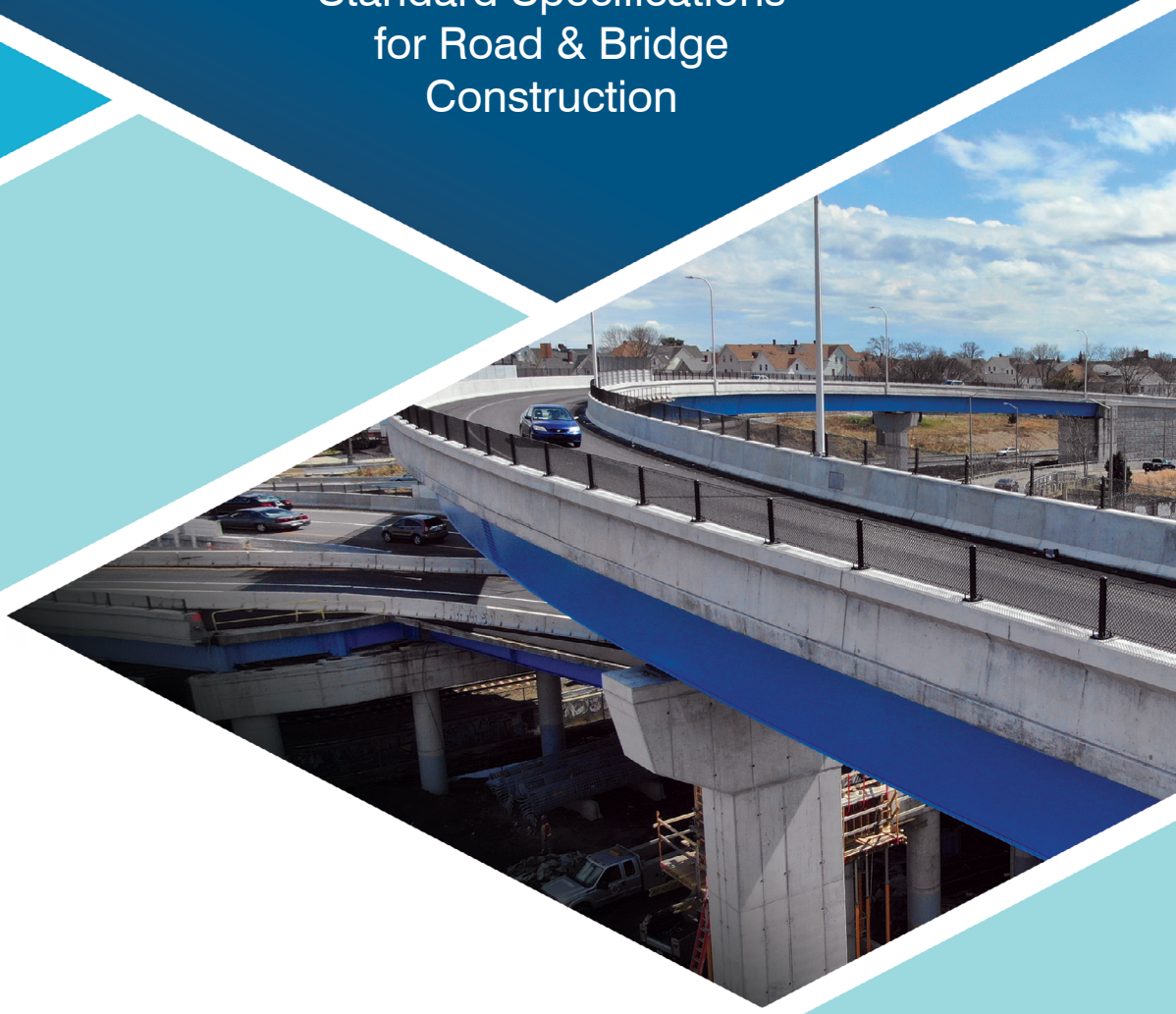
2022 EDITION

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

Standard Specifications for Road & Bridge Construction



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PREFACE

The 2022 edition of the Rhode Island Department of Transportation *Standard Specifications for Road and Bridge Construction* will be used on all Contract work awarded by the Rhode Island Department of Transportation and may also be incorporated by reference into Contract work on local, secondary, or transit systems or into other Contract work in which the Department has an interest.

The 2022 Specifications replace the 2004 edition of the *Standard Specifications for Road and Bridge Construction*, as amended, and all Compilations, Supplemental Specifications, and other revisions, modifications, and updates to the 2004 edition published from 2004 through 2021.

These Specifications shall control the work on Rhode Island Department of Transportation construction Contracts, except were modified by Supplemental Specifications or the Contract Special Provisions, for all Contracts awarded by the Department subsequent to the publication of the 2022 edition. If conflicts exist between the Contract provisions and these Specifications, the Contract provisions shall govern.

This publication is not available in print format but may be obtained on the Department of Transportation's website: https://www.dot.ri.gov/business/bluebook.php.

ACKNOWLEDGEMENTS

The 2022 edition of the Rhode Island Department of Transportation *Standard Specifications for Road and Bridge Construction* was developed by the Department's Specification Groups, with oversight and technical assistance provided by the following:

Peter Alviti, Jr., P.E., Director
Loren Doyle, Chief Operating Officer (Acting)
Lori A. Fisette, Administrator of Project Management (Acting)
John J. Igliozzi, Esq., Assistant Director for Legal Services/Chief of Staff
James R. Primeau, P.E., PMP, Managing Engineer, Scoping & Compliance
Robert Soscia, P.E., Managing Engineering, Scoping & Compliance
Myles C. Beltram, Esq., Chief of Legal Services, Office of Legal Counsel
Brian Ferguson P.E., Deputy Chief Engineer, Construction Management
Lawrence Bailey, P.E., Managing Engineer, Construction Management
Jose S. Lima, Manager, Materials Management
Michael Byrne, P.E., Managing Engineer, Materials Management
Michael D. Sock, Principal Civil Engineer, Materials Management
Courtney M. Raymond, P.E., PMP, Project Manager II, Project Management
Sean Raymond, P.E., Managing Engineer, Safety/Traffic
Keith Gaulin, P.E. Managing Engineer, Bridge Engineering
Mary Vittoria-Bertrand, P.E., Chief Civil Engineer, Bridge Engineering
Alisa Richardson, P.E., PMP, Administrator (Acting), Environmental Division
Joseph D. Baker P.E., PMP, Manager, Project Management, Stormwater Management
Susan Votta, RLA, Supervising Landscape Architect, Environmental Division

Federal Highway Administration
American Council of Engineering Companies of Rhode Island (ACEC-RI)
Construction Industries of Rhode Island (CIRI)
Roy Jorgensen Associates, Inc. in association with GM2 Associates, Inc.

Blue Book Cover Design by Jonathan Murray, RIDOT Communications

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GENERAL REQUIREMENTS AND COVENANTS

SECTION 101 — DEFINITIONS AND TERMS

101.01 GENERAL.

The titles and headings of the Sections and Subsections are for convenience and do not bear on the meaning of the text. A cross reference to a specific Subsection includes all general requirements of the Section of which the Subsection is a part.

Action required of the Bidder or Contractor in these Specifications is written as a command in the active voice, imperative mood to communicate the Bidder's or Contractor's responsibilities in a direct manner, with the exception of PART 100. The subject “the Bidder” or “the Contractor” is understood. Omission of words or phrases such as “the Contractor shall,” “unless otherwise specified,” or “unless otherwise directed” is intentional. Interpret the Specifications as if they were included. Sentences that define the Department’s responsibility are written in the indicative mood, in either active or passive voice.

The passive voice may leave the reader unclear as to who is responsible for the activity, and it often yields awkward reading. The active voice tells the reader what to do and/or who performs the activity. For example:

- Passive Voice: The Shop Drawings shall be submitted by the Contractor and approved by the RIDOT Engineer before initiating work.
- Active Voice, Indicative Mood: The Contractor submits the Shop Drawings and obtains the RIDOT Engineer’s signature before initiating work.
- Active Voice, Imperative Mood: Complete the Shop Drawings and obtain the RIDOT Engineer’s signature before initiating work.

When a publication is specified, it refers to the currently adopted version, including all applicable updates and official interpretations, before the date of Proposal Bid opening for the Project unless the publication issue has a specific date or year.

Acronyms, abbreviations, terms, or pronouns used in the Contract shall be interpreted as defined in this Section.

101.02 ACRONYMS AND ABBREVIATIONS.

Acronyms and abbreviations used in the Contract shall mean the following:

AADT	Annual Average Daily Traffic
AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
AGC	Associated General Contractors of America

AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALS	American Lumber Standards
ANSI	American National Standards Institute
ARA	American Railway Association
AREA	American Railway Engineering Association
ARTBA	American Road and Transportation Builders Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CPA	Certified Public Accountant
CPM	Critical Path Method
CRSI	Concrete Reinforcing Steel Institute
DHV	Design Hourly Volume
EPA	Environmental Protection Agency
ESAL	Equivalent Single Axle Loads
FHWA	Federal Highway Administration; U.S. Department of Transportation
FSS	Federal Specifications and Standards
IME	Institute of Makers of Explosives
IMSA	International Municipal Signal Association
MASH	Manual for Assessing Safety Hardware
MIL	Military Specifications
MUTCD	Manual on Uniform Traffic Control Devices (For Streets & Highways)
NCHRP	National Cooperative Highway Research Program
NEC	National Electrical Code
NESC	National Electrical Safety Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NRMCA	National Ready Mix Concrete Association
NTPEP	National Transportation Product Evaluation Program
OSHA	Occupational Safety and Health Administration
QCP	Quality Control Plan
RIDOT	Rhode Island Department of Transportation
RIGL	General Laws of the State of Rhode Island
ROC	Report of Change
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
TMP	Transportation Management Plan
UL	Underwriters Laboratory
USC	United States Code
USGS	United States Geological Survey

101.03 ACCEPTANCE.

The Engineer’s decision that the Contractor’s work is in conformance with the Contract.

Acceptance is the system used by the Engineer to measure the degree of compliance with Contract requirements. Acceptance sampling and testing is the responsibility of the Engineer and

will be performed according to the Master Schedule of Testing. Acceptance is based on the Engineer's inspection of the work, acceptance sampling and testing, and monitoring of the Contractor's QC efforts.

101.04 ACTS OF NATURE.

Events in nature so extraordinary that the history of climate variations and other conditions in the particular locality affords no reasonable warning of or preparation for the events, including but not limited to earthquakes, lightning strikes, tidal waves, tornadoes, hurricanes, floods, or other cataclysmic phenomena of nature.

101.05 ADDITIONAL WORK.

Work which results from a change or alteration in the Contract and for which there are existing Contract unit prices.

101.06 ADJUSTMENT.

A modification to the Contract Price or Time occasioned by the performance of work beyond that required by the original Contract, including but not limited to Additional Work, Extra Work, Differing Site Conditions, Altered Work or Significant Changes in the Character of Work, and Suspensions of Work.

101.07 ADVERTISEMENT.

A public announcement inviting bids for work to be performed and/or materials to be furnished.

101.08 APPROVAL.

The Engineer's review and concurrence of the Contractor's submittals, submissions, or work for conformance with the Contract. The Engineer's approval does not relieve the Contractor from any requirements of the Contract. Approval does not constitute acceptance. The terms "Approval" and "Approved" are used synonymously.

101.09 AWARD.

The executed Contract Agreement and a Purchase Order issued by the State. The Award date shall be the date of the Purchase Order.

101.10 BID.

The written offer of a Bidder, submitted on prescribed forms generated by the State's procurement system, to perform the Work at the Contract Price and within the Contract Time and unit prices quoted. The terms "Bid" and "Proposal" are used synonymously.

101.11 BID BOND.

The security furnished by the Bidder with the bid as a guaranty that the Bidder will execute the Contract Agreement if his bid is accepted by the State. The Bid Bond shall be provided by a surety acceptable to the State and licensed and authorized to conduct business in the State of Rhode Island and shall be listed with the Department of the Treasury, Fiscal Services, Circular 570 (latest revision published by the Federal Register). The terms “Bid Bond” and “Proposal Guaranty” are used synonymously.

101.12 BIDDER.

An individual, partnership, firm, corporation, joint venture, or legal entity formally submitting a Bid pursuant to the Advertisement. The terms “Bidder” and “Contractor” are used synonymously.

101.13 BID DOCUMENTATION.

All writings, working papers, computer printouts, charts, computer data files associated with the preparation, and/or submittal of a Bid, and all other information, data, or calculations used by the Contractor to determine its Bid for a Project. Bid documentation shall include but not be limited to:

- All materials relating to the determination and application of equipment rates
- Overhead rates
- Labor rates
- Production rates and productivity factors
- Calculations
- Schedules for time or any determination of time related to Project overhead
- Quotations from Subcontractors and material suppliers if these rates and quotations were used by the Contractor in formulating and determining the Bid amount

Bid documentation shall also include any manuals used by the Contractor in determining its Bid. These manuals may be included in the bid documentation by reference and will show the name and date of the publication and the publisher. The term does not include bid documents provided by the Department for use by the Contractor in bidding on a Project.

101.14 BID SCHEDULE.

The portion of the Proposal form where the various Contract Items are listed in a numbered sequence and that includes the unit prices entered by the Bidder, the estimated quantities by the Department, and the extended total bid amounts of each item, which are computed by the State’s procurement system.

101.15 BRIDGE.

A structure, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads.

and having a length measured along the center of roadway of more than 20 ft between undercopings of abutments or extreme ends of openings for multiple boxes.

a. Bridge Length. The length of a bridge structure is the overall length measured along the line of survey stationing back-to-back of backwalls of abutments, if present, or otherwise end to end of the bridge floor, but in no case less than the total clear opening of the structure.

b. Bridge Roadway Width. The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or, in the case of multiple heights of curbs, between the bottom of the lower risers or, in the case of no curbs, between the inner faces of parapet of railing.

101.16 CALENDAR DAY.

A day shown on the calendar comprising the 24-hr period beginning and ending at midnight.

101.17 CLAIM.

A formal, written notification certified by the Contractor to the Department, asserting or justifying the right to additional compensation and/or Contract time, or other changes to the Contract.

101.18 COMPLETION.

The compliance with all Contract requirements including the delivery of all documents, certificates, and proofs of compliance to the Engineer, and if the Department has issued its Final Acceptance. The terms “Completion” and “Final Completion” are used synonymously.

101.19 CONSENT DECREE.

The settlement between RIDOT and EPA (CV-15-433), which directs RIDOT activities related to stormwater planning, illicit discharge detection, drainage repairs, stormwater treatment, and maintenance.

101.20 CONSTRUCTION AND MAINTENANCE AGREEMENT/UTILITIES.

An agreement between the State, acting through its Department of Transportation, and the Owners of Utilities (Owners). Owners may be either Municipalities or private Utility Companies. The agreements establish conditions for removing, relocating, or otherwise altering the location of utilities to facilitate proposed highway and bridge construction work. The agreements divide responsibility for such alterations between the two parties and establish payment procedures by which the State will reimburse the Owners for Cost they incur in performing their respective portions of the Work.

101.21 CONSTRUCTION MANAGER.

The authorized field representative of and working under the direct supervision of the Engineer. The Construction Manager's main responsibility is to supervise construction for the purpose of assuring compliance with approved Plans and Specifications, and the terms of the Contract.

101.22 CONTRACT.

The formal written agreement between the State and the Contractor for the performance of the prescribed Work and consisting of the following:

a. Purchase Order. A document issued by the State and transmitted to the Contractor with copies of the executed Contract, which indicates that the appropriate accounts have been established and that funds have been assigned to those accounts for reimbursing the Contractor for its Work in implementing the Contract.

b. Contract Agreement. The written agreement, executed by the State and the Contractor setting forth the obligations of the parties for the performance of the Work.

c. Contract Documents. Documents required to complete the performance of the Contract in an acceptable manner. The documents include:

- Notice to Contractor (advertisement for bids)
- The Contract Award Booklet
- Proposal
- Contract Bond(s)
- Standard Specifications
- Supplemental Specifications
- General Provisions
- Supplement General Provisions
- General Provisions – Contract Specific
- Specifications – Job Specific
- Special Provisions
- Required Contract Provisions Federal-Aid Construction Contracts
- General and Detailed Plans
- Notice of Award
- Notice to Proceed
- Any subsequently executed Contract Addenda

d. One Instrument. The Purchase Order, executed Contract Agreement, and Contract Documents constitute one instrument; i.e., the Contract.

101.23 CONTRACT ADDENDUM.

Any change to the Contract made after its initial execution, which change shall become part of the Contract Agreement. Contract Addenda shall be in writing and executed by the original signatories, their successors in interest, or their designees. The terms "Contract Addendum" and "Contract Amendment" are used synonymously.

101.24 CONTRACT AWARD BOOKLET.

A document provided to the Contractor after Contract award containing the following elements of the Contract Documents:

- Notice to Contractors
- Bidder's Proposal
- Executed copies of both the Contract Agreement and Contract Bonds
- Contract Award compact disc (CD), or other media, containing:
  - Rhode Island *Standard Specifications for Road and Bridge Construction*
  - Supplemental Specifications
  - Special Provisions
  - Required Contract Provisions for Federal-Aid Projects
  - Federal Wage Rates
  - All Contract Addenda issued before the date of the opening of proposals
  - Distribution of Quantities
  - Plans
  - Appendices
  - Bid Tabulation Reports

101.25 CONTRACT BID PACKAGE.

Documents provided to prospective bidders for bid preparation purposes, containing the following items:

- Rhode Island *Standard Specifications for Road and Bridge Construction*
- Supplemental Specifications
- Special Provisions
- Required Contract Provisions for Federal-Aid Projects
- Federal Wage Rates
- Distribution of Quantities
- Plans
- Appendices

101.26 CONTRACT BOND.

The approved security furnished by the Contractor and its Surety or Sureties as a guaranty to fulfill the terms of the Contract and all amendments thereto and to pay all legal debts pertaining to the construction of the Project.

101.27 CONTRACT ITEM.

An item of Work, as provided in the Contract, for which a price is provided in the Proposal. The terms "Contract Item," "Pay Item," and "Bid Item" are used synonymously.

101.28 CONTRACT PRICE.

The total amount of the Award.

101.29 CONTRACT TIME.

The number of days allowed for the completion of the Contract or the date by which the Contract shall be completed as stated in the Proposal, including any approved time extensions. The Contract Time includes Winter Shutdown. The terms “Contract Time” and “Contract Completion Date” are used synonymously.

101.30 CONTRACTOR.

The individual, partnership, firm, corporation, joint venture, or legal entity contracting with the State for performance of the Work. The terms “Contractor” and “Bidder” are used synonymously.

101.31 COST.

The Contractor’s actual expenses to provide labor, material, equipment (owned or rented), and administrative overhead necessary for the Work. The Contractor shall substantiate these costs with documentation (e.g., paid Invoices, certified payrolls, financial statements) as required by the Engineer. The Department may audit the Contractor’s financial records to determine these expenses.

101.32 COUNTY.

The administrative division of cities and towns according to RIGL and is the location of the Work to be performed pursuant to the Contract.

101.33 CRITICAL PATH.

The longest path of activities through a Project or a specified milestone/phase that determines the Project duration and the anticipated Substantial Completion date.

101.34 CULVERT.

A structure not classified as a Bridge that provides an opening under any highway.

101.35 DAILY CHARGE.

The monetary per diem rate(s) for Liquidated Damages specified in the Contract.

101.36 DELAY.

An event, action, or factor causing all or a portion of the Work to extend beyond the specified Contract Time.

101.37 DEPARTMENT.

The State of Rhode Island, acting by and through its Department of Transportation (RIDOT).

101.38 DIG SAFE.

A one-call damage prevention system, established and funded by public utilities that own and operate underground facilities within the State, for receiving and providing notice of proposed excavation activity pursuant to RIGL.

101.39 DISTRIBUTION OF QUANTITIES.

A document provided as part of the Contract Bid Package that provides the following information for each Contract Item in the Proposal:

- Item Number
- Item Code
- Item Description
- Item Unit of Measure
- Approximate locations where the Item is to be provided
- Estimated Item quantities at each location and total estimated Item quantity

101.40 DIVISION OF PURCHASES.

The Division within the Rhode Island Department of Administration primarily responsible for Contract Procurement.

101.41 ENGINEER.

The Chief Engineer or equivalent of RIDOT, acting directly or through his or her duly authorized representatives, who is a full-time employed State engineer responsible for engineering and administrative supervision of the Contract. Within the Project Management Division as organized by RIDOT, the Engineer is the highest-ranking individual who meets the definition of engineer as found in Rhode Island General Law § 5-8-2(e). The Engineer is the individual with responsible charge who may delegate the day-to-day responsibilities for the Project and will be identified on an annual basis. The Engineer will maintain responsibility for the Project and will have oversight over those staff that are designated for day-to-day field operation.

101.42 ENVIROMENTAL MONITOR.

A qualified environmental professional who provides services to ensure compliance with environmental Project commitments throughout the design, construction, and/or maintenance phases of a Project.

101.43 EQUIPMENT.

All machinery, tools, apparatus, and supplies necessary to preserve, maintain, construct, and complete the Work.

101.44 EXTRA WORK.

Work not provided for in the Contract as awarded but found essential by the Engineer for the satisfactory completion of the Contract within its intended scope.

101.45 FAILURE TO COMPLY CHARGE.

A specified amount charged for non-compliance of the Contract.

101.46 FINANCIAL STATEMENTS.

A set of reports detailing, on an annual, semi-annual, or other prescribed time period, the financial activity of a company, corporation, or other business venture.

101.47 FORCE ACCOUNT.

A method of payment for Work performed by the Contractor at the Engineer's direction, calculated as specified in **Subsection 109.04**.

101.48 HIGHWAY, STREET, OR ROAD.

A general term denoting a public way for vehicular and pedestrian travel, including the entire area within the Right-of-Way. The terms "highway," "street," and "road" are used synonymously.

101.49 HOLIDAYS.

In the State of Rhode Island, legal holidays occur on New Year's Day; Martin Luther King Day; Memorial Day; Independence Day; Victory Day; Labor Day; Columbus Day; Election Day in even numbered years; Veteran's Day; Thanksgiving Day; and Christmas. If any holiday falls on a Saturday or Sunday, the following Monday shall be considered a holiday.

101.50 INCIDENTAL.

Work performed under the provisions of the Contract and for which no direct compensation is required.

101.51 LABORATORY.

A State testing facility or any other testing facility that may be designated or approved by the Engineer. On Federal-Aid Projects, all laboratories shall be accredited or qualified, as applicable, according to the CFR.

101.52 LIMIT OF DISTURBANCE.

The outermost boundary of the area planned to be disturbed by construction, material storage, grading, grubbing, or landscaping as indicated by the approved design Plan. The area outside this boundary shall not be touched.

101.53 LIQUIDATED DAMAGES.

The daily amount set forth in the Contract to cover additional costs incurred by the Department because of the Contractor's failure to complete the work within the time required by the Contract.

101.54 MAJOR AND MINOR CONTRACT ITEMS.

Any item having an original value in excess of 5 percent of the original Contract amount will be a major item. All other original Contract items will be minor items. In addition, any minor item that has been increased by 100 percent will be considered a major item. The revised quantity will then be considered the original Contract quantity to determine a major item of work under **Subsection 104.07**.

101.55 MATERIALS.

Any substances specified for use in the construction of the Project.

101.56 NON-RESPONSIVE PROPOSAL.

A proposal that is not eligible for Award consideration as determined by the State pursuant to **Subsection 102.07**.

101.57 NOTICE TO CONTRACTORS.

A public announcement inviting Bids for work to be performed and/or materials to be furnished. This Notice will indicate with reasonable accuracy the nature and location of the work to be performed; the time and place of the opening of Proposals; and any Contract statutory provisions required by the Federal Government or the State.

101.58 NOTICE TO PROCEED.

First written notice to the Contractor to proceed with the work identifying the start date for Contract time.

101.59 NOTICE OF TENTATIVE AWARD.

A written communication from the State to the successful Bidder indicating the conditional intention of the State to award the Contract. This communication instructs the successful Bidder to arrange the Contract Agreement and Contract Bond, and to arrange the delivery of the required Certificates of Insurance. “Apparent Low Bidder Letter” is used synonymously.

101.60 PAVEMENT STRUCTURE.

The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute the load to the subgrade.

a. Pavement Subgrade. The top surface of the roadbed on which the subbase, base course, surface course, pavement, or layers of similar materials are placed.

b. Subbase. The layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

c. Base Course. The one or more layers of specified material and thickness placed on a subbase or a subgrade to support a surface course.

d. Surface Course. One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called the "wearing surface."

101.61 PHASE COMPLETION.

The Substantial Completion of a portion of the Work as set forth in the Contract. The terms "Phase," "Milestone," and "Interim" are used synonymously.

101.62 PLANS.

The Department's Contract drawings, profiles, typical cross sections, standard details, notes, and supplemental drawings or exact reproductions showing the location, character, dimensions, and details of the Work. "Plans" and "Contract Drawings" are used synonymously.

101.63 PRECONSTRUCTION CONFERENCE.

A meeting between the Department and the Contractor to discuss the Project.

101.64 PROFILE GRADE.

The trace of a vertical plane intersecting the top surface of the proposed roadway, usually along the longitudinal centerline of the roadbed. Profile grade means either the elevation or gradient of the trace according to the context provided.

101.65 PROJECT.

The specific section of the highway or property on which construction will be performed including all improvements to be constructed under the Contract.

101.66 PROJECT COMMITMENTS.

Actions to mitigate (restore, enhance, avoid, minimize, and/or compensate) activities to the human environment made during the National Environmental Policy Act (NEPA) process, environmental permit requirements, and other legal and regulatory requirements related to environmental compliance.

101.67 PUNCH LIST.

An itemized list of non-conforming Work to be repaired or corrected, and the outstanding submission(s) of all executed documents, certificates, or proofs of compliance, all as required by the Contract.

101.68 REPETITION OF EXPRESSIONS.

To avoid cumbersome and confusing repetition of expressions in these Specifications, when anything is, or is to be, done, if, as, or, when, or where “contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered, necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected or condemned,” it shall be understood that the expression is followed by the words “by the Engineer” or “to the Engineer.”

101.69 REPORT OF CHANGE (ROC).

Documentation describing the need for a change to the Contract. The terms “Report of Change” and “Change Order” are used synonymously.

101.70 REQUEST FOR COMPENSATION.

Written notice by the Contractor of the State’s action, lack of action, or other situations that may result in a Contract revision.

101.71 RESPONSIBLE BIDDER.

A Bidder that the State determines possesses the skill, ability, resources, and integrity to perform the Contract.

101.72 RESPONSIVE BID.

A bid conforming in all respects to the terms and conditions of the Advertisement.

101.73 RIGHT-OF-WAY.

A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

101.74 ROADBED.

The shaped subgrade of a highway within top and side slopes, prepared as a foundation for the pavement structure.

101.75 ROADSIDE.

A general term denoting the areas between the outer edge of the roadway and the Right-of-Way boundaries and may also include the areas between the roadways of a divided highway.

101.76 ROADSIDE DEVELOPMENT.

Those items necessary for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, or

mulching and the placing of other ground covers; and suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

101.77 ROADWAY.

That portion of a highway improved, designed, or ordinarily used for vehicular travel, paved shoulders and parking lanes, but exclusive of the sidewalk, berm, or unpaved shoulder although the sidewalk, berm, or unpaved shoulder may be used by persons riding bicycles or other human-powered vehicles.

101.78 QUALITY ASSURANCE (QA).

QA applies to those planned and systematic actions necessary to provide confidence that the Work or material will satisfy given requirements for quality. QA includes Quality Control (QC) and Acceptance.

101.79 QUALITY CONTROL (QC).

Operational techniques and activities used to control the quality of a product or service to satisfy the given requirements. QC is the system used by the Contractor to monitor, assess, and adjust production and placement processes to ensure that Work and material meet the specified quality.

101.80 QUALITY CONTROL PLAN (QCP).

A Contractor-prepared plan describing the type and frequency of Contractor inspection, sampling, and testing necessary to measure and control the various properties governed by the Contract specifications.

101.81 SHOULDER.

The portion of the Roadway adjacent to the traveled way for the accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses. Shoulders may be paved or unpaved. If paved, it becomes a portion of the Pavement Structure and Roadway.

101.82 SIDEWALK.

That portion of the Right-of-Way constructed for pedestrian use.

101.83 SPECIALTY ITEMS.

The Work required to implement specialty items considered to be a type that a Contractor would not generally perform with its own resources. Those specific Work items listed in either the Bid Schedule or elsewhere in the Contract with Item Numbers designated by the prefix “S”.

101.84 SPECIFICATIONS.

The compilation of provisions consisting of the following:

a. Standard Specifications. A publication of specifications approved for general application and repetitive use. Specifically, the "Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction" of latest revision.

b. Supplemental Specifications. Approved additions and revisions to the Standard Specifications, including General Provisions and Compilations of Approved Specifications.

c. Special Provisions. Additions and revisions to the Standard and Supplemental Specifications applicable for an individual Project, including General Provisions – Contract Specific, Specifications – Job Specific, and Appendices.

d. Plans.

101.85 SOIL STABILIZATION.

Modification of soils or aggregates by incorporating materials and/or implementing engineered process(es) that will improve or develop its suitability for the Work.

101.86 STATE.

The State of Rhode Island acting through its authorized representatives.

101.87 STRUCTURES.

Bridges (foundations, substructures, superstructure, endwalls), conduits, culverts, catch basins, drop inlets, retaining walls, cribbing/bridge-shoring, manholes, light-poles and support members, sign-poles and support members, buildings, foundations, sewers, service pipes, underdrains, storm-drains, foundation drains and other human-made features that may be encountered or incorporated in the Work.

101.88 SUBCONTRACTOR.

The individual, partnership, firm, corporation, joint venture, or legal entity with whom the Contractor sublets part of the Work.

101.89 SUBSTANTIAL COMPLETION.

Substantial completion of a unit, or portion of the Work, such as a structure, an interchange, or section of road or pavement occurs when the portion of the Work has been completed so that it can safely and effectively be used by the public and only corrective or repair work remains for the physical completion of the Contract including, but not limited to:

- All courses of pavement are complete
- Curbing and sidewalks are placed
- All Project drainage and stormwater quality treatment is complete
- Guardrail and terminal sections are properly installed
- All pavement markings are in place
- Regulatory and warning signs are installed

- Highway lighting is operational
- Traffic signal systems meet the following requirements:
    - For isolated traffic signals, the signal control equipment is fully programmed, detectors are installed and functioning, and the signal is in actuated operation
    - For coordinated traffic signal systems, the requirements of condition first bullet are met, the interconnect is installed and functioning, and the signals are operating as a coordinated system
    - For closed loop signal systems, the conditions of the first and second bullets are met, the communications link is operating, and the monitoring functions, including system and intersection graphics, are installed and operating at the Department's monitoring stations

101.90 SUBSTRUCTURE.

The portion of the bridge structure below the bearings of simple and continuous spans, skewbacks of arches, and construction joints at the top of vertical abutment members or rigid frames, and including backwalls, wingwalls and protection railings, and piers.

101.91 SUPERINTENDENT.

The Contractor's on-site authorized representative responsible for the supervision of all Work related to the Project.

101.92 SUPERSTRUCTURE.

The entire Structure above that portion called the Substructure.

101.93 SURETY.

The legal entity, other than the Contractor, executing a bond or bonds furnished by the Contractor.

101.94 TITLES (OR HEADINGS).

The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

101.95 TMP IMPLEMENTATION MANAGERS.

The Department’s and Contractor’s designated representatives with the primary responsibility and authority for implementation of the Transportation Management Plan.

101.96 TRANSPORTATION MANAGEMENT PLAN (TMP).

The document that lays out the set of coordinated transportation management strategies that will be used to manage the Work zone safety and mobility impacts of the Project.

101.97 TRAFFIC.

The passage of vehicles, bicycles, or pedestrians of the traveling public along an established route or pathway. When expressed specifically as “pedestrian traffic,” “vehicular traffic,” or “other-type traffic,” then that traffic shall be so defined.

101.98 TRAVELED WAY.

The portion of the Roadway provided for the movement of vehicles, exclusive of shoulders and bicycle lanes.

101.99 UNBALANCED BID.

A Bid containing one or more Contract Items that the State determines do not reasonably reflect the Bidder’s cost to complete the Contract. The two types of Unbalanced Bids are:

a. Mathematically Unbalanced. Where the Bidder’s Contract items do not reasonably reflect the Cost of performing the Contract.

b. Materially Unbalanced. A Mathematically Unbalanced Bid that generates reasonable doubt that Award will result in the lowest Contract Price.

101.100 WINTER SHUTDOWN.

The period from December 15th through the following April 15th.

101.101 WORK.

The furnishing of all labor, materials, equipment, and incidentals necessary for the completion of the Project and the performance of all duties and obligations imposed pursuant to the Contract.

101.102 WORKDAY.

A calendar day during which normal construction operations could proceed for a major part of a shift, normally excluding Saturdays, Sundays, and holidays. The terms “Workday,” “workday,” “Working Day,” and “working day” are used synonymously.

SECTION 102 — BIDDING REQUIREMENTS AND CONDITIONS

102.01 CONTRACTOR QUALIFICATIONS.

Contractors who bid on Department of Transportation Projects shall provide the State with the following information according to 23 C.F.R. §635.110 & R. I. Gen. Laws § 37-2-26:

a. Equipment. For each Contract, provide an up-to-date inventory of all operational motor vehicles and power equipment owned, leased, or in the possession of the Contractor for use on the RIDOT Project.

b. Personnel. For each Contract, the apparent low bidder shall provide the full name and address of any superintendents, Project managers, engineers, or other supervisory personnel assigned to RIDOT Projects. For each individual, include the following:

- A detailed statement of qualifications and/or current resume for each superintendent, Project manager, engineer, or other supervisory personnel to be assigned to RIDOT Projects

- Disclosure of any suspension or debarment action taken against any principal, officer, director, superintendent, Project manager, or other supervisory personnel by any federal, state, or municipal agency within the preceding five years

c. Financial. On an annual basis, the Contractor shall provide financial references and an original copy of its current financial statement.

d. Minority Owned/Disadvantaged Enterprise Agreements. For each Contract, the apparent low bidder shall:

- Provide copies of executed agreements with any proposed minority owned business enterprise (MBE)/disadvantaged business enterprise (DBE) Subcontractor(s) who will provide services or materials on a RIDOT Project.

- Provide documentation that the proposed MBE/DBE Subcontractor(s) has received Subcontractor approval from the RIDOT minority business office.

- Disclose any suspension or debarment action taken against any principal, officer, director, and superintendent of the proposed MBE/DBE Subcontractor by any federal, state, or municipal agency within the preceding five years.

- Provide a summary of the type of Work that the MBE/DBE is authorized to perform.

e. Trainees. On an annual basis, the Contractor shall:

- Provide a written statement to RIDOT's equal employment opportunity office setting forth the number of employees who shall be trained in each job classification and job training program as required by Contract provisions for Federal aid Projects.

- Provide a written certification that the Contractor and all Subcontractors shall comply with all statutory apprenticeship and prevailing wage requirements.

f. Equal Employment Opportunity. On an annual basis, provide the full name of the person who shall serve as the Contractor's equal employment opportunity officer (EEOO) and a statement on the EEOO's qualifications.

g. Non-Discrimination. On an annual basis, provide a written statement (4 copies) on the Contractor's letterhead certifying that the Contractor shall not discriminate in affording equal employment opportunity to all job applicants and employees.

h. Subcontractors. For each Contract, the apparent low bidder shall provide a written statement containing the full name and business address of all proposed Subcontractors with a summary of the type and extent of Work, services, and/or material that the Subcontractors shall provide on RIDOT Projects. For each Subcontractor listed, state:

- If the proposed Subcontractors have performed or provided similar Work services or materials on other Rhode Island public works projects and, if so, provide a list thereof

- All suspension or debarment action taken against all proposed Subcontractors and their principals, superintendents, Project managers, and other supervisory personnel by all federal, state or municipal agency within the preceding five years.

i. Bonds and Insurance.

- For each Contract, the apparent low bidder shall provide a written statement from a State licensed and authorized bonding company listed in the United States Department of the Treasury, Fiscal Services, Circular 570 (or latest revision of Federal Register), that it shall issue the required bond(s) for RIDOT Projects and all limitations thereon;

- Provide a written statement from insurance companies authorized to transact business in the State of Rhode Island indicating a willingness to issue the required commercial general liability, business, automobile, workers compensation, environmental, Contractor's equipment floaters, and other types of insurance coverage in the amounts necessary for RIDOT Projects.

j. Joint Ventures. In addition to compliance with **Subsection 102.01**, a bidder who is a joint venture shall submit:

- A copy of the joint venture agreement with the Proposal that clearly identifies the entities or former entities comprising the joint venture and the officers of the joint venture

- For Proposals as a joint venture, the joint venture shall be independently registered as a user of the State's procurement system

- Financial Statements for each entity according to **Subsection 102.01** if a newly formed joint venture has no previous record of finances

102.02 CONTENTS OF PROPOSAL FORMS.

The State's procurement system generates the Proposal Form as part of the Contract Bid Package with the Plans, Specifications, and additional Contract bid documents.

The Proposal consists of three parts:

- The Notice to Contractors and the Bidder Certifications required of the prospective Bidder as conditions to its offer to perform the Contract Work.
- The "Proposal Pages," or "Bid Schedule," where the various items of Work are listed in a numbered sequence, and where the unit prices entered by the Bidder and the total bid amounts of each item are recorded and tabulated.
- The "Signature Page," which includes the "Total" or "Gross Sum of Bid", and which is signed by the Bidder or its authorized signatory. This signature signifies the Bidder's acceptance of all requirements and conditions of the Contract and its agreement to complete the Work by the specified Contract Time(s).

102.03 INTERPRETATION OF ITEM QUANTITIES IN THE PROPOSAL.

The quantities appearing in the Bid Schedule are estimates used by the Department for the comparison of bids. The Department pays the Contractor for the measured quantities of Work performed and accepted or materials furnished and accepted according to the Contract. The estimated quantities of Work to be performed and the materials to be furnished may be increased, decreased, or eliminated as deemed necessary by the Engineer and/or according to **Subsections 104.02** and **109.03**.

102.04 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OF WORK.

Bidders shall examine the site of the proposed Work, the Contract Bid Package, and the State Procurement Regulations before submitting a Proposal. The Bidder is responsible for all site conditions that should have been discovered if a reasonable site investigation had been performed. The State considers the submission of a Proposal to be conclusive evidence that the Bidder is satisfied with the conditions it expects to encounter in performing the requirements of the proposed Contract. The submission of a Bid is an affirmative statement that the Bidder and its proposed Subcontractor(s) consent to the entire Bid package provisions upon which the Bidder has submitted its Bid.

Whenever boring logs or other records of subsurface investigations are included in the Contract Documents and/or are available for inspection by Bidders, it is understood that such information is not intended as a substitute for the personal investigation, interpretation, and judgment of the Bidders. This information is available to the Bidders such that all have access to identical subsurface information available to the State. Boring logs and other records of subsurface investigations apply only to the locations of the samples at the time so indicated in the record(s). Since material quantities naturally vary within its source, the Bidder and/or Contractor should anticipate variances in proportions and quantities. The State makes no warranty or guaranty, either expressed or implied, that the conditions indicated in the subsurface information provided by the Department will be the actual conditions that may be encountered. Bidders may perform

their own independent subsurface evaluation before submitting a Bid Proposal. Submitting a Bid is an affirmative statement that the Contractor had the opportunity to perform its own independent evaluation and, therefore, waives any potential claim for reliance on such information.

The locations of all utilities depicted on the Plans are approximate. The Contractor is responsible for determining the exact location of all existing utilities, both underground and overhead by notifying Dig Safe according to State law. The Contractor is responsible for damage to utilities that are shown on the Plans or located according to Dig Safe. The State may pay for damage to utilities and their associated service connections that are not shown on the Plans or located by the respective utilities according to Dig Safe.

102.05 PREPARATION OF PROPOSAL.

The Contractor shall use the State's procurement system to prepare its Proposal. The submission of a Proposal verifies the Bidder's acceptance of all requirements and conditions of the Contract and its agreement to complete the work by the specified Contract Time(s).

102.06 PROPOSAL GUARANTY.

A Proposal will not be accepted or considered unless accompanied by a guaranty in the form of an original Bid Bond made payable to the State of Rhode Island. Surety companies licensed and authorized to conduct business in the State of Rhode Island shall provide bid bonds. All surety companies shall be listed with the Department of the Treasury, Fiscal Services, Circular 570, (latest revision published by the Federal Register). The amount of the Proposal Guaranty shall be as designated in the Notice to Contractors. When the Bidder is a Joint Venture, the Proposal Guaranty shall be in the name of the Joint Venture. Execution of the Bid Bonds is not complete unless accompanied by a certified copy of the power of attorney for the surety's attorney-in-fact.

102.07 NON-RESPONSIVE PROPOSALS.

a. Mandatory Disqualification. The State will declare a Proposal non-responsive and reject it for any of the following irregularities:

- More than one Proposal for the same Work is submitted from an individual, partnership, firm, corporation, Joint Venture, or other legal entity under the same or different name.
- The Proposal form is obtained from any party other than the State.
- The Bidder is not a registered user of the State's procurement system.
- The Proposal form is altered or any part is detached or incomplete.
- The Proposal form is not signed.
- There are unauthorized additions, unauthorized conditional or alternate bids, or irregularities of any kind that may make the Proposal incomplete, indefinite, or ambiguous regarding its meaning.

- The Bidder adds any provisions reserving the right to accept or reject an award.
- The Proposal is not completed using the State's procurement system.
- The State determines that the low bid is materially unbalanced.
- The Proposal is received after the time designated for the opening of bids in the Notice to Contractors.
- The Bidder fails to execute the required certifications enumerated in the Proposal.
- The Bidder fails to submit an original Bid Bond of the character and amount indicated in the Proposal.
- The Bidder's electronic files and the hard copy submission do not match, unless such a discrepancy is determined to be the result of an error or malfunction within the State's procurement system.
- The electronic files are not submitted, according to the requirements of **Subsection 102.05**.

b. Other Reasons for Disqualification. The State reserves the right to declare a Proposal non-responsive and may reject it for any of the following irregularities:

- The Bidder fails to include at least a minimum amount where required for a particular item.
- The Bidder fails to comply in every detail with the instructions provided in **Subsection 102.05**.
- The Proposal is mathematically unbalanced.
- The Bidder fails to comply with any other requirement set forth in the Notice to Contractors.

102.08 WITHDRAWL OR REVISION OF PROPOSALS.

A Bidder may withdraw or revise a Proposal after its submission only as permitted by the Division of Purchases. If a Bidder withdraws its Proposal according to this provision, the State will return the Proposal Guaranty to the Bidder.

The State reserves the right to revise the Plans, Specifications, other Contract documents, the Proposal, and bid opening date for any Project at any time before the time set for opening Proposals. The State makes such revisions by addendum, duly numbered and dated, and accessible to bidders through its procurement system.

102.09 COMBINATION OR CONDITION PROPOSALS.

The State may issue Requests for Proposals for Projects in combination or separately, so that Bidders may submit Proposals on the combination or on separate units of the combination. The

State reserves the right to make awards on combination bids or separate bids in such manner deemed most advantageous to the State. The State will consider only specified Proposal combinations and may issue separate Contracts for each Project included in the combination. The State will consider Conditional Proposals only when specified in the Special Provisions.

102.10 DISQUALIFICATION OF BIDDERS.

a. Mandatory Disqualification. The State will disqualify a Bidder as not responsible and reject its Proposal as non-responsive at any time upon any of the following occurrences:

- Indication of collusion among Bidders
- Making false statements on prequalification documents and/or any other required Bidder's certifications
- Failure to comply with any requirements in **Subsection 102.01**
- Debarment or suspension by Federal or State authorities
- Failure to provide a properly executed Contract Bond

b. Other Reasons for Disqualification. The State reserves the right to disqualify a Bidder as not responsible and reject its Proposal as non-responsive upon occurrence of any of the following:

- Lack of competency, adequate workers, equipment, or demonstrated ability to meet Contract requirements
- Incomplete Work under current Contracts, which in the judgment of the State may adversely affect the timely completion of additional Work, if awarded
- Failure to comply with a written order of the Engineer as provided in **Subsection 105.01** under current and/or prior Contracts
- Attempts, whether successful or not, to influence Department policy through gratuities, gifts, or offers of employment
- Failure to pay, satisfactorily settle, or provide good cause justification for all bills, claims, debts, or judgments pertaining to the Contractor’s labor and material on existing Contracts, provided that the State has paid the Contractor for the amounts expended on the labor and material being considered on a specific Contract and specific Contract pay item, except for any amounts in dispute between the State and the Contractor
- Failure to pay or satisfactorily settle Subcontractor payments as provided in **Subsection 109.10**
- Failure to comply with any post qualification regulations or requirements of the State
- Default under previous State Contracts

- Refusal to remove and replace rejected materials or nonconforming Work
- Failure to execute a previous Contract after receipt of the Notice of Tentative Award
- Any other reason deemed appropriate or necessary by the State that is in the public's best interest

102.11 MATERIAL GUARANTY.

The successful Bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials it uses in the construction of the Project, including samples tested for conformance with Contract provisions. Include the cost of furnishing statements, certifications, and material samples in the Bid.

For Federal-aid Projects, the Bidder is advised of the Buy America (23 CFR 635.410) requirements for domestic steel and iron products in **Subsection 106.01.1**.

102.12 BIDDING CERTIFICATIONS.

a. Anti-Collusion Certification. Every Proposal submitted to the State shall contain an Anti-Collusion Certificate for Contract and Force Account, affirmed by the Bidder as true under penalty of law.

   By submission of a Proposal, each Bidder and each person signing the Proposal, which includes the Anti-Collusion Certificate on behalf of the Bidder, certifies as to its own organization, under penalty of perjury, that to the best of their knowledge and belief:

   - It arrives at its prices in its Proposal independently without collusion, consultation, communication, or agreement with any other Bidder, or with any competitor, for restricting competition.
   - The prices in its Proposal have not been nor will the Bidder knowingly disclose them, directly or indirectly, to any other Bidder or competitor before the opening of Proposals unless required by law.
   - The fact that a Bidder (i) has published price lists, rates, or tariffs covering items being procured, (ii) has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (iii) has sold the same items to other customers at the same prices being bid, does not constitute a disclosure within the meaning of this Subsection.
   - The Bidder has not induced, nor will it attempt to induce, any other person, partnership, or corporation to bid or not to bid for the purpose of restricting or manipulating the competitive bid process.
   - The State's procurement system will not enable a prospective Bidder to complete the preparation of a Proposal unless the Bidder certifies that it has complied with this Section.

