shall be compacted with at least 10 passes of a smooth wheel vibratory roller weighing at least 10,000 lbs. Compact the foundation area to provide a hard and level surface to support the wall units. The foundation for the structure shall be inspected and approved by the Resident Engineer before erection is started.

### **Wall Erection**

Precast modular block units shall be placed so that their final position is vertical as shown on the Plans. For erection, units are handled by means of lifting devices connected to the upper edge of the unit. Units should be placed in successive horizontal lifts in the sequence shown on the approved Shop Drawings as backfill placement proceeds. As backfill material is placed behind the units, the units shall be maintained in position by means of temporary wedges or

bracing according to the wall supplier's recommendations. Concrete facing vertical tolerances and horizontal alignment tolerances shall not exceed 3/4 inch when measured with a ten-foot straight edge. During construction, the maximum allowable offset in any unit joint shall be 3/4 inch. The overall vertical tolerance of the wall (top to bottom) shall not exceed 1/2 inch per ten feet of wall height.

### **Geogrid**

The minimum length of geogrid reinforcement shall be the greater of the following:

1. 0.7 times the wall design height, H.
2. 8 feet (2.44 m).
3. The length required by design to meet internal stability requirements, soil bearing pressure requirements and constructability requirements.

Geogrid Reinforcement: Geogrid reinforcement shall be placed in sequence with the PMB Wall units, drainage fill material and Granular Backfill for PMB Wall's.

1. All geogrid reinforcement shall be installed at the proper elevation and orientation as shown on the approved shop drawings and in accordance with the PMB Wall manufacturer guidelines.
2. Geogrid reinforcement layers shall be one continuous piece for the entire embedment length. Splicing of the geogrid reinforcement in the design strength direction shall not be permitted.
3. Tracked construction equipment shall not be operated directly on the geogrid reinforcement. A minimum of six (6) inches of Granular Backfill for PMB Wall is required prior to operation of tracked equipment over the geogrid reinforcement. Turning shall be kept to a minimum. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds (less than five (5) miles per hour).
4. Geogrid reinforcement shall be free of wrinkles prior to the placement of Granular Backfill for PMB Wall. Nominal tension shall be applied and the geogrid reinforcement shall be secured in place with staples, stakes, or by hand tensioning until the geogrid reinforcement is covered by six (6) inches of Granular Backfill for PMB Wall.

### **Backfill Placement**

Backfill placement shall closely follow erection of each course of units. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the facing units. Any wall materials which become damaged during backfill placement shall be removed and replaced at the Contractor's expense. Any misalignment or distortion of the wall facing units due to placement of backfill outside the limits of this specification shall be corrected at the Contractor's expense.

Backfill shall be compacted to 95 percent of the maximum density as determined by AASHTO T-99, Method C or D (with oversize corrections as outlined in Note 7 of that test). For backfills containing more than 30 percent retained on the 3/4inch sieve, a method of compaction

consisting of at least 4 passes by a heavy roller shall be used.

The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift.

The maximum loose lift thickness before compaction shall not exceed 12 inches. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

Compaction within three feet of the back face of the wall shall be achieved by at least three passes of lightweight mechanical tamper, roller, or vibratory system.

At the end of each day's operation, the Contractor shall slope the last lift of the backfill away from the wall facing to rapidly direct runoff away from the wall face. In addition, the Contractor shall not allow surface runoff from other areas to enter the wall construction site.

### **Drainage**

The Contractor is responsible for the design of the drainage system depending on the elected wall system. This pipe or tubing shall consist of slot-perforated corrugated polyethylene tubing, couplings and fittings. Materials, dimensions, physical properties and fabrication shall be in conformance with AASHTO M 252.

If weep holes are to be used through the face units along the wall, they can either be shop fabricated or field cored.



## **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

Item 996.4. **PREFABRICATED CONCRETE MODULAR BLOCK WALL (WITH GEOGRID REINFORCEMENT)** included in this item are all grading necessary for wall construction, excavation, removal and disposal of unsuitable material and or ground improvements, gravel borrow, crushed stone, drainage, geotextile, support of excavation, backfill, construction of leveling pads, segmental unit erection and miscellaneous items necessary for a complete installation, technical representative, survey and wall design engineer.

Payment will be at the contract unit price of lump sum for design, fabrication, transportation, and erection of Prefabricated Modular Block Walls (With Geogrid Reinforcement), including excavation, test pits, removal of unsuitable material and or ground improvements, support of excavation, control of water, backfill, gravel borrow, crushed stone, drainage, leveling pad and miscellaneous items necessary for a complete installation. Price and payment will be full compensation for all labor, tools, equipment, materials, and incidental expense necessary to complete this Item to the satisfaction of the Engineer.

### **BREAKDOWN OF ITEM 996.4 PREFABRICATED CONCRETE MODULAR BLOCK WALL (WITH GEOGRID REINFORCEMENT) (LUMP SUM)**

<u>SUB ITEM</u>	<u>DESCRIPTION</u>	<u>QTY</u>	<u>UNIT</u>
141.	CLASS A TRENCH EXCAVATION	1600	CY
144.	CLASS B ROCK EXCAVATION	240	CY
151.4	GRAVEL BORROW FOR PMB WALL	1400	CY
156.	CRUSHED STONE	800	TON
269.06	6 INCH SLOT-PERFORATED CORRUGATED PLASTIC PIPE (SUBDRAIN)	375	FT
694.41	GEOGRID REINFORCEMENT	1800	SY
901.	4000 PSI, 1.5 INCH, 565 CEMENT CONCRETE	40	CY
-	REMOVAL OF UNSUITABLE MATERIAL/GROUND IMPROVEMENTS	4	EA
-.	PREFABRICATED CONCRETE MODULAR BLOCK WALL	1	LS

The Lump Sum breakdown quantities provided above are estimated and not guaranteed.

## **STATE WAGE RATES**