- Submission of the Proposal to the State is affirmative evidence that the Bidder's board of directors or other applicable entity authorized the signing and submission of the Proposal and all corresponding certificates, including the certificate of non-collusion by the corporation.

b. Certification Regarding Debarment, Suspension, and Other Responsibility Matters. Every Proposal submitted to the State shall contain the Certification regarding Debarment, Suspension, and Other Responsibility Matters, duly affirmed by the Bidder as true under penalty of law. Through its submission of the Certificate, the Bidder certifies, under penalty of law, that it:

- Is not presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from covered transactions by any Federal or State department or agency

- Has not been convicted of or had a civil judgment rendered against it for fraudulent or criminal acts in connection with a public contract or transaction within the last three years

- Is not presently indicted or otherwise criminally charged for fraudulent or criminal acts regarding a public contract or transaction

- Has not had one or more public contracts or transactions terminated for cause or default within the last three years.

If a Bidder is unable to certify to any of the conditions above, the Bidder shall attach the reasons for its inability to certify to the hard copy, which the State will consider for mandatory or non-mandatory disqualification and Contractor responsibility. The State's procurement system will generate a statement on the signature page of the Proposal that additional documentation is attached in support of the Bidder's inability to fully certify to the provisions.

c. Disadvantaged Business Enterprise Affirmative Action Certificate. For all Contracts containing provisions for the participation of Minority Owned Business Enterprise (MBE)/Disadvantaged Business Enterprises (DBEs), Bidders shall complete a Certification affirming compliance with the US Department of Transportation and applicable State of Rhode Island regulations regarding participation by Disadvantaged Business Enterprises in the Work as Contractors, Subcontractors, and/or suppliers of materials and services. The Certification requires the Bidder to affirmatively seek out and consider qualified Disadvantaged Business Enterprises to participate in the Contract and to submit a Disadvantaged Business Enterprise Program within ten days from the receipt of bids.

The State's procurement system will not enable a prospective Bidder to complete the preparation of a Proposal unless the Bidder completes the DBE Certification form in the Proposal.

d. Disclosure of Lobbying Activities. Every Bidder shall certify and disclose, through the submission of a Proposal, any lobbying of Federal agencies, employees, officers,

members of Congress, or officers or employees of Congress regarding a covered Federal action. Each Bidder and person signing a Proposal shall certify that:

- No Federal appropriated funds were paid, or will be paid, by or on behalf of the Bidder to any individual or entity for the purpose of influencing or attempting to influence any Federal agency, employee, or officer regarding the awarding of any Federal Contract, the making of a Federal grant or loan, or any other form of a contractual nature.

- Although it has not used Federal appropriated funds, it engages in lobbying activities and submits a complete Standard Form LLL "Disclosure Form to Report Lobbying" with its Proposal.

- The Bidder also acknowledges by submitting a bid Proposal that the requirements of this certification shall also apply to all lower tier Subcontracts that exceed $100,000 and that all Subcontractors shall certify and disclose accordingly.

- The State's procurement system will not enable a prospective Bidder to complete the preparation of a Bid Proposal unless the Bidder certifies that it has met the requirements of this Subsection. To complete a Bid Proposal, the Bidder shall certify that it did not use Federally appropriated funds for lobbying purposes or, if it engaged in lobbying activities, it discloses this activity on Standard Form LLL, which is included in the State's procurement system.

e. Title VI Assurance. For all Contracts subject to Title VI of the Civil Rights Act of 1964, 42 USC §§ 2000d – 2000d4 (the Act) and 49 CFR Part 21, Nondiscrimination in Federally Assisted Programs of the Department of Transportation – Effectuation of Title VI of the Civil Rights Act of 1964 (the Regulations), Bidders shall complete a Certification affirming compliance with the Act and the Regulations. By submission of a Proposal, each Bidder and each person signing a Proposal certifies that the Bidder affirmatively agrees as follows:

- Compliance with Regulations. The Bidder shall comply with the regulations for nondiscrimination in Federal-aid programs of the State and 49 CFR Part 21, as amended.

- Nondiscrimination. The Bidder shall not discriminate on the grounds of race, color, sex, national origin, age, or disability in the selection and retention of Subcontractors, including procurements of materials and leases of equipment. The Bidder shall not participate either directly or indirectly in discrimination prohibited by Section 21.5 of the Regulations, including employment practices when the Contract covers a program listed in Appendix B of the Regulations.

- Solicitations for Subcontractors, Including Procurements of Materials and Equipment. In all solicitations either by competitive bidding or negotiation made by the Bidder for Work to be performed under a Subcontract, including procurements of materials or leases of equipment, each potential Subcontractor or supplier shall be notified by the Bidder of its obligations relative to nondiscrimination on the grounds of race, color, sex, national origin, age, or disability.

- Information and Reports. The Bidder shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and facilities as the State determines to be pertinent to ascertain compliance with the Regulations, orders, and instructions. Where any information required of the Bidder is in the exclusive possession of another who fails or refuses to furnish this information, the Bidder shall so certify to the State and shall document its efforts to obtain the information.

- Sanctions for Noncompliance. In the event of the Bidder's noncompliance with the nondiscrimination provisions, the State may impose such Contract sanctions as it determines to be appropriate, including, but not limited to:

    - Withholding of payments under the Contract until the Bidder complies

    - Deductions of monies from payments otherwise owed in an amount equal to the value of the affected Work

    - Cancellation, termination, or suspension of the Contract in whole or in part

- Incorporation of Provisions. The Bidder shall include the provisions of Non-Compliance below in every Subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations or directives issued pursuant thereto.

  The Bidder shall take such action with respect to any Subcontract or procurement as the State may direct as a means of enforcing such provisions, including sanctions for non- compliance provided, however, that if the Bidder becomes involved in or is threatened with litigation with a Subcontractor or supplier as a result of such direction, the Bidder may request the State to enter into such litigation to protect the interests of the State.

- Non-Compliance. The State's procurement system will not enable a prospective Bidder to complete the preparation of a Proposal unless the Bidder completes the Title VI Certification form in the Proposal.

SECTION 103 — AWARD AND EXECUTION OF CONTRACT

103.01 CONSIDERATION OF PROPOALS.

The State compares the Proposals on the basis of Contract Item quantities and unit prices. The State may investigate apparent discrepancies or errors in the Proposals. If discrepancies between unit prices and the computed extensions exist, the unit price shall govern. The State reserves the right to reject any or all Proposals, to waive technicalities, or to advertise for new Proposals, if the best interests of the State are served.

103.02 POST-QUALIFICATION REQUIREMENTS AND AWARD OF CONTRACT.

The apparent low Bidder shall submit all post qualification requirements according to the State's instructions contained in its post qualification letter.

a. Financial Statements. Unless an annual, audited financial statement or financial review statement is on file with the State for the current year according to **Subsection 102.01(c)**, the successful Bidder is required to submit a complete set of audited financial statements certified by a CPA for Contracts exceeding $5,000,000. For Contracts valued at $5,000,000 and under, the successful Bidder is required to submit a financial review statement. For Contracts under $1,000,000, a financial compilation statement is required.

b. Award of Contract. The State shall award the Contract within the time specified in the Notice to the responsive and responsible Bidder whose Bid is either the lowest Bid price or, for alternative contracting methods, the best value. This time period may be extended by mutual agreement of the parties.

- The successful Bidder will first receive a Notice of Tentative Award. This written communication indicates the conditional intent of the State to award the Contract and instructs the successful Bidder to arrange for the execution of the Contract Agreement and Contract Bond and for the delivery of the Certificates of Insurance.
- No Proposal shall bind the State, nor shall any Work begin within the Project limits before Contract Award.
- The Contractor shall bear all risks for any Work begun outside such areas and for any materials ordered before the State awards the Contract.
- On Contracts jointly bid, Contractors are held jointly and severally liable for the entire Contract.
- Corporate Bidders shall furnish documentary evidence that they have met all legal requirements to transact business in the State of Rhode Island as a condition to Contract Award.

103.03 CANCELLATION OF CONTRACT.

The State reserves the right to cancel the Contract before the Award without liability.

103.04 RETURN OF PROPOSAL GUARANTY.

The State will return Proposal Guaranties to all Bidders after Contract Award or after the cancellation of the Contract is announced.

103.05 CONTRACT BOND.

At the time of the execution of the Contract, the successful Bidder shall furnish a Contract Bond in a sum equal to the full Contract Price. The Contract Bond shall guarantee the following:

- Complete performance of the Contract and all Contract Addenda
- Full payment for all materials and equipment
- Full payment of all wages of labor

The form of the Contract Bond shall be acceptable to the State. If the Surety fails or becomes financially insolvent, the Contractor shall file a new Bond in the amount designated by the State within fourteen calendar days of such failure or insolvency. Failure to furnish a replacement Bond may result in the State withholding of any amounts due the Contractor.

The Contract Bond shall be provided by a Surety licensed and authorized to conduct business in the State of Rhode Island. All Surety companies shall be listed on the most current State of the Treasury, Fiscal Services, Circular 570. Subsequent to Contract award, the State may require an increase in the Bond.

103.06 EXECUTION OF THE CONTRACT.

The successful Bidder shall execute the Contract according to the instructions contained in the Notice of Tentative Award. No Contract, express or implied, shall be binding on the State until execution of the Contract.

103.07 FAILURE TO EXECUTE CONTRACT.

Failure of the successful Bidder to comply with the terms of the Notice of Tentative Award may result in a revocation of the Notice and forfeiture of the Bid Bond. Subsequently, the State may elect to award the Contract to the next lowest responsible and responsive Bidder or reject all Bids and re-advertise the Project.

If the State does not execute the Contract within sixty days of Bid opening, or as agreed upon by the parties, then the Contractor may withdraw its Proposal without penalty by submitting a notice of such intent to the State. Upon submission of the notice, the Contractor releases the State from any and all liability or obligation on its behalf and any other party who may have an interest, either direct or indirect, in the award of the Contract.

103.08 ESCROW OF BID DOCUMENTATION.

The placing in escrow of Bid Documentation according to this Subsection is applicable only when specified in the Contract. The purpose of this Subsection is to preserve the Bid documents of the Contractor for use by the parties to resolve any disagreement, dispute, or claim between the State and Contractor.

a. Copy of Bid Documentation. The Bidder shall submit a legible copy of all Bid Documentation used to prepare the Bid for this Contract with its Proposal or as otherwise specified in a separate, sealed container clearly marked “Bid Documentation” and shall be labeled with the Contractor's name and address, the date of submittal, the Project Number, the Contract Number, and Project Name.

b. Cost Itemization. The Bid Documentation shall clearly itemize the costs of performing the work of each Contract item in the Proposal. Contract items shall be separated into those items necessary to present a complete and detailed estimate of all costs. Plant, equipment, material, labor, jobsite overhead, and indirect costs shall be detailed in the Contractor’s usual format. The allocation of contingencies, mark ups, and other items shall be identified for each Contract item.

   All costs shall be identified. For Contract items amounting to less than $10,000, the Contractor may provide costs without a detailed breakdown. The Bid Documentation shall include all quantity take-offs, calculations of rates of production and progress, copies of quotes from Subcontractors and suppliers, memoranda, narratives, add/deduct sheets, and all other information used by the Contractor to arrive at the Bid submitted by the Contractor.

c. Cost Reconciling. If the itemized cost breakdowns and allocations described elsewhere are not revised to reflect the final Bid prices, then information shall be submitted reconciling the Bid preparation documents and the Bid unit prices. This reconciliation shall be considered part of the Bid Documentation and included in the Bid Documentation submittal.

d. Separate Bid Documentation. If any Contractor’s Bid is based on Subcontracting any part of the work, each Subcontractor/Supplier, whose total Subcontract price exceeds five percent of the total Contract Price bid by the Bidder, shall provide separate Bid Documentation to be included with those of the Bidder.

e. Escrowed Bid Documents. These are the property of the Contractor and are not public records. If a third party requests a copy of the escrowed bid documents, the Contractor, and not the State, shall take the legal steps needed to defend the confidentiality of the escrowed Bid Documents.

f. Affidavit. The Contractor shall submit an affidavit, signed under oath by an authorized representative with its Bid Documentation, listing each Bid document submitted by author, date, nature, and subject matter. The affidavit shall attest that the affiant has personally examined the Bid Documentation, that the affidavit certifies that the material submitted for escrow constitutes all the documentary information used in preparation of the bid, and that all such Bid Documentation is included in its submission to the State.

g. Duration and Use. If awarded the Contract, the Bid Documentation shall be escrowed with a mutually agreeable document storage facility and preserved by that institution/facility as specified in the following Sections of this clause.

h. Return of Bid Documents. The State shall return the sealed containers containing the Bid Documents with the return of Proposals to the unsuccessful Bidders upon Contract Award.

i. Escrow. The Bid Documents shall be escrowed for the duration of the Contract and shall be released to the State upon receipt of written authorization by the Contractor, or notification of the Contractor's intention to file a claim or its initiation of litigation against the State. In the absence of such actions, the Bid Documentation shall be released to the Contractor upon Acceptance and Final Payment.

According to its certification that the sealed container placed in escrow contains all materials relied upon by the Contractor in preparing its Bid, the escrowed Bid Documentation shall be the only documents accepted from the Contractor regarding preparation of the Bid.

j. Failure to Provide Bid Documentation. Failure to provide Bid Documentation according to the requirements of this Section may render the Bid non-responsive under **Subsection 102.07**.

k. Escrow Costs. The cost of the escrow storage will be borne by the State. The State will provide escrow instructions to the document depository consistent with this clause.

SECTION 104 — SCOPE OF WORK

104.01 INTENT OF CONTRACT.

The intent of the Contract is to provide for the construction and completion of the Work. The Contractor shall furnish all labor, material, equipment, transportation, supplies, services, incidentals, and other resources required to complete the Work. Omissions from the Contract of details of Work that are necessary to carry out the intent of the Contract shall not relieve the Contractor from performing the omitted Work.

104.02 CONTRACT REVISIONS.

a. General. The Engineer reserves the right to revise the Contract at any time. These revisions do not invalidate the Contract nor release the Surety and the Contractor from performing the Work as amended or as directed by the Engineer. The State shall pay for the revised Work at the Contract unit bid prices unless the cost of production or character of the Work is materially changed, in which case the Contractor shall be paid according to **Subsection 109.04**. Lost or anticipated lost profits resulting from a Contract revision are not compensable. Revisions that result in requests for time extensions shall be determined according to **Subsection 108.07**. When changes are time sensitive, the Engineer may issue written orders to proceed with the Work, and such written orders shall be implemented as if a change.

b. Causes for Change. The following issues may result in a Contract change:

- Differing Site Conditions
- Alterations in the Plans or Details
- Extra Work for which there is no item of work in the Proposal
- Suspension of the work for any reason
- Significant changes in the character of the work

c. Change Request. The State will only consider requests for Contract revisions when the Contractor meets the notification procedures in **Subsection 104.02(d)**. If the Engineer determines that a Contract revision requested by the Contractor is not necessary, the Contractor shall proceed with the Work as directed by the Engineer and may seek redress under **Subsection 105.19**. The Contractor shall maintain records of the additional resources that resulted from the conditions. The record keeping shall start upon receipt of initial written notice by the Engineer.

d. Contractor Notification Requirements. The Engineer will consider requests for Contract changes only when the Contractor submits documentation in the Department approved format and follows the notification procedures in this Subsection.

- Initial Written Notice of Change by Contractor. If the Contractor believes that the State's action, or lack thereof, or some other situation results in or necessitates a Contract revision, the Contractor shall provide written notification to the Engineer within two Working Days from discovery of the condition that may warrant a change to the Contract. The Notice shall contain the time and date that the issue was discovered, the nature of the issue, and its location.

- Additional Contractor Submission. If the Engineer and Contractor are unable to resolve the issue after two Working Days from the initial notification, the Engineer will provide a written denial of the request for Contract revisions, at which time the Contractor shall augment the original written notice with the following information for submission to the Engineer within five Working Days of the receipt of the Engineer's written denial:

    - A clear explanation of why the situation represents a change to the Contract, including accurate references to the pertinent portions of the Contract

    - All potential adjustments to pay items that have been or may be affected by the change, condition, or event

    - Labor or materials that will be added, deleted, or wasted by the change, condition, or event

    - Existing or anticipated delays and disruptions in Contract performance, schedule, or sequences

- Written Response by Engineer. Within 10 Working Days of receiving the Contractor's augmented submission in the previous bullet, unless the Contractor agrees to a longer time, the Engineer will provide a written response that includes one of the following:

    - Confirmation of the need for a revision to the Contract. A time extension, if one is necessary, will be determined according to **Subsection 108.07**. Compensation for the revision, if any is necessary, will be determined according to **Subsection 109.04**. The Engineer will give direction to the Contractor regarding how to proceed with Work affected by the revision.

    - Denial of the request for a revision to the Contract, in which case the Engineer will state why the issue does not represent a revision to the Contract. Upon receipt of such a denial, the Contractor shall continue with all Work that may have been halted due to the circumstances for which the Contractor provided notice.

    - A request for additional information, in which case the Engineer will identify what is needed and by when. The Engineer will issue a response within 10 working days of receiving the additional information. Any Contract adjustments will exclude increased costs or time extensions resulting from the Contractor's failure to provide the requested information.

- Failure to Provide Notice. If the Contractor fails to provide notice as specified under this Subsection, the Contractor waives its entitlement to compensation or time and releases the State from responsibility for compensation or time upon the occurrence of any condition resulting in a Contract Change under **Subsection 104.02(c)**.

- Contractor's Recourse. If the Contractor disagrees with the Engineer's final written response, the Contractor may pursue a claim according to **Subsection 105.19**. Failure to provide notice under this Subsection waives the Contractor's entitlement to compensation or a time extension and releases the State from responsibility for compensation or time under any related claims brought under **Subsection 105.19**.

104.03 DIFFERING SITE CONDITIONS.

During the progress of the Work, if subsurface or latent physical conditions are encountered at the Project Site differing materially from those indicated in the Contract, or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the Work provided for in the Contract, are encountered at the site, the party discovering such conditions shall notify the other party in writing of the specific differing conditions before the site is disturbed and before the affected Work is performed. Notification procedures shall be followed according to **Subsection 104.02(d)**.

The State will not pay additional compensation or allow for additional Contract time without written notice before initiation of the affected Work according to **Subsection 104.02(d)**. Upon written notification, the Engineer will investigate the conditions and respond according to the third bullet in **Subsection 104.02(d)**. If the Contractor disagrees with this determination, it may initiate a claim according to **Subsection105.19** but shall proceed with the Work as directed by the Engineer.

104.04 ALTERATIONS IN THE PLANS OR DETAILS.

The Plans or details are subject to change and may result in an increase, reduction, or elimination of any Contract Item. Unless otherwise provided for under **Subsection 104.07**, the Contractor shall perform the Work as specified for the original unaltered quantities, and the State will pay for the Work as specified in **Subsection 109.03**.

The Engineer may find it necessary to decrease or eliminate Contract Items that involve prefabricated materials that are not considered stock commercial items. If fabrication of these materials was started or completed before the Contractor is advised of the decrease in quantity or elimination of the items in question, the State will either:

- Direct the Contractor to retain ownership of the material and upon verification reimburse the Contractor for the cost of the material and its fabrication, less its salvage value; or
- Direct the Contractor to deliver the fabricated material to the Project and placed in the custody of the Engineer to be paid according to **Subsection 109.06**.

104.05 EXTRA WORK.

The Contractor shall perform Extra Work when ordered by the Engineer according to the Specifications and as directed in writing. The State will compensate the Contractor for the Extra Work according to **Subsection 109.04**. Time extensions, if warranted, will be determined according to **Subsection 108.07**.

104.06 SUSPENSION OF WORK ORDERED BY THE ENGINEER.

If the Engineer suspends all or any portion of the Work for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry), and the Contractor believes that additional compensation, Contract time, or both is due because of the suspension, the Contractor shall submit a request for adjustment to the Engineer upon receipt of the notice to resume Work according to **Subsection 104.02(d)**.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost and/or time required for Contract performance has increased as a result of the suspension, the Engineer will make an adjustment to cost, time, or both if the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or Subcontractors at any approved tier, and not caused by weather.

No Contract adjustment will be allowed under this clause if that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of the Contract.

104.07 SIGNIFICANT CHANGES IN THE CHARACTER OF THE WORK.

The Engineer reserves the right to make, in writing, at any time during the Work such changes in quantities and alterations in the Work as necessary to satisfactorily complete the Project. The Contractor will be compensated according to **Subsection 109.03** and/or **Subsection 109.04** for significant changes in the character of the Work. Otherwise, the Contractor will be paid as provided elsewhere in the Contract at the original unit price. Time extensions, if warranted, will be determined according to **Subsection 108.07**. These changes in quantities and alterations shall not invalidate the Contract nor release the surety, and the Contractor agrees to perform the Work as altered. If the parties disagree on whether an alteration constitutes a significant change, the Contractor shall notify the State according to **Subsection 104.02(d)**.

The term "significant change" applies only to the following circumstances:

- The character of the altered Work differs materially from that involved or included in the original Contract.
- The total quantity of a Major Contract Item of Work, as defined elsewhere in the Contract, is increased by more than 125 percent or decreased below 75 percent of the original Contract quantity. An adjustment for an increase in quantity shall apply only to that portion in excess of 125 percent of the original Contract Item quantity or, if a decrease below 75 percent, an adjustment will be applied to the actual amount of Work performed.

104.08 MAINTENANCE OF TRAFFIC.

Except as otherwise permitted by the Contract, the Contractor shall keep roads open to traffic at all times during the Project. The Contractor shall implement all approved detour routes according to the Contract. Alternative detours proposed by the Contractor shall require submission of proposed detour plans according to **Subsection 105.02** and the TMP and shall require written approval from each local city/town within which the proposed detour route will be implemented.

a. The Contractor shall maintain all portions of the Project that are open to traffic to safely and adequately accommodate traffic and take all necessary precautions for the protection of the work and the safety of the public. The Contractor shall furnish, erect, and maintain all temporary traffic control devices according to the latest edition of the MUTCD. The signs and other temporary traffic control devices shown on the Plans are minimum requirements. The Contractor shall supplement the Plans if necessary to ensure the safety of traffic. Existing traffic control devices that are inconsistent with the intended traffic travel paths and/or with restrictions on the Project roads shall be covered or

removed. All temporary traffic control devices shall be in place before starting Work at a particular location. Temporary traffic control devices shall be removed or covered when they are no longer applicable to traffic.

b. The Contractor shall obtain all necessary permits, approvals, and licenses concerning haul routes and traffic detours and for complying with the ordinances, rules, and regulations of each local city/town within which haul routes and traffic detours pass, all at no additional expense to the State.

c. The Contractor shall bear all expense of maintaining traffic affected by the Project, including all traffic within Project limits, along detour routes, and associated with utility work at no additional cost to the State, except as provided below:

- During any suspension of the Work, the Contractor shall open those sections of the Project to traffic, including temporary roadways or as otherwise mutually agreed to by the Contractor and the Engineer, to temporarily accommodate traffic during the suspension. If the reason for the suspension is beyond the control and/or without fault of the Contractor, the Contractor will be paid for this maintenance of traffic on the basis of prevailing unit prices or according to **Subsection 104.05**.

- If the Engineer directs maintenance of traffic operations that are not included within the original Contract, the Contractor will be paid for this maintenance of traffic on the basis of prevailing unit prices or according to **Subsection 104.05**.

d. The Contractor's TMP Implementation Manager and all other Contractor and Subcontractor personnel responsible for the setup, operation, maintenance, inspection, movement, and/or breakdown of temporary traffic control devices shall be trained according to the Department's "Training Guidelines for Personnel Responsible for Work Zone Safety & Mobility" and shall possess a valid certificate of satisfactory completion of the training. Training shall be at a level appropriate to the individual's job responsibilities and to the job decisions the individual is required to make and shall be completed before the commencement of Work.

104.09 MAINTENANCE OF PUBLIC ACCESS.

Except as otherwise permitted by the Contract, the Contractor shall maintain existing streets, highways, roads, sidewalks, driveways, and private walks within the Project limits open to traffic. The Contractor shall also provide and maintain in a safe and passable condition all temporary roadways, sidewalks, approaches, crossings, and intersections with trails, roads, streets, businesses, parking lots, residences, garages, farms, and other features as may be necessary, at no additional cost to the State and as directed by the Engineer in writing.

When the Work affects pedestrian traffic, the Contractor shall be responsible for the development, implementation, and maintenance of an ADA- and MUTCD-compliant temporary pedestrian access route (TPAR). Temporary traffic control devices for each TPAR shall be in place and operational before affecting and/or restricting pedestrian traffic.

With respect to maintaining public access in the locations described in the preceding paragraph, snow removal is not required by the Contractor unless ordered by the Engineer in writing, which will be paid for according to **Subsection 104.05**. Snow removal for areas outside of the locations

described in the preceding paragraph shall be the responsibility of the Contractor at no additional cost to the State.

104.10 RIGHTS IN AND USE OF MATERIALS FOUND ON THE PROJECT.

With the prior written approval of the Engineer, the Contractor may use excavated materials within the grading limits as indicated by the slope and grade lines such as stone, gravel, or sand that is acceptable for completing other bid items of Work. The State will pay for the excavation of these materials at the corresponding Contract unit price and under the pay item for which the material is used. The Contractor shall replace excavated material used for completing other bid items of Work with acceptable material at no cost to the State. The Contractor shall not excavate or remove any material from within the highway right-of-way that is outside the grading limits as indicated by the slope and grade lines without prior written approval from the Engineer.

104.11 FINAL CLEAN-UP.

Before its submission of the Notice of Substantial Completion, the Contractor shall clean all areas impacted by the Work of rubbish, excess materials, temporary structures, and excess equipment. Before any inspections performed after the Notice of Substantial Completion, the Contractor shall clean and remove all concrete streaks, washout areas, drippings, paint smears and drippings, rust stains, oil, grease, asphalt materials, dirt, and other foreign materials on or in any structure, curb, gutter, median or gore marker due to its operation.

The cost of final clean-up shall be incidental to the work and no separate payment shall be made to the Contractor.

The Contractor shall remove its equipment, materials, and any other obstacles from the Project Right-of-Way and from property adjacent to the Project site that is not owned or controlled by the Contractor within 30 days after completion of the Punch List.

104.12 RAILWAY-HIGHWAY PROVISIONS.

If the Contract requires materials to be hauled across railroad tracks, the State will arrange with the railway company for new crossings or for the use of any existing crossings. If the Contractor elects to use crossings other than those specified in the Contract, the Contractor shall obtain written approval from the railway company and shall bear all costs and Contract delays relating with such crossings, including installation, drainage, maintenance, insurance, watchman service, flagging protection, removal of such crossings, and other services required by the railway company.

The Contractor is responsible for executing a Temporary Permit to Enter Agreement with the railroad company before performing any Work within the railroad right-of-way and shall provide a copy of the executed agreement to the Engineer and obtain all insurance required according to the Permit to Enter Agreement. The Contractor shall comply with all requirements of the temporary permit from the railway company.

104.13 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS.

Work over, on, or adjacent to navigable waters shall be conducted so that free navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired, except as allowed by permit issued by the US Coast Guard or the US Army Corps of Engineers, as applicable.

104.14 CONTRACTOR'S RESPONSIBILITY FOR THE WORK.

The Contractor is responsible for protecting all Work from injury or damage until Final Acceptance. The Contractor shall rebuild, repair, restore, and make good all losses, injuries, or damages to any portion of the Work under the control of the Contractor at no additional cost to the State before Final Acceptance. Rebuilding, repairing, and restoring damage to the Work not under the control of the Contractor, including but are not limited to damage caused by Acts of Nature, such as an earthquake, lightning strikes, tidal wave, tornado, hurricane, or other cataclysmic phenomenon of nature or acts of the public enemy or of governmental authorities will be paid for under **Subsection 104.05**.

For suspension of Work from any cause, the Contractor shall remain responsible for maintaining and preventing damage to the Work, provide for normal drainage, and erect necessary temporary structures, signs, or other facilities. During the suspension period, the Contractor shall maintain all newly established plantings, seeding, and sodding and shall protect new tree growth and other designated vegetative growth against injury.

All costs associated with the Work described in this Subsection shall be borne by the Contractor, unless otherwise provided under **Subsections 104.08,** and **109.04.**

104.15 ENVIRONMENTAL PROTECTION.

104.15.1 General.

The Contractor shall comply with all Federal, State, and local laws and regulations that control and prevent pollution and the protection of the land, waters, groundwater, air, wildlife, and other environmental resources of the State.

The Contractor shall read, become familiar with, and adhere to all environmental permits and approvals, agreements, mitigation plans, and standard BMPs controlling pollution and protection of the environment. The Contractor shall be responsible for ensuring that all employees, and all employees of each Subcontractor, are familiar with, adhere to, and comply with this Section.

No Contract provisions release the Contractor from any responsibility or requirement under any environmental or other laws. The absence of any direct references to any environmental laws or regulations in the Contract does not release the Contractor from its responsibility, requirement, and obligation to comply with the environmental laws.

Do not initiate any work requiring permits, authorizations, approvals, or notifications until the appropriate regulatory agency has issued the applicable permit, authorization, approval, or notification. The Contractor shall adequately protect catch basins and inlets to prevent any asphalt materials from entering. The Contractor shall make provisions to capture and legally dispose of all concrete and flushing water after equipment clean-out.

When an Environmental Monitor (EM) is specified, the EM must have sufficient experience and knowledge of environmental regulations and permitting. The EM shall assist the Contractor with environmental compliance and shall report non-compliance. The EM shall be responsible for providing the Construction Manager and the appropriate regulatory authorities with all environmental reports, as required.

If the Contractor initiates a change that differs from the permitted design or any construction method that alters the permitted impacts, the Contractor shall obtain a new or revised permit(s) at no additional cost to the State.

Pay all fines and penalties assessed against the State as a result of the Contractor's non-compliance with any Contract requirement pertaining to the protection of the environment and indemnify, defend, and hold harmless the State from any enforcement actions by Federal, State, or local regulatory authorities according to **SECTION 107.**

The State may deduct the fines and/or penalties assessed against the State from monies due the Contractor.

Failure to comply with the provisions of this Subsection and the applicable permits and approvals will result in a Failure to Comply charge under **SECTION 110** and will be deducted from monies due the Contractor. The State may deduct the costs incurred for corrective actions necessary for compliance with any laws and Contract provisions pertaining to the protection of the environment. The Engineer will determine whether multiple violations exist and, if so, the charge will be deducted per each violation. The charge for each violation will be deducted in addition to any penalties, fines, or corrective actions resulting from regulatory agency enforcement actions.

104.15.2 Protection of Aquatic Resources, Wild and Scenic Rivers, Waters of the State, Navigable Waters of the US, and Waters of the US, including Wetlands.

The Contractor shall adhere to the requirements of all State, Local, and Federal laws and regulations controlling impacts and pollution to Waters of the State, Navigable Waters of the US, and Waters of the US, including wetlands. The Contractor shall adhere to all agreements, mitigation plans, permits, and standard best management practices for environmental practice. The Contractor must be aware of conditions that are incorporated by reference (for example, NEPA Project Commitments and standard conditions in Programmatic Agreements). Regardless of permitting, the Contractor must always follow the requirements of **SECTIONS 206** through **212** and **SECTION 214**.

Except where allowed by the Contract or by permit, do not:

- Discharge pollutants to waters of the State, including dewatering of contaminated soils
- Blast underwater or produce excessive harmful sound in the water
- Use water jetting
- Release petroleum products, concrete washout, bitumen, slurries, chemicals, or other harmful materials into the water
- Disturb spawning beds
- Obstruct stream channels

- Cause silting or sedimentation of waters of the State or waters of the US
- Use treated timbers within the regulated work area
- Impede fish passage, including intermittent streams
- Allow equipment to enter or work in or on the water
- Dump debris in water
- Place fill in waters or wetlands
- Interfere with navigable waterways or impacting existing navigable depths.
- Conduct an activity within a Wild and Scenic Rivers Watershed (16 USC 1271, et. sq.)

104.15.3 Protection of Wildlife and Wildlife Habitat.

a. Migratory Bird Treaty Act (16 USC 703-712), Bald and Golden Eagle Protection Act (16 USC 668-686c). This Act protects most species of birds in Rhode Island; the few exceptions include rock pigeons, house sparrows, and European starlings.

   Except where allowed by the Contract or by permit, do not:

   - Disturb or remove active nests containing eggs or dependent young
   - Inhibit the capability of adult birds to care for eggs or dependent young
   - Do not impact the supporting structure on which an active nest is built
   - Destroy unoccupied nests
   - Disturb a Bald or Golden Eagle to the point of substantially interfering with normal breeding, feeding, or sheltering behavior
   - Alter a previously used Bald or Golden Eagle nest site that will interfere or interrupt normal breeding, feeding, or sheltering habits or causes injury

b. Threatened and Endangered Species Act (ESA) (16 USC 1531 et seq.). Except where allowed by permit, do not:

   - Conduct, or attempt to, harass, harm, hunt, shoot, wound, kill, trap, capture, or collect threatened endangered plants or animals.
   - Conduct any activity when bats are present in the Project work area. Do not disturb bat colonies. Do not resume work until approved by the RIDOT Environmental Division.

104.15.4 Noxious Weed and Invasive Species Control (EO 13112 & 13751).

Executive Orders 13112 and 13751 state that a federal agency cannot authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive

species (plants, plant pests, or noxious weeds) unless all reasonable measures to minimize risk of harm have been analyzed and considered. Therefore, the Contractor shall:

- Be familiar with the presence and locations of invasive species on the project.
- Wash all equipment before leaving a Project site with invasives. Equipment should be cleaned and contained at the site of infestation in a manner to avoid introduction or spread.
- Inspect all construction equipment and remove all attached vegetation and animals before leaving the construction site.
- Immediately notify the RIDOT Environmental Division upon discovery of all prohibited aquatic plants, plant pests, or noxious weeds within the Project limits.
- Ensure that all borrow material transported to the Project site is free of prohibited aquatic plants, plant pests, noxious weeds, and their reproductive parts.
- Monitor the construction, borrow, and staging areas at intervals necessary to prevent noxious weeds from developing viable seed.
- Control noxious weeds through hand-pulling or herbicide application.
- Comply with the USDA regulations for plant and pest control where applicable to the State of Rhode Island.

104.15.5 Contaminated and Hazardous Materials.

If material is encountered or exposed that was not previously known or suspected to be contaminated, but which exhibits properties that may indicate the presence of controlled, contaminated, or hazardous material, immediately suspend all operations in the vicinity of the suspected contaminated/hazardous material and notify the Construction Manager and the RIDOT Environmental Division. The presence of barrels, discolored earth, metal, wood, visible fumes or smoke, abnormal odors, or excessively hot earth may indicate the presence of controlled or hazardous material and must be treated with extreme caution.

Secure a licensed transporter and disposal facility and ensure that their licensing is valid and current. Collect and secure shipping manifests and disposal slips/bills of ladling for the disposal of all contaminated material and provide the documentation to the Construction Manager.

104.16 VALUE ENGINEERING CHANGE PROPOSAL.

The Contractor is encouraged to use ingenuity and experience to develop and offer any Value Engineering Change Proposal (VECP) to the Department for alternative construction designs, methods, procedures, and other innovations that result in a lower total cost, improved quality, or both. It is the intent of this provision to share with the Contractor any direct cost savings as a result of VECP(s) generated by the Contractor and approved by the Department. Any cost savings generated to the Contract as a result of a VECP shall be shared equally between the Contractor and the Department. Bid prices shall not rely on the anticipated approval of any VECP(s) by the Department. If a VECP is rejected, the work shall be completed per the Contract requirements at the Contract bid prices. VECP(s) shall only be submitted by the Contractor after the Contract is awarded.

The Contractor shall have no claim against the State for any delay to the Contract based on the failure to respond within the time indicated in item b or c below in the submittal if additional information is needed to complete the review.

The Contractor is responsible for the time and costs for preparing and obtaining permitting modifications based upon the VECP. The Department is not responsible for any delays incurred either due to successful or unsuccessful attempts.

The Department will not be responsible for additional costs associated with the implementation of the VECP work including, but not limited to, additional traffic control beyond the proposed Contract quantities and different site conditions in areas that were not identified for disturbance until the VECP was implemented.

a. Submittal of VECP – General. VECP(s) that will be considered are those contemplated to produce a savings to the Department without diminishing functions and characteristics of the facility including but not limited to, service life, economy of operation, ease of maintenance, desired appearance, safety, and impacts to the traveling public or the environment during and after construction.

b. Submittal of a Conceptual Proposal. The Contractor may submit a conceptual proposal for preliminary evaluation for VECP(s) that require a significant amount of design or other development resources. The Engineer will evaluate the information provided and advise the Contractor if any conditions or parameters of the Conceptual Proposal are found to be grounds for rejection. Preliminary review of a Conceptual Proposal reduces the Contractor's risk of subsequent rejection but does not commit the Department to eventual approval of the full VECP. The following materials and information shall be submitted with each Conceptual Proposal:

   - A statement that the proposal is submitted as a Conceptual VECP.
   - A general description of the difference between the existing Contract and the proposed change, and the advantages and disadvantages of each, including effects on cost, service life, economy of operation, ease of maintenance, desired appearance, safety, and impacts to the traveling public and the environment during and after construction.
   - A set of conceptual plans and description of the proposed changes to the Contract requirements.
   - An estimate of the anticipated cost savings.
   - When a response to the Conceptual VECP by the Department is required.
   - Amount of time necessary to develop a Full VECP.
   - Date by which a Contract Change Order shall be executed to obtain the maximum benefit from the VECP.
   - The effect the VECP will have on the completion dates in the Contract.

- After all Department questions have been answered, the Department will respond to the Contractor within two weeks.

c. Submittal of Full VECP. The following materials and information shall be submitted with each Full VECP:

- A statement that the proposal is submitted as a full VECP.
- A description of the difference between the existing Contract and the proposed change, and the comparative advantages and disadvantages of each including effects on service life, economy of operations, ease of maintenance, desired appearance, safety and impacts to the traveling public and the environment during and after construction.
- A complete set of Plans, Specifications, and calculations, when applicable, showing the proposed revisions relative to the original Contract features and requirements. The State requires a RI Professional Engineer's stamp and signature on any Engineering changes.
- A complete cost analysis indicating the final estimated costs and quantities to be replaced, compared to the new costs and quantities generated by the VECP, and the cost effects of the proposed changes on operational, maintenance, and other considerations.
- A statement specifying the date by which a Change Order adopting the VECP shall be executed to obtain the maximum cost reduction during the remainder of the Contract.
- A proposed revised Project schedule illustrating the impacts of the VECP on the Contract completion date(s) and any other milestone dates.
- A description of any previous use or testing of the VECP and the conditions and results therewith. If the VECP was previously submitted on another Department Project, indicate the date, Contract number, action taken by the Department, and any difference between the VECPs.
- After all Department questions have been answered, the Department will respond to the Contractor within three weeks.

d. Conditions. VECP(s) will be considered only when all of the following conditions are met:

- VECP(s), approved or not approved by the Department, apply only to the ongoing Contract(s) referenced in the Proposal and become the property of the Department. The VECP(s) shall contain no restrictions imposed by the Contractor on their use or disclosure. The Department has the right to use, duplicate, and disclose in whole or in part any data. The Department retains the right to utilize any accepted VECP or part thereof on any other or subsequent Projects without any obligation to the Contractor. This provision is not intended to deny rights provided by law with respect to patented materials or processes.

- The VECP proposed Work shall not contain experimental features but shall be proven features that have been used under similar or acceptable conditions on other projects or locations acceptable to the Department.

- VECP(s) will not be considered if equivalent options are already provided in the Contract documents.

- If the Department is already considering certain revisions to the Contract, or the Standard Specifications, or has approved certain changes in the Contract for general use that are subsequently incorporated in a VECP, the Department will reject the VECP and require the Contractor to proceed without any obligation to the Contractor.

- The Contractor shall have no claim against the State for additional costs or delays resulting from the rejection of a VECP, including but not limited to development costs, loss of anticipated profits, increased material, or labor costs.

- The Department will determine if a VECP qualifies for consideration and evaluation. It may reject any VECP that requires excessive time or costs for review, evaluation, or investigations, or that is not consistent with the Department's design policies and basic design criteria for the Project.

- The Engineer will reject all or any portion of Work performed under an approved VECP if unsatisfactory results are obtained. The Engineer will direct the removal of such rejected Work and require construction to proceed under the original Contract requirements without reimbursement for any Work performed or removal of that Work under the VECP. Where modifications to the VECP are approved to adjust to field or other conditions, reimbursement will be limited to the total amount payable for the Work at the Contract bid quantities and prices as if the Work were constructed under the original Contract requirements. The rejection or limitation of reimbursement shall not constitute the basis of any claim against the Department for delay or for any other costs.

- The savings generated by the VECP shall be in the sole judgement of the Department sufficient to warrant review and processing.

- A VECP changing the type or thickness or both type and thickness of the pavement structure will not be considered. Also, any VECP that solely substitutes one material for another will not be considered.

- Additional information needed to evaluate VECP(s), shall be provided in a timely manner. Untimely submittals of additional information could result in rejection of the VECP.

- Where design changes are proposed, the additional information could include results of field investigations and surveys, design computations, and field change sheets, as necessary for the Department to evaluate the VECP.

- Approval or disapproval of a VECP on one Contract does not imply approval or disapproval on another Contract.

- Approval of the Conceptual VECP in no way obligates the Department to approve the full VECP.

- No Work related to a VECP shall be performed under Force Account. Agreed prices shall be determined for all pay items related to the VECP before it is approved.

- VECP(s) that only reduce or eliminate Contract pay items will not be considered.

- If the VECP creates a significant change as defined in **Subsection 104.02** that would not have otherwise resulted, the Contractor has no entitlement for additional compensation as provided for in **Subsection 104.02**.

e. Payment. If the VECP is approved, the changes and payment will be authorized with a Change Order. Payment will be made as follows:

- The changes will be incorporated into the Contract by changes in quantities of unit bid items, or new agreed price items, as appropriate, under the Contract.

- The cost of the revised Work as determined from the changes will be paid directly. In addition, the Department will pay the Contractor 50 percent of the savings to the Department as reflected by the difference between the cost of the revised Work and the cost of the related construction required by the original Contract computed at Contract bid prices.

- The cost for development, design, and implementation of the VECP are not eligible for reimbursement.

- The Contractor shall submit VECP(s) for an approved Subcontractor.

- VECP payments are for direct savings or costs. Indirect savings or costs (time, Contract completion date, shift duration, user costs, etc.) will not be included in payment calculations.

SECTION 105 — CONTROL OF WORK

105.01 AUTHORITY OF THE ENGINEER.

The Engineer decides all questions regarding the quantity, quality, and acceptability of materials furnished, work performed, work progress, Contract interpretation, and acceptable Contract fulfillment.

The Engineer may suspend the Project, wholly or in part, for the Contractor's failure to correct conditions unsafe for the workers or the public; for failure to implement provisions of the Contract and for failure to comply with the Engineer's direction. Contract time will continue to be charged during suspensions for these reasons. The Engineer may also suspend the Project, wholly or in part, due to unsuitable weather and for any other condition or reason determined to be in the Department's interest.

105.02 PLANS AND SHOP DRAWINGS.

Plans shall be supplemented by Contractor-prepared Shop Drawings as necessary to control the Work and its prosecution. Shop Drawings consisting of details that are not included in the Plans but required for the Work shall be furnished to the Department. Copies of any calculations required or used to prepare the Shop Drawings shall be furnished with the submission. Manufacturer's engineering data for prefabricated material, including that for falsework and forms shall be furnished with each set of Shop Drawings.

The Contractor shall not perform Work for items requiring Shop Drawings before review by the Department. This review shall neither confer upon the Department nor relieve the Contractor of any responsibility for the accuracy and completeness of the drawings, conformity with Contract requirements, and successful completion of the Contract. Before review of the Contractor's Shop Drawings, the Contractor bears all risk and all costs of delays for items related to the respective Shop Drawing.

Shop Drawings illustrate the Contractor's methods intended to implement the Work in the Contract; they are not part of the Contract. The Contractor's submission of a Shop Drawing represents to the Engineer that the Contractor (i) coordinated the Shop Drawing with the Contract; (ii) verified and measured the field dimensions and other information; (iii) calculated all details, construction, and performance criteria; and (iv) reviewed and accepted the Shop Drawings as its means and methods.

a. Submission of Shop Drawings. All Shop Drawings shall be submitted in a timely fashion so that the Contractor's accepted schedule will not be adversely impacted by the submittal process.

    - Shop Drawing submittals shall be via PDF files submitted electronically by the Contractor into the Department's web-based Project Management Portal (PMP), per RIDOT procedure posted in the Documents Tab. Each Shop Drawing submittal shall be accompanied by design computations, cuts from manufacturers' catalogs, and/or all other supporting technical bulletins and data. Upon the Department's request, once the Shop Drawings are final, the Contractor shall submit for the record four hard copy sets of Shop Drawings to the Department.

- All Shop Drawings shall be stamped by a Rhode Island Registered Professional Engineer. The stamping of Shop Drawings shall be according to the applicable requirements of the Rhode Island Board of Registration for Professional Engineers or other Boards of Professional Registration, as applicable.

b. Review of Shop Drawings. All Shop Drawings will be reviewed and returned to the Contractor for appropriate action within 30 calendar days from receipt of the submission or resubmission.

- Shop Drawings that are erroneous, lacking required Professional Engineer stamps, lacking information necessary to control construction, or not in conformance with accepted design criteria will be rejected and returned to the Contractor. The Contractor shall address the Engineer's comments and resubmit revised Shop Drawings.

- Shop Drawings designated "No Exception Taken – Subject to Revisions as Noted" may be used by the Contractor to commence corresponding Work subject to satisfying the written conditions of the review; these Shop Drawings shall be revised according to the notes (as applicable) and transmitted to the Engineer within fourteen calendar days of such approval.

- There shall be no claims for additional payment by the Contractor, nor will there be an extension of time under **Subsection 108.07,** for delays resulting from submissions or resubmissions due to incomplete Shop Drawings; for the time taken by the Contractor to submit revised Shop Drawings caused by an erroneous submission; or by a previous submission either lacking the information necessary to control construction; or for not conforming to accepted design criteria. In addition, the Engineer's review time of the revised Shop Drawings will not constitute justification for an extension of time.

- The Contract price shall include the cost of furnishing all Shop Drawings, including resubmissions. Shop Drawings are deemed incidental to the Contract.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS.

Work performed and materials furnished shall be in conformity with the lines, grades, cross sections, dimensions, and material requirements as required by the Contract, including standard industry tolerances when not otherwise specified or indicated.

Quality Control (QC) is the responsibility of the Contractor. Ensure that all work and material meet the Contract requirements without depending on the Department's acceptance sampling, testing, and inspection. The Contractor shall provide a project-specific competent and experienced individual who is designated for the responsibility for overall Quality Control. The Contractor shall cooperate with the Department and provide all necessary access, assistance, and material samples for Department inspection and testing. This work is incidental to meeting the Contract requirements, and all costs shall be included in the respective bid items and will not be paid separately.

If a Contract Item fails to conform to the Contract requirements, the Engineer will determine whether the Work may remain in place. If the Engineer determines that the Work is adequate to

serve the design purpose, the Engineer may allow it to remain and will document the basis of this decision. The State will take a credit or reduced payments to the Contractor for such Work, all of which would be included in a corresponding Change Order.

If a Contract Item does not meet the Contract requirements and the Engineer determines the Work is not acceptable, the Contractor at no cost to the State shall remove and replace the Work to meet the Contract requirements. The Engineer may require the Contractor to propose and submit a Shop Drawing for approval according to **Subsection 105.02**.

105.04 COORDINATION OF PLANS, SPECIFICATIONS, SUPPLMENTAL SPECIFICATIONS, AND SPECIAL PROVISIONS.

The Standard Specifications, Supplemental Specifications, Plans, Special Provisions and Contract Addenda are essential parts of the Contract and a requirement occurring in one is binding as though occurring in all. They are complementary and provide and describe the complete Contract. If there is a discrepancy, the governing ranking is in order of 'descending precedence:

Dimensions	Documents
1. Plan	1. Special Provisions*
2. Calculated	2. Plans
3. Scaled	3. Supplemental Specifications
	4. Standard Specifications
	5. Standard Details**
	6. Information received at mandatory prebid meetings.

* *Special Provisions include General Provisions Contract Specific (CS) and General Provisions Job Specific (JS).*

** *Standard Details include Rhode Island Standard Details and Bridge Standard Details.*

The Contractor shall not take advantage of any apparent Contract error or omission in the Contract and shall notify the Engineer promptly of any omissions or errors so that necessary corrections and interpretations can be made.

105.05 COOPERATION BY CONTRACTOR AND REMOVAL OF PERSONNEL.

The Contractor is required to maintain a complete copy of the Contract Documents on the Project site at all times. The Contractor shall give the Work the attention necessary to facilitate progress according to the Contract and shall cooperate fully with the Engineer, its representatives, and other Contractors on or adjacent to the Project.

The Contractor shall provide a Superintendent for the Project that is available and responsive at all times and is responsible for all aspects of the Work, including Subcontracted Work. The Superintendent shall be capable of reading and understanding the Contract and experienced in the type of Work being performed. The Superintendent shall receive instructions from the Engineer or the Engineer's authorized representatives. The Contractor shall provide full authority

to the Superintendent to promptly execute the Engineer's orders or directions and supply the required materials, equipment, tools, labor, and incidentals to complete the Work.

If the Contractor or any of its representatives fail to cooperate such that the integrity of the Work is compromised or the safe prosecution of the Work is jeopardized, the Department may immediately suspend all Work. Any unsafe conditions shall be corrected by the Contractor, and the uncooperative person or persons shall be removed from the Project before the resumption of the Work. Failure to rectify the situation in a timely manner acceptable to the Department may result in Contract default according to **Subsection 108.09**. The Contractor shall not receive compensation for any delays, nor will it be provided with additional time due to such suspension or removal.

The Department may remove any personnel from the Project at any time if:

- The performance of the personnel is unsatisfactory, or
- The personnel are uncooperative in their relationship with the Department, or
- A pattern of inaccurate or incomplete invoice submissions

105.06 COOPERATION WITH UTILITIES.

The Department will notify all utility companies, municipalities, pipeline owners, or other parties affected by the Work and make, as soon as practical, all necessary adjustments of the public or private utility fixtures and appurtenances within or adjacent to the limits.

Water lines, sewer lines, gas lines, power lines, communications lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals, and all other utility appurtenances within the limits of the Project in which the respective owners hold no private easements will be relocated or adjusted by the owners according to the executed Utility Construction and Maintenance Agreements.

It is agreed that the Contractor has considered in its Bid all of the permanent and temporary utility facilities in their present or relocated positions as shown on the Plans and as evident on the site, and that no compensation will be allowed for any delays, inconvenience, or damage sustained due to any interference from such utility facilities or the operation of moving them, unless otherwise provided for in **Subsection 104.03**. The Contractor shall adhere to all clearance and safety requirements of the affected utility company.

The Contract will indicate whether the utility owner, Contractor, or other party shall relocate or adjust the utility. When Contractors are required to retain firms to relocate the utility, it shall submit to the Engineer written statements from the respective utility companies that the firm or firms selected by the Contractor are approved for such Work before subletting the Work.

Before commencing Work, the Contractor shall make arrangements to protect the property of utility owners from damage and loss of operation. The Contractor shall notify utility owners and/or affected municipalities at least one week, or as specified in the Contract Documents, whichever duration is longer, in advance of commencement of such work.

The locations and depths of existing utilities as shown on the Plans are approximate. The Contractor shall verify the location of all existing utilities, both underground and overhead, before proceeding to commence the Work or order materials. The Contractor is specifically required to

follow the Dig Safe process. Damage to existing utilities that are shown on the Plans or located by the respective utilities according to the Dig Safe process shall be the sole responsibility of the Contractor and repaired to the satisfaction of the utility owner at no additional cost to the Department.

The Contractor shall coordinate and cooperate with the utility owners in the removal and rearrangement of any underground or overhead utilities to minimize interruption to utility services and duplication of Work by the utility owners. Facilities or appurtenances that are to remain in place during construction shall be accounted for and protected by the Contractor. If an underground facility is not shown on the Plans, this shall not relieve the Contractor of its responsibility under this Section. Where the Contractor's operations are adjacent to properties of railway, telecommunications, gas, and electric power companies and other utilities, or are adjacent to other property where damage might result in considerable expense, loss, or inconvenience, Work shall not commence until all arrangements necessary for their protection have been made.

The Contractor shall be responsible for damage to identified and located utilities on or adjacent to the Project at its own expense. The Contractor shall restore damaged utilities to the satisfaction of the utility owner according to current standards and code requirements and any specific requirements of the utility owner.

If utility services are interrupted due to damage or exposure, the Contractor shall promptly notify the utility owner and proper authority and shall cooperate fully in the restoration of such services. If the Contractor interrupts service, repair Work shall be continuous until service is restored.

The local fire authority must approve the Contractor's work plan for continued uninterrupted water service before commencement of Work around fire hydrants. Fire hydrants shall be accessible to fire departments at all times.

If the Engineer determines that adjustment or relocation of utilities is necessary, the Engineer will make necessary arrangements with the utility owner or Contractor to perform the Work not otherwise provided for in the Contract.

If the Contractor desires to reconfigure any utility facility or other improvement for the Contractor's convenience, which is in addition to or different from the configuration indicated in the Contract, the Contractor shall make whatever arrangements necessary with the owner for such reconfiguration and bear all related expenses.

a. Contractor Coordination with US Postal Service. The Contractor shall notify and coordinate with the US Postal Service where existing US Postal Boxes (mail drop/collection boxes) within the limits of the Project will be removed and reset to allow for sidewalk/curbing construction. This requirement applies only for standard US Postal Service main drop boxes. It is not applicable for the removal, resetting or replacement of private mailboxes. The removal and resetting of US Postal Service mail drop boxes shall be conducted only by the US Postal Service and, therefore, the Contractor shall plan Work operations to allow the US Postal Service time to complete the removal before start of construction. Finally, the Contractor shall notify the US Postal Service when the relevant Work is complete so that the boxes may be reset without any subsequent disturbance or impedance to access.

b. Contractor Coordination with Narragansett Bay Commission. The Contractor shall obtain a sewer facility alteration permit from the Narragansett Bay Commission (NBC) before undertaking any Work that affects sanitary sewer facilities that fall within NBC jurisdiction.

105.07 COOPERATION BETWEEN CONTRACTORS.

The Department reserves the right to contract separately for and perform extra or additional Work within or near the Project at any time during the life of the Contract.

When separate Contracts are let by the Department within the limits of one Project, each Contractor shall conduct its Work without interfering or hindering the progress or completion of the Work being performed by other Contractors. For any unavoidable interference, the Engineer will determine priorities.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with its Contract and shall protect and save harmless the Department from all damages or claims that may arise because of inconvenience, delay, or loss experienced because of the presence and operations of other Contractors working within or adjacent to the limits of the Project.

The Contractor shall arrange its Work and shall place and dispose of the materials used without interference to the operations of the other Contractors within or adjacent to the Project.

105.08 CONSTRUCTION STAKES, LINES, AND GRADES.

The Contractor shall be responsible for performing construction surveys and shall set and maintain all construction stakes for establishing lines, slopes, profile grades, centerline, and benchmarks for roadwork, bridge work, culvert work, protective and accessory structures, and appurtenances. These stakes and marks shall constitute the field control by which the Contractor shall establish other necessary controls to perform the Work.

The Contractor shall maintain construction lines, points and grade staking to ensure accurate and proper control of the Work and to verify final grades and construction lines. The Contractor shall be held responsible for preserving all stakes and marks and, if the stakes or marks are destroyed or disturbed, the responsibility of replacing the stakes shall be borne by the Contractor at no cost to the Department.

The Contractor shall be responsible for the accuracy of lines, slopes, grades, and other engineering Work in the Contract Documents and the provisions of **SECTION 934**. No entitlement to additional compensation will be considered because of alleged inaccuracies.

All Work in this Subsection is deemed incidental to the Contract and no separate payment will be made.

105.09 AUTHORITY AND DUTIES OF CONSTRUCTION MANAGER.

As the representative of the Engineer, the Construction Manager has immediate charge of the engineering details of each Project and is responsible for the administration, enforcement, and satisfactory completion of the Contract.

- The Construction Manager is delegated commensurate authority by the Department, including but not limited to the authority to:
  - Reject defective or non-conforming material and/or work
  - Suspend any Work improperly performed or proceeding contrary to the Contract
  - Unilaterally grant approvals that pertain to increases or decreases in quantities not greater than ten percent of the corresponding values that appear in the Bid
- The Construction Manager does not have the authority to:
  - Unilaterally change any design element or specification
  - Unilaterally grant approvals that pertain to increases or decreases in quantities greater than ten percent of the corresponding values that appear in the Bid
  - Act in a supervisory capacity for the Contractor or to interfere with the management of the work by the Contractor. Any recommendation that the assistants or representatives of the Engineer may give the Contractor shall not be construed as directing the Contractor or as binding the Engineer or Department in any way, nor shall it release the Contractor from the fulfillment of the terms of the Contract.

105.10 INSPECTION OF WORK.

Materials and each part or detail of the Work is subject to inspection by the Engineer. The Engineer shall be afforded unlimited and safe access, including traffic controls, to all parts of the Work and shall be furnished with the information and assistance by the Contractor to make a detailed inspection. The Contractor shall provide any necessary equipment for inspection, including walkways, railings, ladders, lifts, and platforms at no additional cost to the Department.

The Contractor shall remove or uncover such portions of the finished Work if directed by the Engineer. After examination, the Contractor shall restore the Work to the standard required by the Contract. If the Work conforms to the Contract, the uncovering, removing, and replacing of the covering or restoring the Work will be paid as Extra Work. If the Work so exposed and examined indicates that it is unacceptable and requires removal and replacement, or is non-conforming Work that may remain in place at reduced payment, the uncovering, removal, and restoration of the Work shall be at no cost to the Department.

The Contractor bears sole responsibility for the quality of Work and compliance with the Contract regardless of the Department's level of inspection. The Department's failure to identify defective Work or material shall not prevent later rejection when defective Work or material is discovered, nor shall it obligate the Department to grant acceptance under **Subsections 109.08** or **109.09**.

If the Contractor fails to notify the Engineer of Work performed or materials installed that prevented an opportunity for inspection, the Engineer may order the removal or replacement of the Work at no cost to the Department.

The Contractor shall be responsible for providing advance notice to the Engineer of any work scheduled to be performed and changes to that schedule. Any cancellation of planned work without proper notice to the Engineer may result in charges withheld from future payments for additional costs.

When any unit of government or political subdivision, utility company, or railroad corporation is required to accept and/or pay a portion of the cost of the Work covered by this Contract, its representatives have the right to inspect the Work and shall be afforded the same access and support as if the Engineer. Such inspection does not make any unit of government or political subdivision, utility company, or railroad corporation a party to the Contract, and will in no way interfere with the rights of either such party.

105.11 REMOVAL OF UNACCEPTABLE OR UNAUTHORIZED WORK.

Work that does not conform to the Contract requirements will be considered unacceptable, unless accepted under the provisions of **Subsection 105.03.**

Unacceptable Work found to exist before final acceptance of the Work, whether the result of poor workmanship, use of defective or non-conforming materials, or damage through carelessness or neglect, shall be removed and replaced at the Contractor's expense. This requirement has full effect whether or not the unacceptable work or defective materials were inspected by the Department.

Work performed contrary to the Contract or beyond the lines and grades shown on the Plans or as otherwise provided will be considered unauthorized Work and may not be considered for payment. Unauthorized Work may be ordered to be removed and/or restored to its original condition at the Contractor’s expense.

If the Contractor fails to promptly comply with any directive from the Engineer pursuant to this Subsection, the Engineer has the authority to require that unacceptable Work and unauthorized Work be removed and replaced or restored by others and to deduct that cost from any monies due to the Contractor.

105.12 LOAD RESTRICTIONS.

The Contractor shall comply with all legal load restrictions and obtain all necessary permits when hauling equipment or materials on stormwater infiltration areas, water quality treatment units, or public roads. A special permit will not relieve the Contractor of liability for damage that may result from the moving of such equipment or materials.

The Contractor shall not operate equipment that causes damage to any structure, roadway, or any other Work. Handling or hauling of materials shall be subject to approval of the Engineer to prevent damage to the pavement. No loads will be allowed on new concrete before the concrete has attained its specified strength, unless authorized in writing by the Engineer and subject to any conditions of that authorization.

105.13 MAINTENANCE DURING CONSTRUCTION.

Upon receipt of the NTP, the Contractor shall maintain the Project during construction, including during winter shutdown and other shutdowns, until completion as provided in **Subsection 101.18**. Maintenance includes the performance of all requirements of the Contract to allow safe public passage through the limits of the Project including approved laydown areas and any temporary work.

Maintenance work performed before acceptance under **Subsection 105.17** is incidental to other Contract items, and the Contractor will not be paid any additional amounts above the Contract price. Maintenance Work includes, but it not limited to, maintaining existing drainage flow, periodic grass mowing (not to exceed eight times per calendar year) and removing of construction debris, to the satisfaction of the Engineer, which will provide safe and convenient conditions at all times for the public. The Contractor shall continuously and effectively satisfy these maintenance responsibilities with such equipment and forces as may be necessary to maintain a safe and satisfactory condition for the duration of the Project.

If the Contract requires the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

The Contractor shall schedule pavement removal such that no location remains unpaved for longer than seven calendar days for full depth or 14 calendar days for milling. This means that, once the Contractor commences with the removal of existing full depth pavement from any location where traffic flow is to be maintained, they shall restore the roadway with no less than a full-depth asphalt base course at that location within the seven calendar days. For partial depth pavement removal (cold planing/milling), the Contractor shall schedule the pavement removal so that no location remains without a new paved surface course (or friction course) for longer than 14 Calendar Days.

If the Contractor fails, according to the provisions of this Subsection, to maintain the Project during construction, the Engineer will notify the Contractor of such non-compliance. If the Contractor fails to promptly comply with any directive, the Engineer may immediately proceed to have the maintenance Work performed by other forces. The cost of this maintenance will be deducted from monies due the Contractor.

If the Engineer determines that the work was delayed because of conditions beyond the control and without the fault of the Contractor, the above requirements for pavement restoration may be extended only for a time period justified by the field conditions, based on the judgement of the Engineer.

105.14 WINTER SHUTDOWN.

The Contractor shall suspend field work during the winter shutdown period. During this period, the Contractor is not relieved of its duties including, but not limited to, sediment and erosion control upkeep and SWPPP reports. If the existing pavement is removed before the winter shutdown, do not close the Project for the season until a new HMA layer has been placed and striped with epoxy pavement markings.

The Contractor may submit a written request to work during the winter shutdown period. This request shall demonstrate the reason for requesting to work during the winter, the benefit to the Project (cost or schedule), and detailed activities to be performed, and shall address how temperature sensitive work will be in performed accordance to the Specifications. The Department reserves the right to deny the request for any reason and will not be responsible for any time or costs associated with this denial.

If the Contract contains a traffic shift or traffic control setup that will remain in place over the winter shutdown, the Contractor shall provide a letter each year outlining how they plan to maintain the work zone through the winter.

105.15 OPENING SECTIONS OF PROJECT TO TRAFFIC.

The Engineer may order certain sections of the Project to be opened to traffic before Substantial Completion or Acceptance. Opening these sections shall not constitute acceptance of the Work or a waiver of any Contract provision.

If the Contractor is late in completing features of the Work according to the Contract and/or Project schedule, the Engineer will give written notification establishing a time period for completing these features. If the Contractor fails to complete the Work as directed, or make a reasonable effort to complete the Work according to the written notification, the Engineer may order all or a portion of the Project opened to traffic. The Contractor shall not be relieved of its liability or responsibility for maintaining the Work, and shall conduct the remaining construction operations with minimum interference to traffic at its own expense.

The Contractor shall notify the Department three weeks in advance of a bridge or roadway closure/split/shift/travel lane width reductions on any roads within the State. All full closures, splits, or shifts shall be scheduled to begin on Friday or Saturday night, as determined by the TMP, to allow the motoring public time to adjust to new travel patterns while allowing RIDOT the opportunity to evaluate its success.

105.16 FURNISHING RIGHT-OF-WAY.

The Department is responsible for securing Rights-of-Way in advance of construction. Exceptions will be indicated in the Contract, and no work is allowed in these areas until the ROW has been certified.

105.17 PARTIAL ACCEPTANCE.

The Contractor may submit a written request for acceptance of a completed portion of the Project, clearly identifying the limits of the Work.

The Engineer may reject the Contractor's request for partial acceptance or, if eligible, schedule an inspection, provided that:

- All safety items are in place including final pavement markings
- All Work on a bridge (as applicable) and its approaches are complete
- Traffic is in its final pattern
- The Work meets all Contract provisions, including submission of all required documents
- All areas that contribute runoff to a stormwater treatment unit have been permanently stabilized

The Engineer will designate in writing if the Work is accepted, the date of acceptance, and any warranty provisions initiated by the partial acceptance.

If the Work is not accepted, the Engineer will identify the incomplete or nonconforming portion of the Work and notify the Contractor in writing. The Contractor may request a second inspection pursuant to the above provisions upon completion and correction of the Work. If partial acceptance again is denied, the acceptance of that Work may be delayed until Final Acceptance of the Project.

Partial acceptance will relieve the Contractor of maintenance responsibility for that portion of the Work. This partial acceptance does not relieve the Contractor of responsibility to correct defective Work or repair damage caused by the Contractor or waive any other provisions of the Contract.

Additionally, the Contractor may submit quarterly a written request for partial acceptance of the following items to allow for their release of retainage:

- Drum Barricades Std 26.2.0
- Shadow or Advance Warning Vehicles
- Flagpersons
- Flagpersons OT Trainee Man-Hours
- Advance Warning Arrow Panel Portable Changeable Message Board Maintenance of Traffic Control
- Maintenance of Erosion Controls

Partial Acceptance of Contract Work completed may occur when:

- The Contractor shall notify RIDOT within seven days upon the Contractor’s assessment that the Subcontractor’s Work is complete and ready for inspection for partial acceptance by RIDOT.
- Within 14 calendar days of the Contractor's request, the Engineer may schedule an inspection of the Work under the completed Subcontract.
- Within 21 calendar days of the inspection, the Engineer will provide the Contractor with written notice of acceptance or a report containing the following elements:
    - Work not started, but required to be completed.
    - Incomplete Work, the completion of which is required.
    - Unsatisfactory Work, the correction of which is required.

The process of issuing inspection results will be completed within 60 calendar days from the receipt of the Contractor’s letter requesting release of retainage.

The Contractor is obligated to complete all identified incomplete Work and correct all noted deficiencies contained in the inspection report. Upon completing all Contract Work and correcting all identified deficiencies, the Contractor shall submit documentation of corrective actions and request re-inspection.

Within 14 calendar days of the request for re-inspection of completed punch list Work, the Engineer will conduct an inspection.

The Engineer will have 10 calendar days from the second scheduled inspection to respond to the Contractor with a written determination of the acceptance of the Work performed. If Work has been satisfactorily completed in compliance with the Contract, the Engineer will accept that unit or portion of the Work as physically completed. The Engineer will designate in writing the date of acceptance and any warranty provisions initiated by the partial acceptance.

The State will pay the Contractor for all Work covered by the partial acceptance including the relevant portion of retainage due the Subcontractor according to **Subsections 109.09** and **109.10**.

Partial acceptance will relieve the Contractor of maintenance responsibility for that portion of the Work. This partial acceptance does not relieve the Contractor of responsibility to correct defective Work or repair damage caused by the Contractor or waive any other provisions of the Contract.

If, however, during this second inspection the Engineer finds any incomplete or unsatisfactory Work, no partial acceptance will be granted, and acceptance of the unit or portion of the Work must await the final acceptance of the entire Project.

105.18 FINAL ACCEPTANCE.

The procedure for obtaining Final Acceptance is as follows:

a. The Contractor shall notify the Engineer in writing that the Project is substantially complete, as defined by **Subsection 101.89**.

b. The Department will perform a final inspection within 45 calendar days from receipt of the notice, weather permitting.

c. Within 45 calendar days of the inspection, the Engineer will provide the Final Inspection Report containing the Punch List to the Contractor.

d. The Contractor shall complete and resolve all issues within the Final Inspection Report, including all Punch List items, submission of as-builts, DBE closeout and other outstanding paperwork, within 60 calendar days of receipt. The 60-calendar day period for completion is suspended during winter shutdown, if a Project has a winter shutdown.

e. Upon completion of the Punch List, the Contractor shall notify the Department, in writing, with written details addressing each Punch List finding.

f. After notification of Punch List completion or 60 calendar days of punch list Work completion, the Engineer will perform a second final inspection to determine if the Contractor completed the Work according to **Subsection 101.18**. If the Project is complete, the Engineer will notify the Contractor in writing of Final Acceptance.

g. If incomplete Work is noted at the time of the final inspection under e., the Contractor may be subject to Liquidated Damages pursuant to **Subsection 108.08**, commencing from the Contract completion date.

105.19 CLAIMS FOR ADJUSTMENTS AND DISPUTES.

a. Notification. The Contractor is not entitled to file a claim according to this Section unless it has complied with the notice provisions of **Subsection 104.02(d)**.

b. Submission. Claims shall be submitted in writing to the Engineer within 30 calendar days of receipt of the Engineer's written denial of the Contractor's request for a Contract change, as provided for in the third bullet of **Subsection 104.02(d)**. Failure to submit a claim as provided above shall constitute a waiver of entitlement to compensation and/or time adjustment.

c. Documentation of Claims. A claim shall be in sufficient detail to enable the Engineer to determine the basis for entitlement and the compensation and time extension due, if applicable. The following information shall be included in the claim submitted:

- A detailed factual statement of the claim providing all relevant dates, locations, and items of Work affected by the claim
- The date that the actions resulting in the claim occurred or the conditions resulting in the claim became evident
- A copy of the Contractor's notification submission under **Subsection 104.02(d)**
- The name and title of each Department employee knowledgeable about facts that gave rise to such claim
- The name and title of each Contractor or employee knowledgeable about facts that gave rise to such claim
- The specific provisions of the Contract that support the claim, and a statement of why such provisions support the claim
- The identification of any pertinent documents, and the substance of any material or communications relating to the claim
- A statement whether the additional compensation or extension of time is based on the provisions of the Contract or an alleged breach of Contract
- If an extension of time is also sought, the specific days for which it is sought and the basis for such claim as determined by an analysis of the accepted Construction Schedule
- The amount of additional compensation sought and a breakdown of that amount.
- A copy of the Contractor's Time Extension Request under **Subsection 108.07** and supporting documents, if the Claim includes Delay

d. Certification. In addition to the information required above, the Contractor's Claim shall be accompanied by the following signed certification. The Contractor's failure to provide this certification will constitute a waiver of the Contractor's entitlement to compensation or a time extension for the claim:

CERTIFICATE OF CLAIM

The undersigned (Name and Title of Officer of the Contractor) certifies that the documentation is submitted in good faith, that the information provided is accurate and complete to the best of (the Contractor's) knowledge and belief, and that the compensation and time extension requested are accurately reflected in the subject claim.

Name and Title:

Company:

Date of Signature:

Notarized:

e. Review of Claims. The Engineer will acknowledge in writing receipt of the claim to the Contractor and will initiate the claim review process. During the claim review process, the Contractor shall provide the Engineer access to and, if requested, copies of any supporting documentation, including but not limited to the following documents:

- Daily time sheets and foreman's daily reports
- Union agreements, if any
- Insurance, welfare, and benefits records
- Certified Payroll register
- Earnings records
- Material Invoices, purchase orders, and material and supply acquisition Contracts
- Material cost distribution worksheets
- Equipment records (list of company equipment, rates, etc.); Vendor rental agreements
- Subcontractor payment certificates and Invoices
- Canceled checks, receipts of electronic payments, and other supporting documentation to verify payroll payments and payments to vendors, suppliers, or Subcontractors
- Job cost report
- Job payroll ledger

The Contractor's failure to provide this access or copies as requested will constitute a waiver of the Contractor's entitlement to compensation or a time extension for the claim.

105.20 PROCEDURE FOR CLAIMS AND DISPUTES.

No claim shall be allowed against the State unless the Contractor has met the notification procedures in **Subsection 104.02(d)**.

The Contractor and the State mutually agree that conditions precedent to the filing of a lawsuit include:

- Participation in the Department's internal claim resolution process, and if unresolved at the conclusion of the Department's internal claim resolution process.
- Mediation or other mutually acceptable Alternative Dispute Resolution (ADR) procedure.
- The Mediator's costs and expenses associated with these ADR methods shall be borne by all parties equally.
- Each party shall bear its own costs in preparation and participation of these conditions precedent to the filing of a lawsuit.
- If these efforts are unsuccessful, claims may be adjudicated either through binding arbitration or litigation according to State Law. Any party bringing an action under this Section shall be entitled to an award of prejudgment interest beginning with the filing date of the court action or date of demand for arbitration. Any interest shall be computed daily to the date of payment and shall be compounded annually. Pre-judgment and post-judgment interest shall be calculated according to RI Gen. Laws §37-13.1-1, et seq.

105.21 REQUEST FOR INFORMATION (RFI).

An RFI is a document submitted by the Contractor requesting clarification of a portion of the Contract Documents or a field condition. All such requests shall include a detailed written statement indicating the specific Drawings or Specifications to be clarified and the clarification requested. In addition, the Contractor shall:

- Clearly state the item to be clarified, provide background information as appropriate, and explain why a response is needed.
- Identify Drawings by Drawing number and location on the sheet.
- Identify Specifications by Section number, page, and paragraph.
- Provide a description of the field condition requiring clarification.
- Present the Contractor's interpretation or understanding of the requirement.
- Include a possible solution by text and/or drawings.

Improper RFIs are defined as:

- RFIs that are not complete.
- RFIs that request information that is clearly shown on the Contract Documents.
- RFIs that do not comply with the definition of an RFI as indicated above.

Improper RFIs will be returned unanswered. Delays caused by improper RFIs are the sole responsibility of the Contractor. The Contractor is not entitled to additional time or monetary compensation as a result of such delays.

a. RFI Submission. The Contractor shall enter RFIs into the electronic system as described for the Project. The Contractor shall ensure that all attachments are fully legible after download. Each page of attachments to RFIs shall bear the RFI number.

The Contractor shall originate all RFIs. RFIs from Subcontractors or material suppliers shall be submitted through, reviewed by, commented on, numbered, logged, and signed by the Contractor before submission to the Department.

The Contractor shall carefully study the Contract Documents to determine that the requested information is not available therein. RFIs that request information available in the Contract Documents will be deemed improper, as defined above.

The Contractor shall identify and submit RFIs in a timely fashion to not cause delay to the Project. Any delays due to the untimely submission of RFIs will be the responsibility of the Contractor.

RFIs shall not be used for the following purposes:

- To request approval of submittals
- To request approval of substitutions
- To request different methods of performing work than those drawn and specified
- To request changes to the Contract Documents
- To request additional cost or credit
- As routine written communications between the State and the Contractor
- To reply to notices issued by the Department
- To clarify Subcontract bid questions
- For any other purpose not listed in this Specification

b. RFI Response. RFIs do not automatically justify a cost increase in the work or a change in the Project Schedule. Answered RFIs shall not be construed as approval to perform Extra Work.

Responses from the Department will not change any requirement of the Contract Documents. If the Contractor believes that a response to an RFI will cause a change to the requirements of the Contract Documents, the Contractor shall immediately give written notice to the Department stating that the Contractor considers the response to require a Change Order. Failure to give such written notice immediately (48 hours) shall waive the Contractor's right to seek additional time or compensation.

The Contractor shall allow the Department 30 calendar days for the review and response time for RFIs.

105.22 TOLLING FACILITIES.

Tolling facilities are defined as the steel gantry (or gantries), gantry supports, foundations, hardware, tolling equipment (both attached to the gantry and roadside), electrical cabinets, electrical cables and conduits, communication cables and conduits, manholes, handholes, utility poles, guardrail, barriers, and any other tolling infrastructure needed to safely operate the tolling location. Short-term is defined as a lane closure or lane shift for a 24-hour duration or less. Any lane closure or shift that is not considered short-term is considered long-term.

Except for short-term outages due to scheduled construction activity, all tolling locations within the Project limits must continue to collect revenue during the construction of the Project. The

Contractor shall schedule the work to minimize impacts to the tolling facility. The Contractor must conform to the following:

- The Contractor shall locate the tolling facility, including any portion that may be underground before initiating any work.
- The tolling facility cannot be relocated. Temporary bypass or crossover roads that result in traffic not flowing under the gantry will not be allowed without written approval from the Department.
- If guardrail or barrier protecting the tolling facility is temporarily removed, the Contractor shall protect the tolling facility with temporary barrier that has an allowable deflection that is less than the distance between the barrier and the tolling facility.
- The Contractor shall maintain access to the tolling facility at all times, including means for RIDOT and RIDOT's Tolling Contractor to safely access the facility from the limited access roadway.
- The tolling facility is configured to the existing lines and grade of the highway which passes underneath it. Any changes to the pavement elevation, pavement markings, tolling control points, lane alignment, or roadway alignment will require RIDOT's Tolling Contractor to reconfigure and/or recalibrate the tolling facility. The Contractor shall plan its work to minimize disruption to the tolling facility by reducing the amount of downtime, reconfiguration, and recalibration necessary.
- No traffic splits or bifurcated traffic will be allowed within 100 ft of a toll gantry without written approval from the Department.
- When milling to remove pavement 100 ft on either side of the gantry, the Contractor shall mill the complete width of the roadway in one shift.
- The Contractor shall repave the roadway as expeditiously as possible while conforming to requirements of the Standard Specifications. If the entire roadway cannot be repaved during a single shift, the Contractor shall repave the roadway on consecutive days until the entire roadway under the gantry is repaved and line striping in its permanent location is installed while conforming to requirements of the Standard Specifications. The Contractor shall schedule the work so that the paving can be completed on consecutive days and also conform to the approved Traffic Management Plan.
- The Contractor shall submit a milling and paving schedule for work within 100 ft on either side of the gantry to RIDOT at least three weeks in advance showing the approximate dates of the milling and paving operations. The Contractor shall revise the approximate dates with actual dates no later than one week before the start of milling or paving.
- The Contractor shall not park any vehicles or equipment or store any materials within 100 ft on either side of a toll gantry.
- The Contractor shall coordinate all lane closures or shifts, whether permanent or temporary, with the RIDOT Tolling Section. Long-term lane shifts or lane closures will require the Contractor to submit a 21-day notice to the RIDOT Tolling Section. Short-term lane closures or shifts will require 48 hours notice to the RIDOT Tolling Section, not including weekends or holidays. The Contractor shall provide notice as defined in this paragraph to the RIDOT Tolling Section through the RIDOT Project Manager. Notice in this paragraph is in addition to any other notices required.

- The Contractor shall repair any damage to the tolling facility due to construction operations as determined by the Department. RIDOT will repair the tolling facility and the Contractor shall reimburse RIDOT for any and all costs associated with the damage including, but not limited to, reimbursement of repair costs and RIDOT staff time.
- Costs associated with adjustments and/or recalibration of the tolling facility due to lane shifts, milling, and/or paving operations will be the responsibility of RIDOT.

SECTION 106 — CONTROL OF MATERIAL

106.01 CERTIFICATION OF MATERIALS.

All materials used in the Work shall meet all requirements of the Contract, including the requirements of the "Master Schedule of Testing (MST) for the Preparation of a Project Schedule for Sampling, Testing, and Certification of Materials." All materials are subject to inspection, which includes acceptance sampling and testing, by the Engineer. Results of testing performed by the Contractor shall not substitute for acceptance testing, and shall only be used by the Contractor for Quality Control purposes. All materials shall be new.

The Department reserves the right to re-inspect any materials at any time before issuing Final Acceptance.

106.01.1 Buy America Requirement – for Federal-Aid Projects.

The Contractor shall perform the Work pursuant to 23 USC et seq., Buy America, and Title 23 of the Code of Federal Regulations, Buy America requirements, the current version, as amended.

106.02 INSPECTION, SAMPLING, AND TESTING.

Before any Department sampling and testing for acceptance, the Contractor shall perform all inspection, sampling and testing for quality control (QC) as required by the Contract, and as needed to meet the Project Specifications. The Contractor shall not rely on any Department testing results for controlling its operations and processes.

The Department will perform all inspection, sampling, and testing for acceptance and will not use Contractor QC test results for acceptance. Upon request by the Contractor, copies of acceptance inspection, sampling and testing information, including test results, will be provided by the Department. Work and/or material may be inspected, sampled, and tested for acceptance by the Department at any time before, during, or after incorporation into the Project including up to the time of inspection of Final Acceptance punch list items.

All inspection, sampling, and testing of Work and/or materials shall be performed by qualified personnel and Laboratories, according to the most current specified standards of AASHTO, ASTM, or other organizations adopted or approved by the Department. Additionally, for Federal-aid Projects, this work will be performed according to Title 23 of the Code of Federal Regulations Part 637, Construction Inspection and Approval. When there is an AASHTO designation followed by an ASTM designation, the AASHTO designation will govern when there are minor differences between the two standards.

The Department will determine the extent and manner for sampling and testing Work where standard test procedures are not specified or applicable.

106.03 CERTIFICATES OF COMPLIANCE, WARRANTIES, AND GUARANTEES.

The Engineer may permit the use, before sampling and testing, of certain materials or assemblies accompanied by Certificates of Compliance (CoC), signed by the manufacturer, that certify that each manufacturer's lot of identified manufactured materials or assemblies complies with the

requirements of the Contract. Each CoC shall contain a list of the specific Contract provisions being certified.

The Contractor shall not incorporate the materials or assemblies in the Work before acceptance of the CoC by the Engineer. If requested by the Engineer, the Contractor shall provide copies of the manufacturer's documentation used to substantiate the CoC. The Engineer reserves the right to reject any product solely on the basis of an inadequate CoC.

The Engineer reserves the right to perform its own inspection, sampling, and testing for acceptance of any product, regardless of whether accompanied by a CoC, all according to **Subsection 106.02**.

If the manufacturer provides the Contractor with a warranty or guaranty for the materials or assemblies that have not expired at the time of Final Acceptance, then the warranty or guaranty shall then be transferred to the Department.

106.04 PLANT INSPECTION.

The Engineer may inspect the Contractor's plant or production facilities and operations. The Engineer may obtain material samples for determining compliance with the requirements of the Contract. Acceptance or rejection of plant or production facilities and operations may be based on visual inspection and/or records.

When the Engineer inspects the plant or production facilities and operations, the following conditions shall apply:

- The Contractor and plant operator shall cooperate with the Engineer and provide assistance as requested at no additional expense to the Department.
- The Contractor and plant operator shall provide the Engineer access to those parts of the plant or production facilities and operations where storage, manufacture, or production occurs.
- The Contractor and plant operator shall provide and maintain for the Engineer's use at the plant or production facilities all personal protective equipment and other safety measures as necessary and as required by OSHA.

106.05 GENERAL STORAGE OF MATERIALS ON SITE.

To ensure the preservation of the quality and fitness for the Work, materials shall be stored according to the requirements of the Contract including but not limited to the manufacturer's recommendations. Stored materials, even though approved before storage, may again be inspected before their use in the Work. Materials shall be stored to facilitate inspection by the Engineer. All costs associated with this Subsection shall be at the sole expense of the Contractor.

The following applies to the location of stored materials and equipment.

a. Roads without Curbing and Sidewalks. Materials and/or equipment shall not be stored within existing and/or newly constructed travel lanes, designated parking areas, paved shoulders, or adjacent areas other than as noted below. Materials and equipment may be

stored within specified areas only with written approval by the Engineer. Materials stored in these locations shall be removed within 14 calendar days. Material and/or equipment may be stored during successive daily operations in conformance with the AASHTO *Roadside Design Guide* Clear Zone Tables.

b. Roads with Curbing and/or Sidewalks. Materials and/or equipment shall not be stored within existing or newly constructed travel lanes, paved shoulders, or designated parking lanes. No portion of the sidewalks may be used for storage of equipment and/or materials.

c. Stormwater Water Quality Treatment Areas. Areas that have existing water quality structures, new water quality structures, or proposed water quality structures shall not be used to store materials and/or equipment. The following applies:

- Storage of equipment and/or materials not used in the daily operations is prohibited.
- All trash shall be contained and disposed of legally. All waste and/or spent material shall be removed from the site daily.
- All erodible material stockpiles shall be covered and contained with the proper erosion controls.
- All portions of an area used for storage of construction material and/or equipment shall be clearly delineated with appropriate erosion control devices, pollution control devices, and as directed by the Engineer.
- Storage site entrance shall utilize RI Standard 9.9.0 Construction Access.
- Storage sites shall be restored to their original condition at no cost to the State.
- Additional storage space outside the Contract limits is at the Contractor's discretion. The Contractor shall obtain written permission from property owners/lessees prior to storing materials or equipment and shall furnish copies of such permission to the Engineer.

106.06 HANDLING MATERIALS.

Materials shall be transported to prevent loss, damage, or segregation after loading and measuring.

106.07 MATERIALS NOT WITHIN CONTRACT REQUIREMENTS.

Any material used in the Work that fails to meet the Contract requirements shall be corrected to conform to the Contract requirements or removed and replaced at the Contractor's expense. If the Engineer determines removal or replacement of the material would compromise the integrity of the Work performed, pay factors will be applied.

106.08 STATE-FURNISHED MATERIAL.

The Contractor shall be responsible for all materials delivered or made available. Deductions will be made from any monies due the Contractor for shortages, deficiencies, other causes, and

damage that may occur after delivery. Demurrage charges, resulting from the Contractor's failure to accept the material at the designated time and point of delivery, will also be deducted from monies due the Contractor.

SECTION 107 — LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.01 LAWS TO BE OBSERVED.

The Contractor shall be fully informed with, and observe and comply with, all Federal, State, and local laws, ordinances, regulations, permits, orders, and decrees of bodies or tribunals having jurisdiction or authority, as amended, which may affect the Work or those engaged or employed in the Work.

The Contractor shall protect, defend, and indemnify the Department and its representatives against any claim or liability arising from the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor, the Subcontractors, suppliers of materials or services, or others engaged by the Contractor or the employees of any of them. If any discrepancy or inconsistency is discovered between the Contract and any law, ordinance, regulation, order, or decree, the Contractor shall immediately report this to the Engineer in writing.

The Contractor shall execute and file such documents, statements, and affidavits required under applicable Federal or State law or regulation affecting its Proposal, Contract, or the prosecution of the Work. The Contractor shall permit the examination of any records required by Federal, State, and local laws, ordinances, or regulations.

107.02 SPECIFIC STATUTES REQUIRED TO BE INSERTED.

All Federal, State, and local laws, ordinances, permits are incorporated by reference, including but not limited to:

- § 5-6-2 – Work for which license required
- § 24-8-4.2 – Use of truck mounted attenuator
- § 28-26-5 – License required for operation of hoisting machinery
- § 31-25 – Size, weight, and load limits
- § 37-13-5 – Payment for trucking or materials furnished – Withholding of sums due
- § 37-13-6 – Ascertainment of prevailing rate of wages and other payments – Specification of rate in call for bids and in Contract
- § 37-13-7 – Specification in Contract of amount and frequency of payment of wages
- Chapters 85, 86, and 88 of the Public Laws or Rhode Island, 1960:

  Section 123 of the aforesaid chapters defines the authority of Director of Department of Public Works and use of Federal assistance and provides in part that in the event that Federal funds or Federal assistance are made available to the State for use in carrying out highway projects, said projects shall be carried out and executed in all respects subject to the provisions of the appropriate Federal law providing for the construction of such projects and the rules and regulations made pursuant thereto, and to such terms, conditions rules and regulations, not inconsistent with such Federal law, rules and regulations as said Director may establish to ensure the proper execution of said projects, therefore, any provisions of the State laws that conflict with the Federal laws, rules and

regulations are not applicable to projects financed in whole or in part with Federal Aid Highway funds.

107.03 PERMITS, LICENSES AND TAXES.

The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the prosecution of the Work at the Contractor's own cost. The Contractor is responsible to secure permits, variances, or modifications to the permits secured by the Department necessary for the Contractor's means and methods of construction.

107.04 PATENTED DEVICES, MATERIALS, AND PROCESSES.

If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, the Contractor shall provide for their use by suitable legal agreement with the patentee or owner. The Contractor and the Surety shall defend and indemnify the Department, any affected third party, or political subdivision from all claims for infringement by reason of the use of any such patented design, device, material, process, trademark, or copyright. The Contractor shall indemnify the Department for costs, expenses, and damages that it may be obligated to pay by reason of any infringement thereof during the prosecution or after the completion of the Contract.

107.05 RESTORATION OF SURFACES OPENED BY PERMIT.

The right to construct or reconstruct any utility service in a State owned and/or maintained highway or to grant permits for same is expressly reserved by the Department.

Any individual, firm, or corporation wishing to make an opening in the highway shall first secure a permit from the Department. The Contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. When directed by the Engineer in writing, the Contractor shall make all repairs necessitated by such openings. This Work will be paid for as Extra Work.

107.06 FEDERAL-AID PARTICIPATION.

When any Federal laws, rules, or regulations are in conflict with any provisions of a Federally assisted Contract, the Federal requirements will prevail, take precedence, and be in force over any conflicting provisions.

If there is Federal participation in the cost of the Project, the Work shall be performed under the supervision of the Department but subject to the inspection and approval of the United States Government. Such inspection shall neither make the United States Government a party to this Contract nor interfere with the rights of either party to the Contract. At no additional cost to the Department, the Contractor shall fully cooperate with the inspection and provide safe access to all Project areas and allow the United States Government to examine any records or interview any person working on this Contract. Nothing in this Section shall be interpreted to limit or restrict in any way the authority of the United States Government.

107.07 SANITARY, HEALTH, AND SAFETY PROVISIONS.

The Contractor shall observe and comply with all Federal, State, and local laws, ordinances, rules, regulations, and orders pertaining to sanitary, health, or safety provisions. The Contractor shall not require any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to health or safety. The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of its employees and the Department as may be necessary to comply with the requirements of the Contract.

The Contractor shall admit without delay and without the presentation of an inspection warrant, any inspector of the Occupational Safety and Health Administration or other legally responsible agency involved in safety and health administration upon presentation of proper credentials.

107.08 PUBLIC CONVENIENCE AND SAFETY PROVISIONS.

The Contractor shall construct the Project to minimize obstructions to traffic. The Contractor shall provide all adequate safeguards, safety devices, protective equipment, and any other needed actions to protect the public and property in connection with the performance of the Work and as specified under **Subsection 104.08**. The Contractor shall perform any measures or actions the Engineer may deem necessary to protect the public and property. Except for Work done under items in the Contract, Work prescribed herein will not be paid for separately but is incidental to the Work.

The Contractor shall report all accidents on the Project to the Engineer. The Contractor shall furnish the Engineer with two copies of a report of any accident occurring on the Project that involves any of the following:

- Personal injury requiring medical treatment
- Loss of time on the job
- Public liability or property damage

Accident reports shall be submitted on forms acceptable to the Engineer.

107.09 BARRICADES AND WARNING SIGNS.

Highways or bridges closed to traffic shall be protected by traffic control devices according to the latest edition of the MUTCD.

107.10 USE OF EXPLOSIVES.

The use of explosives is prohibited except when provided by the Contract.

The Contractor shall obtain all required permits or licenses for possession and use of explosives.

The Contractor shall comply with all pertinent laws and ordinances, including but not limited to Title 29 and Title 30 of the Code of Federal Regulations, and the Safety and Health Regulations for Construction of OSHA, and R.I.G.L. 23-28.28, whichever is the most restrictive, in the use, handling, loading, transportation, and storage of explosives and blasting agents.

If the Contractor uses explosives, the Contractor shall not endanger life, property, or the Work. The Contractor shall be liable for all property damage and injury resulting from the use of explosives.

Subsection 202.03.1 discusses the use of explosives and blasting.

107.11 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE.

The Contractor shall protect all public and private property impacted by its operations. The Contractor shall not move, disturb, or damage any land monuments or property markers unless directed by the Engineer in writing.

The Contractor is responsible for damage to public and private property resulting from any act, omission, neglect, misconduct in the Contractor's method of executing the Work, defective Work or materials, or failure to perform the Contract.

The Contractor shall restore all damaged property to a condition similar or equal to that existing before the damage or injury occurred at its own expense. If the Contractor fails to restore the damaged property, the Department may restore the property and deduct applicable amounts from the Contract balance.

Moved, disturbed, or damaged land monuments or property markers shall be replaced according to the standards in 435-RICR-00-00-1 Rules and Regulations for Professional Surveying in the State of Rhode Island.

107.12 CULTURAL RESOURCES.

If the Contractor encounters artifacts of historical or archaeological significance, the Contractor shall immediately cease its operations in that area and notify the Construction Manager in writing. The Construction Manager will inform the RIDOT Historic Preservation Specialist who will determine the disposition of the site and determine the appropriate methods to preserve the artifacts.

107.13 PUBLIC LANDS PROTECTION.

When performing Work within or adjacent to public lands or waters, including State or national forests, parks, or other public or federal lands, the Contractor shall comply with all Federal, State, and local laws, ordinances, rules, regulations, and orders. The Contractor shall maintain the areas in a safe and clean condition, dispose of all refuse, and obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, sanitary facilities, and other structures.

107.14 RESPONSIBILITY FOR DAMAGE CLAIMS.

a. Indemnification. The Contractor shall indemnify, defend and save harmless the State, the Department, its officers, employees and agents, adjoining states, cities, towns, municipalities, public utilities, railroad or railway company, any fee owner from whom a temporary Right-of-Way was acquired for the Project, from any and all suits, actions, claims, liabilities, damages, losses, penalties, or costs of any character or nature brought

on account of any injuries, death, or damages sustained by any person or property arising out of or from any cause whatsoever from the performance of the Work. In addition to any remedy authorized by law, the Department may withhold from monies due to the Contractor an amount deemed necessary by the Engineer to ensure the defense and indemnification obligations of this Section until disposition has been made of any suits or claims. The Department reserves the right to pay any claimant and deduct monies from the Contract.

The Contractor's responsibility for indemnity shall survive the termination of the Contract. Notwithstanding the foregoing, nothing contained herein shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved by the State.

b. Required Insurance. The Contractor shall procure and maintain at the Contractor's own expense, until final acceptance of Work, insurance coverage for damages assumed by the Contract or imposed by law, of the kinds and in the amounts specified, with insurance companies authorized to do business in the State. The insurance shall cover all operations performed under the Contract, whether by the Contractor or by Subcontractors. Before commencing with the Work, the Contractor shall furnish certificates of insurance satisfactory to the Department certifying that the policies will not be changed or canceled unless 30 days written notice has been given to the Department. The limits of the insurance are specified by law or under the terms of the Contract:

- Workers' Compensation Insurance. Coverage shall be according to prevailing laws.

- Liability and Property Damage Insurance. Each policy shall name the Department as an additional insured and shall include a provision requiring the insurer to investigate and defend the Department against all claims for death, bodily injury, or property damages even if groundless. Coverages shall be in the following amounts:

    - Bodily injury liability:

      $500,000 each person
      $1,000,000, each occurrence

    - Property damage liability:

      $500,000 each occurrence
      $1,000,000 aggregate

- Insurance Covering Special Hazards. Special hazards shall be covered by either riders to the liability and/or property damage policy or policies specified above or by separate policies of insurance as follows:

    - Property Damage Liability arising out of the collapse of or structural injury to any building or structure due to:

        + Excavation (including borrowing, filling, or backfilling), tunneling, pile driving, cofferdam Work, or caisson Work; or

+ Moving, shoring, underpinning, razing, or demolition of any building or structure, or removal or rebuilding of any structural support.

- Property Damage Liability for injury to or destruction of property arising directly or indirectly from blasting or explosions however caused, other than explosions of air or steam vessels, piping under pressure, prime movers, machinery, or power transmitting equipment.

107.15 THIRD PARTY BENEFICIARY CLAUSE.

Anyone not a party to the Contract is not a third-party beneficiary and may not maintain any action for damages under the Contract.

107.16 PERSONAL LIABILITY OF STATE EMPLOYEES.

The State's authorized representatives are acting solely as agents and representatives of the State when carrying out and exercising the power or authority granted to them under the Contract. There shall not be any liability either personally or as employees of the State. Notwithstanding the foregoing, nothing contained herein shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved by the State.

107.17 NO WAIVER OF LEGAL RIGHTS.

Final Acceptance does not preclude the Department from correcting any measurement, estimate, or certificate made before or after completion of the Work. The Department may recover from the Contractor, the Surety, or both, any overpayments by the Department. A waiver on the part of the Department of any breach of any part of the Contract is not a waiver of any other or subsequent breach.

The Contractor shall be liable to the Department for latent or patent defects, fraud or such gross mistakes as may amount to fraud, and/or regarding the Department's rights under any warranty or guaranty of the Work without prejudice to the terms of the Contract.

107.18 HAZARDOUS MATERIAL.

If the Contractor encounters or exposes any abnormal condition that may indicate the presence of a hazardous material or toxic waste, it shall immediately suspend Work in the area and notify the Engineer in writing. The Contractor's operation in this area shall not resume until directed by the Engineer in writing. However, the Contractor shall continue working in other areas of the Project.

- Abnormal conditions shall include:
  - Barrels
  - Tanks
  - Discolored earth
  - Obnoxious odors

- Obnoxious or discolored liquids
- Excessively hot earth
- Smoke
- Any other condition that could indicate the presence of hazardous material or toxic waste

- The Contractor shall comply with all Federal, State, and local laws, ordinances, rules, regulations, and orders for the disposition of the hazardous material or toxic waste.

107.19 CIVIL RIGHTS.

The Contractor shall comply with Federal, State, and local laws, rules, and regulations, including Title VI of the Civil Rights Act of 1964, 42 USC §§ 2000d – 2000d4 (the Act) and 49 CFR Part 21, Nondiscrimination in Federally-Assisted Programs of the Department of Transportation – Effectuation of Title VI of the Civil Rights Act of 1964 (the Regulations), as amended, which set forth unlawful employment practices including that of discrimination because of race, religion, color, sex, or national origin and that define actions required for Affirmative Action and Minority (Disadvantaged) Business programs.

SECTION 108 — PROSECUTION AND PROGRESS

108.01 SUBLETTING OF CONTRACT.

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the Contract or any portion, or of its right, title, or interest therein, without written consent of the Engineer. The Contractor's work force shall perform at least 40 percent of the total Contract price excluding the total cost of specialty items listed in the Proposal, which may be Subcontracted without regard to the 40 percent limitation. Specialty items are defined in **Subsection 101.83**.

No subcontracts, transfers, or assignments of the Contract shall relieve the Contractor of liability under the Contract and Bonds. The Contractor shall submit a copy of its written agreements with subcontractors, including lower tiered subcontractors, when requesting to sublet any Work under the Contract. No agreements between the Contractor and its Subcontractors or vendors shall create third party relationships to the Department.

108.02 PRECONSTRUCTION.

Before commencement of any major Work on the Project, a Preconstruction Conference will be held to review the proposed Project schedule and coordinate the Work of the Contractor, utilities, and Subcontractors as defined in **Subsection 101.63**. The Contractor shall be prepared to discuss in detail the proposed schedule, the plan for stormwater pollution prevention, and the Traffic Management Plan, especially as these relate to coordination with the schedules of the utilities and Subcontractors. In addition, the Contractor shall be prepared to provide details of the sources and delivery of materials.

The Department will issue a written Notice to Proceed for Construction operations within 14 calendar days after Contract Award.

108.03 PROSECUTION AND PROGRESS.

a. General Requirements.

- The Contractor shall develop and maintain an integrated schedule management and controls program through Completion of all Projects. The Contractor shall initiate the Schedule Development process upon its receipt of the Apparent Low Bidder letter. The Special Provisions of the Contract will identify the applicable schedule requirements, according to the following levels:
    - Schedule Level A. Projects with a high level of complexity, impact to the motoring public or community, and/or larger size Projects.
    - Schedule Level B. Projects of average to moderate complexity, moderate impact to the motoring public or community, and/or average size.
    - Schedule Level C. Smaller Projects with minimal to no complexity, and minimal impact to the community. Examples include Projects such as resurfacing, maintenance, and landscaping.

- The Contractor's Schedule is the primary tool for the Contractor to organize and communicate its plan for the timely completion of the Project. The Contractor's Schedule shall include all Contract requirements, including Work performed by the Department, Contractor, Subcontractors, vendors, suppliers, utilities, regulatory agencies, and any other third party. The Contractor's Schedule is used to identify the Critical Path and near critical activities, assess progress, perform contemporaneous delay analyses, Project time and resources required for tasks, and identify opportunities for mitigation, if necessary.

- If the Contractor fails to provide an acceptable Project Baseline Schedule and Project Schedule Update according to the requirements of the Contract, the Contractor shall be responsible for all delays and resulting costs to the Project.

- The Department may withhold progress payments if the Contractor fails to submit required Schedule Submissions, including, but not limited to Schedule Development, Schedule Updates, and Recovery Schedule Submissions.

- The software used to generate the Critical Path Method (CPM) Schedule shall be capable of producing schedules according to the requirements of the Contract Documents and fully compatible with software utilized by the Department. Primavera Project Planner (P6 Professional Latest Release) or approved equivalent.

b. Schedule Development.

- Scheduling and Schedule Submittals requirements shall be based on the defined schedule level. The Schedule Development process shall commence on the date that the Apparent Low Bidder letter is transmitted to the Contractor, which will be deemed Day 0 (zero) for all Schedule Submittals.

- Meetings will be held as deemed necessary by the Department, to facilitate the Schedule Development Process. Each Submission shall incorporate the comments from the previous Submission(s). If any Schedule Development Submission does not conform to the Contract, the Contractor shall revise and resubmit before proceeding to the next step. Each Submission shall include electronic files in their corresponding format and in PDF format.

  The table below details the required Submissions and their corresponding Submission due dates for each schedule level.

Step	Step Description*	Schedule Level			RIDOT Review Deadline (after receipt of submission)
		A	B	C	
Step 1	Scheduler's Resume	Day 3	-	-	3 days
Step 2	Initial Schedule Framework	Day 7	-	-	4 days
Step 3	Complete Schedule Framework	Day 14	Day 14	-	5 days
Step 4	Preliminary Schedule	Day 28	Day 28	Day 28	7 days
Step 5	Baseline Schedule – Activities and Logic	Day 42	Day 42	Day 42	7 days
Step 6	Baseline Schedule – Bid Item Loaded	Day 70	Day 70	Day 70	7 days
Step 7	Baseline Schedule – Resource-Loaded Schedule	Day 84	-	-	7 days
Step 8	Project Baseline Schedule – Finalized	Day 98	Day 98	Day 98	7 days
		All days are Calendar Days			

* *Refer to Para. d. Schedule Requirements for Technical Scheduling Requirements; refer to the Special Provisions for Project specific information, including Project Groups, ID Standards, Milestones, Activity Data, and Amtrak Outage Work.*

- The requirements for each Schedule Development Submission are listed below:

  (a) Step 1: Scheduler's Resume. The Contractor shall retain a scheduler(s) dedicated full-time to the Project, with a minimum of three (3) years' experience on Projects similar in size and scope. The scheduler shall be responsible for developing, updating, and maintaining the Schedule. The Contractor shall submit the resume of the proposed scheduler(s) to the Department within 3 days of the Department transmitting the "Apparent Low Bidder" Letter. The Department may impose additional conditions based upon qualifications submitted. The scheduler shall be present at all required meetings, including but not limited to the Schedule Development, Schedule Update, and any other meetings that may affect the Project's Schedule.

  (b) Step 2: Initial Schedule Framework.

  (1) Work Breakdown Structure (WBS).

  (2) Activity Codes: All Contractor defined activity code values.

  (3) Calendars: All Contractor defined calendars.

  (4) Contractor's Submittal List (including all required Contractor Submittals).

  (5) Potential VECP, when not otherwise prohibited in the Contract, or alternate sequencing/methods.

(c) Step 3: Complete Schedule Framework.

(1) All requirements of Step 2 with prior comments addressed.

(2) Activity Data for all Milestones, Submittals, Procurement and Work by Others. Data includes:

A. Activity ID
B. WBS ID
C. Responsibility Code
D. Activity Type
E. Calendar IDs

(3) Resource Definitions (Level A Only): labor resources, work types, and equipment resources detailed by crews, incorporating all Department comments to date.

(d) Step 4: Preliminary Schedule.

(1) All requirements of Step 3 with prior comments addressed.

(2) Activity Data, including all logic, for all Work required to be performed within the first 120 days after the NTP.

(3) All Work after the first 120 days from NTP shall be shown in summary activities (summary activities shall not have durations greater than 60 days).

(4) Narrative explaining the sequence of the Work and all critical Submittals and activities.

(e) Step 5: Baseline Schedule – Activities and Logic.

(1) All requirements of Step 4 with prior comments addressed.

(2) Completed Schedule showing all Work activities and logic for the complete Contract.

(3) Narrative Report.

(f) Step 6: Baseline Schedule – Bid Item Loaded.

(1) All requirements of Step 5 with prior comments addressed.

(2) Complete Bid Item Loaded Schedule.

(3) Schedule Narrative that shall explain the use of resources and an explanation of all logic changes since the Baseline Schedule Submittal.

(g) Step 7: Baseline Schedule – Resource Loaded Schedule (Level A Only).

(1) All requirements of Step 6 with prior comments addressed.

(2) Resource loading completed for all activities in the Schedule for the entire Project.

(3) Project Schedule Narrative that shall explain the use of resources and an explanation of all logic changes made since the Baseline Schedule Submittal.

(h) Step 8: Project Baseline Schedule.

(1) The Contractor shall incorporate and integrate all comments from the previous Steps into the Project Baseline Schedule to conform to the Plans and Specifications.

(2) The Project Baseline Schedule shall be revised and resubmitted until accepted by the Department. The Contractor shall not change the Project Baseline Schedule after acceptance by the Department.

c. Project Schedule Updates.

- Project Update Meetings shall be held (every two weeks for Level A and once a month for Levels B and C) from Notice to Proceed to the completion of the Project. The Contractor is required to attend each meeting with all updated information (data as of the data date) compiled in advance.

- The Contractor shall furnish written meeting minutes from the previous Project Meeting using a standard template provided by the Department, a complete and accurate report of the current progress, a printed Critical Path report, a report of the days gained or lost relative to the Substantial Completion date and any other completion dates along with detailed explanation, and a depiction of how future Work plans shall meet the Contract completion dates. The Contractor shall disseminate a copy of the draft meeting minutes to the attendees and others that are required (discussed with team members). All recipients of the meeting minutes shall express any comments at the next Project Update Meeting or send an email documenting any comments. The Contractor shall incorporate any comments into the minutes. The meeting attendees shall discuss if the meeting minutes will become part of the Project file. The meeting minutes do not become official until the Department accepts the minutes.

- Failure to attend meetings or submit schedule updates may result in withheld Progress Payments. At each meeting, the Contractor shall provide sufficient copies of the updated schedules and documentation in the format acceptable by the Department. The Contractor shall submit an electronic copy of the Schedule Update Submittals on the scheduled Project Update Meeting date or no later than two (2) working days after the Project Update Meeting. Updates shall be submitted even in the absence of a Project Update Meeting at the same frequency. The Department has five (5) working days to review the Schedule Update Submittal. The Schedule Updates shall contain the following components:

  (a) Schedule Update Narrative
  (b) Schedule Activity Report –Past Month and Remaining
  (c) Schedule Activity Report Longest Path (per completion date)
  (d) Two week Look Ahead Schedule

(e) Predecessor/Successor Report
(f) Schedule Data File
(g) Other reports as requested by the Department

- Additional Requirements for Schedule Level A Projects:

  (a) The Contractor is required to submit a Four Week Look Ahead Schedule rather than Two Week Look Ahead Schedule.

  (b) A monthly Resource Utilization Report.

- All Schedule data, logic and duration changes, and any modifications to the Schedule shall be addressed, discussed, and documented with the Department at the Project Update Meeting. This shall be done before the Contractor submitting their finalized Schedule Updates. Failure to do so may result in rejected updates.

- Changes to the accepted Baseline Schedule shall be detailed in the Schedule Update Narrative. The acceptance and inclusion of these changes will not be the sole basis of acceptance or entitlement to any time extension(s) or monetary compensation(s).

- Schedule Update Submittals will not be used as the sole basis for any adjustment in the Contract Time(s), regardless of their acceptance by the Department. Any acceptance of the Schedule Update Submittal by the Department, either expressed or implied, will only apply to the issue of progress.

d. Schedule Requirements. The Department will provide the Contractor with templates during Schedule Development. The Schedules shall be developed and maintained according to the following requirements:

- Schedule Narrative. A description of the sequence of events summarizing the detailed Milestone Status, Critical Path, and all changes made to the Schedule, including Actual Dates, logic revisions, and Calendar and Duration changes. All Project Schedule Submissions shall include a Schedule Narrative as follows:

  (a) Preliminary Schedule Narrative. The Preliminary Schedule Narrative shall:

    (1) Identify the data date and schedule file name.

    (2) Describe the planned flow of Work, including details of all key or driving activities/resources for the first 120 calendar days and summarize Project activities thereafter. Summary activities shall not be greater than 60 calendar days in duration.

    (3) Identify all proposed alternative methods and product substitutions.

    (4) Include responses to all Department’s comments and identify and explain all changes made to the Schedule Submission.

    (5) Identify key constraints and potential problems affecting the Contractor's Work.

    (6) For Schedule Level A Projects, the Preliminary Schedule Narrative shall include:

A. A detailed summary of planned labor utilization for the Project for the first 120 calendar days, including the average and maximum number of workers by craft designation on site each month, the shifts to be worked and actual and potential labor resource limitations.

B. A detailed summary of planned operated equipment utilization for the first 120 calendar days, including each type of operated equipment, the quantity each month, the criteria for mobilizing and demobilizing to and from the site and actual and potential resource limitations.

(b) Baseline Schedule Narrative. The Baseline Schedule Narrative shall:

(1) Identify the data date and schedule file name.

(2) Describe the planned flow of Work identifying all key or driving resources.

(3) Identify all proposed alternative methods and product substitutions.

(4) Include responses to all Department comments and identify and explain all changes made to the Schedule Submission.

(5) Explain treatment of normal adverse weather in the Baseline Schedule, including all activities that contain contingency days for adverse weather. Lack of preparation for normal adverse weather is unacceptable.

(6) Identify key constraints and potential problems affecting the Contractor's Work.

(7) For Schedule Level A Projects, the Baseline Schedule Narrative shall:

A. Summarize planned labor utilization for the Project, including the average and maximum number of workers by craft designation on site each month, the shifts to be worked and actual and potential labor resource limitations.

B. Summarize planned operated equipment utilization, including each type of operated equipment, the quantity each month, the criteria for mobilizing and demobilizing to and from the site and actual and potential resource limitations.

C. Identify resolutions to constraints and potential problems, such as interface with plant operations, coordination with third parties, temporary Contractor facilities or fixed equipment planned for use.

(c) Schedule Update Narrative. The Schedule Update Narrative shall:

(1) Identify the Update Period, the data date, and the schedule file name.

(2) Detail the Work accomplished in the past two weeks and Work planned for the next two weeks.

(3) Identify and explain why any planned Work was not accomplished and how it affects the Project.

(4) Describe the activities driving the current critical path to each Milestone or Phase Completion Work.

(5) Identify all proposed alternative methods and product substitutions.

(6) Include responses to all Department comments and identify and explain all changes made to the Schedule Submission.

(7) Identify any proposed elective changes, including the activities and logic changed, a description of the scope of the elective change, its effect on the Project, driving resources and key constraints.

(8) For Schedule Level A Projects, the Update Narrative shall:

A. Identification of all activities with critical or near critical float (within ten (10) Working Days of the Critical Path) that were planned to occur during the Update Period, but did not occur or occurred later than the scheduled late start or late finish date, and an explanation of these delays. Identification of delays to activities taking place off the Project site, e.g., Submittal preparation, fabrication, and delivery activities.

B. Provide a listing of all activities that have surpassed their planned duration by more than twenty (20) percent and justification for maintaining original planned durations for future activities of like Work.

C. A summary of changed plans for labor utilization for the Project, identifying the average and maximum number of workers on site each month. Identify actual and potential labor resource limitations. A summary of the actual labor utilization used over the past month.

D. A summary of changed plans for equipment utilization for the Project, identifying each type of operated equipment to be used on the Work, the planned quantity of each type of operated equipment utilized each month, and all changes to the criteria for mobilizing and demobilizing each piece of equipment to and from the site. Identify actual and potential equipment resource problems. A summary of the actual equipment utilized over the past month.

- CPM Schedule. All CPM Schedules shall utilize a Work-Breakdown Structure (WBS) developed by the Contractor. The WBS shall be used as the primary code for displaying and organizing the graphical output schedules utilized for the Project, unless otherwise directed by the Department. Title case shall be used for WBS and Activity descriptions. The following is the basic dictionary for the WBS.

(a) Basic Structure for WBS:

(1) XX.00 Contract Name
(2) XX.10 Milestones
(3) XX.15 Summary Activities
(4) XX.20 Request for Information
(5) XX.30 Procurement/Shop Drawings

(6) XX.40 Utility/RR & Work by Others
(7) XX.60 Construction
(8) XX are Contract specific, alpha-numeric characters that will be defined by the Department.

(b) Project Naming Standards:

(1) Preliminary Project Schedule: PS00
(2) Baseline Schedule: BL00
(3) Bi-Weekly Project Schedules: UPxx
(4) Recovery Schedule: Rxxx

(c) Project Milestones, Interim Completion Dates and Phase Completion Dates: The Contractor shall include Milestones, Interim Completion Dates, and/or Phase Completion Dates, if specified in the Contract. Late Finish Constraints shall be assigned to these dates.

(d) Activity Code: The CPM Schedules shall contain activity code classifications and code values. The Contractor shall propose a coding structure for the Department's review and acceptance. The activity code structure combined with the activity identification number shall provide the capability to organize information by location, road or ramp, structure, Work type, Subcontractor, discipline, etc., as deemed necessary by the Department. The Contractor shall reserve three (3) code classifications (fields) and a minimum of six (6) characters for the Department's use. RESP code shall be utilized for identification of responsible party. RESP values shall be discussed at the Schedule Development Meetings.

(e) Activity Description: An activity description shall consist of a Work function, construction element and specific location of Work. No two activities will have the same description Non-specific terminology shall not be used in the activity's description. Any abbreviations used in the activity descriptions shall be defined in the Schedule Narrative Report. The activity description shall be left-justified and in title case.

(f) Activity Durations: The CPM Schedule shall incorporate a minimal number of activities with durations less than two (2) working days and more than twelve (12) working days. The Contractor may request acceptance from the Department to assign durations greater than twelve (12) working days. The justification for such request shall be fully detailed in the Preliminary and Baseline Schedule Narratives.

(g) Activity Type: The following activities or events are required in the Schedule:

(1) Milestones. The Contractor shall only use this Activity Type for Milestones, Interim Completion Dates and Phased Completion Dates as specified in the Contract.

(2) Summary (Hammock and Level of Effort Activities) Schedule Activities. The Contractor shall maintain a Summary Activity schedule. These Summary Activities shall remain in all Schedule Submittals. The predecessor and successor activities of the Summary Activities may be modified to include all those activities that are entered the Schedule and considered part of the respective Summary Activity's scope of Work.

(3) Task Activities. This is the primary activity type. All activities other than Milestone and Summary as defined above shall be Task Activities.

(h) Activity Dates. Activity Early and Late Start and Finish dates shall be calculated for each activity based upon the schedule data date, actual dates, schedule logic, schedule constraints, calendars, and original duration or remaining duration according to the scheduling parameters defined in this Section. The Contractor shall provide actual start and finish dates to the Department for acceptance. In the event of a disagreement, the Department will assign the dates to be used for the activities at issue.

(i) Activity Bid Item Loading. All bid items listed in the proposal pages shall be assigned to its corresponding schedule activity or distributed to a group of activities using Primavera's resources dictionary and resource assignment. The total value and quantities of the activities allocated to each bid item shall equal the total value and quantities of the corresponding bid item listed in the proposal.

(j) Calendars. The Contractor shall include the below referenced calendars in the Schedule or may request acceptance from the Department to create additional calendars. It is the responsibility of the Contractor to schedule the Work according to the Contract. The Contractor shall not schedule Work during winter shutdown or any other Contract shutdown period unless permitted by Contract or as permitted by the Department. If Work during the winter shutdown period is accepted by the Department, the Department will not consider delays during this period eligible for a time extension.

The following calendars are:

(1) Calendar 1 – 5-day workweek (includes Holidays and Winter Shutdown);
(2) Calendar 2 – Procurement;
(3) Calendar 3 – 6-day workweek (includes Holidays and Winter Shutdown);
(4) Calendar 4 – 7-day workweek (includes Holidays and Winter Shutdown);
(5) Calendar 5 – 5-day workweek (includes Holidays and No Winter Shutdown);
(6) Calendar 6 – 6-day workweek (includes Holidays and No Winter Shutdown);
(7) Calendar 7 – 7-day workweek (includes Holidays and No Winter Shutdown);
(8) Calendar 8 – Interstate 5-day workweek (includes Holidays and Winter Shutdown);
(9) Calendar 9 – Interstate 6-day workweek (includes Holidays and Winter Shutdown);
(10) Calendar A – Seeding;
(11) Calendar B – Wetland Seeding;
(12) Calendar C – Plants B&B.

(k) Data Date. The following are the definitions of the data dates for the CPM Schedules:

(1) Preliminary CPM Schedule – Date of Bid Opening;
(2) Baseline CPM Schedule – Date of Bid Opening;
(3) Project Schedule Updates – TBD at Schedule Development Meeting.

(l) Logic. The logic in the Schedules shall represent the progression of time and the sequence of Work performed within the Contract Time(s). The CPM Schedules shall conform to the following requirements:

(1) Every activity shall have assigned predecessors and successors. Unless otherwise specified, “Bid Opening” shall be the only activity without a predecessor; “Substantial Completion” and each Milestone or Phase Completion shall be the only activities without successors.

(2) Activity constraints are limited to the use of “Start-No-Earlier-Than” and “Finish-No-Later-Than” for access restraints and Contract Milestone(s) or Phase(s). The Contractor shall request acceptance from the Department to use their constraints for other activities before the and incorporation in the CPM Schedule. The use of “Zero Free Float”, “Start On”, “Expected Finish”, “Mandatory Start” or “Mandatory Finish” is prohibited.

(3) Activity lag durations shall not have a negative value unless accepted by the Department. Activity lags shall not be used in lieu of logic relationships.

(4) Redundant ties to preceding activities in a sequential series of activities are not allowed. A tie representing a different constraint will not be considered redundant.

(m) Schedule Layout Requirements. The Department will provide the Contractor with the required layouts and templates for the Schedule.

(n) Schedule Calculations. Performing scheduling calculations requires the following settings:

(1) Turn off automatic scheduling and leveling.

(2) When scheduling activities, apply retained logic.

(3) Calculate the start-to-start lag from early start.

(4) Schedule durations as contiguous.

(5) Show open ends as non-critical.

(6) Calculate total float as finish float.

(7) Summary calculations shall use Calendar No. 1 and the weighting factor for determining percent complete shall be duration.

(8) Set the auto-inserting option on automatic with a minimum increment of three (3).

(9) Initially set critical activities using defined critical as total float less than one (1). This setting may be changed at the direction of the Department.

(10) Set language for output as U.S. English.

(o) Submittals and Procurement: The Schedule shall include activities for all items within the Contractor's Submittal List (CSL) Each submittal item shall have an activity for submittal preparation, review, fabrication, and delivery. The Contractor is responsible for the accuracy and completeness of its schedule activities. All delays and/or inaccuracies related to submittals and procurement are the responsibility of the Contractor.

e. Review and Acceptance of Project Schedule Submittals. The Department will review Schedule Submittals for conformance with the requirements of the Contract Documents. The planning, scheduling, and execution of the Work and the accuracy of any Project Schedule is the responsibility of the Contractor. The Contractor remains responsible for errors in any previously accepted Project Schedule, including but not limited to omitted activities, activity durations, relationships between activities, resource allocation, or any float suppression techniques. The Department may direct the Contractor to address and adjust schedules that do not accurately reflect the Work at any time, with no additional cost to the Department. Acceptance of any Project Schedule does not relieve the Contractor of any responsibility for the completion of the Work in conformance with all Contract requirements.

f. Progress Delays.

- Recovery Schedules.

(a) The Contractor shall identify all schedule and progress delays during the prosecution of the Work. Whenever the Project Schedule Update indicates late critical path progress by 20% or more in Contract Time, or at the Department's request, the Contractor shall develop and submit a Recovery Schedule in the form of a proposed Baseline Schedule Revision.

(b) The Contractor is not relieved from the submission of Project Schedule Updates during the development of a Recovery Schedule.

(c) The Recovery Schedule shall illustrate a clear process and procedure for eliminating or mitigating said delays to the Contract Time(s). The Recovery Schedule shall be submitted within thirty (30) calendar days of the corresponding Project Schedule Update and is subject to acceptance by the Department.

- Non-Excusable Delays. The development and submission of the Recovery Schedule shall be at no additional cost to the Department.

- Excusable Delays. The Department may reimburse the Contractor for the costs of the development of the Recovery Schedule.

- Progress Payments. The Department may withhold progress payments, either in whole, or in part if the Contractor fails to submit a Recovery Schedule.

g. Baseline Schedule Revisions.

- Project Baseline Schedule Revisions shall conform to all requirements for acceptance of the Project Baseline Schedule and associated updates, including but not limited

to inclusion of added or deleted activities, changes to logic or relationships, and a distribution of costs for the added Work or changes.

- The Department will review and comment on this revision within 14 calendar days of its submission.
- The final draft of the proposed Baseline Schedule Revision shall incorporate all accepted changes and be submitted for acceptance within 5 calendar days following the Department's acceptance.
- The accepted Baseline Schedule Revision shall be referred to as "Baseline Schedule of Record – rev #" in subsequent Project Schedule Update submittals.
- A Baseline Schedule Revision is required whenever there is a change to the Baseline Schedule of Record or its corresponding Project Schedule Update, and whenever a Progress Delay threshold is triggered.

108.04 LIMITATION OF OPERATIONS.

The Contractor shall limit its operations to prevent unnecessary inconvenience to the traveling public. If the Engineer concludes that the extent of the Contractor's Work unnecessarily inconveniences the public or concludes that limiting operations are necessary to protect the existing or new construction from damage, the Engineer will require in writing that the Contractor finish portions of Work in progress before starting new Work.

108.05 CHARACTER OF WORKERS.

The Contractor shall provide workers with the skill and experience necessary to perform the work.

Any person employed by the Contractor or by any Subcontractor who does not perform the Work in a proper and skillful manner or is intemperate, disorderly, or creating a hostile work environment shall, at the written direction of the Engineer, be removed from the Project immediately by the Contractor or Subcontractor employing such person. This individual shall not be employed again on any RIDOT Projects without the prior written approval of the Engineer.

Should the Contractor fail to remove such person or persons as directed above, the Engineer may withhold progress payments from the Contractor and suspend the Work until the person or persons are removed. The Contractor will not be entitled to additional time or costs in these cases.

108.06 EQUIPMENT, MEANS, AND METHODS.

The Contractor shall use suitable equipment of sufficient size and mechanical condition to produce the specified quality of work and to complete the Project according to the Contract. The Contractor is responsible for ensuring that the equipment does not harm the roadway, adjacent property, other highways, workers, or public. The Engineer may order the removal and replacement of any equipment deemed unsuitable with no additional time or costs to the Department.

The Contractor shall operate all equipment with adequate lighting at night.

The Contractor is responsible for its means and methods to safely accomplish the Work in conformity with the requirements of the Contract. The Contractor is not entitled to a time extension or compensation for an approved change in means and methods.

108.07 DETERMINATION AND EXTENSION OF CONTRACT TIME.

If completion of the Work requires additional time, a written time extension request may be made according to the requirements of **Subsections 104.02** and **108.03** for an Extension of Contract Time. A claim that insufficient time was specified in the Contract is not a valid reason for extension of time. The Department will not evaluate a request for extension of the Contract Time unless the Contractor notifies the Engineer as specified in **Subsection 104.02.**

The Department will have no liability for any constructive acceleration of the Work, nor shall the Contractor have any right to make any Claim for constructive acceleration nor include it as an element of any claim the Contractor may otherwise submit under this Contract. If the Engineer gives express written direction for the Contractor to accelerate its efforts, the written direction will set forth the prices and other pertinent information and will be executed by a written Contract Amendment.

a. Requirements for an Extension of Contract Time Request. The Contractor shall submit an Extension of Contract Time Request that includes a narrative, accepted Project schedules, copies of all supporting documentation, and related correspondence in one complete package.

   - The narrative shall include the following:

     - A certification by the Contractor that it performed the Work according to the Project Schedule Baseline and that the Request for Extension of Contract Time results from unforeseeable delays that were not the Contractor's responsibility. Information to be contained in the narrative includes the identification, description, and documentation of each delay, including the circumstances resulting in the delay, the responsible parties for the delay, and the date of delay notification to the Department. The Contractor shall calculate and submit the number of calendar days that each delay impacted each Contract date.

     - Identification, description, and documentation of each mitigation action, including actions taken by each party to mitigate delays, the dates of such actions, and the calculation of calendar days that were gained or mitigated by such actions.

   - Accepted Project Schedules shall be included in an Extension of Contract Time Request. Department Accepted Schedules shall be referenced as is; schedules either Accepted as Noted, Not Accepted, or Rejected shall be corrected before use in the Extension of Contract Time Request. The number of days requested shall be supported in the Project Schedules.

   - All Project documentation and correspondence that substantiates any delays or mitigation detailed in the narrative shall be included in the Extension of Contract Time Request.

- Contractor's Extension of Contract Time Request. The Contractor shall use a Contemporaneous Analysis when evaluating delays to:

    - Identify the accepted Project Schedule Update that occurs immediately before the start of the delay being evaluated.

    - Identify each Project Schedule Update in effect during the delay and the Project Schedule Update with a data date that immediately follows the conclusion of the delay.

    - Identify the critical path each day from immediately before the start of the delay to the Project Schedule Update to immediately following the delay.

    - Determine whether the delay falls on the critical path. If the delay falls on the critical path, the time extension due, if any, will be based upon the number of days the critical path is delayed. If the delay does not fall on the critical path, then no Project delay occurred and no time extension is due.

    - The Department will review the Contractor's evaluations and calculations and determine the time extension due, if any.

    - Notification. The Contractor shall be responsible for notifying the Engineer according to **Subsections 104.02** and **108.03** of any Department action or omission that the Contractor believes has delayed or may delay the Project. Such notification shall be a precondition to consideration of an Extension of Contract Time Request.

b. Types of Delays.

- Excusable, Non-Compensable Delays. Excusable, non-compensable delays are unforeseeable delays that are neither the Contractor's nor the Department's responsibility. The following events are examples of excusable, non-compensable delays:

    - Delays due to Acts of Nature, such as earthquake, lightning strikes, tidal wave, tornado, hurricane, or other cataclysmic phenomenon of nature.

    - Delays due to weather, if the Contractor is entitled to a time extension for weather as specified in **Subsection 108.07(b),** 4th bullet.

    - Extraordinary delays in material deliveries that the Contractor or its suppliers could not foresee or avoid that resulted only from freight embargoes, government acts, or nationwide material shortages.

    - Delays due to civil disturbances or acts of the public enemy.

    - Delays due to labor strikes that are beyond the Contractor's, Subcontractor's, or supplier's power to settle and are not caused by unlawful acts or omissions of the Contractor, Subcontractor, or supplier.

- Delays due to acts of the government or a political subdivision other than the Department.

- Delays due to utility or railroad interference on the Project.

- Excusable, Compensable Delays. Excusable, compensable delays are unforeseeable delays that are the Department's responsibility. The following events are examples of excusable, compensable delays:

  - Delays due to revised Work as specified in **Subsections 104.03**, **104.05**, and **104.07**.

  - Delays due to an Engineer-ordered suspension as specified in **Subsection 104.06**.

  - Delays due to the Department's failure to act according to the Contract.

- Non-Excusable Delays. Non-excusable delays are delays that are the Contractor's responsibility. All non-excusable delays are non-compensable. Examples of non-excusable delays include the following events:

  - Delays due to the Contractor's, Subcontractor's, or supplier's insolvency or mismanagement.

  - Delays due to delivery of materials.

  - Delays due to the Contractor's failure to provide sufficient forces and equipment.

  - Delays caused by plant and equipment failure.

  - Delays due to non-compliance with **Subsection 104.15** or Federal, State, or Local laws, or Regulations, including corrective work.

- Weather Delays. The Contractor shall anticipate the number of days lost per month for weather-sensitive activities according to the Table below. The Department will extend Contract Time for weather if the Contractor cannot perform Work on the critical path due to weather, and if the cumulative delay due to weather each month exceeds the number of days specified in the Table below. Work on the critical path is considered delayed if the Contractor is prevented from proceeding on an activity for at least 60 percent of the total daily time planned for the activity for all shifts scheduled for that day. Submit daily documentation, as specified in **Subsection 105.19**, for activities that are delayed by weather.

Anticipated Number of Days Lost Per Month for Weather-Sensitive Activities

Month	Number of Days Lost
January[3]	31[1]
February[3]	28[1,2]
March[3]	20
April[3]	15
May	10
June	10
July	10
August	10
September	10
October	15
November	15
December[3]	20

1 *For concrete placement Items, as specified in **PART 800**, other than approach slabs, the number of days anticipated is 20 days.*

2 *For leap years, the number of days restricted is 29.*

3 *For projects without Winter Shutdown*

The number of days will be adjusted based on the Transportation Management Plan. For example, if the TMP only allows the Contractor to work five days per week, the days lost column will be adjusted by 5/7ths and applied to the actual workdays permitted by the TMP.

- Concurrent Delays. Concurrent delays occur when both parties are responsible for the same period of delay. When a non-excusable delay is concurrent with an excusable delay, the Contractor is entitled to a non-compensable extension of time for the period of the excusable delay.

108.08 FAILURE TO COMPLETE ON TIME.

For each day, including workdays, Saturdays, Sundays, and Holidays, that any Work shall remain uncompleted after the time established for completion of the Work in **Subsection 105.18**, the applicable Daily Charge specified below will be deducted from any money due the Contractor, not as a penalty but as liquidated damages. An adjustment of the Contract time for completion of the Work granted under the provisions of **Subsection 108.07** will be considered in the assessment of liquidated damages.

Permitting the Contractor to continue and finish the Work, or any part of it after the Contract time or any time extensions has passed, will not waive the Department's rights under the Contract. Unless otherwise specified, liquidated damages will not accrue during the winter shutdown period; i.e., December 15th through the following April 15th.

Rates for liquidated damages will be established according to the Schedule. When the Contract time is either on the calendar day or fixed calendar day basis, the Schedule for calendar days shall be used. When the Contract time is on a workday basis, the Schedule for workdays will be used. See the Table below.

Schedule of Liquidated Damages

Original Contract Amount		Daily Charge	
From More Than	To and Including	Calendar Day or Fixed Date	Workday
$ 0	$ 25,000	$ 200.00	$ 300.00
25,000	50,000	350.00	500.00
50,000	100,000	450.00	600.00
100,000	500,000	900.00	1200.00
500,000	1,000,000	1200.00	1700.00
1,000,000	2,000,000	1500.00	2050.00
2,000,000	6,000,000	1950.00	2700.00
6,000,000	10,000,000 *	2350.00	3250.00

* *Projects over $10,000,000 will have Liquidated Damages assigned in the Job Specific Special Provisions.*

108.09 DEFAULT OF CONTRACT.

The Department may declare the Contractor in default for one or more of the following:

- Failure to commence the Work according to the Contract Documents
- Failure to perform the Work with sufficient workers and equipment or with sufficient materials to ensure the prompt completion of the Work within the Contract Time
- Failure to perform the Work according to the Contract requirements and/or refusal to remove and replace rejected materials or unacceptable Work
- Discontinues the prosecution of the Work
- Failure to resume Work suspended by the Engineer or discontinued by the Contractor within the time ordered by the Engineer
- Insolvency, bankruptcy, or receivership
- Makes an assignment of the Contract for the benefit of creditors
- Fails to comply with Contract requirements regarding minimum wage payments or EEO requirements
- Unlawful acts or omissions

The Department will provide written notice to the Contractor and the Surety of a default (Notice of Default). The written Notice of Default will include a notice to cure and will establish a date by which the cure shall be completed. The Department may allow more time to cure than originally stated in the Notice to Default if the Department deems it to be in its best interest. Failure to cure the delay, neglect, or default within the time specified in the Notice of Default authorizes the Department to terminate the Contract according to **Subsection 108.10**. In this case, the Department will provide the Contractor and the Surety with a written Notice of Termination.

After a Notice of Termination is issued, the Department may assume the Work without further notice; may complete it by itself, by Contract or otherwise; and may take possession of and use the materials, appliances, equipment, or plant on the Work site necessary for completing the Work. The Department may transfer the obligation to perform the Work from the Contractor to the Surety. In that event, the Surety shall submit its plan for completion of the Work, including any Contracts or agreements with third parties for completion, to the Department for approval before beginning Work.

The Surety shall follow the Contract requirements for approval of Subcontracts, except that the limitation on percent of Work subcontracted will not apply. On receipt of the transfer notice, the Surety shall take possession of all materials, tools, equipment, and appliances at the Work site, employ an appropriate Work force, and complete the Contract Work as specified. The Contract specifications and requirements shall remain in effect, except that the Department will make subsequent Contract payments to the Surety or other entity as required.

The Contractor and the Contractor's Surety are jointly and severally liable for any damage to the Department resulting from the Contractor's delay, neglect, or default, whether or not the Department terminates the Contractor's right to prosecute the Work. The Department's damages include any increased costs incurred by the Department in completing the Work or paying for the Work to be completed. The Department will not relieve the Contractor and the Contractor's surety of the liability for the assessment of liquidated damages because of the Contractor's default. All additional costs incurred by the Department due to the default will be deducted from any monies due or to become due to the Contractor. If such costs exceed the sum that would have been payable under the Contract, then the Contractor and the Surety shall be liable for the balance of such costs. The Department's rights and remedies are in addition to any other rights and remedies provided by law or under the Contract.

If, after Notice of Termination of the Contractor's right to proceed under this clause, it is determined that the Contractor was not in default or that the default was excusable, the rights and obligations of the parties will be determined as if the termination had been issued for the convenience of the Department according to **Subsection 108.10**. Thus, damages to which the Contractor may be entitled due to the improper default termination will be limited to appropriate amounts for the items listed in **Subsection 108.10**.

108.10 TERMINATION OF CONTRACT.

a. Reasons for Termination. The Department may terminate the Contract at any time due to any of the following:

   1. Executive Orders of the President of the United States or the Governor of the State of Rhode Island with respect to the prosecution of war or the interest of national defense or any disaster declaration.

   2. Restraining orders or injunctions by a court of competent jurisdiction affecting prosecution of the Work based on acts or omissions of persons or agencies other than the Contractor.

   3. Any reason determined by the Engineer to be in the best interest of the State.

4. Any circumstance that precludes the orderly prosecution or completion of the Contract. The Engineer will issue a written Notice of Termination to the Contractor, which shall include the effective date of the termination and for which of the above-listed reasons the Contract is terminated.

b. Required Actions. Upon receipt of a Notice of Termination, the Contractor shall immediately:

1. Stop Work as directed in the Notice

2. Place no further orders or Subcontracts for materials, services, or facilities except as approved to complete Work not terminated

3. Terminate all orders and Subcontracts for the terminated Work

4. Accomplish either of the bullets below as directed by the Engineer:

(a) Assign to the Department all right, title, and interest in any terminated orders or Subcontracts. The Engineer will settle all claims on the terminated orders or Subcontracts.

(b) Settle any outstanding liabilities and claims arising from termination of orders and Subcontracts. Settlements shall be limited to costs allowed under this Section.

5. Submit to the Engineer a list, certified as to quantity and quality, of all materials acquired or produced for incorporation into the Project and that are properly allocable to the terminated portion of the Project, exclusive of items disposed of under item #6(b) below.

6. Dispose of materials in the Contractor's possession or control that were acquired or produced but not incorporated into the Project as of the termination date, and as directed by the Engineer under either (a) or (b) below:

(a) Transfer title and deliver the materials to the Department. The Department will pay for the materials at the actual cost delivered to the Project or storage site, including transportation charges, to which cost 15% will be added.

(b) Sell the materials. Credit will not have to be extended to prospective purchasers. The Contractor may acquire the materials if the Engineer approves the sale price and if the Contractor meets any other conditions prescribed by the Engineer. At the sole discretion of the Department, the proceeds of any sale, transfer, or disposition of materials may be:

(1) Applied to reduce any payments to be made by the Department under the Contract,

(2) Credited to the cost of the Work, or

(3) Paid in any other manner as directed.

7. Deliver to the Department completed or partially completed plans, drawings, information, and other property required to be furnished under the Contract.

8. Take all necessary actions and comply with all directives to protect Contract-related property in which the State has or may acquire an interest.

9. Complete Work not terminated.

The Contractor shall proceed immediately with performance of the above obligations notwithstanding any delay in determining or adjusting the amount of any item or reimbursable cost under this clause.

c. Claim. The Contractor shall submit its termination claim to the Engineer within 60 days after the effective date of termination with the following stipulations:

1. Without duplication of any amount paid for under **Subsection 108.10(b)**, the claim may be for the total of:

(a) Costs incurred in performing the terminated Work from the date of Contract award to the effective date of the termination subject to **Subsection 108.10(c)(2)** regarding reimbursement of equipment costs and **Subsection 108.10(c)(3)** regarding unallowable items.

(b) Payments approved by the Engineer under **Subsection 108.10(b)(4)(b)** to settle the termination claims of suppliers and Subcontractors to the extent not covered under **Subsection 108.10(c)(1)(a)**.

(c) Reasonably incurred costs for:

(1) Accounting, legal, clerical, and other costs reasonably necessary for the preparation of the termination claim, excluding costs incurred after the submission of the claim to the Department.

(2) Settling Subcontractor and supplier claims, excluding the amounts of those settlements paid under **Subsection 108.10(c)(1)(b)**.

(d) Extra Work performed because of the termination shall be paid according to **Subsection 109.04**.

(e) At no time will the loss of anticipated profits be allowed as part of any settlement.

2. Equipment claims will be reimbursed as follows:

(a) Idle time for equipment shall be paid according to **Subsection 109.04**. Idle equipment time is limited to the actual period of time equipment is idle as a direct result of the termination not to exceed 30 days. Operating expenses will not be included for payment of idle equipment time.

(b) Rented equipment based on reasonable, actual rental costs according to **Subsection 109.04.**

3. The following costs are not payable under a Contract termination:

   (a) Loss of anticipated profits or consequential or compensatory damages
   (b) Unabsorbed home office overhead related to ongoing business operations
   (c) Bidding and Project investigative costs
   (d) Costs of repairing equipment to render it operable for use on the terminated Work

d. Deductions. In determining the amount due under this Subsection, the Department will deduct:

   1. All previous payments made before termination

   2. Any claim that the Department may have against the Contractor

   3. The proceeds of the sale or transfer of any materials, supplies, or other items acquired for the terminated Work and not otherwise recovered by or credited to the Department

   4. All partial payments made under this Section

e. No Waiver of Rights. The termination of Work by the Department does not affect or extinguish any of the rights of the Department against the Contractor or the Contractor's Surety then existing or which may thereafter accrue. Any retention or payment of monies by the Department due under the terms of the Contract will not release the Contractor or the Contractor's Surety from the contractual obligations.

f. Retaining Records. The Contractor shall maintain and make available all Project cost records to the Department for audit. This includes all books and other evidence bearing on the Contractor's costs and expenses under this Contract. The Contractor shall make these records and documents available to the Department at the Contractor's office at all reasonable times without any charge.

SECTION 109 — MEASUREMENT AND PAYMENT

109.01 MEASUREMENT OF QUANTITIES.

The Department will verify the quantities of Work and calculate payments based on the method of measurement and basis of payment provisions provided in these Specifications. When the following units of measurement are specified, the Department will measure or ascertain quantities as described below. For any Contractor survey data used for measurement and payment, the Contractor shall have a professional surveyor licensed in the State of Rhode Island stamp the data.

a. Lump Sum. Not measured. Describes payment as reimbursement for all resources necessary to complete the Work. When a complete structure or structural unit is specified as the unit of measurement, the unit includes all necessary items of work to complete the item in its entirety. The Contractor shall submit its lump sum break down for this method of measurement.

b. Each. Measured by the number of individual items of Work completed.

c. Linear Foot. Measured parallel to the longitudinal base or foundation upon which items are placed or along the longitudinal surface of the item.

d. Vertical Linear Foot. Measured vertically to the nearest 0.01 ft.

e. Square Yard or Square Foot. Measured by a two-dimensional area method on the surface of the item.

f. Cubic Yard or Cubic Foot. Measured by a three-dimensional volume method.

g. Acre. Measured by a two-dimensional area method on the surface to the nearest 0.1 acre.

h. Pound. Measured by actual item net weight avoirdupois (mass).

i. Ton. The term “ton” means the short ton consisting of 2000 pounds avoirdupois. All materials shall be weighed on accurate and approved scales as approved by the Engineer. Trucks used to haul material shall be weighed before and after loading to determine net weight of the material transported. Each truck shall bear a plainly legible identification mark that corresponds to each weight slip.

   For work on a tonnage basis, submit freight bills for railroad shipments and certified weight bills when materials are received by any other method, showing the actual tonnage used.

   Costs for furnishing, installing, certifying, testing, and maintaining scales, for furnishing check weights and scale house, and for all other items specified in this Subsection for weighing of highway and bridge construction materials for proportioning or payment are incidental to the pay items of the Project.

j. Gallon. Measured by actual item liquid volume.

k. Board Feet. Measure timber by the number of Board Feet actually incorporated in the structure. Base the measurement on nominal widths, thicknesses, and the extreme length of each piece.

l. Standard Manufactured Items. When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by size, unit weight, section dimensions, etc., such identification will be to nominal weights or dimensions set by the industry.

109.02 SCOPE OF PAYMENT.

The Department will pay the Contractor for the actual measured quantities of Work performed or for the materials furnished according to the Contract. The Contractor shall accept the payment as full and complete compensation for (a) furnishing all equipment, materials, tools, and labor necessary to complete and maintain the Work, and for (b) all of the Contractor's risk, loss, damage, or expense of whatever character arising from or relating to the performance of the Work, subject to **Subsection 107.17**.

All work that is obviously necessary for completion of a bid item but is not listed under its own bid item is incidental to the bid item. This work is not paid separately but is included in the unit bid price.

109.03 COMPENSATION FOR ALTERED QUANTITIES.

When accepted quantities of Work or materials vary from the quantities stated in the bid schedule, the Contractor shall accept payment at the original Contract unit prices for the quantities of Work and materials furnished. Payment at the Contract unit price shall compensate the Contractor for all costs, expenses, and profit that the Contractor is entitled to receive for the altered quantities, except as provided below:

When the final quantity of a Major Contract Item varies by more than 25 percent above or below the bid quantity, either party to the Contract may receive a cost adjustment in the Contract unit price of that item according to **Subsection 109.04**. If the final quantity of Work is:

- Greater than 125 percent of the bid quantity, the cost adjustment will be made only for those units that are in excess of 125 percent of the bid quantity.
- Less than 75 percent of the bid quantity, the cost adjustment will be made for those units of work done and accepted, except that the total payment for the item shall not exceed 100 percent of the total amount bid for the item.

No allowance shall be made for any increased expenses, loss of expected reimbursement, or loss of anticipated profits suffered or claimed, either directly from alterations in quantities or indirectly from unbalanced allocations among the Contract items on the part of the bidder and subsequent loss of expected reimbursements or any other causes.

109.04 COMPENSATION FOR CONTRACT REVISIONS.

a. General. If the Department revises the Contract as provided in **Subsection 104.02**, the Department will pay for the revision following the sequence specified in

Subsection 109.04(b),(c), & **(d)**. Such payment will include compensation for performing the revised Work, delay costs, and all other costs not expressly precluded by **Subsections 104.02** and **109.04(e)**. The Department may, at any time, direct the Contractor to perform all or part of the revised Work according to **Subsection 109.04(d)**.

If a Contract Revision includes a time extension for compensable delays as provided by **Subsection 108.07**, the Department will pay the costs associated with the time extension according to **Subsection 109.04(e).**

The Contractor shall submit its request on Department approved forms.

b. Contract Pay Item. Before proceeding to another pricing method, the Engineer will attempt to price and pay for Contract changes using Unit Bid Prices.

c. Negotiated Prices. If the Engineer and Contractor cannot agree on compensation according to **Subsection 109.04(b)**, they will attempt to negotiate the price of a Contract change.

When determining a negotiated price, the Contractor shall first provide an estimate of the proposed unit prices or lump sum price for the Contract change to the Engineer, including the following:

- Labor requirements by trade in hours for each task
- Equipment costs and time requirements
- Material costs

The Contractor shall provide the estimate within 5 working days after the Department's request. The Department will respond to the estimate within 5 working days after receipt of the Contractor's justification.

If the Department and the Contractor cannot agree on a negotiated price for the Contract Revision, the Engineer may direct the Contractor to perform all or part of the revised Work according to **Subsection 109.04(d).**

d. Force Account. When directed to perform work on a Force Account basis, the Department will pay the Contractor as specified in this Section as full compensation for performing the Force Account Work, including delay costs and all other associated costs. The Engineer may request the Contractor to submit a written proposal for the Work, including the planned equipment, materials, labor, and Work schedule.

The Contractor's representative and the Engineer at the end of each Workday shall compare records of the cost of Work completed on a Force Account basis. These daily records will be provided on the forms provided by the Engineer and will thereafter be the basis for payment of the Work performed but will not preclude subsequent revisions based on a later audit by the Department.

No payments will be made for Work performed on a Force Account basis until the Contractor has furnished the Engineer with a statement of the cost of the Force Account Work showing the following:

- Name of Subcontractor, if appropriate
- Certified Payrolls with the name, classification, date, daily hours, total hours, rate, and extension for each laborer, operator, and foreman
- Quantities of materials, prices, and extensions
- Charges for transportation of materials
- Specialized Work charges
- Make, model, serial number, year of manufacture, designation, dates, daily hours, total hours, rental rate, and extension for each unit of equipment or plant
- Cost of property damage liability and worker's compensation insurance
- Premiums, unemployment insurance contributions, and social security

The Contractor shall certify that the labor, materials, and equipment listed were actually used on the Force Account Work described, that the labor and equipment were used for the hours indicated, and that the rates for labor do not exceed those for comparable labor currently employed on the Project.

Statements shall be accompanied and supported by certified copies of the appropriate payrolls, Invoices for all materials and specialized Work and, all transportation charges. If materials used on the Force Account Work are not specifically purchased for the Work but are taken from the Contractor's stock, the Engineer shall be furnished an affidavit certifying that the materials were taken from stock, that the quantity claimed was actually used, and that the price and transportation costs claimed represent the Contractor's actual cost.

During the life of the Contract and for a period of not less than three years after the date of Acceptance, the Contractor's cost records pertaining to Work paid for on a Force Account basis shall be open to inspection or audit by representatives of the State, and the Contractor shall retain such records for that period. Where payment for materials or labor is based on the cost to forces other than the Contractor, the Contractor shall ensure that the cost records of these other forces will be open to inspection and audit by representatives of the State on the same terms and conditions as the cost records of the Contractor.

Payment for Force Account Work will be determined by the Engineer as follows:

- Labor. For all labor and foremen in direct charge of the specific operations, the Contractor shall receive the rate of wage actually paid according to its certified payroll for each hour that the labor and foremen are actually engaged in the Work.

  No part of the salary or expenses of anyone connected with the Contractor's forces above the grade of foreman, and/or having general supervision of the Work, shall be included in the labor item as specified above.

  The Engineer reserves the right to approve the number and type of labor employed and not pay for unapproved labor.

The Contractor shall be reimbursed the costs paid to, or on behalf of, workers by reason of subsistence and travel allowances, health, and welfare benefits, pension fund benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed in the Work.

A surcharge of 20 percent of the total amount of the above items will be paid the Contractor.

- Bond, Insurance and Tax. For property damage and liability insurance premiums, unemployment insurance contributions, and social security taxes incurred on Force Account Work, the Contractor shall receive the actual cos, to which a surcharge of 6 percent will be added. For Worker's Compensation Insurance Premiums, the Contractor shall receive the actual cost of the worker's compensation costs incurred, which shall be calculated net of all applicable credits, rebates, refunds, and allowances. An additional surcharge will be added to the actual costs incurred. The surcharge amount is calculated from the Experience Modification Factor (MOD Factor) as follows:

    - For MOD factors greater than 1.0, the surcharge shall be 6%

    - For MOD factors greater than 0.80 and less than or equal to 1.0, the surcharge shall be 8%

    - For MOD factors less than or equal to 0.80, the surcharge shall be 10%

    The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bonds, insurances, and taxes. In addition, the Contractor shall submit a copy of its Worker's Compensation policy showing the current MOD factors.

- Materials. For materials accepted by the Engineer and used in the Work, the Contractor will be reimbursed the cost of such materials, including transportation charges paid (exclusive of machinery rentals as discussed in Item 4(n) below), to which cost a surcharge of 15 percent will be added. The Contractor will not be reimbursed for any penalty or carrying charge incurred due to late or delayed payment for materials used in the Work.

- Equipment. For any Contractor-owned machinery or special equipment (other than small tools), the use of which is approved by the Engineer, the hourly rate will not exceed that determined from the appropriate edition of the "Rental Rate Blue Book for Construction Equipment" published by Equipment Watch used in the following manner:

    - The hourly equipment rental rate R will be determined by formula as follows: R = (A × B × C) + D, where A = Monthly rate divided by 176. The listed weekly, hourly, and daily rates will not be used. B = Average regional adjustment factor for Rhode Island. C = Factor from Rate Adjustment Table (FHWA Column) for the year of equipment manufacture. D = Estimated operating costs per hour.

- Mobilization/demobilization is based on standby rates per subparagraph in the 6th bullet. The number of hours to be paid for will be the number of hours that the equipment or plant is actually used on a specific Force Account activity. In addition, the hours shall include the time required to move the equipment to the location of such Force Account activity and return it to the original location or to another location requiring no more time than that required to return it to its original location, except that moving time will not be paid for if the equipment is used during the move on Work other than the specific Force Account activity.

- The "Rate Effective Date" to be selected online will be the actual date that the work was performed.

- The estimated operating costs per hour will be used for each hour that the equipment or plant is in operation on the Force Account Work. Operating costs are not reimbursable for the time the equipment is idle.

- The maximum rental period paid per day shall not exceed eight hours unless the equipment operates for more than eight hours.

- If equipment is idled solely due to the responsibility of the Department, then the Contractor may be compensated for such idle equipment at 50% of the rate "A" as defined in the first bullet above.

- The FHWA Column rates are inclusive of all allowable costs.

- The following items are deemed incidental to the Work and will not be paid for separately — fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs, overhauls, maintenance of any kind, depreciation, storage, field and home office overhead, profits, and insurance.

- The Contractor shall provide the Engineer with the following — the manufacturer's name, equipment type, make, model, serial number, year of manufacture, type of fuel used, horsepower rating, attachments required, together with their size or capacity, and any further information necessary to ascertain the proper rate. Unless otherwise specified, manufacturer's ratings and manufacturer approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment that has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer. The Contractor shall have available for the Engineer's use a revised copy of the Rental Rate Blue Book as referenced above.

- Equipment used by the Contractor shall be in good working condition and shall be of suitable size and suitable capacity required for the work to be performed. The rate for the basic equipment with the appropriate attachments shall include only the rate for the combined equipment necessary to perform the Extra Work. If the Contractor elects to use equipment of a higher rental value than that suitable for the Work, payment will be made at the rate applicable to the suitable equipment. The equipment actually used and the suitable equipment to be paid for will be recorded as a part of the record for Force Account Work. The Engineer will determine the suitability of the equipment. If there is a differential in the rate of pay

of the operator of oversize or higher rate equipment, the rate paid for the operator will likewise be that for the suitable equipment.

+ Payable time periods will not include:

+ Time elapsed while equipment is inoperative due to breakdowns

+ Time spent repairing equipment

+ Time elapsed 24 hours after the Engineer has advised the Contractor that the equipment is no longer needed.

- If a piece of equipment is needed that is not listed in the above stated rental rate guide, a rate will be established by the Engineer in writing before the equipment is used. The Contractor may furnish any cost data that might assist the Engineer in the establishment of such rate.

- If the Contractor does not own a specific type of equipment and must obtain it by rental, the Contractor shall inform the Engineer of the need to rent the equipment and of the rental rate for that equipment before using it on the Work. The Contractor will be paid the actual rental for the equipment for the time that the equipment is actually used to accomplish the Work, provided that the rate is reasonable, plus the cost of moving the equipment onto and away from the job. The Contractor shall provide a copy of the paid receipt or canceled check for the rental expense incurred. Other costs not covered by the rental agreement, necessary to complete the Work will be reimbursed, except for repairs and downtime.

- Equipment leased from an affiliate, division, subsidiary, or other organization under common control with the Contractor will be considered Contractor owned equipment, unless the affiliate, division, subsidiary, or other organization has an established practice of leasing to unaffiliated lessees.

- Transportation charges for each piece of equipment, whether owned or rented, moved to and from the site of the Work will be paid provided that (1) the equipment is obtained from the nearest approved source, (2) the return charges do not exceed the delivery charges, (3) haul rates do not exceed the established rates of licensed haulers, (4) charges are restricted to those units or equipment not already available and not on or near the Project, and (5) equipment is not used elsewhere on the Project.

- Subcontracting. For costs incurred in connection with approved Subcontractor Work, the Contractor shall be paid the cost of the subcontractor Work plus a surcharge of ten percent. The Contractor shall require its Subcontractor to provide the same documentation as required in this Section.

- Miscellaneous. No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is provided.

- Record Keeping. On a daily basis, the Contractor's representative and the Engineer shall compare records of completed Force Account Work. The Engineer will then prepare the daily work sheets, which shall be signed by the Contractor's representative no later than noon of the next Workday.

- Cost Statements for Payment. No payment will be made for Force Account Work until the Contractor has furnished the Engineer with two copies of itemized statements of the cost of the Work, incurred on a daily basis, and detailed as follows:

    - Certified payrolls, name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman

    - Make, model, serial number, year of manufacture, designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment

    - Quantities of materials, prices, and extensions

    - Transportation of materials

    - Cost of property damage, liability and worker's compensation insurance premiums, unemployment insurance contributions, and social security taxes

    Statements shall be accompanied and supported by certified payrolls and paid Invoices for all materials used and transportation charges. However, if materials used on the Force Account Work are not specifically purchased for the Work but are taken from the Contractor's stock, then in lieu of the Invoices, the Contractor shall furnish an affidavit certifying that the materials were taken from its stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the cost to the Contractor.

- Non-Allowable Costs. The Department will not reimburse the Contractor for the following:

    - Profit in excess of that provided herein

    - Loss of profit

    - Labor inefficiencies

    - Home office overhead in excess of that provided herein

    - Consequential damages, including but not limited to loss of bonding capacity, loss of bidding opportunities, insolvency, the effects of Force Account Work on other projects, and business interruption

    - Indirect costs of any nature

    - Costs for Attorneys' fees, claim preparation expenses, and the costs of litigation

    - Constructive acceleration

e. Compensation for Delays. For an excusable, compensable delay as identified in **Subsection 108.07**, the Department will pay for the costs as specified below:

- Allowable delay costs shall include:
  - Non-salaried labor expenses
  - Material Costs
  - Equipment Costs
  - Extended jobsite overhead (inclusive of the costs to maintain the job site during the delay)
  - An additional surcharge of 10 percent of the total of items I, ii, iii and iv, to account for home office overhead and all salaried labor (both home office and extended field supervision), and profit
- The Contractor shall document all costs claimed when measuring additional equipment expenses (e.g., ownership expenses) that result directly from a delay caused by the Department. Use actual records kept in the usual course of business, not equipment rental rate guides, and measure increased ownership expenses according to generally accepted accounting principles. The Department will not pay for delay costs before the Contractor submits an itemized statement of those costs.
- The Department will not pay for non-allowable charges specified in **Subsection 109.04(d)**, nor duplicate payment made under **Subsection 109.04(b)** through **Subsection 109.04(d)**. The Department will not make any payments for costs calculated using any of the following methods:
  - Total cost methods based on calculation of costs as the difference between the Contractor's bid for the Work and the Contractor's calculation of the costs for the Work.
  - Calculation of home office overhead using the Eichleay Formula or other formulas used to calculate home office overhead due to delay.

f. Directed Acceleration. The Engineer may order the Contractor in writing to accelerate the Work to mitigate Excusable Delays or to complete the Project early. When directed to accelerate, the Department will pay the Contractor as specified in **Subsection 109.04**.

109.05 ELIMINATED ITEMS.

The Department may partially or completely eliminate Contract Items. When notified of the elimination of a Contract Item, if the Contractor believes that such elimination will necessitate a revision to the Contract Price, the Contractor shall provide notice according to **Subsection 104.02(d)**. Failure to provide notice as specified in **Subsection 104.02(d)** constitutes a waiver of the Contractor's entitlement to compensation or a time extension and releases the Department from responsibility for providing compensation or a time extension for any related

claims filed under **Subsection 105.19**. The Department will reimburse the Contractor for the Work completed according to **Subsection 109.04**.

109.06 PAYMENT FOR WORK.

a. General. The Department will make payment for Work before the Project is accepted and final payment is made. These payments for Work will be processed via progress payments. To receive a payment for Work, the Contractor shall prepare an Invoice according to **Subsection 109.06(c)**. The Department may suspend progress payments if the Contractor does not comply with the terms of the Contract or the Engineer's instructions or written directives.

   The Department will notify the Contractor whenever progress payments will be suspended. Processing of progress payments for Work before the Department's acceptance and final payment of the Work does not constitute the Department's acceptance of the Work, and does not relieve the Contractor of responsibility for the Work, which includes but is not limited to:

   - Protecting, repairing, correcting, maintaining, or renewing the Work where necessary to meet Contract requirements before acceptance.
   - Replacing or repairing all defective Work or materials used in the construction of the Work, and repairing all damage to other Work or materials whose damage is attributable to the defective Work or materials.
   - All defects or damage that the Engineer may discover on or before the Engineer's acceptance and final payment of the Work. The Engineer is the sole judge of these defects or damage.

b. Frequency. The Department will make progress payments a minimum of bi-weekly and maximum of monthly based on the Contractor Invoice provided according to established Department procedures. Progress payments will be subject to a 5 percent retainage.

c. Invoice for Payment for Work. The Contractor shall submit an Invoice for payment at the above frequency for any and all work completed in the previous month and, as requested by the Engineer, a weekly progress report for review detailing the items included in the Invoice. The Contractor shall use Invoice forms supplied by the Department, including a certification for payment, according to the instructions provided. If an Invoice is not submitted as described above, any quantity overage may not be reimbursed.

d. Invoice for Partial Payment for Materials, Supplies, and Equipment. The Engineer may allow invoicing as provided above and permit partial payments for those materials, supplies, and equipment delivered to an approved location but not yet incorporated into the Work. Payment for materials, supplies, and equipment furnished at an approved site but not yet incorporated into the work may be allowed under the following conditions:

   - The schedule of completion of the work has been terminated by authorized suspension of Contract work (pending final settlement), or

- The schedule of completion of the work has been hindered and delayed by seasonal closing of the Project or by similar causes over which the Contractor has no control, or

- When, in the opinion of the Engineer, the advance delivery of such materials is in the best interest for the timely completion of the Project.

Work will not exceed the lesser of the following amounts:

- 100 percent of the cost incurred by the Contractor, or

- 80 percent of the value calculated by multiplying the quantity of the item delivered by the unit price for the corresponding item in the Bid Schedule.

For verification of costs, the Contractor shall provide the Engineer with an original paid supplier's Invoice for the furnished materials, supplies, or equipment within 30 days after receiving the partial payment. Otherwise, the amount of the partial payment will be deducted from subsequent Invoices.

The Engineer will not approve any payment for perishable plant materials until such plant materials are planted as specified in the Contract.

e. Engineer's Review of Contractor's Request for Payment for Work and Request for Partial Payment for Materials, Supplies, and Equipment. Upon receipt of the Contractor's Invoice, the Engineer will review the Invoice and may approve or reject payment or portions thereof. The Engineer will notify the Contractor in writing of any modifications and/or rejection of the Invoice. Modifications and reasons for the change will be made to the Excel spreadsheet in the columns provided. For a rejection, the Engineer will request that the Invoice be resubmitted.

f. Subcontractor Payments and Release of Retainage. The Contractor shall make progress payments to the subcontractor incrementally as the Contractor is paid progress payments by RIDOT, with each progress payment made no more than 30 days from when paid by RIDOT. Within 30 days of partial acceptance of the completed Subcontract Work as provided for in **Subsection 109.10**, the Contractor must Invoice all Work covered by the acceptance including the relevant portion of retainage due the Subcontractor. Within 30 days of receipt of such payment, the Contractor shall pay the Subcontractor for all accepted Subcontract Work including all retainage owed. The Contractor shall obtain RIDOT's prior written consent for good cause delays in or postponement of payment to the Subcontractor.

g. Final Release of Contractor Retainage. Retainage due the Contractor may be requested upon acceptance of the Project (Partial or Final) and will be released when all documentation requirements, review and acceptance of final quantities on Contractor's final Invoice, and items on the Punch List have been addressed to the satisfaction of the Engineer documented by an "Acceptance of Work" letter from the Department.

h. Procedures for Payment for Work. The Contractor shall prepare an Invoice to apply for a payment for Work completed. This Invoice shall use the Request for Payment templates supplied by the Department, including the following attachments:

- Detailed Invoice. The detailed Invoice shall be submitted in both hard copy and Excel® and include the following information:

  - The date of the Invoice
  - The Project Name and State and Federal-aid Project Numbers
  - The Contract Item number(s) and name(s) for which the Contractor is seeking payment, as they appear in the Contract Proposal
  - The date(s) each Contract Item was performed
  - Name of Contractor/Subcontractor(s) that performed the Work
  - The location(s) where the Work associated with each Contract Item was performed, cross referenced to the location(s) shown in the Distribution of Quantities
  - Invoiced Item Quantities: The quantity of each Contract Item performed by date and by location within the Invoice period

  For Lump Sum Items, the Contactor shall provide the percentage of Work completed since the previous Invoice. Before the start of Work, the Contractor shall submit a Lump Sum Item Breakdown for the Engineer's review, acceptance and allocation of payments for the item, according to **Subsection 109.07**.

  All calculations shall conform to the Method of Measurement and Basis of Payment portions of the appropriate Item Code(s). Documentation will include backup calculations, measurements, sketches, and related supporting information, cross referenced with DOQ quantities and locations provided on Department provided format or approved equivalent in accordance with 23 CFR 635.123.

  - Cumulative Item Quantities: A cumulative total of the quantities performed for each Contract Item, including the current request.
  - Bid Prices: The Contract Price for each Contract Item, including Unit Bid Items and Lump Sum Bid Items as applicable, shall be listed for each item being Invoiced.
  - Extended Prices: Calculate the extended price of each item being Invoiced in this request.

    For Unit Bid Items, this will be calculated by multiplying each item quantity completed during the Invoice period by its Contract Unit Bid Price (i.e., Extended Price $ = Qty. Invoiced × Unit Bid Price).

    For Lump Sum Items, this will be calculated by multiplying each item by the percentage of Work completed during the Invoice period by its Lump Sum Bid Price (i.e., Extended Price $ = % Complete-this-Invoice-period × Lump Sum Bid Price).
  - Total Invoice Price: Sum all extended prices calculated in step 10 and report this amount as the total amount being Invoiced under the request.

- Certificates of Compliance. A list of the Certificate(s) of Compliance attached or that have been submitted to the Department, including date(s) submitted, for the Work that is listed on the Invoice according to **Subsection 106.01.1** Buy America and **Subsection 106.03**, Certification of Compliance, Warranties, and Guarantees.

- Certified Payrolls. A report from Prism will be included all Certified Payrolls required for the Invoice.

- Subcontractor Payments. A report from Prism will be included of all payments made to Subcontractor for the Project.

- Extra Work. A list of approved and/or potential Extra Work subject to approval, including dates(s) when the Work was identified and/or approved, and a description and associated cost(s) of the Work, including information pertaining to when and by whom the Work was performed. The Contractor shall submit the request for change for any Extra Work or any increase in quantities on Department provided forms and submit to the Engineer.

- EEO Certification. A statement that all EEO documentation has been submitted as required by the Contract.

- As-Built Data. A set of as-built data in hard copy or electronic form of the Work billed on the Invoice, including Plans, sketches, diagrams, and all other information necessary for resulting in a complete and accurate set of as-built data representing the Work completed. A final set of as-built Plans is also required according to **SECTION 940**.

- General. Outstanding or missing documentation for Items (1) through (7) above will be a basis for rejection and/or modification of the Request for Payment.

109.07 PARTIAL PAYMENT OF LUMP SUM ITEMS.

The Contractor shall submit a breakdown of the cost of Lump Sum items to enable the Engineer to make partial payments as the Work is performed. The breakdown shall detail both standard and job specific Specification codes associated with the Lump Sum item and estimated quantities for the Department's use for materials testing and compliance. Lump sum item breakdowns shall be submitted on Department approved forms within 70 days of the Apparent Low Bidder letter so that it can be incorporated into the Step 6 Baseline Schedule – Bid Item Loaded submission. The Engineer reserves the right to reject the Contractor's Lump Sum item breakdown if the breakdown does not fairly represent the Work to be performed and the materials included. The Engineer may make progress payments based on quantities and/or prices determined by the Engineer.

109.08 ACCEPTANCE AND FINAL PAYMENT.

When the Project has been accepted as provided in **Subsection 105.18**, and upon submission by the Contractor of all required reports, completed forms, certifications, and all other required submissions, the Contractor may request the release of retainage. The Engineer will prepare a final accounting of the quantities of Work performed. The Department will make the final payment if the Contractor concurs with or does not dispute the final accounting within 30 days of receipt.

109.09 PROMPT PAYMENT PROCEDURES.

In accordance with Title 42, Chapter 11.1-1 of the General Laws, all Invoice vouchers submitted by the Contractor will be paid within thirty (30) days, provided however, that according to 42-11.1-5(B)2, the thirty (30) day period will not commence until the Department has reviewed and accepted all Invoice documentation in its proper and approved form.

109.10 SUBCONTRACTOR PROMPT PAYMENT.

The Contractor shall pay Subcontractors, including payments of retainage, pursuant to R.I.G.L. 42-11.1-3, as amended. If a Subcontractor has not provided a performance and payment bond, and subject to the Contractor's rights of setoff as stated in R.I.G.L. 42-11.1-3, then the Contractor shall pay the Subcontractor for its Work, including payments of retainage, no later than 30 days from the Department's payment to the Contractor. The Contractor shall certify payments to Subcontractors as provided in **Subsection 109.06**; otherwise, the Department may suspend progress payments to the Contractor.

The Contractor shall make progress payments to the Subcontractor incrementally as the Contractor is paid progress payments by RIDOT, with each progress payment made no more than 30 days from when paid by RIDOT. The Work of a Subcontractor will be inspected by RIDOT within 14 days of the date of the Contractor's notification for partial acceptance. Within 30 days of partial acceptance of the completed Subcontract Work, the Department will pay the Contractor for all Work covered by the acceptance including the relevant portion of retainage due the Subcontractor. Within 30 days of receipt of such payment, the Contractor shall pay the Subcontractor for all accepted Subcontract Work including all retainage owed. The Contractor shall obtain RIDOT's prior written consent for good cause delays in or postponement of payment to the Subcontractor.

SECTION 110 — FINES/CHARGES TABLE

The Department will place the Contractor on notice for each failure to perform or comply with each provision. The Department will follow its internal process to review and assess the fines or charges in the Table below.

Specification	Failure to Perform and/or Comply	Frequency	Posted Speed up to 35 MPH	Posted Speed over 35 MPH
104.08	Maintenance of Traffic	Each day or location	$ 5,000.00	$ 10,000.00
104.09	Maintenance of Public Access	Each day per location	$ 2,500.00	$ 5,000.00
104.15	Environmental Protection	Each day per incident and location	$ 1,000.00	$ 1,000.00
105.01	Authority of the Engineer	Each incident	$ 1,000.00	$ 1,000.00
105.05	Contractor and Removal	Each day per person	$ 1,000.00	$ 2,000.00
105.07	Cooperation Between Contractors	Each day	$ 1,000.00	$ 1,000.00
105.12	Load Restrictions	Each Incident	$ 1,000.00	$ 1,000.00
105.13	Maintenance During Construction	Each day per location	$ 500.00	$ 1,000.00
105.15	Opening Sections of Project to Traffic	Each day	$ 1,000.00	$ 2,000.00
105.22	Tolling Facilities	Each incident	Daily Lost Revenue	Daily Lost Revenue
106.05	Storage of Materials	Each day per location	$ 1,500.00	$ 3,000.00
107.07	Sanitary, Health and Safety Provisions	Each day per location	$ 1,000.00	$ 2,000.00
107.08	Public Convenience and Safety	Each incident per day	$ 500.00	$ 1,000.00
107.09	Barricades and Warning Signs	Each incident per day	$ 500.00	$ 1,000.00
107.11	Protection and Restoration of Property and Landscape	Each day	$ 500.00	$ 1,000.00
107.13	Public Lands Protection	Each day per location	$ 1,000.00	$ 2,000.00

Specification	Failure to Perform and/or Comply	Frequency	Posted Speed up to 35 MPH	Posted Speed over 35 MPH
107.18	Hazardous Material	Each day per location	$ 1,000.00	$ 2,000.00
108.03	Prosecution and Progress	Each incident per day	$ 500.00	$ 1,000.00
108.03(c)	Meeting Minutes Not Provided/Not prepared for Project Status Meeting	Each meeting	$2,500.00	$2,500.00
108.04	Limitation Of Operations	Each incident per day	$ 500.00	$ 1,000.00
108.05	Character of Workers	Each person per day	$ 500.00	$ 1,000.00
108.06	Equipment, Means, and Methods	Each Incident per day	$ 500.00	$ 1,000.00
206	Perimeter Erosion Controls	Each day	$ 500.00	$ 1,000.00
207	Check Dams	Each day	$ 500.00	$ 1,000.00
209	Storm Drain Inlet Protection	Each Incident per day	$ 500.00	$ 1,000.00
212.03.3	Failure to Maintain, Erosion, Sediment, and Pollution Prevention Controls	Each day per location	$ 1,500.00	$ 1,500.00
401	Cleaning and sweeping pavement	Each day	$ 500.00	$ 1,000.00
401.03.7	Joints	Each incident	$30,000.00	$30,000.00
403.06	Asphalt Emulsion Tack Coat	Per subsection	$5,000 or Removal	$5,000 or Removal
410	Temporary Patching of Potholes and Trenches	Each location per day	$1,000	$1,000
413	Rideability – Surface Course	413.03.01	$ 1,000.00	$ 2,500.00
814.03.8(c)	Falling Temperatures	Each day, incident, and location	10% if no structural effect	10% if no structural effect
905.03.1	Sidewalks – Scheduling Construction	Each day or location	$ 500.00	$ 1,000.00
905.03.2	Compliance with the Americans with Disability Act	Each day or location	$ 1,500.00	$ 3,000.00
907	Dust Control	Each day or location	$ 500.00	$ 1,000.00
914	Flagpersons	Hourly per person	$ 200.00	$ 300.00

Specification	Failure to Perform and/or Comply	Frequency	Posted Speed up to 35 MPH	Posted Speed over 35 MPH
916	Crash Cushions	Daily per each	$ 1,000.00	$ 2,000.00
922	Temporary Construction Signs	Daily per each	$ 1,000.00	$ 2,000.00
923	Portable Channelizing Devices and Barricades	Hourly per location	$ 500.00	$ 1,000.00
924	Advanced Warning Arrow Panel	Each day or location	$ 500.00	$ 1,000.00
925	Portable Changeable Message Sign	Each location or Day	$ 500.00	$ 1,000.00
926	Anchored and Unanchored Barrier for Temporary Traffic Control	Hourly per location	$ 1,000.00	$ 2,000.00
928	Truck Mounted Attenuator (TMA)	Per Hour	$ 500.00	$ 1,000.00
929	Field Offices	Each day	$ 500.00	$ 500.00
930	Plant Field Laboratory	Each day	$ 500.00	$ 500.00
934	Field Control and Construction Layout	Each day	$ 500.00	$ 1,000.00
937.05.2(a)	Maintenance	Each day	$ 5,000.00	$ 5,000.00
937.05.2(b)	Movement	Per instance	$5,000 and an additional $1,000** per half hour per lane (paved shoulders will be counted as lanes) per direction of travel that travel lane(s) remain out of compliance with the Transportation Management Plan.	$5,000 and an additional $1,000** per half hour per lane (paved shoulders will be counted as lanes) per direction of travel that travel lane(s) remain out of compliance with the Transportation Management Plan.
937	Daily Reports upon request if not provided within 24 hours	Each day	$ 500.00	$ 1,000.00
937	Emergency Response if not initiated within 90 minutes	Per hour	$ 3,000.00	$ 6,000.00
944	Lighting for Night Work Operations	Each day	$ 2,500.00	$5,000.00

Specification	Failure to Perform and/or Comply	Frequency	Posted Speed up to 35 MPH	Posted Speed over 35 MPH
L02.03.7	Seeding - Care During Construction	Each location or day	$ 500.00	$ 1,000.00
L03.03.10	Sodding - Care During Construction	Each location or day	$ 500.00	$ 1,000.00
L06.03.10	One Year Establishment Period	Each day	$ 250.00	$ 500.00
L07.03.10	Extended Establishment Period	Each day	$ 250.00	$ 500.00
T13	Detectors And Relays	Each location per day	$ 500.00	$ 1,000.00

** *Project specific hourly charges shall be set at a default value of $1,000 and increased accordingly based on the location of the project and other various project specific factors.*

Explanations. The following frequencies used in the above Table are applicable:

1. Per Each. Each individual sign, arrow panel, message board, truck mounted attenuator, barrier module (regardless of location).

2. Each Day. Fine applies once every calendar day.

3. Each Location. Each individual channelizing device setup, concrete barrier (regardless of locations).

4. Per On/Off Ramp. Each individual State numbered on ramp and off ramp (regardless of location).

5. Per Person. Each individual flag person (regardless of location).

6. Per Shoulder. Each individual high-speed lane and low-speed lane shoulder (regardless of location).

7. Per Travel Lane. Each individual travel lane, including all turn lanes (regardless of location).

8. After the first occurrence the amounts listed in the Table above will double for subsequent occurrences. Hourly items continue to be a single occurrence until they are no longer in violation.

110.01 EMERGENCIES.

If emergency repair work has not been initiated within the 90-minute time frame specified above, the charge set forth above will be deducted from monies then due the Contractor until the repair work is completed

Part 200
EARTHWORK AND EROSION CONTROL

SECTION 201 — SITE PREPARATION

201.01 DESCRIPTION.

This work includes actions that are required to clear and prepare the site for construction. The actions all have a common characteristic — they involve the removal and legal disposal of both designated vegetative materials and man-made objects and facilities. The actions include removal and disposal of the following:

- Clearing and grubbing
- Cutting and removing isolated trees and stumps
- Partial or complete removal and disposal of isolated tree stumps
- Trimming tree roots
- Culverts and other stormwater components
- Masonry
- Drainage and utility structures
- Pipe
- Rigid and flexible pavement
- Granite, concrete, and asphalt curbing
- Concrete and asphalt sidewalk
- Fences and railings
- Guardrail
- Underground and above ground storage tanks
- Miscellaneous items such as highway bounds and signs
- Demolition of buildings and structures
- All other obstructions or undesirable materials within the right-of-way
- All necessary trimming and fine grading
- Any other item shown in the Plans

The Contractor will be compensated for clearing and preparing the site for construction operations through individual Proposal items. There is one item for each removal and disposal action.

The following Subsections contain descriptions of some of the most common removal and disposal actions.

201.01.1 Clearing and Grubbing.

This work includes cutting, removing from the ground, and disposing trees, stumps, brush, shrubs, hedges, roots, and other vegetation that occurs within the right-of-way and interferes with excavation, embankment, fencing, or clear vision or is otherwise considered objectionable. The work also includes the preservation from the injury or defacement of all vegetation and objects outside of the clearing limits.

201.01.2 Cutting, Removing, and Disposing Isolated Trees and Stumps.

This work includes cutting, removing, and disposing designated isolated trees and stumps in excess of 4 in. in diameter (measured at 4 in. above existing ground) that are located within the general area of construction work but are not located within the areas specified for clearing and grubbing.

201.01.3 Partial Removal and Disposal of Isolated Tree Stumps.

This work includes the partial removal and disposal of designated isolated tree stumps that are located within the limits of the Project.

201.01.4 Metal Frames, Covers or Grates.

This work includes the removal and disposal of metal frames, covers, or grates from existing utility and drainage structures.

201.01.5 Culverts, Drainage, and Utility Structures.

This work includes the removal and disposal, in whole or in part, of culverts and drainage structures (e.g., catch basins, drop inlets, manholes); utility structures such as gas, electric, water, telephone boxes, manholes, and pits; and sewer manholes. The removal and disposal of metal frames, covers, or grates of drainage structures is not covered under this item but is included under **Subsection 201.01.4**.

201.01.6 Pipe.

This work includes removing and disposing all pipe of whatever nature and sizes as required.

201.01.7 Pavement, Sidewalks, and Curbing.

This work includes removing and disposing flexible and rigid pavement including the surface, base, and/or subbase courses; granite, concrete, and asphalt curbing; and concrete and asphalt sidewalks.

201.01.8 Asbestos Cement Pipe.

This work includes removing and disposing existing asbestos cement pipe/duct bank of all types and sizes.

201.01.9 Underground/Above-Ground Storage Tanks.

This work includes locating, removing, and disposing of existing gasoline and oil storage tanks previously abandoned and left in place and any other storage tanks as encountered in the work, either above or below ground, regardless of size and type. Perform all work according to both the currently adopted State of Rhode Island Department of Environmental Management, Division of Water Resources, “Regulations for Underground Storage Facilities Used for Petroleum

Products and Hazardous Materials" and all other applicable State and Federal laws and regulations.

The removal and disposal of cesspools and septic tanks is not covered under this item but is included under **Subsection 201.01.12**.

201.01.10 Fences, Railings, and Guardrail.

This work includes removing and disposing all fences, railings, and guardrail of the types and sizes indicated on the Plans to be removed.

201.01.11 Miscellaneous Objects.

This work includes removing and disposing miscellaneous objects such as mailboxes and posts, road signs, private signs, highway bounds, and any other objects not covered by any preceding Subsection, as specifically indicated on the Plans to be removed or required to be removed for the construction of the new work.

201.01.12 Demolition of Buildings.

This work includes the demolition of the buildings and their foundations as required. Each portion of the work includes the disposal of all outbuildings, such as garages and sheds, adjacent to or a part of the unit designated, unless the outbuildings are designated as separate units.

The work also includes the removal and disposal of cesspools, septic tanks, distribution boxes, and other tanks as encountered.

The work includes the implementation of rodent control measures for each building before its demolition.

201.01.13 Load and Haul Solid Waste and Disposal of Solid Waste.

This work includes collecting, loading, hauling, and disposing of on-site solid waste material, including trash, litter, household appliances, tires, vegetative, and other on-site debris.

Unless otherwise provided for in the Contract documents, this item of work does not include the removal and disposal of solid waste material or debris generated by the Contractor's construction operations, including soil and rock excavation, the removal and disposal of pavement, sidewalks, and other highway infrastructure, clearing and grubbing operations, and/or the removal and disposal of contaminated soils.

Ensure that the removal and disposal of all debris is conducted consistent with the requirements of the Rhode Island Building Code and OSHA Standard 29 CFR 1926, "Safety and Health Regulations for Construction."

Dispose of solid waste materials according to the currently adopted EPA regulations (40 CFR 239 - 259) and RIDEM solid waste regulations (DEM OWM-SW-04-01) and any other applicable regulations.

Obtain all required permits for hauling and disposal of waste materials, including the payment of tipping and other required fees.

201.02 MATERIALS.

For the requirements relating to common borrow and gravel borrow, see **Subsections 202.02.1** and **202.02.2**.

201.03 CONSTRUCTION METHODS.

201.03.1 Clearing and Grubbing.

Obtain and comply with all applicable permit requirements before starting earthwork on the Project, as discussed in **SECTION 107** and **Subsection 104.15**.

Clear and grub all trees, stumps, brush, shrubs, hedges, and roots not designated to remain but within the fill lines of embankments and less than 3 ft in height to subgrade. When the height of embankment to subgrade exceeds 3 ft, leave stumps that do not extend more than 6 in. above the original ground or low water level.

Before initiating the clearing and grubbing work, install erosion control measures according to **SECTIONS 206**, **207**, and **208**.

The Engineer may permit sound stumps to be cut off not more than 6 in. above the ground and left outside of the construction limits of cut and embankment areas. An exception is in the area to be rounded at the top of back slopes. In this area, cut off stumps flush with or below the surface of the final slope line.

Except in areas to be excavated, backfill stump holes and other holes from which obstructions are removed with acceptable material, and compact according to **Subsection 202.03.3**.

The following additional requirements apply to the clearing and grubbing:

a. Disposal of Perishable Materials. Do not burn trees, brush, shrubs, or perishable material on any construction Project site. Do not haul trees, brush, shrubs, or perishable material from the Project for the purpose of burning. Dispose of these items by any of the following methods:

   - Sell or salvage all merchantable timber in the clearing and grubbing area that has not been removed from the right-of-way before the beginning of construction.

   - Chip trees on site. All wood chips become the property of the Contractor and must be removed promptly from the site. Stockpile the required quantity on the site at a location approved by the Engineer. Mechanical chipping of small branches and brush may be used where disposal area space limitations require these measures. The resulting chips need not be buried.

   - Dispose of brush, shrubs, and other perishable material off the Project site. Supply the Engineer with a copy of the written permission from the property owner for any off-site disposal.

b. Low Hanging Branches. Remove and dispose of low hanging branches and unsound or unsightly branches on trees and shrubs designated to remain. Trim branches of trees extending over the road surface to provide a clear height of 20 ft above the road surface. Perform all trimming according to sound tree surgical practices and under the supervision of a licensed arborist.

c. Diseased Vegetation. Dispose of all elm trees, trimmings, or branches or other wood that is designated by the Rhode Island Department of Environmental Management as a host for a serious plant disease or a disease carrier at a sanitary landfill location within 48 hours after cutting.

201.03.2 Cutting, Removing, and Disposing Isolated Trees and Stumps.

Remove and dispose of any isolated trees and stumps regardless of diameter (measured at 4 in. above existing ground) that are located within the general area of construction work but that are not located within the areas specified for clearing and grubbing in **Subsection 201.03.1**.

201.03.3 Partial Removal and Disposal of Isolated Trees and Stumps.

The Engineer will designate any isolated tree stumps for partial removal and disposal. Remove and dispose of these to 6 in. below final grade. Fill the resulting hole with like materials as required at no additional cost to the Department.

201.03.4 Frames, Covers, or Grates.

Remove frames, covers, or grates, and either dispose of or stack and salvage for subsequent re-use. Deliver the materials to a RIDOT Maintenance facility (or other facility as dictated by RIDOT) at no additional cost to the Department.

201.03.5 Culverts, Drainage, and Utility Structures.

a. Culverts and Drainage Structures. Remove and dispose of the substructures of existing structures down to the natural stream bottom, and remove and dispose of the parts outside of the stream down to 1 ft below natural ground surface. Where portions of existing structures lie within the limits of a new structure, remove and dispose of as necessary to accommodate the construction of the proposed structure.

b. Utility Structures. Remove and dispose of all abandoned utility structures that interfere with proposed work. When existing sewers or utilities will be extended or otherwise incorporated into the new work, only remove and dispose of the portion of the existing lines necessary to provide a proper connection with the new work.

c. Backfilling. Do not use portions of the existing structures to backfill the excavations required for the removal and disposal of the structures. Backfill excavations with gravel borrow placed in 6-in. layers and compacted to 95 percent of maximum density according to AASHTO T180. Only use existing materials that are clean and that meet the gradation requirements.

d. Bridges. Remove and dispose of bridges as specified in **SECTION 803**.

201.03.6 Pipe.

Remove and dispose of all pipe not designated to remain. Cap all pipes according to **SECTION 706**. Do not abandon pipe in place without approval of the Engineer.

201.03.7 Pavement, Sidewalks, and Curbing.

Remove and dispose of all flexible and rigid pavement, base course; concrete and asphalt sidewalks; granite, concrete, and asphalt curbs; and gutters. Remove and stockpile ballast, gravel, asphalt material, or other surfacing or pavement materials to be used on the Project at a site approved by the Engineer. Otherwise, dispose of this material.

Where the remainder of the existing pavement or sidewalks will remain undisturbed, make a clean saw cut to separate the remaining pavement from that being removed.

201.03.8 Asbestos Cement Pipe.

- Approved Disposal Sites. Remove and dispose of asbestos cement pipe at an approved landfill site. Provide a copy of the license or approval to the Engineer for any disposal site, which must be valid at the time of disposal in the selected landfill.
- Construction Methods (Removal and Disposal Procedures). Remove and dispose of asbestos cement pipe/duct bank as follows:
    - A person trained and certified in asbestos removal shall be on site during asbestos pipe removal and disposal operations. Submit the qualifications of personnel required for the removal and disposal operation to the Engineer.
    - Excavate the trench to the necessary width on either side and to the depth that will not exceed the bottom of the pipe while maintaining a safe angle of repose. A trench box may be used instead. Do not disturb the pipe during excavation. The AC material may need to be wetted with water before breaking/cutting.
    - Perform any breaking or cutting of the AC pipe/duct bank to meet the length requirements inside the trench area before the pipe is removed.
    - Cover the AC pipe/duct bank with a minimum 6-mil polyethylene sheet and/or bag fastened with high strength duct tape. Fold the free ends of the sheeting or the end of the bag outside and over the pipe/duct bank and seal transversely with the duct tape.
    - Lift the polyethylene sealed asbestos cement pipe intact without additional breaking, and place in a transport vehicle (box type trailer) that entirely contains the wrapped and sealed portion of pipe/duct bank on all sides. Do not use a box trailer with tarpaulin top.
    - Collect and place any remaining portions of AC material (e.g., pieces, fragments, collars, rubber gaskets) in the trench, overburden, or work area in a 6-mil polyethylene bag or sheeting. Place the bags or sheeted materials for transport according to the above bullet. If the polyethylene bag or sheet is torn or punctured, repeat the process to ensure a sealed mode of handling at no additional cost to the Department.
    - Perform all removal and placement of the AC material into the transport truck in the presence of the Engineer and/or designated representative.

- Notify the Engineer one week before the implementation of removal, disposal, and transport operations.
- Do not dump any AC material at any site except in a legal asbestos landfill.

201.03.9 Underground/Above-ground Storage Tanks.

Remove and dispose of all existing storage tanks previously abandoned and left in place and any other storage tanks encountered in the work, either above or below ground. Secure a permit for the Permanent Closure Application for Underground Storage Tanks from the Department of Environmental Management, Land Revitalization and Sustainable Material Management, Underground Storage Tank Management Program at least 10 days before the proposed closure. Perform all excavation and backfill according to **Subsections 202.03.1** and **202.03.3**.

201.03.10 Removal and Disposal of Fences, Railings, and Guardrail.

Remove and dispose of all fences, railings, and guardrail as required.

201.03.11 Removal and Disposal of Miscellaneous Objects.

Remove and dispose of all miscellaneous objects such as mailboxes and posts, roadway signs, private signs, highway bounds, and any other objects not covered otherwise as required for the construction. For any object designated remove and salvage, deliver the materials to a RIDOT Maintenance facility (or other facility as dictated by RIDOT) at no additional cost to the Department.

201.03.12 Demolition of Buildings and Structures.

The demolition of buildings includes foundations and outbuildings, such as garages and sheds, adjacent to or part of the unit designated.

a. General. All buildings and contents will become the property of the Contractor with the exception of materials or contents claimed by owners as part of a land damage settlement or agreement with the Department.

   Plug with concrete any drain pipes or other pipes, ducts, etc., disconnected and deemed advisable to remain underground, except that metal pipes may be capped with screw-type plugs or caps.

   If any concrete cesspools, septic tanks, galleys, or distribution boxes are present, pump the items out and break them into pieces sufficiently small to preclude the formation of voids. Backfill and compact the resulting depression with common borrow. Treat stone cesspools in a similar manner.

   If steel septic tanks are present, remove the covers and pump out the interiors and fill with common borrow.

   Do not raze or demolish any building or structure until provisions have been made for proper rodent control according to the Town or City requirements where the work is being performed.

b. Methods of Removal and Disposal. Raze and dispose of the building to be demolished according to the most practical conventional method as approved by the Engineer in writing. Take the necessary precautions, and use sufficient water on non-salvageable materials to prevent excessive spreading of dust during demolition operations. If any water contamination occurs (e.g., in wells), resolve the problem and comply with any applicable regulations at no additional cost to the Department. Do not perform any blasting without an approved Shop Drawing, and not until receiving proper permission from the appropriate State and/or local fire department. For special requirements regarding the use of explosives, see **Subsections 107.10** and **202.03.1**.

   Do not burn any portion of the building or structure. Do not allow any debris to accumulate in the streets, sidewalk areas, or ground surrounding the demolition work. Upon completion of the work, ensure that the site remains in a clean and safe condition.

   Break up concrete basement floors into segments no larger than 2 sq yd each before filling. Fill basements or cavities left by structure removal with common borrow to the level of the surrounding ground and, if within the highway prism of construction, compacted according to **Subsection 202.03.3**.

   For locations documented in the demolition plan, shore up, brace the underpinning, and protect all walls and other parts of existing structures adjacent to the demolition area that may be affected by the demolition operation.

c. Disposal of Tanks. Ensure that the disposal of storage tanks, including excavation and backfill and all other incidentals pertaining to this work, conforms to **Subsection 201.03.9**.

d. Temporary Fencing. When cellar holes, pits, or other hazardous depressions or excavations are adjacent to or within the vicinity of a pedestrian access, erect a temporary guard fence for the protection of pedestrians. Ensure that the fencing material is free from nails, fastenings, or splinters, and presents a reasonably smooth surface on the sides of possible contact. Leave in place the temporary fences and properly maintain until their removal and disposal is authorized by the Engineer in writing.

e. Watchman. At all times, provide a sufficient number of watchmen and guards as necessary to properly safeguard the public from active construction operations.

201.03.13 Load and Haul Solid Waste and Disposal of Solid Waste.

Ensure that the removal and disposal of all debris is consistent with the requirements of the Rhode Island Building Code and OSHA Standard 29 CFR 1926, “Safety and Health Regulations for Construction.”

Dispose of solid waste materials according to EPA regulations (40 CFR 239 – 259, currently adopted version) and RIDEM solid waste regulations (DEM OWM-SW-04-01, currently adopted version). Obtain all required permits for hauling and disposal of waste materials.

Perform the removal and disposal of solid waste material from the Project site with the necessary labor, tools, and equipment to minimize the effects of noise, dust, and other adverse conditions.

This work does not include the removal and disposal of solid waste material or debris generated by the Contractor's construction operations, including soil and rock excavation, the removal and disposal of pavement, sidewalks and other highway infrastructure, clearing and grubbing operations, and/or the removal and disposal of contaminated soils.

Notify the Engineer if hazardous waste materials are encountered or may be present, including contaminated soils, oil, and/or other hazardous or potentially hazardous waste materials (OHM).

201.04 METHOD OF MEASUREMENT.

The removal and disposal actions required to clear and prepare the site for construction will be measured for payment as follows.

201.04.1 Clearing and Grubbing.

Clearing and Grubbing will be measured by the number of square yards.

201.04.2 Cutting, Removing, and Disposing Isolated Trees and Stumps.

Cutting, Removing, and Disposing Isolated Trees and Stumps will be measured by the number of trees and stumps, or the number of stumps alone if there are no trees, cut, removed and disposed.

201.04.3 Partial Removal and Disposal of Isolated Tree Stumps.

Partial Removal and Disposal of Isolated Tree Stumps will be measured by the number of stumps removed.

201.04.4 Removal and Disposal of Frames, Covers, or Grates.

Removal and Disposal of Frames, Covers, or Grates will be measured by the number of units removed.

201.04.5 Removal and Disposal of Culverts, Drainage, and Utility Structures.

Removal and Disposal of Culverts, Drainage, and Utility Structures will be measured by the number of structures removed.

201.04.6 Removal and Disposal of Pipe – All Sizes.

Removal and Disposal of Pipe – All Sizes will be measured by the number of linear feet of pipe removed.

201.04.7 Removal and Disposal of Pavement, Sidewalks, and Curbing.

Removal and Disposal of Pavement and Sidewalks will be measured by the number of square yards of pavement removed. Removal and Disposal of Curbing will be measured by the number of linear feet of curbing removed.

201.04.8 Removal and Disposal of Asbestos Cement Pipe.

Removal and Disposal of Asbestos Cement Pipe will be measured by the number of linear feet of pipe removed.

201.04.9 Removal and Disposal of Underground/Aboveground Storage Tanks.

Removal and Disposal of Underground/Aboveground Storage Tanks will be measured by the number of tanks removed.

201.04.10 Removal and Disposal of Fences, Railings, and Guardrail.

Removal and Disposal of Fences, Railings, and Guardrail will be measured by the number of linear feet of fencing removed.

201.04.11 Removal and Disposal of Miscellaneous Objects.

Removal and Disposal of Miscellaneous Objects will be measured by the number of objects removed.

201.04.12 Demolition of Buildings and Structures.

Demolition of Buildings and Structures will be measured by the number of buildings or structures demolished.

201.04.13 Load and Haul Solid Waste and Disposal of Solid Waste.

Load and Haul Solid Waste and Disposal of Solid Waste will be measured by the number of tons of waste material disposed. The tonnage will be determined from weight slips generated at the waste disposal facilities.

201.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Clearing and Grubbing	SY
Cutting, Removing, and Disposing Isolated Trees and Stumps	EA
Partial Removal and Disposal of Isolated Tree Stumps	EA
Removal and Disposal of Frames, Covers, or Grates	EA
Removal and Disposal of Culverts, Drainage and Utility Structures	EA
Removal and Disposal of Pipe – All Sizes	LF
Removal and Disposal of Pavement and Sidewalks	SY
Removal and Disposal of Curbing	LF
Removal and Disposal of Asbestos Cement Pipe	LF
Removal and Disposal of Underground/Aboveground Storage Tanks	EA
Removal and Disposal of Fences, Railings, and Guardrail	LF
Removal and Disposal of Miscellaneous Objects	EA
Demolition of Buildings and Structures	EA
Load and Haul Solid Waste and Disposal of Solid Waste	TONS

When the Contract does not contain estimated quantities or lump sum items for removal and disposal of structures and obstructions and is shown on the Plans for removal and disposal, the work is incidental to and included in payment for other items of work.

Saw cutting is incidental and not paid separately. Include saw cutting cost in the associated work items.

The several removal and disposal actions required to clear and prepare the site for construction will be paid for as follows.

201.05.1 Clearing and Grubbing.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.2 Cutting, Removing, and Disposing Isolated Trees and Stumps.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.3 Partial Removal and Disposal of Isolated Tree Stumps.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.4 Removal and Disposal of Frames, Covers or Grates.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.5 Removal and Disposal of Culverts, Drainage and Utility Structures.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.6 Removal and Disposal of Pipe – All Sizes.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.7 Removal and Disposal of Pavement, Sidewalks, and Curbing.

The prices so-stated constitute full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.8 Removal and Disposal of Asbestos Cement Pipe.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.9 Removal and Disposal of Underground/Aboveground Storage Tanks.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.10 Removal and Disposal of Fences, Railings, and Guardrail.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.11 Removal and Disposal of Miscellaneous Objects.

The price constitutes full compensation for all labor, materials, and equipment and for all incidentals required to finish the work, complete and accepted.

201.05.12 Demolition of Buildings and Structures.

The price constitutes full compensation for demolition and removal, including disposal of surplus and waste materials, excavation, backfilling, rat eradication, pumping out, breaking up, testing, disposal and backfilling of cesspools and septic tanks; filling basements or cavities left by structure removal with common borrow to the level of the surrounding ground and, if within the highway prism of construction, compacting the fill; installing and removing temporary fencing; all expenses incidental to procurement of health, fire, and police certificates; fencing and fence materials and watchmen or guards, clean-up, and all labor equipment, materials, and incidentals necessary to finish the work, complete and accepted.

201.05.13 Load and Haul Solid Waste and Disposal of Solid Waste.

The price constitutes full compensation for all disposal fees, recycling of waste materials, labor, materials, equipment and all incidentals required to finish the work, complete and accepted.

SECTION 202 — EXCAVATION AND EMBANKMENT

202.01 DESCRIPTION.

This work includes excavation and the satisfactory placement and compaction or disposal of all materials encountered within the limits of the work as necessary for the construction of the roadway, bridge, stormwater structures, etc.

202.01.1 Earth Excavation.

Earth excavation includes the removal of suitable and unsuitable soils not otherwise classified and the removal of boulders and rock fragments less than 1 cu yd in volume from the following areas:

- Within the design excavation section
- Beyond the design excavation section of the roadbed or side slopes where unsuitable materials are encountered
- Beyond the design excavation section of shallow embankments when unsuitable materials are encountered

202.01.2 Presplitting Bedrock.

This work includes producing a plane of split rock before any drilling or blasting for roadway rock excavation. Ensure that the plane follows the design rock slope lines and extends from the top of the bedrock surface to the proposed rock shelf levels and either to the toe of finished rock slope or to the invert of side drains.

202.01.3 Rock Excavation.

Rock excavation includes the removal of intact bedrock and boulders or detached bedrock fragments that have a volume of 1 cu yd or more. Boulders and detached rock fragments that have a volume of less than 1 cu yd are considered Earth Excavation.

202.01.4 Rock Excavation – Mechanical.

Use this classification of rock excavation where blasting is prohibited. Remove rock excavated under this classification using hydraulic splitters, air rams, or paving breakers.

202.01.5 Unsuitable Soils.

Unsuitable soils include those soils other than muck that, due to their consolidation properties, degree of saturation, gradation, or other deleterious characteristics, will not provide:

- A stable subgrade or side slopes
- Cannot be used as or support embankment
- Cannot be placed and compacted as backfill

202.01.6 Muck Excavation.

Muck excavation includes the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material regardless of moisture content. Stockpile the excavated muck at approved locations within the right-of-way and/or disposed of.

202.01.7 Channel Excavation Earth.

Channel Excavation Earth includes all materials other than water or Channel Excavation Rock, removed from existing, new, or temporary water courses.

202.01.8 Channel Excavation Rock.

Channel Excavation Rock includes intact bedrock and boulders 1 cu yd or more in volume removed from existing, new, or temporary water courses.

202.01.9 Channel Excavation Rock – Mechanical.

Use this classification of rock excavation in channel construction areas where blasting is prohibited. Remove rock excavation under this classification using hydraulic splitters, air rams, or paving breakers.

202.01.10 Unclassified Excavation.

Unclassified Excavation includes the excavation, stockpiling, and/or removal and disposal of a composite mixture of various types of materials that are impractical to segregate into separate classifications as determined by the Engineer.

202.01.11 Embankment Construction.

Embankment Construction includes constructing roadway embankments, including the preparation of the areas:

- Upon which they will be placed
- The benching of embankments
- The construction of side slopes and toe drainage ditches
- The construction of dikes within or outside the right-of-way
- The placing and compacting of approved material where unsuitable material has been removed
- The placing and compacting of embankment material in holes, pits, and other depressions within the roadway area

Use only materials in the construction of embankments and backfills that meet the material requirements.

202.01.12 Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils.

This item of work includes the requirements for the RIDEM approved Remedial Action Work Plan (RAWP) and the Soil Management Plan (SMP), including:

- Maintaining existing or proposed chain link fencing (as applicable) for excavation locations, temporary staging areas, and soil stockpile
- Furnishing, installing, and removing temporary barrier fencing for excavation locations, temporary staging areas, and temporary soil stockpiles, as applicable
- The special handling, hauling, unloading, and stockpile management of unclassified, contaminated, or hazardous soil from the excavation location to the approved stockpile/testing location(s)
- Testing the soil for contamination
- The management of site security/access
- The setup, maintenance, and removal of the stockpile locations including above soils, polyethylene sheeting, hay bales, and temporary barrier fencing
- Work and contingency plan supplies
- Equipment
- Site maintenance
- Dust control
- Returning the site to a condition acceptable to the Engineer

202.01.13 Load, Haul, and Dispose of Contaminated Soil.

This item of work includes soil management, special handling, loading and hauling of unclassified, contaminated or hazardous soil, and disposal at an off-Project Industrial/Commercial property, recycling or disposal facility according to RIDEM regulations for recycling/disposal of these materials and as directed by the Engineer.

202.01.14 Load, Haul, and Disposal of Other Waste.

This item includes all testing for the presence of controlled/hazardous materials that may exist in and around existing bridge joints classified herein as other waste. Other waste includes solid debris and/or refuse materials such as:

- Bridge joint material
- Caulk
- Concrete
- Rubble

- Pipe
- Lumber and other building materials

This item also includes any special handling, transporting, and disposing of the wastes to a proper and fully licensed off-site disposal or recycling facility.

Manage contaminated and hazardous waste according to all applicable State, Federal, and local regulations including the EPA, OSHA, and RIDEM Remediation Regulations. Perform the work according to all applicable revisions and in compliance with all applicable permits.

202.02 MATERIALS.

202.02.1 Common Borrow.

Ensure that Common Borrow complies with **Subsection M01.01** before final placement.

202.02.2 Gravel Borrow.

Ensure that the Gravel Borrow complies with **Subsection M01.09, Table I**, **Column I** before final placement.

202.02.3 Contaminated Soils.

Contaminated soil classifications are defined as follows:

- Type 1. Excess excavated Project soil that cannot be reused in which levels of arsenic, lead, and other RCRA Eight Metals, TPH, VOCs, and PAHs are found to be below RIDEM Method 1 Residential Direct Exposure Criteria (RDEC) through testing.
- Type 2. Excavated or excess excavated Project soil that cannot be reused in which levels of arsenic, lead, and other RCRA Eight Metals, TPH, VOCs, and PAHs are found to be above RDEC but below I/C DEC through testing. Load, haul, and dispose of this soil at a licensed facility. Concentrations are within disposal parameter limits allowed in State landfills as landfill cover.
- Type 3. Excavated or excess excavated Project soil in which levels of arsenic, lead, and other RCRA Eight Metals, TPH, VOCs, and PAHs are found to be above I/C DEC through testing but are within acceptable criteria parameters such that the material can be disposed in out-of-state landfills for landfill cover or landfilling without pretreatment. Load, haul, and dispose this soil at a licensed facility.
- Type 4. Excavated Project soil in which levels of arsenic, lead, and other RCRA Eight Metals, TPH, VOCs, and PAHs are found to be above I/C DEC through testing but are within acceptable criteria parameters such that the material can be disposed of in out-of-state landfills for landfilling without pretreatment or the material is suitable for asphalt batching. Load, haul, and dispose this soil at a licensed facility.
- Type 5. Excavated Project soil in which contamination levels exceed EPA and/or RIDEM hazardous waste characteristics necessitating disposal as hazardous waste.

202.02.4 Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils.

Use all materials and equipment required to adequately provide and maintain excavation location security/access, minimize the effects of erosion and surface run-off, and complete the unclassified, contaminated, or hazardous soil excavation, and the handling, hauling, unloading, and stockpiling.

202.02.5 Load, Haul, and Disposal of Other Waste.

Use all required materials to adequately remove, contain, haul, and dispose of contaminated other waste, debris, or surplus materials resulting from the Project as described in the Contract. Use personal protective equipment as specified in the Contractor's Project specific Health and Safety Plan (HASP).

202.03 CONSTRUCTION METHODS.

202.03.1 Excavation – General.

Remove all soil, rock, and other material, and use or dispose of the materials as required. Finish the excavation for the roadway, intersections, and entrances to reasonably smooth and uniform surfaces. Clean and scale all rock cuts for all loose fragments. Do not dispose of any excess materials on the Project site. Conduct excavation operations so that material outside of the slope limits will not be disturbed. Before beginning excavation operations, ensure that all work has been performed according to **SECTION 201**, and install all erosion and pollution controls according to **SECTIONS 206** through **211**.

Maintain slopes, crowns, berms, and ditches on all excavations to ensure satisfactory drainage at all times to protect the work and to maintain safe working conditions.

When the excavation operations encounter remains or artifacts of potential historical or archaeological significance, temporarily halt operations. Immediately contact the Engineer, who will determine the disposition of the discovery. When directed by the Engineer, excavate the site to preserve the artifacts encountered, and remove them for delivery to the custody of the proper State authorities. The excavation will be paid for as Extra Work according to **Subsection 104.05**.

a. Rock Excavation – General. If bedrock is encountered above the design finished grade, notify the Engineer of the change in classification. Continue soil excavation to expose the bedrock surface and to allow the Engineer to perform the necessary elevation survey and take cross-sectional measurements.

   Before removal of overburden or presplitting and blasting to excavate to the design rock slope face, locate the presplit line and the intersection of the crest of the design slope with the existing ground surface. Establish elevations of the existing ground surface along the intersection alignment at one-half station intervals. Install marker stakes at the directed station intervals, offset as directed by the Engineer in writing.

   Rock Excavation may be performed by blasting, where not prohibited, or by mechanical methods. However, where blasting is allowed, bedrock removal will be classified, measured, and paid for as Rock Excavation.

Submit a Blasting Plan before the performance of any drilling or blasting. Ensure that the Plan includes as a minimum the full details of drilling and blasting patterns and techniques proposed for controlled and production blasting. Department review of the Blasting Plan does not relieve the Contractor of the responsibility to use current drilling and blasting technology and for obtaining the desired results.

Furnish a technical representative from the manufacturer of the explosive materials. Provide an individual experienced in the use of explosives commensurate with the circumstances encountered in the Project. Ensure that the manufacturer's representative is available before starting and during blasting operations to determine the proper equipment, devices, materials, methods, and procedures used for the work.

For all operations involving explosives and/or blasting agents, ensure that the work is performed according to the "NFPA 495: Explosives Materials Code," as amended. If the Code conflicts with the RIDOT *Standard Specifications*, the Code will apply. For blasted excavation work, develop the means and methods necessary to attain rock slopes consistent with the most conservative safety requirements.

Excavate material classified as rock to a minimum depth of 12 in. below subgrade within the limits of the roadbed, and backfill the excavation as required.

b. Care in Blasting. Conduct the blasting operations to prevent injury to persons and property. For each occurrence of blasting, provide a sufficient warning to everyone in the vicinity of the work according to "NFPA 495: Explosives Materials Code," as amended, but not later than immediately before blasting. Do not conduct blasting within 25 ft of an existing building or in-service underground utility line.

c. Power of Explosives. Ensure that the explosives employed have the power and are placed in the quantities and positions that will not:

- Unduly enlarge the excavation
- Unnecessarily shatter the rock beyond the limits of the excavation
- Injure work already in place.

d. Transportation, Handling, and Storage. Transport, store, handle, and use as required by applicable Federal, State, and local laws, codes, and ordinances. Obtain the necessary permits for these activities.

Ensure that each storage facility is clearly signed "Danger – Explosives" with the signs visible on all exterior walls of the facility. Retain on the job only that quantity of explosives needed for the work underway and only during the time they are being used. Store explosives securely and separately from all tools. Store caps or detonators separately and more than 100 ft from the explosives. When there is no further need for explosives, immediately remove all explosive material remaining on the job from the premises.

e. Approval by the Engineer. Submit to the Engineer a safety program that includes the procedures for the prevention of injury to persons and or damage to property and the work. The Engineer may reject the safety plan for any deficiency. The Engineer's approval does not relieve the Contractor from any responsibility or liability from the use of explosives.

Revise and resubmit rejected plans accordingly. Comply with this program at all times during the prosecution of the work.

Not later than two calendar weeks before initiating blasting, present permits to the Engineer before any blasting will be allowed. Do not initiate blasting until the Engineer has given approval in writing. If the Engineer determines at any time that the use of explosives is unsafe or dangerous to persons, property, utilities, or the work, the Engineer may direct the Contractor to use other means that do not require the use of explosives at no additional cost to the Department.

f. Notification of Local Authorities and Utilities. Before any explosives or detonator caps are stored or used, notify the Police, Fire, public works, public officials, and utilities where the Project is located as required by applicable Federal, State, and local laws, codes, and ordinances.

In addition, adhere to the following:

- Designate an individual who shall be responsible for the explosive materials at all times.

- Immediately report all unaccounted explosive materials to the Engineer, Police, Fire, public works, public officials, and utilities where the Project is located.

g. Records. Maintain a complete record of blasting operations, noting the date, exact location with reference to a datum, weight of charge, and whether the firing was instantaneous or delayed according to Federal, State, and local laws, codes, and ordinances.

Furnish the Engineer with a complete record of blasting operations during the preceding weekly period. Ensure that the records document:

- The date, quantity, and type of explosive materials delivered to the construction sites(s)

- The quantity of explosive material used

- The quantity of material subsequently removed from the construction site(s)

Immediately upon request, provide all records related to the possession and use of explosive materials for review by the Engineer, Police, Fire, public works, public officials, and utilities. The Engineer may withhold payments related to blasting work until the records are submitted.

h. Repairs. Repair any damage to existing roadway and roadside surfaces, drainage lines, structures or other objects as a result of the use of explosives as directed by the Engineer and according to the Contract. Make all repairs at no additional cost to the Department.

i. Rock Excavation – Presplitting. When required, presplit the rock along the designated cut face to produce a uniform plane of rupture so that the resulting face will not be affected by subsequent fragmentation blasting and excavation operations.

Use presplitting where the intended exposed rock slope exceeds 10 ft in vertical height. Rock cuts more than 25 ft in vertical height may be presplit in stages (lifts), provided that no stage is less than 10 ft in depth. Offset presplitting holes in successive stages not more than 2 ft inside of the previously presplit stage face.

When drilling and blasting behind existing previously drilled and blasted rock faces to widen the rock cut, presplit along the new rock face alignment to prevent over blasting of the new rock face. If after excavating the blasted rock, it is not possible to hold a true and neat face-of-rock, excavate all loose and unstable, fractured, or seamed rock to a stable face of rock behind the neat lines.

Ensure that the drilled presplitting holes follow the required rock slope lines and inclinations. Provide a maximum spacing of 3 ft between presplitting holes, center-to-center, and a diameter not greater than 3 in.

Extend presplitting holes from the top of solid bedrock surface to 2 ft below the toe of finished bedrock slope. Maintain the proper angle of drilling so that all presplit holes lie essentially in the same plane and are parallel to each other. Do not allow any hole to deviate more than ½ ft at any location in the plane of the specified slope line nor in its vertical alignment.

j. Rock Excavation – Fragmentation Blasting. Adjust the blasting operations according to the characteristics and structure of the rock formation to obtain the required slope without fracturing rock beyond the presplit face.

- Position fragmentation blast holes so that:
    - No portion of any blast hole 3 in. or less in diameter is within 4 ft of the designated presplit face
    - No portion of any blast hole greater than 3 in. in diameter is within 12 ft of the designated presplit face
- Inspect and test each hole for its entire depth to determine the presence of any obstruction before placing the charge. Do not allow any loading until the hole is clear of all obstructions for its entire depth. When placing the charge, prevent cave-in of material along the sidewall of the hole.
- Fill all space in each hole not occupied by the explosive charge with ⅜-in. size clean stone chips. Do not use any other material or type of stemming.
- Ensure that blasting for presplitting precedes fragmentation blasting.
- Remove the blast rock and expose the presplit face so that the surfaces of slopes in rock cuts are free from all loose stone or shattered edges.
- Remove all unsuitable material, breakage, and slides, even if located beyond the payment lines.

k. Excavation of Unsuitable Materials. Where unsuitable soils are encountered within the excavated section and above the specified finished grade, suspend excavation to allow area measurements and survey of elevations across the exposed surface. Proceed with the excavation of unsuitable soils until either a change of excavation classification occurs or until the excavation reaches a stable base. If a change in classification occurs, obtain a second set of surveyed elevations. The Engineer will determine the required transverse spacing and station intervals of survey points in writing.

Where excavation to the specified subgrade elevation results in a subgrade or slopes of unsuitable soil, remove the unsuitable materials and backfill and compact to the specified subgrade elevation with material approved by the Engineer in writing. Conduct operations to allow the Engineer to take the necessary cross sectional measurements before placing the backfill.

Before placing any subbase, base, or pavement courses, remove all surplus excavated material including stumps, earth, rock, etc., and grade the shoulders, ditches, and slopes to the approximate final lines.

l. Muck Excavation. If the unsuitable material involved is muck, perform the excavation without entrapping muck within the backfill. Proceed with the backfilling of the excavation immediately after the muck excavation so that material that is displaced by the backfill can be removed. Backfill the excavation to the ground level or 3 ft above water level, whichever is higher, with rock or other suitable granular material selected from the roadway excavation. If suitable material is not available from the excavation, obtain the material from other approved sources.

202.03.2 Embankment Construction – General.

Embankment construction is the placement and compaction of suitable earth and rock excavation materials or borrow material for roadways and associated ramps, dikes, and berms. Construction of embankment may continue during cold weather; however, remove frozen soils that cannot be used as fill for embankment. Do not place rocks, broken concrete, or other solid materials in embankment areas where piling, guardrail, electrical poles, conduits, etc., will be driven or placed.

a. Preparation of Foundation. After cleaning and removal of topsoil where necessary, notify the Engineer and prepare the embankment foundation as follows:

- Where embankment will be greater than 4 ft in height above existing ground, the Engineer will determine whether preparation of the foundation will be necessary.

- For embankment less than 4 ft in height above existing ground, break up the cleared ground surface to a minimum depth of 6 in. by plowing or scarifying. Compact the existing ground surface according to **Subsection 202.03.3**.

- Where unsuitable soils are present at the existing ground surface, excavate and replace unsuitable soils with excavation or approved borrow material, and compact according to **Subsection 202.03.3**.

- Where embankment is less than 2 ft in height above an existing road surface, scarify or pulverize the existing roadway to a depth of 6 in. below the pavement surface.

Reduce all particles to a maximum size of 6 in. and produce a uniform material. Compact the roadway surface according to **Subsection 202.03.3**.

b. Roadway Embankment – Earth. Roadway embankments may consist of earth excavation, borrow material, or a combination. Do not place borrow material until all suitable and accessible materials from all structure, trench, and roadway excavations have been placed.

- Determine the suitability of the borrow material for use in embankment according to **Subsection M01.01**.
- Construct all roadway earth embankment sections in horizontal lifts not exceeding 15 in. (before compaction). Compact as specified in **Subsection 202.03.3** before the next lift is placed.
- Place each lift to the full width of the embankment section. If the full width of the embankment section cannot be placed at one time, step back the lifts at least the length of the lift thickness to allow for benching of the remaining fill.
- Uniformly compact the entire area of each lift to at least the required minimum density.
- Ensure that the moisture content of all roadway embankment materials at the time of compaction is suitable for the soil to meet the density as specified in **Subsection 202.03.3**. The moisture content cannot exceed 2.5 percent above the optimum moisture content as determined by AASHTO T180. If the compacted lift exhibits instability as evidenced by pumping or rutting under equipment, insufficient moisture as evidenced by dusting, or excessive moisture or saturation, correct the deficiencies at no additional cost to the Department.
- If the natural, in-place moisture of the excavated material makes it impractical to compact the soil, dry the soil by effective means. If the soil does not meet the specified compaction, strip and replace the soil.
- Provide an embankment crown to shed runoff, and construct the side slopes to protect from soil erosion.

c. Roadway Embankment – Rock. For rock fragments or boulders used in embankment construction, reduce the segment size to a maximum dimension of 36 in. Ensure that the shape and proportion of the rock fragments and boulders allow their embedment into the top of the existing ground surface or the preceding embankment layer. Ensure that the rock fragments and boulders are embedded in the placement layer, which must not exceed 3 ft in depth.

Individual boulders may be placed in the embankment. However, ensure that the boulders are not nested, and use methods and equipment to satisfactorily embed the boulders in soil lifts and to compact the adjacent fill.

Level each layer and ensure that the interstices are filled with finer fragments and earth. Do not construct the rock lifts above an elevation 2 ft below the finished subgrade. Ensure

that the balance of the embankment is composed of suitable material compacted as specified.

d. Excess Materials. Place all excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments in a satisfactory manner on the side slopes of the nearest fill.

e. Benching Existing Embankments. When embankment will be placed and compacted against either an existing embankment or slope steeper than 4H:1V, cut horizontal benches into the existing slopes to a sufficient width to accommodate placing and compaction operations and equipment. Bench the slope as each embankment layer is placed and compacted. Ensure that each bench begins at the intersection of the original ground and the vertical cut of the previous bench.

   Benches may be cut to a maximum height of 3 ft. Place embankment layers and compact the embankment according to **Subsection 202.03.3**.

f. Embankment Against Structures. If embankment can be deposited on one side only of abutments, wing walls, piers, or culvert headwalls, ensure that the area immediately adjacent to the structure is not over compacted such that it will cause overturning of or excessive pressure against the structure. Where embankment will be placed on both sides of a concrete wall or box type structure, conduct the work operations to ensure that the embankment is always at approximately the same elevation on both sides of the structure. In addition, refer to **Subsection 203.03.5**.

g. Embankment Below Prevailing Water Level. Backfilling and compacting excavated muck areas below the prevailing water level may be performed until the excavated area is backfilled to an initial loose state level not more than 3 ft above the prevailing water level.

   Use rock to construct embankments to an elevation 3 ft above the free water surface at the time of filling, or use an approved free-draining granular material.

   Where placing 12-in. layers is impractical, the Engineer may allow the construction of embankment in one layer to the minimum elevation at which equipment can be operated. Above this elevation, construct the embankment as specified in **Subsections 202.03.2b** and **202.03.3**.

h. Drainage Extension Embankment Detail. On projects that require the extension of existing drainage lines in excavation and embankment areas, maintain the flow of water throughout the construction process. Use the following method of construction up to a minimum height of 3 ft above the outside diameter of the pipe:

   - Construct the embankment to an elevation equal to the invert elevation.
   - Perform trench excavation in the compacted embankment for the placing of pipe bedding. The width of trench excavation is governed by the dimensions specified in **SECTION 205**.
   - Place a layer of bedding material against the outside of the pipe. The width is governed by the horizontal pay limits of trench excavation. Outside of these limits,

place common borrow. Do not exceed a thickness of 8 in. for each fill layer, measured after compaction.

- The bedding material will extend to the height specified in **Subsection 701.03.3**.

202.03.3 Compaction – General.

Uniformly compact each lift to the specified density before the next lift is placed.

Keep dumping and rolling areas separate from one another, and do not cover a lift by another until the compaction requirements have been met. Route and distribute hauling and leveling equipment over each lift of the fill to make the best use of the compaction effort.

a. Densities.

- Determine maximum dry density and optimum moisture content by AASHTO T180.
- Determine field density of soil in place by either AASHTO T191 or a nuclear moisture density gauge conforming to AASHTO T310.
- Ensure that the method of correcting for oversize particles in soil compaction test results conforms to AASHTO T224.
- The method specification for compaction of soils, as described in this Subsection, Para. d, applies if an approved soil does not meet the parameters in AASHTO T180.

b. Compaction of Earth Embankment.

- Subgrade**.** Where the resulting subgrade surface is the bottom of an excavation (i.e., undisturbed existing ground), compact the subgrade surface to not less than 95 percent of the maximum dry density. When a nuclear density gauge is used, measure the in-place dry density by the direct transmission method according to AASHTO T 310 to a depth of 12 in. below the exposed surface.

  Correct the lift at no additional cost to the Department if the Engineer determines that the subgrade material is unstable or does not contain the proper moisture content.

- Embankment Sections. Where embankment sections are greater than 3 ft in height above existing ground, compact the earth in embankment sections below a plane 3 ft below subgrade to not less than 90 percent of maximum dry density. Compact the remainder of the roadway section up to subgrade to 95 percent of maximum dry density. When a nuclear density gauge is used, measure the in-place dry density by the direct transmission method according to AASHTO T 310 to a depth of 12 in. below the exposed surface or equal to the height of the lift thickness, whichever is smaller.

c. Compaction of Rock Embankment. Ensure that rock fill layers are sized, placed, and choked as described in **Subsection 202.03.2(c).**

d. Method Specification for Compaction of Soils. When an approved soil does not meet the parameters in AASHTO T180, describe the method of compaction in writing, which must be approved by the Engineer in writing.

202.03.4 Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils.

202.03.4.1 Health and Safety Plan.

Submit to the Engineer, maintain, and implement a site specific Health and Safety Plan (HASP) that complies with the Occupational Safety and Health Administration (OSHA) Standards as defined in 29 CFR 1910.120.

Ensure that the necessary personal protective equipment is available as specified in the site specific Health and Safety Plan, and ensure access to an inventory of personal protective equipment if the level of personal protection equipment needs to be upgraded.

During excavation, handling, hauling, unloading, and/or stockpiling, minimize odors by methods including the use of odor suppressant shell material, as necessary or as directed by the Engineer.

Ensure that the Contractor's and Subcontractor's employees who will be potentially exposed to the subsurface soils in the RAWP have OSHA 40-hour health and safety training and the eight-hour refresher training, if applicable. Provide training certificates to the Engineer for the individuals who will be performing the work.

If visible dust is generated, determine the level of dermal and respiratory protection based on periodic air monitoring as performed by the Contractor and the requirements of the Project specific HASP. The Engineer may conduct duplicate air monitoring for quality assurance purposes. At a minimum, provide Level D personal protection for all on Project personnel.

202.03.4.2 Applicable Laws and Regulations.

Conduct the management of site security/access, excavation, removal, stockpiling, and transportation of unclassified, contaminated, or hazardous soil according to the Environmental Protection Agency (EPA) and Rhode Island Department of Environmental Management (RIDEM) regulations, the RIDEM approved RAWP and SMP, and in compliance with all applicable permits.

Ensure that compliance with site security/access requirements, according to the SMP and applicable regulations, are maintained during all earthwork operations. Maintain a daily field/operating report during the earthwork activities according to the SMP and RAWP to include dates of earthwork activities, dates, and times of field sampling, soil management observations, and tracking related to stockpile generation and the documentation of lawful off-site disposition. Submit the report to the Engineer on a daily basis to document the operations associated with earthwork activities. Submit copies of the daily field/operating report to the Engineer on a monthly basis by the 15th of each month.

In addition, provide fencing and erosion and pollution controls according to local, State, and Federal regulations and the Contract Documents.

202.03.4.3 Methods.

The Contractor may implement any effective and lawful method for handling, hauling, unloading, and/or stockpiling unclassified and contaminated soil encountered in the work area, if the required excavation has the approval of the Engineer. Assume all responsibility for the adequacy of the methods, materials, documentation, and equipment employed.

Test all stockpiled soil before disposing at an industrial/commercial site.

202.03.4.4 Security Fencing.

Provide fencing with ingress/egress gates around all areas of construction, including all excavations, staging areas, and stockpiles to limit access by unauthorized persons and to protect the public. Include the use of existing or proposed chain link fencing or temporary barrier fencing. Use temporary barrier fencing where sufficient chain link fencing has not yet been placed or will not be placed to enclose an area to limit access. Install temporary barrier fence according to the manufacturer's recommendations.

Maintain fencing until the appropriate pavement or a 2-ft soil cover has been placed or a permanent fencing has been installed.

202.03.4.5 Dust and Erosion.

During excavation of unclassified and contaminated soil, use acceptable methods to control dust and sedimentation erosion. Install fencing and staked hay bales around excavations to minimize the effects of erosion and surface run-off as directed by the Engineer.

202.03.4.6 Unclassified Excavated Soil.

Ensure that all unclassified excavated soil within utility easements for installation of storm drain lines and associated structures is visually screened for environmental issues at point of excavation origin before placement in trucks and hauling to a temporary stockpile for ultimate reuse as backfill at point of excavation origin.

While engaged in unclassified, contaminated, or hazardous materials removal, the Engineer will provide an on-Project inspection. If the work violates the requirements of the Contract, the Engineer will issue a stop work order effective immediately and until the violation is resolved. Standby time and expenses required to resolve the violation will be at no additional cost to the Department.

202.03.4.7 Stockpiles.

Maintain and protect designated stockpiles from exiting damage with chain link fencing. At all temporary stockpile locations, maintain and protect from exiting damage with proposed chain link fencing (as applicable), or provide temporary barrier fencing before initiating the development of soil stockpiles. Before initiating the development of all soil stockpiles, furnish and install erosion control hay bales along the interior perimeter of the fencing.

Use all required equipment to adequately place and maintain the stockpiles in a neat and orderly fashion within approved stockpile areas, volume, and buffer limitations. Place all stockpiled

unclassified and contaminated soil entirely on two layers of 12-mil polyethylene, and ensure that the soil is entirely covered with a 12-mil layer of polyethylene at the completion of each day. Overlap the polyethylene sheets with adjacent sheets by 4 ft minimum. If additional stockpile locations are required, the materials and setup required will be at no additional cost to the Department.

Ensure that each stockpile location has been placed on and covered by the required polyethylene and that the fencing and erosion control hay bales are in place. Maintain site security/access, fencing, erosion control hay bales, and dust control as required by the Contract and Soil Management Plan at the stockpile locations and at all areas traveled for the stockpiling operation leading to and from the stockpile areas.

Maintain the unclassified soil stockpile until the soil has been reused to backfill the excavation at the point of origin. Test, classify, and approve the excess unclassified stockpile soil for proper disposal off-site. See **Subsection 202.02.3** for testing criteria.

Maintain the contaminated soil stockpile until the soil has been tested and approved for proper disposal off-site. See **Subsection 202.02.3** for testing criteria.

Maintain an inventory of supplies and equipment required to execute the required work that includes the supplies to be used to implement a contingency plan for unexpected conditions.

After removal of stockpiled soils and upon completion of the use of the stockpile area(s), remove and dispose of the polyethylene sheeting, hay bales, and temporary barrier fencing, and restore the stockpile area(s) to a condition acceptable to the Engineer.

202.03.5 Load, Haul, and Dispose of Contaminated Soils.

If unclassified, contaminated, or hazardous soil will be stockpiled, place the soil on and cover with polyethylene sheeting, as described in the RAWP and SMP.

Minimize odors during excavation, handling, loading, hauling, and/or disposal.

For unclassified and contaminated soil excavation and handling, the Contractor may choose and implement any effective and lawful method for handling, loading, hauling, and/or disposal of unclassified, contaminated, or hazardous soil encountered in the work area, provided that the Contractor performs the required excavation subject to the approval of the Engineer.

Control access, dust, and sedimentation erosion during excavation of unclassified, contaminated, or hazardous soil. Install fencing and staked hay bales around excavations to protect the public, limit site access, and minimize the effects of erosion and surface run-off.

While engaged in unclassified, contamination, or hazardous materials removal, the Engineer may conduct an on-site inspection. If the work violates the requirements of the Contract, RIDOT will issue a stop work order effective immediately and until the violation is resolved. Standby time and expenses required to resolve the violation will be at no additional cost to the Department.

For all excavated Type 1 or Type 2 soils proposed for reuse as common borrow, perform geotechnical, arsenic, and lead testing at the point of excavation origin before placing in trucks.

Place soils that meet common borrow requirements into trucks, and haul to the project specific designated temporary stockpile location for reuse within the limits of the Project.

For all excavated Type 1 and Type 2 soils that do not meet common borrow requirements, place the soils into trucks and haul to the project specific designated area for further characterization (before off Project disposal). Cover the soils with a 12-mil layer of polyethylene at the completion of each workday.

For excavated Type 1 or Type 2 soils proposed for reuse as common borrow, perform geotechnical, arsenic, and lead testing at the point of excavation origin before placing in trucks. For soils meeting common borrow requirements, place the soils into trucks, and haul to an approved temporary stockpile location for reuse within the Project limits.

For excavated Type 1 and Type 2 soils not meeting common borrow requirements, place the soils into trucks and, as applicable, haul to the project specific designated stockpile area for further characterization (before off Project disposal). Cover with a 12-mil layer of polyethylene at the completion of each work day.

For excavated Type 1 or Type 2 soils not proposed for reuse and Type 3, Type 4, or Type 5 soils, immediately place the soils into trucks, and haul directly to an off-Project recycling/disposal site, or haul to the project specific designated stockpile area for further characterization (before off Project disposal). Cover the soils with a 12-mil layer of polyethylene at the completion of each workday.

Surround all temporary stockpile locations with fencing and erosion control. If necessary, select additional, temporary stockpile areas subject to the approval of the Engineer. Inspect the covers, fencing, and erosion control on a daily basis. If necessary, restore as needed to control dust and erosion.

Reuse contaminated soil within the Project limits, or dispose the soil at an off-Project facility according to RIDEM regulations for recycling/disposal of the materials. Perform the on-project confirmatory testing and characterization testing of Types 2, 3, 4, or 5 soils for disposal. Do not dispose the material at any facility that currently maintains a listing as a State or Federal waste site.

Perform imported soil testing. Conform to the applicable RIDEM requirements for handling, storage, transporting, and disposal of contaminated/hazardous waste material when handling and disposing of the materials.

Submit the material testing data and any additional data to the receiving facility, to the Engineer, and to RIDEM before the removal and final disposal of contaminated material from the Project limits or an interim stockpile area. Where specifications, requirements, and reference documents vary, the more stringent requirements shall apply.

202.03.6 Load, Haul, and Disposal of Other Waste.

202.03.6.1 Separation of Contaminated Materials.

Segregate the hazardous materials from non-hazardous materials to prevent contaminating larger quantities of material.

202.03.6.2 Regulatory Requirements.

Perform all work to comply with RIDEM or other State, Federal, or local agency regulations pertaining to the proper testing, removal, containment, transporting, and disposal of known or suspected other waste, debris, or surplus materials resulting from the Project. The following documents are commonly required in the Contract for RIDOT Projects:

- Rhode Island Rules and Regulations for the Investigation and Remediation of Hazardous Materials (the Remediation Regulations) (250-RICR-140-30-1)
- Rhode Island Rules and Regulations for Hazardous Waste Management
- Rhode Island Solid Waste Regulations
- Rhode Island Oil Pollution Control Regulations
- "Hazardous Waste Operations and Emergency Response," Federal Occupational Safety and Health Act (OSHA), 29 CFR 1910.120
- "General Regulations for Hazardous Waste Management," USEPA, 40 CFR 260
- "Regulations for Identifying Hazardous Waste, Hazardous Waste Generators and Hazardous Waste Transporters," EPA, 40 CFR 261, 262 and 263
- US Department of Transportation (USDOT) Title 49 Code of Federal Regulations (CFR)
- Safety and Health Regulations Promulgated by the US Department of Labor, OSHA, 29 CFR 1910 – Occupational Safety and Health Standards and 29 CFR 1926 – Safety and Health Regulations for Construction
- USEPA Standard Operating Safety Guidelines – Office of Emergency and Remedial Response, Emergency Response Division
- USEPA Medical Monitoring Program Guidelines

202.03.6.3 Health and Safety.

Health and safety measures must comply with **SECTION 826**.

202.03.6.4 Conformance.

While engaged in contaminated waste material transportation and disposal, the Engineer will provide on-site inspection. If the work violates any requirements of this or any other specification or violates any State, local, or Federal regulation, the Engineer may issue a stop work order effective immediately and until the violation is resolved. Standby time and expenses required to resolve the violation will be at no additional cost to the Department.

The disposal of waste or other material that becomes contaminated as a result of careless handling or use of unauthorized procedures by the Contractor or its employees/subcontractors will be at no additional cost to the Department.

202.03.6.5 Contaminated Waste Transportation and Disposal.

Obtain all necessary permits, manifests, shipping papers, bills of lading, and acceptance approvals in conjunction with contaminated hazardous material/waste and/or solid waste removal,

hauling, transportation, and disposal. Provide timely notification of the actions as required by applicable Federal, State, and/or local authorities.

Transport all contaminated waste to an off-site recycling or disposal facility according to applicable local, State, and Federal regulations governing the transportation, recycling, and disposal of the waste.

202.04 METHOD OF MEASUREMENT.

202.04.1 Excavation – General.

The quantities of all types of excavation will be measured in the cubic yards as surveyed or calculated.

Two sets of cross sections will be taken over the area to be excavated — one for the area in its original position and one after completion of the excavation. Intermediate sets of cross sections may be taken for progress payments. The cross sections will be taken at intervals by field survey techniques.

If the final set of cross sections demonstrate unauthorized excavation below the specified subgrade, the excess excavation will not be measured for payment. Replace and compact the excess excavation by suitable excavation or borrow material, at no additional cost to the Department.

The final set of cross sections may include an amount for overbreakage or slides that, in the judgment of the Engineer, were not caused by the Contractor's carelessness.

The cross sections will be plotted and the volume determined by either the average end-area method or other equivalent method.

a. Earth Excavation. Earth excavation will be measured by the cubic yard as calculated by determining the difference between the area excavated and its original position before the earth excavation to its position when:

   - A change in classification of excavation has occurred, or
   - The specified subgrade elevation has been reached, or
   - The approved limits of excavation of unsuitable soils below specified subgrade elevation or behind the specified side slopes are reached, or
   - The approved limits of excavation of unsuitable soils under shallow embankment have been reached.

b. Presplit Bedrock. Presplitting of bedrock will be measured by the number of square yards of presplit rock face along the alignment at the required inclination. Rock Excavation in presplit areas will be measured to the presplit face or specified limits, whichever is less. Overbreakage from blasting will not be measured for payment. Remove as directed at no additional cost to the Department.

c. Rock Excavation and Rock Excavation – Mechanical. When rock surface occurs above the specified grade of bottom of excavation, notify the Engineer so that determinations of the initial surface elevation and area of rock exposure can be made for the preparation of cross sections for measurement. Cross sections for rock excavation measurement will be prepared at a maximum spacing of one-half stations (50 ft). At the completion of rock excavation and clearing of loose fragments, a second set of elevations will be determined for the excavated and cleared rock surface.

The volume of Rock Excavation and Rock Excavation – Mechanical measured for payment will be calculated from the difference between the cross-sectional surface elevations, using the average end-area method or other equivalent method.

Volume calculated for payment will include overbreakage of up to 12 in. below the specified bottom of excavation in rock as described in **Subsection 202.03.1(a)**. If the cross sections indicate bottom overbreakage and excavation exceeding the 12-in. allowance, the Contractor will not be paid for rock excavation exceeding the overbreakage allowance. Provide, place, and compact fill and/or borrow required to replace the excess overbreakage at no additional cost to the Department.

Except for presplit areas, measurement for payment for Rock Excavation or Rock Excavation – Mechanical will include an allowance for overbreakage along rock side slopes to an amount not to exceed, in any half-station of 50 ft, 10 percent of the actual quantity of rock excavation measured and calculated for that half-station. Rock side slope overbreakage in excess of the allowance will not be included for payment. Remove the excess at no additional cost to the Department.

This **Subsection 202.04.1(c)** also applies to Channel Rock Excavation and Channel Rock Excavation – Mechanical.

202.04.2 Embankments.

When embankments are constructed with material obtained from sources other than excavation, embankment will be measured by the number of cubic yards of material placed and compacted within the limits of the specified embankment section. The in-place volume will be calculated by the difference between cross sections taken along the original ground and those taken along the top of the completed embankment. The two sets of cross sections will be plotted and the volume determined by either the average end-area method or other approved method.

All boulders and detached stones that have a volume in excess of 1 cu yd and that the Contractor desires to incorporate into embankment construction must first be broken up into fragments with volumes of 1 cu yd or less. There will be no additional payment for breaking up such boulders and stones.

When the Contract does not specifically provide for payment for embankment, or when embankments are constructed with material obtained solely from excavation, embankment construction will not be measured or paid for separately and will be considered incidental to the various classifications of excavation.

However, when embankment is constructed from excavation material and there is required borrow material to complete the embankment, this borrow material will be measured for payment.

Appurtenances, structures, pipes, and drainage structures less than 50 cu yd in volume will not be deducted from embankment volumes for measurement of embankment or measurement of borrow for embankment.

If the Contractor places more borrow than is required and thereby causes a waste of excavation, the waste will be deducted from the borrow volume as measured.

202.04.3 Borrow.

Common Borrow, Gravel Borrow, or other borrow approved for use to replace unsuitable materials removed by excavation or to construct embankment will be measured by the cubic yard as in-place and compacted. This volume will be determined by the difference in areas using cross sections as described in **Subsection 202.04.1.**

202.04.4 Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils.

This item will be measured for payment by the ton. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.5 Load, Haul, and Dispose Soil, Type 1.

This item will be measured for payment by the tons of soil loaded, hauled, and disposed. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.6 Load and Haul Contaminated Soil, Type 2.

This item will be measured for payment by the tons of soil loaded and hauled. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.7 Disposal of Contaminated Soil, Type 2.

This item will be measured for payment by the tons of soil disposed. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.8 Load and Haul Contaminated Soil, Type 3.

This item will be measured for payment by the tons of soil loaded and hauled. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.9 Disposal of Contaminated Soil, Type 3.

This item will be measured for payment by the tons of soil disposed. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.10 Load and Haul Contaminated Soil, Type 4.

This item will be measured for payment by the tons of soil loaded and hauled. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.11 Disposal of Contaminated Soil, Type 4.

This item will be measured for payment by the tons of soil disposed. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.04.12 Load, Haul, and Dispose Of Contaminated Soil, Type 5.

This item will be measured for payment by the actual cost, verified by the Force Account records, for the facility profiling, loading, transporting, and disposing, and by Invoices from the disposal facility per soil type.

202.04.13 Load, Haul, and Disposal of Other Waste.

Load, Haul, and Disposal of Other Waste will be measured for payment by the tons of the removed, handled, and disposed waste. The number of tons will be determined from weight slips generated by a certified scale at the receiving facility or at a location approved by the Engineer.

202.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Earth Excavation	CY
Rock Excavation	CY
Rock Excavation – Mechanical	CY
Muck Excavation	CY
Channel Excavation – Earth	CY
Channel Excavation – Rock	CY
Channel Excavation – Rock Mechanical	CY
Loam Excavation	CY
Unclassified Excavation	CY
Presplitting Bedrock	SY
Common Borrow	CY
Gravel Borrow	CY
Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils	TON
Load, Haul, and Dispose Soil, Type 1	TON
Load and Haul Contaminated Soil, Type 2	TON
Disposal of Contaminated Soil, Type 2	TON
Load and Haul Contaminated Soil, Type 3	TON
Disposal of Contaminated Soil, Type 3	TON
Load and Haul Contaminated Soil, Type 4	TON
Disposal of Contaminated Soil, Type 4	TON
Load, Haul, and Disposal of Contaminated Soil, Type 5	Force Account
Load, Haul, and Disposal of Other Waste	TON

Payment at the Contract unit prices is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work according to the Contract, complete and accepted.

202.05.1 Excavation.

Grading, compaction, and disposal of surplus material is incidental to this work and no separate payment will be made.

Rock removal in excess of 12 in. below subgrade will not be paid for but will be measured to determine excess backfill volume. The volume will be deducted from that backfill measured for

payment. Perform all backfilling in excess of the 12-in. depth at no additional cost to the Department.

No payment will be made for additional excavation quantities caused by the offsetting of presplitting holes beyond the specified face in the top or successive stages.

Compensation for hauling earthwork materials within the Project limits will not be paid for separately but will be included in the Contract unit prices for the items.

202.05.2 Borrow.

Common Borrow and/or Gravel Borrow will be paid for at their Contract unit prices per cubic yard, if in the Contract for embankment construction or if approved for replacement of unsuitable soils in excavation or under shallow embankment.

202.05.3 Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils.

The accepted quantities of Handling, Hauling, and Stockpile Management of Contaminated Soils and Unclassified Soils will be paid for at the Contract unit price per ton.

202.05.4 Load, Haul, and Dispose Soil, Type 1.

This item will be paid for at the Contract unit price per ton.

202.05.5 Load and Haul Contaminated Soil, Type 2.

This item will be measured for payment by the tons of soil loaded and hauled.

202.05.6 Disposal of Contaminated Soil, Type 2.

This item will be paid for at the Contract unit price per ton. If the actual cost paid to the disposal facility for disposing this material is different than the only acceptable bid price, the price paid per ton for this item will be adjusted (higher or lower) by that difference in Dollars/Ton.

202.05.7 Load and Haul Contaminated Soil, Type 3.

This item will be paid for at the Contract unit price per ton.

202.05.8 Disposal of Contaminated Soil, Type 3.

This item will be paid for at the Contract unit price per ton. If the actual cost paid to the disposal facility for disposing this material is different than the only acceptable bid price, the price paid per ton for this item will be adjusted (higher or lower) by that difference in Dollars/Ton.

202.05.9 Load and Haul Contaminated Soil, Type 4.

This item will be paid for at the Contract unit price per ton.

202.05.10 Disposal of Contaminated Soil, Type 4.

This item will be paid for at the Contract unit price per ton. If the actual cost paid to the disposal facility for disposing this material is different than the only acceptable bid price, the price paid per ton for this item will be adjusted (higher or lower) by that difference in Dollars/Ton.

202.05.11 Load, Haul, and Dispose of Contaminated Soil, Type 5.

This item will be measured for payment by the actual cost, verified by the force account records for the facility profiling, loading, transporting, and disposing, and the Invoices from the disposal facility per soil type referenced herein.

202.05.12 Load, Haul, and Dispose of Other Waste.

This item will be paid for at the Contract unit price per ton. If the actual cost paid to the disposal facility for disposing this material is different than the only acceptable bid price, the price paid per ton for this item will be adjusted (higher or lower) by that difference in Dollars/Ton.

SECTION 203 — STRUCTURE EXCAVATION AND BACKFILL

203.01 DESCRIPTION.

This work includes the removal and disposal of all material necessary for the construction of all structures and incidental foundations not included elsewhere in the Specifications. The work includes preserving channels, shoring and bracing, constructing cofferdams, sealing foundations, dewatering, excavating, preparing foundations, backfilling, and subsequent removal of safety features and cofferdams. This work also includes all necessary on-site or borrow backfill.

The material to be excavated is material not otherwise classified in either **SECTION 202** or **SECTION 205**.

Structure Excavation and Backfill is subdivided into the following six classifications.

203.01.1 Structure Excavation – Earth.

Structure Excavation – Earth includes all excavation not classified as rock, rock-mechanical, masonry, or unclassified excavation.

203.01.2 Structure Excavation – Rock.

Structure Excavation – Rock includes the removal of bedrock or boulders and detached bedrock fragments over 1 cu yd in volume when encountered within the limits of Structure Excavation. Boulder and rock fragments less than 1 cu yd volume are considered Structure Excavation – Earth.

203.01.3 Structure Excavation – Rock-Mechanical.

Structure Excavation – Rock-Mechanical is used where blasting is prohibited.

203.01.4 Structure Excavation – Masonry.

Structure Excavation – Masonry includes the removal of all concrete or stone masonry built either with or without mortar (includes incidental structures in excess of 1 cu yd) where encountered within the limits of Structure Excavation, if the masonry has not been included under **SECTION 201**.

203.01.5 Unclassified Structure Excavation.

Unclassified Structure Excavation includes the removal and disposal of the composite mixture of various types of materials that the Engineer determines is impractical to classify into separate classifications for payment.

203.01.6 Crushed Stone Fill Under Structures.

This work includes providing one or more courses of crushed stone fill and filter fabric under structure footings on prepared subgrade surfaces in reasonably close conformity with the required lines, grades, thicknesses, and typical cross sections.

203.02 MATERIALS.

Provide backfill materials that conform to **SECTION M01**.

Use a crushed stone that conforms to the gradation requirements of **Subsection M01.09**, **Table I**, **Column II**. Filter fabric is included on the Department's Approved Materials List.

203.03 CONSTRUCTION METHODS.

203.03.1 Excavation.

a. Notification. Notify the Engineer sufficiently in advance of the beginning of excavation, and immediately if there may be a change in classification of structure excavation, so that cross-sectional elevations and measurements can be taken of the undisturbed ground.

b. Dimensions of Excavation. Ensure that the excavation for footings has sufficient size to accommodate both the placement of the structure and the placement and compaction of backfill. Extend the excavation at least 2 ft horizontally beyond the vertical face of footings and a minimum of 12 in. below the base of footings.

c. Change in Elevation or Dimension of Excavation. The Engineer may direct the Contractor to make necessary changes in the elevation or dimensions of the excavation to secure a satisfactory foundation.

d. Approval of Foundation. Do not initiate formwork or permanent work until the Engineer has approved the depth and dimensions of the excavation, the character of the material, and the condition of the foundation. Drive sounding rods at the points and depths as directed by the Engineer.

   Provide assistance to the Engineer as necessary to conduct an adequate inspection of the foundation material.

   Ensure that all unsheathed excavation has sufficient side slopes to prevent earth from encroaching onto the work.

e. Utilization of Excavated Materials. Use suitable excavated material as backfill or in embankments. Dispose of surplus excavation or unsuitable materials in non-critical areas within the Project limits.

f. Blasting. Complete all blasting associated with rock excavation before placing any structure concrete.

g. Alternatives & Unsatisfactory Bearing Surfaces. If the natural foundation material is inadequate to safely support the structure, proceed with alternative methods as directed by the Engineer.

h. Water. When water is encountered, make provisions for draining or dewatering within the excavation. Ensure that the dewatering work prevents disturbing the bottoms of excavations or adjacent structures. When foundation material is relatively impermeable and water accumulations soften the cementing material or puddle the surface, make provisions to drain the excavation by suitable channels outside of and slightly below the footing level. Ensure that these channels convey the water to outfalls or sump pumps. Remove foundation material unduly disturbed or softened by the use of equipment or by inadequate handling of water, and replace with satisfactory material at no additional cost to the Department.

i. Preparation of Bearing Surface. Extract all rock or other hard foundation material from all loose material, cleaned and cut to a firm surface, either level, stepped, or serrated. Clean out all seams and fill with concrete mortar or grout. Shape all ledge rock to avoid any unnecessary excavation of sound rock.

203.03.2 Cofferdams.

Use cofferdams when the bottoms of excavation are below the prevailing water surface. Cofferdams include timber, steel sheet piling, cylindrical metal shells, or other structural components. Earthen embankments and dikes are not classified as cofferdams.

a. Shop Drawings. For substructure work, submit Shop Drawings showing the proposed method of cofferdam construction and other discretionary details not fully shown on the Plans. The Engineer will approve the Drawings in writing before construction begins. The approval does not relieve the Contractor of the responsibility to secure a safe and satisfactory cofferdam. Prepare the Shop Drawings according to **Subsection 105.02**.

b. Construction. Brace cofferdams for foundation construction to be as watertight as practical. Ensure that the interior dimensions of cofferdams provide sufficient clearance for the construction of forms and the inspection of their exteriors and permit dewatering outside of the forms. Where piles are required, ensure that the cofferdam is of sufficient size to permit the driving of the piles in the exact positions shown on the Plans without interference from the wales or bracing or requiring excessive rebracing. Ensure that cofferdams that are tilted or moved laterally during the process of installation are righted, reset, or enlarged to provide the necessary clearance. Perform these corrective measures at no additional cost to the Department.

   Construct and dewater cofferdams to protect green concrete against damage from water and to prevent damage to the foundation by erosion.

   Do not leave any construction materials in cofferdams that extend into the substructure masonry.

c. Tremie Seal. Dewater cofferdams and place the foundations in the dry. The Engineer will approve the well point systems and methods at suitable locations, if required. However, where conditions are anticipated that would render it impractical to dewater the cofferdam before placing masonry, use a tremie seal according to **Subsection 808.03.5(f)**.

During the placing of a tremie seal and until the seal has set, control the elevation of the water inside the cofferdam to prevent any flow through the seal.

Do not initiate pumping to dewater a sealed cofferdam of the gravity type until the concrete seal has been in place for at least three days for spread footing foundations and at least seven days for pile-supported foundations.

After dewatering, place the balance of the foundations in the dry, with the necessary modifications for structural purposes.

d. Removal of Cofferdams. Remove cofferdams including all sheeting and bracing as directed by the Engineer. During the removal operation, avoid disturbing or otherwise damaging the work.

If the cofferdam will remain in place, ensure that the cofferdam is vented or ported below low water level when dewatering is no longer necessary.

203.03.3 Dewatering.

Dewater the interior of all foundation enclosures to preclude the possibility of movement of water through any fresh concrete. Do not pump during the placement of concrete or for a period of at least 24 hours thereafter, unless a suitable sump is used separated from the concrete work by a mortar-tight form, bulkhead, or other effective means. Adhere to the requirements of **SECTION 208**.

203.03.4 Embankments Under Structure Foundations.

Construct embankments under stub abutments, walls, culverts, footings, and other foundations where stability requirements are essential with gravel borrow conforming to **Subsection M01.09**, **Table I**, **Column I**. Ensure that the material does not contain particles greater than a 6-in. maximum dimension.

Construct embankments such that side slopes are sufficiently stable and such that the widths of embankments extend horizontally 2 ft beyond the vertical faces of footings. Place the gravel borrow in layers not exceeding 12 in. in depth before compaction, and compact to 95 percent of maximum density as determined by AASHTO T180.

Compact embankments under pile supported foundations to 90 percent of maximum density as determined by AASHTO T180.

203.03.5 Backfilling.

a. Protection of Structures During Backfilling. Do not place fill material against any structure until permission to place fill has been granted by the Engineer and not until the masonry has obtained the 28-day compressive strength.

Exercise proper precautions to ensure that the method of backfilling does not cause movement of or undue strain on any part of the structure. Deposit and compact fill material behind abutments, walls, and miscellaneous structures as specified. When placing fill

around slender foundations, rigid frame legs, piers, or over and around arches and box culverts, deposit the material on both sides of the structures to approximately the same elevation at the same time.

Place backfill materials to avoid damage to masonry and waterproofing treatments. If backfilling or other operations damage masonry or waterproofing, remove the backfill and replace or repair the damaged work or waterproofing. Perform all repairs, replacement of materials, and labor at no additional cost to the Department.

b. Pervious Fill Adjacent to Structures. Use pervious fill for the material placed adjacent to, or in contact with, arches, culverts, retaining walls, wingwalls, secondary structures, and other areas.

Place pervious fill in layers not over 12 in. in depth before compaction. Compact to 95 percent of maximum density as determined by AASHTO T180. Where not accessible for normal placing and rolling and for minor operations, place pervious fill in lifts not to exceed 8 in., and compact by means of mechanical tampers or suitable vibratory equipment. For minor operations, hand tamping with heavy iron tampers may be used.

c. Common Backfill. Backfill all spaces excavated and not occupied by permanent works, pervious fill, or gravel borrow with suitable material. Compact the material in 1-ft lifts up to the surface of the surrounding ground.

Ensure that the material is free of vegetative matter and organic or compressible soils and that it meets the requirements for Common Borrow, except that the material can not contain particles larger than 6 in. The Engineer may approve excavated soil for re-use as suitable material.

Smoothly grade the surface. Compact backfill to 95 percent of maximum density as determined by AASHTO T180. No separate payment will be made for this work.

203.03.6 Crushed Stone Fill Under Structures.

Place the crushed stone and compact on a prepared surface to the required thickness. Place a filter fabric, that conforms to **Subsection M20.01**, between the crushed stone and surrounding soils. Ensure that the surface of the crushed stone is placed so that a reasonably uniform texture is provided. The surface will have a tolerance of ±½ in. to the required grade.

203.04 METHOD OF MEASUREMENT.

203.04.1 Structure Excavation.

a. General. Structure excavation will be measured by the cubic yards of material removed. The volume will be computed by taking the difference in elevation between the existing ground surface or the bottom of roadway excavation or channel excavation, whichever is lower, and the surface of the completed structure excavation at plan grade or approved revised plan grade, all between the designated horizontal pay lines described below.

Structure excavation in roadway cuts, or embankment areas where the removal of muck is indicated, will include only that portion below the bottom of the muck.

Structure excavation in roadway cuts will include only that portion below the subgrade, shoulder foundations, and cut slope lines.

When bedrock, boulders, or masonry are encountered, notify the Engineer and expose the items so that the necessary measurements can be taken for structure excavation. If this notice is not provided or if any material is removed before measurements are taken, the Engineer will presume that measurements taken when the Engineer first observes the material in question will provide the true quantity of excavation.

b. Pay Lines. Horizontal payment limits will be measured between plumb lines and 2 ft outside of the neat lines of the original foundations only as shown on the Plans. However, should the size of the footing be increased by more than 2 ft in any direction, the area of the footing that extends beyond the original payment lines will be used for determining the additional amount of excavation. No allowance for rock overbreak will be made beyond the above limits or more than 6 in. below the bottom of footing.

203.04.2 Pervious Fill, Gravel Borrow, and Common Borrow.

Pervious Fill, Gravel Borrow, and Common Borrow will be measured by the cubic yards placed.

203.04.3 Crushed Stone Fill Under Structures.

Crushed stone fill under structures will be measured by the cubic yards placed.

203.04.4 Cofferdams.

Cofferdams do not require a measurement for payment.

203.04.5 Tremie Seals.

When underwater concrete is specified, the horizontal and vertical pay limits will be those specified for the tremie seal. When underwater concrete is not specified but is required, the horizontal pay limits will be extended to the actual inside face of the cofferdam, and the vertical pay limits will be established by the Engineer.

203.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Structure Excavation – Earth	CY
Structure Excavation – Rock	CY
Structure Excavation – Rock-Mechanical	CY
Structure Excavation – Masonry	CY
Unclassified Structure Excavation	CY
Pervious Rock	CY
Gravel Borrow	CY
Common Borrow	CY
Crushed Stone Fill Under Structures	CY
Cofferdams	LS
Tremie Seals	CY

The prices constitute full compensation for all labor, materials, and equipment, including dewatering, removal within the prescribed limits, backfilling and disposal of surplus material, stockpiling, hauling, placing, compaction, preparation of the subgrade, filter fabric, and all incidentals required to finish the work, complete and accepted.

SECTION 204 — TRIMMING AND FINE GRADING

204.01 DESCRIPTION.

This work includes the trimming and fine grading of all shoulders, ditches, side slopes, sidewalks, landscaped areas, new or existing subbase, and new or existing subgrade, whether in excavation or embankment. Perform the trimming and fine grading on the surface to receive a sidewalk and on the surface that will receive the gravel borrow or gravel borrow subbase. For the subgrade surface, the work also includes the compaction of the surface upon which the pavement structure is placed.

204.02 MATERIALS.

Not applicable.

204.03 CONSTRUCTION METHODS.

Clear the areas to be graded of unsatisfactory material. Compact as required within the areas of the proposed pavement structure.

Allow a maximum tolerance of ±1 in., if the deviation from grade does not continue for more than 100 ft in any direction.

Fill any depressions that may occur during compaction with suitable material. Regrade the surface and compact true to the required lines and grades.

Grade the subgrade for the pavement structure and sidewalk and compact to 95 percent of maximum density according to **Subsection 202.03.3**. Perform this operation before construction of the pavement structure.

204.04 METHOD OF MEASUREMENT.

Trimming and Fine Grading is not measured for payment. It will be included in the associated Item of work.

SECTION 205 — TRENCH EXCAVATION

205.01 DESCRIPTION.

This work includes the excavation, dewatering, and the backfill or disposal of all materials required for the construction of box culverts, pipe culverts, storm drains, drainage structures, utilities, utility structures, and ditches.

Trench excavation is subdivided into four classifications.

205.01.1 Trench Excavation – Earth.

Trench Excavation – Earth includes all trench excavation not otherwise classified.

205.01.2 Trench Excavation – Rock.

Trench Excavation – Rock includes the removal of bedrock and boulders or detached rock fragments that have a volume of ½ cu yd or more. Boulders and detached fragments that have a volume of less than ½ cu yd are considered Trench Excavation – Earth.

205.01.3 Trench Rock Excavation – Mechanical.

Trench Rock Excavation – Mechanical will be used where blasting is prohibited.

205.01.4 Ditches.

This classification includes Ditches at inlets and outlets of culverts, except those within normal cut and fill slopes.

205.02 MATERIALS.

Not applicable.

205.03 CONSTRUCTION METHODS.

205.03.1 Excavation of Trenches.

Excavate all unsuitable material to a minimum depth of 12 in. below the specified invert elevation. For all pipe sizes up to 36 in. in diameter, extend the width of the trench 2 ft beyond each side of the inside diameter of the pipe. For pipe sizes greater than 36 in. in diameter, excavate trenches to 30 in. on each side of the inside diameter of the pipe.

Ensure that the material to replace this excavation includes suitable bedding placed and compacted under and around the pipe to the required horizontal and vertical dimensions. Bedding material may be from suitable trench or roadway excavation material. Backfill placed above the bedding may be from suitable trench or roadway excavation material, provided that it meets the minimum requirements for common borrow in **Subsection 202.02.1**. Use common borrow to replace unsuitable material when no excess suitable material is available from onsite.

Shape the surface of bedding material along the bottom of the trench to fit the pipe bells to a depth equal to the thickness of the pipe or bell.

205.03.2 Trench Protection.

If trench protection is required according to either OSHA regulations or for the protection of the roadway or utilities, provide adequate timber sheeting, steel sheeting, or steel box type sheeting.

Provide sheeting that is either timber of 3-in. minimum thickness, steel sheet piling, or a fabricated steel trench box. Except when fabricated steel trench boxes have been approved for use, submit Shop Drawings and computations showing the method and design of the sheeting proposed. Prepare the Shop Drawings according to **Subsection 105.02**.

Design the sheeting and supporting systems to meet acceptable engineering criteria, which must be certified by a Rhode Island Registered Professional Engineer. The Engineer's written approval of the sheeting design is required before the use of any sheeting on the Project and before commencement of any drainage or underground utility work.

Where sheeting will remain in place, cut off the sheeting a distance of 2 ft below subgrade, unless otherwise required to support adjacent utilities and structures with elevations above the cut off. Do not use fabricated steel trench boxes where either permanent steel or permanent timber sheeting is required.

Protect all structures (drainage or otherwise) and unsupported utilities encountered in the trench.

Remove all sheeting and bracing used in trench excavation following the completion of work.

205.03.3 Open Cuts in Lieu of Trenches.

Ensure that all replacement work matches the existing in kind. This provision is applicable only if the requirements for the maintenance and protection of traffic are met and when trench protection is not stipulated.

205.03.4 Dewatering.

Ensure that trench excavation is dry at all times and perform all construction work in the dry. Remove any water that accumulates in the trenches by pumping, draining, bailing, well points, deep wells, or another approved method. Place forms around all pump wells, sumps, dams, flumes, or other works required to keep the trenches clear of water while pipes and structures are being constructed.

Remove all water from the trench excavations, including water discharged from pumping systems and underdrains. Ensure that the discharge of the trench water is properly controlled to prevent discharge of any sediment downstream, including into the RIDOT drainage system.

205.03.5 Backfill and Compaction.

Backfill includes suitable bedding and soil materials placed and compacted in layers. Compact the layers to not less than 95 percent of maximum density according to AASHTO T180. Ensure that the layers are no more than 8 in. thick after compaction.

Compact according to **Subsection 202.03.3**. Ensure that the backfill reaches the surface level of the surrounding ground and is properly graded.

Do not place any backfill against newly constructed masonry or concrete structures.

205.04 METHOD OF MEASUREMENT.

205.04.1 Trench Excavation – Earth.

Trench Excavation – Earth will not be measured for payment.

205.04.2 Trench Excavation – Rock and Trench Rock Excavation – Mechanical.

Trench Excavation – Rock and Trench Rock Excavation – Mechanical will be measured by the cubic yard in its original position within the following horizontal and vertical pay limits:

a. Horizontal Pay Limits. For all pipe sizes up to and including 36 in. in diameter, measurement will be made between parallel vertical planes located at 2-ft offsets on each side of the inside diameter of the pipe.

   For all pipes greater than 36 in. in diameter, measurement will be made between parallel vertical planes located 30 in. on each side of the inside diameter of the pipe.

   The length of the trench will be measured from 1 ft beyond the outside face of a drainage structure to 1 ft beyond the outside face of the adjacent drainage structure.

b. Vertical Pay Limits in Cut Areas. Within the limits of roadway excavation, payment lines will extend vertically from 1 ft below the pipe to the subgrade.

   Outside the limits of roadway excavation, payment lines will extend vertically from 1 ft below the pipe to the existing ground surface.

c. Vertical Pay Limits in Fill. Within the limits of fill areas, payment lines will extend vertically from the invert elevation to a maximum cover of approximately 3 ft of fill over the pipe.

205.04.3 Sheeting for Trench Protection.

a. Steel Sheeting. When required, Temporary Steel Sheeting, Temporary Steel Sheeting Abandoned in Place, and/or Permanent Steel Sheeting will be measured by the number of square feet calculated according to the following dimensions. The height will be the distance from the ground surface or the top of sheeting, whichever is less, to 2 ft below the bottom of the excavation.

b. Timber Sheeting. Temporary Timber Sheeting and/or Permanent Timber Sheeting will be measured by the number of square feet calculated according to the following dimensions. The height will be the distance determined using the vertical pay limits described in Para. a of this Subsection. The length of timber sheeting will be the continuous length measured as described in Para. c of this Subsection.

c. Odd Shapes. The inside face of sheeting will be the plane of the horizontal pay limit for trench excavation as noted in **Subsection 205.04.2(a)**. Regardless of the type of sheeting used (timber or steel), measurement will be on the horizontal plane area, not on any odd shapes developed by the sheeting based on its cross-sectional configurations.

d. Open Cuts in-Lieu of Trenches. No measurement will be made for additional excavation, disposal of unsuitable material, borrow, compaction, or replacement of site features if the Contractor elects to excavate to the angle of repose in lieu of installing trench protection.

205.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Trench Excavation – Rock	CY
Trench Rock Excavation – Mechanical	CY
Temporary Steel Sheeting	SF
Temporary Steel Sheeting Abandoned in Place	SF
Permanent Steel Sheeting	SF
Temporary Timber Sheeting	SF
Permanent Timber Sheeting	SF

If the Contractor elects to excavate to the angle of repose as specified in OSHA 2226 (Excavation and Trenching Operations) and the lines of the angle of repose intersect the ground beyond the pay limits of trench excavation as described in **Subsection 205.04.2**, perform any required additional excavation, disposal of unsuitable material, backfill, borrow, compaction, replacement of pavement structure, curb, sidewalk, lawn area, etc., at no additional cost to the Department.

205.05.1 Trench Excavation – Rock and Trench Rock Excavation – Mechanical.

The accepted quantities of Trench Excavation – Rock or Trench Rock Excavation – Mechanical will be paid for at their Contract unit prices per cubic yard. Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, dewatering, and incidentals required to finish the work, complete and accepted.

205.05.2 Backfilling of Trenches.

The cost of placing and compacting backfill in trenches is not included in any of the classifications for Trench Excavation. These costs will be included in the Contract unit prices for the various classifications of pipe and drainage/utility structures. Excavated material that the Engineer determines is unsuitable or not appropriate for backfilling around or above utilities will be either removed to stockpile at the direction of the Engineer. Any additional borrow material required for trench backfill will be paid for at the Contract unit price. If no unit price is stated, the additional borrow material will be paid for under **Subsection 104.05**.

205.05.3 Sheeting for Trench Protection.

Temporary trench protection and fabricated steel trench box type sheeting required for drainage or utility installations will not be paid for separately. Include the cost in the Contract unit prices for the various classifications of pipe and drainage/utility structure. Do not use fabricated steel trench box type sheeting where either permanent timber sheeting or permanent steel sheeting is specified.

If stipulated, the accepted quantities for the following items will be paid for at the Contract unit prices per square foot:

- Temporary Steel Sheeting
- Temporary Steel Sheeting Abandoned in Place
- Permanent Steel Sheeting
- Temporary Timber Sheeting
- Permanent Timber Sheeting

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, including driving, bracing, cutting off and removal of excess quantities, removal of temporary steel sheeting and incidentals required to finish the work, complete and accepted.

205.05.4 Bedding and Backfill Borrow.

If stipulated or if required to replace unsuitable materials, Bedding and Backfill Borrow will be paid for at its Contract unit price per cubic yard. Otherwise, Bedding and Backfill Borrow will be paid for under **Subsection 104.05**. Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 206 — PERIMETER EROSION CONTROLS

206.01 DESCRIPTION.

This work includes providing erosion, sediment, and pollution prevention controls in reasonably close conformity with the required dimensions and details. Erosion, sediment, and pollution prevention controls include the following four types. Ensure that all erosion, sediment, and pollution prevention controls and devices are in place before the start of excavation when required by the SWPPP/SESC and other Contract Documents. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

206.01.1 Baled Straw Erosion Checks.

Baled straw erosion checks include baled straw, each bale of which is embedded and attached to the ground with wooden stakes.

206.01.2 Silt Fence.

Silt fencing includes oak fence posts to which are attached industrial support netting and sediment control filter fabric.

206.01.3 Baled Straw Erosion Check and Silt Fence Combined.

Baled straw erosion checks and silt fence combined includes baled straw erosion check installed abutting the filter fabric side of a silt fence, with a minimum of 6 in. along the bottom edge of the silt fence toed in under the baled straw erosion check.

206.01.4 Compost Filter Sock.

Compost filter socks include a flexible mesh tube filled with composted material and staked to the ground with wooden stakes.

206.01.5 Surface Erosion Controls.

This work includes providing surface erosion and sediment control devices on previously shaped and seeded areas at the required locations.

206.02 MATERIALS.

206.02.1 Baled Straw Erosion Checks.

Ensure that baled straw is baled within 12 months of use. Ensure that bindings are sufficiently strong to act as handles when placing bales in position by hand. Use a minimum dimension for bales of 18 in. Use wooden oak stakes, 1-in. × 1-in. in section and at least 3 ft in length.

206.02.2 Silt Fence.

Ensure that the filter fabric consists of a material suitable for erosion control applications and is included on the Department's Approved Materials List. Use wooden oak posts, 2-in. × 2-in. in section and at least 4.5 ft in length. Use support netting of heavy-duty plastic mesh. For prefabricated silt fences, 1-in. × 1-in. wooden posts will be permitted.

206.02.3 Baled Straw Erosion Check and Silt Fence Combined.

Ensure that baled straw conforms to **Subsection 206.02.1**. Ensure that silt fencing conforms to **Subsection 206.02.2**.

206.02.4 Compost Filter Sock.

Ensure that compost filter sock material contains composted organic matter according to AASHTO Designation R 51-13 and meets all applicable Federal and State regulations. For compost filter socks 18 in. or less in diameter, use wooden stakes 1 in. × 1 in., at 10-ft intervals on center, and of a length that projects into the soil 1 ft leaving 3 in. to 4 in. protruding above the filter sock. For compost filter socks greater than 18 in. in diameter, use wooden stakes 2 in. × 2 in., at 10-ft intervals on center, and of a length that projects into the soil 1 ft, leaving 3 in. to 4 in. protruding above the filter sock. Use filter sock netting materials made of biodegradable materials if to remain in place.

206.02.5 Surface Erosion Controls.

Ensure that the erosion control mats consist entirely of biodegradable materials. Do not use materials that are bleached, dyed, or otherwise treated with a material or in a manner that will result in toxicity to seeding, soil, or vegetation. Use erosion controls that are non-toxic to plants, soil, or unprotected human skin.

1. Hydraulic Mulch Stabilizer. Asphalt based stabilizer is prohibited. Provide hydraulic mulch stabilizer type, mix, and application rate according to the manufacturer's requirements and as directed by the Engineer.

2. Straw Mating. Use straw matting that consists of a machine-produced mat of clean, weed free, 100 percent grain straw. Ensure that the width is 40 in. to 90 in. and that the matting weighs between 0.50 and 0.75 lb/sq yd. Evenly distribute the straw throughout the mat with a thickness between ⅜ in. and ⅝ in. Cover the top of the blanket with a photodegradable plastic mesh with opening sizes between ⅜ in. and 1 in. Ensure that the mesh adheres to the straw by a knitting process using biodegradable thread.

3. Jute Matting (Mesh). Ensure that this natural biodegradable product consists of a uniform, plain weave of undyed and unbleached, smolder resistant, natural spun single jute yarn. Ensure that the material is at least 4 ft wide, weighs 1.2 lb/linear yd and has approximately 78 warp ends per width of cloth and 41 weft ends per yard.

4. Excelsior Matting. Use an excelsior matting that consists of machine-produced curled wood excelsior mat with at least 80 percent 6-in. or longer fiber with even distribution and consistent thickness. Ensure that the fiber diameter is between 0.015 in. and 0.15 in. For

standard weight product, cover the top of the blanket with a polypropylene mesh with ⅜-in.to 3-in. openings. Ensure that the dry blanket weight is at least 0.80 lb/sq yd. For heavy duty product, cover the top of the blanket with polypropylene mesh with ⅜-in. to 1½-in. openings. Ensure that the dry blanket weight is at least 1.4 lb/sq yd.

5. Staples. Use staples that are 11-gauge untreated or uncoated steel wire formed into a U or T shape with 6 in. or longer vertical legs. Ensure that the horizontal measurements of staples are longer than two mesh opening diameters. Longer staples may be required for looser soils.

206.03 CONSTRUCTION METHODS.

Install the required pollution controls before initiating any drainage, roadway, or bridge construction or disturbance of any soils.

206.03.1 Baled Straw Erosion Checks.

a. Installation. The following stipulations apply:

- Arrange bales in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.
- Entrench and backfill the erosion check. Excavate the trench so that the width of the bale and the length of the check is a minimum depth of 3 in. After the bales are staked and chinked, backfill the excavated soil against the check. Ensure that the backfill conforms to the ground level on the downhill side and is built up to 4 in. against the uphill side.
- Install the bales so that the bindings are oriented around the sides of the bales rather than along their tops and bottoms.
- Securely anchor each bale with at least two stakes driven through the bale. Drive the first stake in each bale toward the previously laid bale to force the bales together.
- Ensure that the gaps between bales are chinked (filled by wedging) with straw to prevent water from escaping between bales. Scatter loose straw over the area immediately uphill from the bale erosion check to increase efficiency.
- At approximately 100-ft intervals, place one bale against the bales positioned along the limit of clearing. Place this bale at a right angle to the line of the toe of slope.

b. Removal. Before removal, remove all accumulated sediment and debris on both sides. Do not remove erosion controls until the adjacent exposed areas are free from future uncontrolled discharges. Remove all baled straw erosion checks from the bales at a time designated by the Engineer. Remove the erosion check only after the adjacent exposed area has been stabilized; i.e., after the area has an established grass or stone cover or has been paved and is free from future uncontrolled discharges. Upon removal of the bales, backfill the remaining exposed areas (under the bales) with plantable soil, raked and graded as necessary to match the surrounding grade and then seeded.

206.03.2 Silt Fence.

a. Installation. The following stipulations apply:

- Dig a 6-in. deep by 1-ft wide minimum trench where the fence will be installed.
- Position the fence in the trench with the fence posts set at 8 ft on center (maximum) in wetland areas and 4 ft on center (maximum) in wetland ravine, gully, or drop-off areas.
- Staple the sedimentation control fabric and the industrial netting to each post. When joints are necessary, splice the filter fabric together only at support posts. Overlap splices 6-in. and securely seal the filter fabric.
- Drive each wood post, with industrial support netting and filter fabric attached, into the undisturbed soil in the trench.
- Backfill the trench and compact the soil over the filter fabric.
- Ensure that the installed height of the fence is 30 in. (minimum) not to exceed 36 in.

b. Removal. This work includes the removal of the silt fence erosion checks and posts. Do not leave silt fences in place. Before removal of the fence, remove all accumulated sediment and debris on the upstream side. Do not remove erosion, sediment, and pollution prevention controls until the adjacent exposed areas are free from future uncontrolled discharges. Only remove a silt fence when the adjacent exposed area is stabilized; i.e., the area has an established grass or stone cover or has been paved and is free from future uncontrolled discharges. Upon removal of the silt fence, finish the remaining exposed areas as specified in **Para. b** of **Subsection 206.03.1**.

206.03.3 Baled Straw Erosion Check and Silt Fence Combined.

a. Installation. Install Baled Straw Erosion Check and Silt Fence Combined according to **Para. a** of **Subsections 206.03.1** and **206.03.2**, with the following additional provisions:

- Install silt fencing before installing the baled straw.
- Ensure that the trench is a minimum of 6-in. deep and has a width sufficiently wide to accommodate the baled straw as it abuts the filter fabric side of the silt fence.
- Before backfilling the trench, install the baled straw tight against the filter fabric side of the silt fence, with a minimum of 6 in. of the bottom edge of the silt fence toed in under the baled straw within the trench.

b. Removal. Remove the combined baled straw erosion check and silt fence according to **Para. b** of **Subsections 206.03.1** and **206.03.2**. However, do not allow the baled straw erosion checks to rot in place. Before removal of the combined baled straw erosion check and silt fence, remove all accumulated sediment and debris on the upstream side. Do not remove erosion, sediment, and pollution prevention controls until the adjacent exposed areas are free from future uncontrolled discharges.

206.03.4 Compost Filter Sock.

a. Installation. The following stipulations apply:

- Use compost filter socks either fabricated on-site or delivered to the site.
- Trenching is not required. Place the compost filter socks over the top of ground, and drive the wooden stakes in pairs on each side of the filter socks to secure them to the ground. Cut down or remove heavy vegetation, and grade uneven surfaces to ensure that the compost filter sock uniformly contacts the ground surface.
- Place filter socks in a continuous line. Where ends intersect, use a sleeve to create an interlock with a 2-ft overlap. After one section is filled and the ends tied off, pull the next section over the tied-off end of the previous section to create a 2-ft overlap. Stake the overlap and ensure that the intersecting overlaps do not allow stormwater to break through at the intersection points.

b. Removal. This work includes the removal of the compost filter sock and stakes. Before removal, remove all accumulated sediment and debris. Do not remove the erosion, sediment, and pollution prevention controls until the adjacent exposed areas are free from future uncontrolled discharges. Cut open the mesh filter sock material, remove the mesh, rake the compost material out level to the surrounding grades, and then seed. After removal of the compost filter socks, finish the remaining exposed areas as specified in **Para. b** of **Subsection 206.03.1**. For biodegradable filter sock netting material, the materials may remain in place, but the Contractor shall cut open, rake out, level up with the ground, and seed.

206.03.5 Surface Erosion Controls.

Raise the areas to receive surface erosion controls to the required lines and grades with a smooth surface free of depressions and eroded areas that would prevent contact of the matting with the soil or allow water to collect or flow underneath. Install the material immediately after seeding and ensure that the material maintains continuous contact with the underlying soil surface.

Unroll matting in the same direction as the surface flow without stretching so that it will lie smoothly to fit the contour of the finished grade. Install the product with netting on the top side. Where one roll of matting ends and a second begins, overlap the end of the upper roll over the end of the second roll to provide a minimum 12-in. overlap. Ensure that side edges overlap a minimum of 4 in. To secure the matting and to prevent flow from getting underneath and eroding the soil, bury the up-slope end of each separate strip or piece of matting, and staple the ends in an anchor trench at least 6 in. deep and 6 in. wide, with the soil firmly tamped after being backfilled, per the manufacturer's requirements and/or as directed by the Engineer. Anchor the outer edges of the blanketed areas where significant runoff is anticipated in a 6-in. square trench. Where ditch or channel flow pass onto or over the blanketed areas, secure any overlaps or edges likely to be exposed to greater than normal flow and/or velocities and at locations determined by the Engineer using a staple check. Ensure that the staple checks include two rows of staggered staples positioned 4 in. apart on 4-in centers and placed perpendicular to the flow.

Before anchoring the first laid section, adjust the net or blanket laterally in the ditch or channel to raise both edges to approximately the same elevation. Insert staples vertically through the

matting at terminal ends, lapped ends, junctions, and trench checks not more than 9 in. apart. Place staples along the outer edges, overlapped, and in the center of each strip of matting not greater than 3 ft apart.

Mix hydraulic mulch stabilizer in an appropriately sized tank with a built-in, continuous agitation or recirculation system of sufficient operating capacity to produce a homogeneous slurry of product being applied. Apply the slurry in a sweeping motion at the specified rate and at the rate that will provide the designated amounts of mix in a continuous uniform and even coat. Apply the slurry from opposing directions to achieve the best, uniform soil coverage. Ensure that the nozzle is sized to produce a spray that does not concentrate nor wash down the material. Provide a mix and application rate according to the manufacturer's requirements. Provide the mix and rate of the product to the Engineer for approval before mixing and application.

Do not apply hydraulic mulch stabilizer in channels, swales, or other areas where concentrated flows are anticipated, unless installed in conjunction with rolled erosion control products.

Perform inspection, maintenance, and repairs of surface erosion controls according to the required environmental permit inspection plans, reports, and procedures, including the SWPPP and/or SESC plan, the specifications, and as directed by the Engineer. If the permits and reports are not part of the Project, inspect the surface erosion controls for failures at least once per week and within 24 hours of the end of each storm event with a rainfall amount of 0.25 in. or greater for the duration for which the controls are installed. Ensure that the inspection includes assessing the surface beneath the blanket to determine if soils and/or seed have washed away from beneath the blanket, and/or if the Engineer determines that the soil surface can be expected to continue to erode, and/or if the blanket has become dislodged from the soil surface or is torn. Make repairs immediately.

If washouts or breakouts occur, reinstall the blankets after regrading and reseeding, ensuring that the blanket installation still meets the design specification requirements. If repetitive failures occur at the same location, review the conditions and limitations for use and determine if other measures are needed to prevent or reduce failures. Protect all treated areas from foot and vehicular traffic and other disturbances. Repair any damage using the procedures as specified above, according to the manufacturer's requirements, and/or as directed by the Engineer

If the Engineer determines that these requirements have not been met or if controls are not adequately maintained, then enforcement will be applied according to **Subsection 212.03.3**.

206.04 METHOD OF MEASUREMENT.

The following will be measured by the linear feet installed (or removed):

- Baled Straw Erosion Checks
- Removal of Baled Straw Erosion Check
- Silt Fence
- Baled Straw Erosion Check and Silt Fence Combined
- Compost Filter Sock

Surface Erosion Control Matting will be measured by the number of square yards installed.

Surface Erosion Control Hydraulic Mulch Stabilizer will be measured by the number of acres installed.

206.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Baled Straw Erosion Checks	LF
Silt Fence	LF
Baled Straw Erosion Check and Silt Fence Combined	LF
Compost Filter Sock	LF
Surface Erosion Control Matting	SY
Surface Erosion Control Hydraulic Mulch Stabilizer	ACRE

206.05.1 Baled Straw Erosion Checks.

The price constitutes full compensation for all labor, materials, and equipment, including excavation, bales, stakes, removal of stakes, removal of straw, grading, raking, seeding necessary to match the surrounding area, and all incidentals required to finish the work, complete and accepted.

206.05.2 Silt Fence.

The price constitutes full compensation for all labor, materials, and equipment, including excavation, filter fabric, industrial netting, posts, removal of fence, grading, raking and seeding necessary to match the surrounding area, and all incidentals required to finish the work, complete and accepted.

206.05.3 Baled Straw Erosion Check and Silt Fence Combined.

The price constitutes full and complete compensation for all labor, materials, and equipment, including excavation, filter fabric, baled straw, stakes, industrial netting, posts, removal of baled straw, removal of fence, backfill material, grading, raking and seeding as necessary to match the surrounding area, and all incidentals required to finish the work, complete and accepted.

206.05.4 Compost Filter Sock.

The price constitutes full compensation for all labor, materials, and equipment, including mesh filter socks, removal of mesh filter socks, compost filter material, stakes, removal of stakes, grading, raking and seeding as necessary to match the surrounding area, and all incidentals required to finish the work complete and accepted.

206.05.5 Cleaning and Maintenance.

The cleaning and maintenance of Baled Straw Erosion Checks, Silt Fence Erosion Checks, Baled Straw Erosion Check and Silt Fence Combined, and Compost Filter Sock will be paid for according to **SECTION 212**. Maintenance includes the removal and proper disposal of all entrapped material.

206.05.6 Surface Erosion Controls Matting and Hydraulic Mulch Stabilizer.

The prices constitute full compensation for all labor, materials, equipment, tools, inspections, maintenance, and other incidentals necessary to finish the work, complete and accepted.

SECTION 207 — CHECK DAMS

207.01 DESCRIPTION.

This work includes providing the required check dams and dikes. Install all erosion, sediment, and pollution prevention controls and devices before initiating excavation when required by the SWPPP/SESC. Check dams include the following types. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

207.01.1 Sand Bag Erosion Dikes.

This work includes the placement of sandbags across either riprap or earth ditches, forming a dike to create temporary sediment basins for pollution control.

207.01.2 Stone Check Dams.

This work includes the placement of stone in ditches or drainage swales.

207.01.3 Compost Filter Sock Check Dams.

This work includes a flexible mesh tube filled with composted material and staked to the ground with wooden stakes.

207.02 MATERIALS.

207.02.1 Sand Bag Erosion Dikes.

Use material for dumped stone that complies with **Subsection M10.03.2** for Modified NSA Class R-4 riprap. Use filled sand bags that weigh a minimum of 60 lb.

207.02.2 Stone Check Dams.

Use filter stone that complies with **Subsection M01.09**, **Table I, Column V**.

207.02.3 Compost Filter Sock Check Dams.

Provide compost filter sock material according to AASHTO Designation R 51-13. In addition, ensure that the compost material meets all applicable Federal and State regulations. For compost filter socks 18 in. or less in diameter, provide wooden stakes that are 1 in. × 1 in. and with a length that projects into the soil 1 ft, leaving 3 in. to 4 in. protruding above the filter sock. For compost filter socks greater than 18 in. in diameter, provide wooden stakes that are 2-in. × 2-in. and with a length that projects into the soil 1 ft, leaving 3 in. to 4 in. protruding above the filter sock. Place stakes at the ends and at 5-ft intervals, center on center.

207.03 CONSTRUCTION METHODS.

Provide the required erosion and pollution controls before initiating any drainage, roadway, or bridge construction or for the disturbance of any soils.

207.03.1 Sand Bag Erosion Dikes.

a. Installation. Place the sand bags a minimum of four layers high. Over the center of the ditch, ensure that the top layer of sand bags has a weir opening equal to one half the bottom ditch width. Extend the sand bags a length so that the bottom of the end sand bags are higher in elevation than the top of the lowest middle sand bag.

   Where the sand bag dike is constructed across an earth ditch, protect the downstream side of the dike at the weir opening with Modified NSA Class R-4 dumped riprap.

b. Removal. Remove sand bag erosion dikes before Project completion when designated by the Engineer. Before removal, remove all accumulated sediment and debris on the upstream side. Do not remove check dams until the adjacent exposed areas are free from future uncontrolled discharges. Upon removal of the sand bag erosion dikes, backfill the remaining exposed areas, rake and grade to match the surrounding grade, and then seed.

207.03.2 Stone Check Dams.

a. Installation. Place the stone across the ditch or swale to achieve total coverage and shape to the required configuration. Slope the stone from the sides of the ditch/swale towards the center so that the center is 6 in. lower than the stone at the sides of the ditch/swale. Provide a check dam with 2H:1V side slopes that do not exceed 2 ft in height.

b. Removal. Remove stone check dams before Project completion when designated by the Engineer. Do not remove until the adjacent exposed areas are free from future uncontrolled discharges. Before removal, remove all accumulated sediment on the upstream side. Upon removal of the Stone Check Dams, backfill the remaining exposed areas, rake and grade to match the surrounding grade, and then seed.

207.03.3 Compost Filter Sock Check Dams.

a. Installation. The following stipulations apply:

   - Compost filter sock check dams may be either fabricated on site or delivered to the site.

   - Trenching is not required. Place compost filter sock check dams over the top of ground, and drive wooden stakes in pairs on each side of the filter socks to anchor the stakes to the ground. Cut down or remove heavy vegetation, and grade uneven surfaces to ensure that the compost filter sock uniformly contacts the ground surface. These may be placed over the top of rolled erosion control mats or turf reinforcement mats, and may be stacked if additional height is needed.

   - Install compost filter sock check dams perpendicular to flow. Extend the check dams to a length where the bottoms of each end are higher in elevation than the lowest middle part or to where the top of the banks (maximum flow line) are reached.

b. Removal. This work includes the removal of the compost filter sock and stakes. Before removal, remove all accumulated sediment and debris on the upstream side. Do not

remove compost filter sock check dams until the adjacent exposed areas are relatively free from future uncontrolled discharges. Unless biodegradable, cut open the mesh filter sock material and remove the mesh. In general, the compost filter material may remain in place. Rake the material level to the surrounding grades, and then seed.

207.04 METHOD OF MEASUREMENT.

207.04.1 Sand Bag Erosion Checks.

Sand Bag Erosion Checks will be measured by the number of sand bags installed.

207.04.2 Stone Check Dams.

Stone Check Dams will be measured by the cubic feet of stone placed.

207.04.3 Compost Filter Sock Check Dams.

Compost Filter Sock Check Dams will be measured by the linear feet of continuous runs of the compost filter sock installed.

207.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Sand Bag Erosion Checks	PBag
Stone Check Dams	CF
Compost Filter Sock Check Dams	LF

207.05.1 Sand Bag Erosion Checks.

The price constitutes full compensation for all labor, equipment, and materials, including bags, sand, the subsequent removal of sand bags, removal and disposal of entrapped material, and all other incidentals required to finish the work, complete and accepted.

207.05.2 Stone Check Dams.

The price constitutes full compensation for all labor, materials, and equipment, including the subsequent removal of the stone, removal and disposal of entrapped material, and all incidentals required to finish the work, complete and accepted.

207.05.3 Compost Filter Sock Check Dams.

The price constitutes full compensation for all labor, materials, and equipment, including mesh filter socks, removal of mesh filter socks, compost filter material, stakes, removal of stakes,

removal and disposal of entrapped material, backfill material, grading, raking and seeding as necessary to match the surrounding area, and all incidentals required to finish the work, complete and accepted.

207.05.4 Cleaning and Maintenance.

The cleaning and maintenance of Sand Bag Erosion Checks, Stone Check Dams, and Compost Filter Sock Ditch will be paid for under **SECTION 212**.

SECTION 208 — DEWATERING

208.01 DESCRIPTION.

This work includes dewatering as necessary in excavations for all demolition and construction requiring dewatering Project wide. To avoid water pollution caused by sediment-laden discharge from excavation sites, additional dewatering may be required during high river flow events. When designing, providing, installing, operating, maintaining, and subsequently removing temporary dewatering systems and temporary dewatering basins, ensure that all erosion, sediment, and pollution prevention controls and devices are in place before the start of excavation when required by the SWPPP/SESC. If contaminated materials are within the dewatering location, the groundwater is assumed to be contaminated. Obtain a DEM RIPDES permit for any discharges of the water to a waterbody or storm drain. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

208.02 MATERIALS.

208.02.1 Dewatering Basins.

Provide precast concrete barrier units that conform to **SECTION 909**. Provide filter fabric that conforms to **Subsection 206.02.2**. Provide filter stone that conforms to **Subsection M01.09**, **Table I**, **Column V**. Provide straw bales and wooden stakes that conform to **Subsection 206.02.1**.

208.02.2 Filter Fabric Retention Basins.

Provide fence that conforms to the requirements for Type I Chain Link Fence in **SECTION 903**. Provide wooden posts that are 2-in. × 2-in. oak and at least 3 ft in length. Provide filter fabric that conforms to **Subsection 206.02**. Provide a layer of stone over the bottom of the basin that complies with **Subsection M10.03.2** for Modified NSA Class R-4 riprap.

208.02.3 Contaminated Groundwater Dewatering Treatment System.

The Contractor shall apply for a RIDEM RIPDES RGP.

208.03 CONSTRUCTION METHODS.

Install the required erosion and pollution controls before initiating any drainage, roadway, or bridge construction or for the disturbance of any soils.

208.03.1 Dewatering.

a. Design. Use a Professional Engineer registered in the State of Rhode Island to perform all designs. Submit the following information:

- The qualifications of the Dewatering Contractor. The Dewatering Contractor shall have experience in installation, operation, and maintenance of dewatering systems including well point systems, contaminated water treatment systems, and sedimentation systems.

- Submit Shop Drawings that identify the proposed types and details of the surface water control. This includes dewatering systems (including well details, well screen openings, and filter pack materials), observation well locations, sedimentation tank to be used, and discharge systems.

- Include the arrangements, sizes, capacities, plan locations, and depths of the proposed systems and a description of the equipment, materials, and procedures for the dewatering system; the standby equipment and power supply; and the strategy for the effluent discharge.

- Provide the design details of the on-site sedimentation control structures and the associated piping, including calculations, supporting technical information, and a schedule for cleaning the sedimentation control structures.

- Provide the design calculations documenting that the dewatering system can handle all seepage into the excavation and will prevent piping or boiling of the excavation subgrade.

- Provide the anticipated peak and average dewatering rates.

- Describe the proposed methods for removing the dewatering system elements. If applicable, describe the details for leaving the dewatering system in place.

b. Design and Performance (General). Meet the following design and performance criteria:

- Select the methods for controlling water inside and outside the work area being dewatered for the dewatering system.

- Modify the dewatering and sedimentation treatment system(s) as required to meet the requirements of the work.

- Maintain the site, construction dewatering equipment, and subsurface drainage to protect the construction work. Maintain site grades to direct surface runoff to collection points, and prevent surface water from running or collecting over prepared subgrades, fill surfaces, or the work area being dewatered. Collect and discharge surface water, seepage, precipitation, groundwater, and other water that enters work areas being dewatered. Do not allow standing water to accumulate in excavations or work areas being dewatered.

- Install observation wells, as approved by the Engineer, to monitor the effectiveness of the dewatering system.

- Dewater to allow installation of temporary excavation support elements without loss of ground or unacceptable ground movements.

- Minimize impacts to water levels outside the site limits during construction.

- Dewater so that all construction and demolition is conducted in-the-dry, which means without standing water or saturated conditions that may interfere with construction.

- Implement measures to prevent damage to properties, buildings, structures, utilities, etc.

- Provide design calculations demonstrating that the selected dewatering system(s) can accommodate seepage and prevent piping into the excavation.

- Modify the system(s) at no additional cost to the Department if, while in operation, the system causes or threatens to cause damage to properties, buildings, structures, utilities, etc., or otherwise does not perform as required.

- Repair damage to any utility, structure, and/or facility resulting from dewatering activities.

- Control effluent on-site if the on-site discharge of the effluent does not result in erosion and off-site surface runoff.

- Employ adequate back-up equipment, dewatering system components, and power in case of equipment breakdown. Develop emergency procedures for maintaining continuous, uninterrupted dewatering operations.

c. Design and Performance (Dewatering System). Meet the following design and performance criteria:

- Provide, install, maintain and operate pumps, wells, and related equipment of sufficient capacity to adequately dewater excavations or work areas, until the required construction, installation, and backfilling of underground structures is complete to avoid construction impacts.

- Provide sedimentation basins that accommodate the dewatering flows and that reduce suspended materials in the dewatering effluent.

- Maintain water levels or hydrostatic pressure heads at least 2 ft below excavation to maintain an in-the-dry stable work area and/or subgrade 24 hours per day.

- Prevent loss of fine materials into bedding, piping, boiling up of trench and excavation bottoms, or other disturbances that may cause subsidence or loss of strength of the underlying natural soils.

- Excavate all soils made unsuitable due to inadequate dewatering or disturbance by construction operations, and replace the unsuitable soils with compacted fill.

- If the dewatering procedures result in boiling, loss of fines, ground instability, uncontrolled flow, or other detrimental effects, notify the Engineer of the unsuitable conditions. Modify the operations to correct the problems at no additional cost to the Department.

- Inform the Engineer of any necessary changes in the dewatering system to accommodate field conditions before making any changes.

- Provide access to the dewatering system(s) to facilitate obtaining samples before and after discharge.

- Ensure that the dewatering effluent contains no hazardous materials at concentrations sufficient to cause a sheen or other visual/olfactory evidence of contamination. If these conditions exist, notify the Engineer and discontinue the discharge until the system can be modified.

208.03.2 Temporary Dewatering Basins.

Dewatering basins form a rectangular concrete barrier enclosure, the bottom and sides of which are lined with filter fabric. The bottom fabric is stabilized with filter stone. The basin is divided into the required number of 12-ft sections by stone berms approximately 18 in. high.

a. Installation. The following stipulations apply:

- Place the precast concrete barrier units on level or nearly level ground.

- Place filter fabric on the bottom of the area enclosed by the concrete barrier units. If more than one sheet of fabric is required, overlap the adjacent section a minimum of 12 in. to ensure full coverage. Turn up the filter fabric along the inside face of the concrete barriers to the top of the barrier, which is folded across the top of the barriers. Maintain the fabric in position with sand bags, end-to-end, along the top of the concrete barrier enclosure.

- Spread a minimum layer of 6 in. of filter stone over the bottom of the basin. Locate the stone berms at 12-ft intervals along the basin length.

b. Removal. Do not remove the dewatering basin until all dewatering operations are complete. Before the removal, however, remove all accumulated sediment within the basin according to **SECTION 212**. Seed and mulch the area covered by the basin immediately after the basin is removed. Backfill any voids resulting from dewatering system removal with cement grout, concrete, or other material to prevent potential loss of ground.

208.03.3 Filter Fabric Retention Basin.

The filter fabric retention basin forms a rectangular enclosure formed by a 2-ft high chain link fence. Both the fence and the bottom of the enclosure are lined with filter fabric that is stabilized by a layer of rock riprap.

a. Installation. The following stipulations apply:

- Place the filter fabric retention basin on stabilized and level ground to prevent erosion by water exiting the basin.

- Dig a 6-in. × 6-in. minimum trench where the basin will be constructed.

- Provide the filter fabric and wire backing that is 3 ft wide (minimum) positioned in the trench and secured to metal posts positioned 4 ft on center (maximum).

- Drive the metal posts into undisturbed soil next to the trench to a minimum depth of 12 in.

- Place fill material in the trench and compact.
- Provide an installed height of fence that is 2 ft (minimum).
- Spread a minimum layer of 6 in. of filter stone (Modified NSA Class R-4 riprap) evenly over the bottom of the basin.

b. Removal. Remove the filter fabric retention basin according to the dewatering basin requirements in **Para. b** of **Subsection 208.03.2**.

208.04 METHOD OF MEASUREMENT.

Dewatering is not measured for payment.

Dewatering Basins, Filter Fabric Retention Basins, and Contaminated Groundwater Treatment Systems will be measured by each.

208.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Dewatering	LS
Dewatering Basins	EA
Filter Fabric Retention Basin	EA
Contaminated Groundwater Treatment System	EA

The prices constitute full compensation for all labor, materials, and equipment, including installation, subsequent removal, and restoration of basin areas, and all incidentals required to finish the work, complete and accepted.

The cleaning and maintenance of Dewatering Basins, and Filter Fabric Retention Basins, will be paid for under **SECTION 212**.

SECTION 209 — STORM DRAIN INLET PROTECTION

209.01 DESCRIPTION.

This work includes providing temporary storm drain inlet protection facilities. Ensure that all erosion, sediment, and pollution prevention controls and devices are in place before the start of excavation when required by the SWPPP/SESC. Storm drain inlet protection facilities include the following types. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

209.01.1 Silt Fence Inlet Protection.

This work includes placing a temporary filter fabric fence around inlet grates.

209.01.2 Baled Straw Inlet Protection.

This work includes placing baled straw around storm drain inlets.

209.01.3 Sack Insert Inlet Protection and High Flow Sack Insert Inlet Protection.

This work includes placing a reusable geotextile sack installed in drainage structures for the protection of wetlands and other resource areas and for the prevention of silt and sediment from the construction site from entering the storm water collection system.

209.02 MATERIALS.

209.02.1 Silt Fence Inlet Protection.

Provide a filter fabric material suitable for sediment control applications, selected from the Department's Approved Materials List. Provide wooden posts that are oak, 2-in. × 2-in. in section and at least 4½ ft in length. Provide support netting that is heavy-duty plastic mesh. For prefabricated silt fence, 1-in. × 1-in. wooden posts are permitted.

209.02.2 Baled Straw Inlet Protection.

Ensure that baled straw and wooden stakes conform to **Subsection 206.02.1**.

209.02.3 Sack Insert Inlet Protection.

Provide Sack Insert Inlet Protection with a permeable geotextile that allows water to pass but prevents silt, sediment, and trash from passing. Provide sacks that are woven polypropylene geotextile and sewn by a double needle machine using high strength nylon. Sacks include overflow holes to make the silt sack effective even in the most extreme weather events. Ensure that that sacks meet the following stipulations:

- Minimum puncture strength, ASTM D4533 of 130 lb
- Minimum sieve size of No. 20
- Minimum flow rate, ASTM D4491 of 100 gal/min/sq ft

209.03 CONSTRUCTION METHODS.

Install the erosion and pollution controls before initiating any drainage, roadway, or bridge construction or for the disturbance of any soils.

209.03.1 Silt Fence Inlet Protection.

a. Installation. The following stipulations apply:

- Extend posts at least 1 ft below grade.
- Extend the filter fabric to a height at least 12 in. above the top of the inlet grate but not to exceed 3 ft.
- Extend the support netting to the full height of the filter fabric.
- Excavate a trench approximately 6 in. wide and 6 in. deep around the outside perimeter of the stakes. Extend the filter fabric and support netting at least 6 in. into the trench. After the fabric and support netting are fastened to the stakes, backfill and compact the trench to original grade.
- Securely fasten the filter fabric and support netting fence to the stakes using heavy duty wire staples at least 1-in. long. Ensure that the ends of the filter fabric meet at a stake and are overlapped, folded, and stapled to the stake.

b. Removal. Remove the silt fence inlet protection, and prepare the area for pavement construction once the contributing drainage area is free from future uncontrolled discharges. Before this removal, remove all silt, mud, and debris entrapped by the silt fence and clean the area according to **SECTION 212**.

209.03.2 Baled Straw Inlet Protection.

a. Installation. The following stipulations apply:

- Ensure that the bales are entrenched and backfilled. Excavate the trench to the width of the bale and the length of the check to a minimum depth of 3 in. After the bales are staked and chinked, backfill the excavated soil against the check. Provide backfill that conforms to the ground level on the inside and is built up to 4 in. around the outside.
- Install the bales so that the bindings are oriented around the sides of the bales.
- Securely anchor each bale with at least two stakes driven through the bale. Drive the first stake in each bale toward the previously laid bale to force the bales together.
- Ensure that the gaps between bales are chinked (filled by wedging) with straw to prevent water from escaping between bales.

b. Removal. Remove the baled straw inlet protection, and prepare the area for pavement construction once the contributing drainage area is free from future uncontrolled

discharges. Before this removal, remove all silt, mud, and debris entrapped by the baled straw and clean the area according to **SECTION 212**.

209.03.3 Sack Insert Inlet Protection.

a. Installation. Ensure that the device is manufactured to fit the opening of the drainage structure and is mounted under the grate. Secure the insert sack from the surface so that the grate can be removed without the insert discharging or falling into the drainage structure. Block all curb inlets to prevent stormwater from bypassing the device. Install the sack (geosynthetic filter material), and maintain the sack according to the manufacturer's literature.

   Repair or replace filter bags that become damaged during construction operations or cause water to collect at the surface at no additional cost to the Department.

b. Removal. Remove the insert sack when surface-borne sediment has been stabilized upon completion of final pavement and sidewalk placement and when the adjacent grade areas have become permanently stabilized by vegetative growth. When emptying the sack, ensure that the captured material does not enter the structure. Remove silt, sediment, and other debris found in the drainage system at the end of construction. Ensure that the silt and sediment from the sack are properly disposed of offsite. Do not deposit the silt and sediment from the insert on site or use the silt and sedimentation in construction. Before this removal, remove all silt, mud, and debris entrapped by the sack, and clean the area according to **SECTION 212**.

209.04 METHOD OF MEASUREMENT.

209.04.1 Silt Fence/Baled Straw Inlet Protection.

Silt Fence Inlet Protection and Baled Straw Inlet Protection will be measured by the linear feet of the protection installed.

209.04.2 Sack Insert Inlet Protection.

Sack Insert Inlet Protection will be measured by the number of inlets protected with sacks.

209.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Silt Fence Inlet Protection	LF
Baled Straw Inlet Protection	LF
Sack Insert Inlet Protection	EA

209.05.1 Silt Fence Inlet Protection.

The price constitutes full compensation for all labor, materials, and equipment, including excavation, stakes, support netting, filter fabric, backfill, the subsequent removal of the entire temporary facility, removal and disposal of entrapped material, and all incidentals required to finish the work, complete and accepted.

209.05.2 Baled Straw Inlet Protection.

The price constitutes full compensation for all labor, materials, and equipment, including excavation, straw bales, stakes, backfill, the subsequent removal of the entire temporary facility, removal and disposal of entrapped material, and all incidentals required to finish the work, complete and accepted.

209.05.3 Sack Insert Inlet Protection and High Flow Sack Insert Inlet Protection.

The price constitutes full compensation for all materials, including sacks, labor, equipment, and all incidentals required to finish the work, including final removal of the inlet protection device and removal and disposal of entrapped material, complete and accepted.

209.05.4 Cleaning and Maintenance.

The cleaning and maintenance of Silt Fence Inlet Protection, Baled Straw Inlet Protection, and Sack Insert Inlet Protection will be paid under **SECTION 212**.

Payment will not be made for repairs and replacements necessary due to Contractor operations and damage or lack of proper maintenance.

SECTION 210 — TEMPORARY SEDIMENT BASIN

210.01 DESCRIPTION.

This work includes providing temporary sediment basins for water pollution prevention in conformity with the required dimensions and details. Install all erosion, sediment, and pollution prevention controls and devices before the start of excavation when required by the SWPPP/SESC. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

210.02 MATERIALS.

The materials required for the construction of temporary sediment basin will be on the Plans.

210.03 CONSTRUCTION METHODS.

Construct the temporary sediment basin to retain in the basin any material that may cause damage to a natural water course or the surrounding environment. If the basin is temporary, restore the area where the basin is located to its original condition.

Excavate the temporary sediment basin from the downstream end of the basin proceeding to the upstream end. Before initiating excavation, construct temporary baled straw ditch erosion checks and/or straw log check dams immediately beyond the downstream end of the basin. When the work requiring the temporary basin is complete, remove the control measures.

210.04 METHOD OF MEASUREMENT.

Temporary Sediment Basin will not be measured by a single unit of measurement. Rather, each individual item of work required to provide these basins will be measured by their respective units of measurement for the quantity provided.

210.05 BASIS OF PAYMENT.

Temporary Sediment Basin will not be paid for as completed facilities. Rather, each basin will be paid for at the Contract unit prices for those items of work required to construct the facility and, for temporary basins, those items of work necessary to remove the basin and restore the area to its original or proposed condition and all incidentals required to finish the work, complete and accepted.

The cleaning and maintenance of Temporary Sediment Basin will be paid under **SECTION 212**.

SECTION 211 — CONSTRUCTION ACCESSES

211.01 DESCRIPTION.

This work includes providing stabilized stone pads located at points of vehicular and equipment ingress and egress to and from construction sites to prevent tracking out sediment. Install all erosion, sediment, and pollution prevention controls and devices before the start of excavation when required by the SWPPP/SESC. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

211.02 MATERIALS.

Provide crushed stone that conforms to **Subsection M01.09**, **Table I**, **Column II**. Provide geosynthetic materials that conform to **Subsection 206.02.2**.

211.03 CONSTRUCTION METHODS.

Install stabilized stone pads for use as construction entrances.

211.03.1 Planning Considerations.

Clean the public roads adjacent to a construction site of any sediment and debris at the end of each day. **SECTION 211** identifies an area where sediment can be removed from the tires or tracks of construction vehicles and equipment before the vehicles and equipment enter a public road. Use construction accesses in conjunction with the stabilization of construction roads to reduce the sediment tracked out by construction vehicles and equipment.

211.03.2 Dimensions.

a. Thickness. Ensure that the thickness of the stabilized stone pad is a minimum of 5 in.

b. Width. Ensure that the width is not less than the full width of the respective points of ingress or egress.

c. Length. Provide a length for construction accesses that is at least 50 ft where the soils are sands or gravels, except where the traveled length is less than 50 ft. Where soils are clays or silts, provide a length for construction accesses that is at least 100 ft, except where the traveled length is less than 100 ft.

211.03.3 Installation Requirements.

Clear the area of the construction accesses of all vegetation, roots, stumps, or other objectionable material. Excavate the area to subgrade and grade the area. Place geosynthetic material on the prepared subgrade before the placement of the stone pad according to the specified dimensions.

211.04 METHOD OF MEASUREMENT.

Construction Accesses will be measured by each access installed.

211.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Construction Accesses	EA

The price constitutes full compensation for all labor, material, and equipment, including excavating, geosynthetic materials, stabilized stone pad, and subsequent removal of the accesses, and all incidentals required to finish the work complete and accepted. The cleaning and maintenance of Construction Accesses will be paid under **SECTION 212**.

SECTION 212 — MAINTENANCE AND CLEANING OF EROSION, SEDIMENT AND POLLUTION PREVENTION

212.01 DESCRIPTION.

This work includes:

- The maintenance and cleaning of erosion, sediment, and pollution prevention control items
- Performing inspection and documentation of RIDOT SWPPP and/or RIDOT SESC reports year-round

Install all erosion, sediment, and pollution prevention controls and devices before the start of excavation when required by the SWPPP/SESC. There is no winter shutdown period associated with **SECTION 212**. **SECTION 907** addresses dust control to reduce dust nuisance and hazards.

212.01.1 Applicable Controls.

Clean and maintain erosion, sediment, and pollution prevention controls according to **SECTIONS 206** through **211**.

212.01.2 Definitions.

a. Cleaning. Cleaning includes removing debris and accumulated sediment-laden deposits from the upstream side of perimeter controls, check dams, storm drain inlet protection, construction accesses, and the bottom of temporary dewatering basins and sediment basins. Ensure that all material removed is properly disposed of.

b. Maintenance. Maintenance includes the restoration and repair of damage sustained by erosion and pollution controls from normal rainfall events and the work necessary to prepare for forecasted events. Abnormal weather events are defined in **Subsection 212.03.4**.

c. Inspection. Inspection includes the required environmental permit inspections, plans, reports, and procedures including the SWPPP and/or SESC Plan.

d. Corrective Action Log. Complete a Corrective Action Log to:

- Document, within 24 hours of identification, the specific condition and the date and time it was identified
- Document, within 24 hours of completing the action, the action taken to address the condition
- Store at the site or at an easily accessible location

212.02 MATERIALS.

Provide materials used to repair and restore damaged erosion, sediment, and pollution prevention controls that comply with **Subsections 206.02**; **207.02**; **208.02**; **209.02**; **210.02**; and **211.02**.

212.03 CONSTRUCTION METHODS.

Maintain erosion, sediment, and pollution prevention controls. Provide erosion, sediment, and pollution prevention controls that prevent, under normal weather conditions, both the movement of soil materials and the intrusion of sediment-laden discharges into environmentally sensitive areas.

Do not initiate or continue construction until all specified erosion, sediment, and pollution controls are in place, properly installed, and accepted by the Engineer.

Routinely inspect erosion, sediment, and pollution prevention controls according to the SWPPP or SESC. Conduct these inspections at a minimum of every seven calendar days, within 24 hours of corrective actions occurring, and within 24 hours if the site receives 0.25 in. of rainfall from an individual storm event.

After each inspection, implement corrective actions and perform all necessary cleaning, maintenance, and repairs when the maintenance of the erosion, sediment, and pollution controls is required. Initiate the requisite cleaning, maintenance, and repairs no later than the next consecutive calendar day after the SWPPP or SESC inspection was conducted and expeditiously perform the cleaning, maintenance, and repair work until the issue is remedied. If a holiday or weekend storm event occurs, ensure that the resources are available to restore and, if necessary, to replace any damaged erosion controls.

Perform SWPPP or SESC inspections until the following criteria are met:

- All disturbed areas are permanently stabilized, including storage/laydown areas.
- All Project specific regulatory permit requirements have been met.

212.03.1 Threshold for Cleaning Erosion, Sediment, and Pollution Prevention Controls.

When directed by the Engineer and/or SWPPP inspector/Environmental Monitor, clean the erosion, sediment, and pollution controls after a rainstorm or when sediment deposits reach the heights indicated in the Table below.

Minimum Threshold for Cleaning

Control Type	Threshold for Cleaning (Minimal)
a. Erosion, Sediment, and Pollution Prevention Controls	
1. Baled Straw Erosion Checks	½ Bale Height
2. Silt Fence	6 in.
3. Baled Straw Erosion Checks and Silt Fence Combined	½ Bale Height
4. Compost Filter Sock	½ Sock Height
b. Check Dams	
1. Sand Bag Erosion Dike	½ Dike Height
2. Stone Check Dam	½ Dam Height
3. Compost Filter Sock Check Dam	½ Sock Height
c. Dewatering	
1. Dewatering Basins	½ Original Basin Height
2. Filter Fabric Retention Basin	½ Original Basin Height
d. Storm Drain Inlet Protection	
1. Silt Fence Inlet Protection	6 in.
2. Baled Straw Inlet Protection	½ Bale Height
3. Sack Insert Inlet Protection	⅓ Sack Height or per manufacturer's requirements
e. Temporary Sediment Basin	½ Depth Below Outlet Elevation
f. Construction Accesses	When track out is occurring

212.03.2 Other Requirements.

a. Certification/Registration. Provide a certified SWPPP/SESC inspector to perform and report on SWPPP/SESC inspections. Ensure that the inspector is a Certified Professional in Erosion and Sediment Control (CPESC), a Certified Professional in Stormwater Quality (CPSWQ), or a Rhode Island Registered Professional Engineer. Adhere to the following stipulations:

- A Certified Professional in Erosion and Sedimental Control (CPESC) and/or Certified Professional in Stormwater Quality (CPSWQ) is required to ensure that inspectors meet the Federal requirements, including the USEPA National Pollutant Discharge Elimination System definition of Qualified Personnel. The inspector shall meet the requirements for all Contract permits and State/local regulations.

- A Professional Engineer is considered certified to perform and report on SWPPP/SESC inspections if the Professional Engineer is claiming competency equal to a CPESC or CPSWQ.

- Certified inspectors shall include their valid, applicable certification number and type of certification on each report. Professional Engineers shall seal (stamp) and sign each report.

- The Engineer may reject Certifications and Professional Engineer registrations if:

- SWPPP/SESC reports from the inspector are incomplete/inaccurate, as determined by the Engineer, more than twice in a calendar year.

- The Engineer determines that the certifying agency/organization does not meet these requirements**.**

- A SWPPP/SESC report has been submitted with intentionally incorrect, inaccurate, or missing information, as determined by the Engineer.

- If the Engineer rejects a Certification or Professional Engineer registration, the Engineer, at his/her discretion, may contact the certifying agency/organization to provide the reason for the Engineer's rejection of the certificate.

- If a Certification or Professional Engineer registration is rejected due to the first two items in the 4th bullet above, the inspector shall submit a new certification. There is no time restriction.

- If a Certification or Professional Engineer registration is rejected due to the 3rd item in the 4th bullet above, the inspector shall submit a new certification no sooner than three months after rejection of the certification or registration. In special cases, the Engineer will forward the falsified documentation to RIDEM and/or EPA under the RIDOT Consent Decree reporting requirements.

b. Erosion, Sediment, and Pollution Prevention Controls, Check Dams, Temporary Dewatering Basins, Storm Drain Inlet Protection, Temporary Sediment Basin, and Construction Accesses. The following requirements apply:

- Clean, repair, or replace all noncompliant, damaged, and/or other controls requiring maintenance as identified in a SWPPP or SESC Plan report within 24 hours of identification. Designate a qualified person, experienced in stormwater management and erosion control, to be available on site throughout Project duration. This person shall have the authority to direct Contractor and/or Subcontractor personnel to implement the corrective actions.

  Submit the inspection documentation as a signed SWPPP or SESC Plan report, according to RIDOT's templates or, as provided in the Contract, to RIDOT's Project Manager and Construction Manager. Templates are available on the RIDOT website.

- The Engineer has the authority to verify, enforce, and specify maintenance activities and to ensure that the erosion, sediment, and pollution prevention controls have been properly maintained.

c. Temporary Dewatering Basins and Temporary Sediment Basin. The following requirements apply:

- Periodically inspect the basins for evidence of erosion around the basin and downslope area.

- Implement repairs as directed by the Engineer.

- The Engineer has the authority to verify, enforce, and specify maintenance activities and to ensure that controls have been properly maintained.

212.03.3 Failure to Maintain Erosion, Sediment, and Pollution Prevention Controls.

The Engineer may determine that the required erosion, sediment, and pollution controls are not in place or have not been adequately maintained as recommended by the manufacturer, as specified in this Section or per permit requirements. The Department will deduct the daily charge from the Contractor's payment for failure to comply. The daily charge per incident will continue for each consecutive calendar day thereafter until the deficiencies have been corrected as determined by the Engineer. The failure-to-comply charges are independent of other charges assessed by other agencies and/or entities.

a. General Permit Violation. The following provides examples of a General Permit Violation:

- Failure to ensure that all stormwater controls are maintained and remain in effective operating condition
- Working without a permit
- Land disturbance, permit noncompliance, performing work without proper sediment, erosion, and pollution controls
- Nonperformance of or falsification of SWPPP/SESC inspection or documentation
- Non-installed BMP or unmaintained BMP

b. Erosion, Sediment, and Pollution Prevention Controls Violation. Ensure that all stormwater and non-stormwater pollution prevention controls are maintained and remain in proper operating condition. The following provides examples of a Stormwater or Non-Stormwater Pollution Prevention Controls Violation:

- Failure to comply with any specific maintenance requirements as found in the Contract, SWPPP, SESC Plan, and/or recommended by the manufacturer
- Failure to prevent non-authorized discharges from leaving the site
- Failure to install sediment controls along all perimeter areas of the site that will receive pollutant discharges (or, for linear construction sites where the controls are infeasible, failure to implement other appropriate practices)
- Failure to minimize sediment track-out
- Failure to properly manage stockpiles or land clearing debris piles composed of sediment and/or soil
- Failure to minimize dust through appropriate application of water or other dust suppression techniques

- Failure to minimize soil compaction where final vegetative stabilization will occur or where infiltration practices will be installed
- Failure to protect storm drain inlets by installing inlet protection measures that remove sediment from discharges before entry into a storm drain inlet
- Failure to use erosion controls and velocity dissipation devices within and along the length of any stormwater conveyance channel and at any outlets to slow down runoff to minimize erosion
- Failure to initiate and complete stabilization measures within the required deadlines
- Failure to properly install other necessary control measures
- Failure to provide effective controls for equipment and vehicular fueling and maintenance activities
- Failure to effectively minimize the discharge of pollutants from equipment and vehicle washing
- Failure to implement appropriate controls to prevent/minimize the discharge of pollutants from any of the following:
    - Building materials/products
    - Landscaping chemicals and materials
    - Petroleum products and other chemicals
    - Hazardous and toxic waste
    - Construction and domestic wastes
    - Sanitary wastes
- Failure to provide effective controls for concrete washout
- Failure to provide effective controls for washing applicators/containers for stucco, paint, form release oils, curing compounds, or other hazardous materials
- Failure to comply with requirements for construction dewatering to minimize the discharge of pollutants

c. Improper Documentation Violation.

- Failure to complete an Inspection or Corrective Action Log when required
- Failure to properly sign/certify an Inspection or Corrective Action Log
- Falsified Corrective Action Logs
- Not conducting and documenting all required inspections
- Not conducting Inspections with qualified personnel
- Failure to inspect all required areas
- Failure to include all required information

d. Adjustment for Repeat Violations. A repeat violator is an operator of a construction site (Contractor) who has been assessed for Failure to Maintain Erosion and Pollution Controls

previously on the same project. This includes any violations stated previously in **SECTION 212** or otherwise identified in the SWPPP and/or SESC reports. Prior formal enforcement actions also include both EPA and State actions against the Contractor on the same Project. The Department will apply an escalation factor of 25 percent for the second time that failure-to-comply charges are assessed; an escalation factor of 50 percent will be applied to the third or subsequent time a failure-to-comply charge is assessed.

e. Schedule for Stormwater Violations. See **SECTION 110** for the failure-to-comply charges.

212.03.4 Failure of Erosion and Pollution Controls due to Abnormal Weather.

a. Erosion and Pollution Controls. In general, **SECTION 212** applies to the maintenance and cleaning of erosion and pollution controls for normal weather. However, after an abnormal weather event, the Engineer may determine that the controls have been damaged to warrant their partial or total replacement. At the direction of the Engineer to replace the controls, the Contractor will be compensated under the applicable provisions of **SECTIONS 206**, **207**, **208**, **209**, and **210**, if:

- The SWPPP/SESC inspection documents that the controls were in place and maintained in a good state of repair, and
- All reasonable preventive measures had been taken to protect the site, as approved by the Engineer.

b. Abnormal Weather. For application, an abnormal weather event is defined as:

- Rainfall equal to or greater than 1.0 in. within 1 hour
- Rainfall equal to or greater than 2.5 in. within 12 hours
- Rainfall equal to or greater than 3.0 in. within 24 hours
- Extreme weather-related events as defined in **Subsection 104.14**

The Engineer will support the claim of abnormal weather events by documented records from the National Weather Service.

212.04 METHOD OF MEASUREMENT.

Maintenance and Cleaning of Erosion, Sediment, and Pollution Prevention Controls will be measured as a lump sum item.

212.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Maintenance and Cleaning of Erosion, Sediment, and Pollution Prevention Controls	LS

The price constitutes full compensation for all labor, material, and equipment, including disposal, replacement, and incidentals to **Subsections 206**, **207**, **208**, **209**, **210**, and **211**; the inspection and development of SWPPP and SESC reports; and all resources, labor, materials, equipment, and incidentals required to complete the work, including:

- Monthly progress payments under this item will be made according to **Subsection 109.07**.
- Payment for authorized Contract time extensions at either the calculated monthly rate as defined above or on a basis according to **Subsection 109.04**.

If the Contract is completed before the authorized completion date, the final monthly payment will be authorized after completion of the punch list and will include the remaining balance of the Contract lump sum price.

SECTION 213 — PLACEMENT OF MILLINGS BENEATH GUARDRAIL

213.01 DESCRIPTION.

This work includes the placement of asphalt millings from cold planing operations at all guardrail locations less than 2 ft from the edge of the existing pavement.

213.02 MATERIALS.

Millings include asphalt material ground or crushed so that 100 percent of the material passes a 1-in. sieve. Ensure that the millings are free of debris, topsoil, and soil clumps.

213.03 CONSTRUCTION METHODS.

Obtain millings from stockpiled locations on the Project site or off-site sources. Do not use millings from off-site sources unless authorized by the Engineer. Ensure that the millings are free of debris, topsoil, and soil clumps. Unless otherwise directed by the Engineer, place millings according to the following:

- For guardrail installations 4 ft or less from the face of guardrail to the edge of pavement, place the millings from 1 ft behind the post to the edge of pavement to a depth of 5 in.
- For guardrail installations greater than 4 ft from the face of guardrail to the edge of pavement, place the millings for a width of 2 ft on center with the guardrail post to a depth of 5 in.

Grade beneath the guardrail to ensure that the finished surface of the millings is flush with the asphalt berm or edge of pavement and shaped, compacted, and sloped to drain away from the pavement. Do not dismantle the guardrail to perform any work associated with this item. Restrict the stockpiling of millings to approved, on-site locations. Do not stockpile millings on the roadway shoulder or adjacent to a travel lane.

Excavate and remove the material beneath the guardrail, in compliance with the SESC, to ensure that damage to the guardrail does not occur. Dispose of all material removed from beneath the guardrail, including excess millings.

213.04 METHOD OF MEASUREMENT.

Placement of Millings Beneath Guardrail will be measured by the linear feet of guardrail for which millings were placed.

213.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Placement of Millings Beneath Guardrail	LF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Trimming and Fine Grading is not measured for payment. It will be included in the associated Item of work.

SECTION 214 — CONTAINMENT SYSTEM FOR HYDRODEMOLITION RUNOFF

214.01 DESCRIPTION.

This work includes providing an on-site containment system for runoff from hydrodemolition operations and the collection and disposal of sediments and other materials.

214.02 MATERIALS.

The Engineer will approve any use of materials not specifically included on the Plans and/or in this Specification.

214.03 CONSTRUCTION METHODS.

At least 30 days before starting hydrodemolition operations, submit for the Engineer's approval the proposed storage area and maintenance plan for the hydrodemolition runoff. Include these elements:

- The containment/sedimentation system
- The maintenance procedures

214.03.1 Containment System for Control of Hydrodemolition Runoff.

If the Project is within the jurisdiction of the Rhode Island Department of Environmental Management (RIDEM) or the Coastal Resources Management Council (CRMC), construct the containment system according to the permit. Otherwise, obtain the necessary approvals before beginning hydrodemolition activities. Provide copies to the Engineer.

Ensure that the containment system meets the following minimum requirements:

- It must be one of the following structures:
    - An open basin formed of natural topography lined with an impermeable fabric
    - An area where excavated material can be placed to form a temporary earth berm, lined with an impermeable fabric
    - A manmade, portable structure that can be placed on-site for the duration of the hydrodemolition process
- Submit computations accompanied by the hydrodemolition equipment's operating specifications, demonstrating that the sedimentation area has the capacity for a maximum discharge from eight hours of hydrodemolition operations and a minimum of 3000 gal.
- Locate the containment system within the available infield(s) of the Project. Do not encroach on the pedestrian or traveled way. Surround the location of the facility with a temporary snow fence to discourage unauthorized entry.

- If disturbance of the original soil is required for the establishment of the containment system, install and maintain proper erosion control measures throughout the hydrodemolition process. Restore the site after completion of the process.

214.03.2 Maintenance and Disposal of Hydrodemolition Runoff.

Develop a method by which hydrodemolition runoff will be managed. Any temporary sedimentation basin will be maintained, cleaned, and emptied before initiating work. Any hydrodemolition discharges to areas of RIDEM or CRMC jurisdiction must be authorized by the appropriate regulatory agency. Discharges outside of the RIDEM or CRMC will not be authorized by the Engineer and must be approved by the Engineer.

a. Requirements. Dispose of the liquid and solid discharge elements of the hydrodemolition operations to conform to the following requirements:

   - Do not initiate hydrodemolition operations on a workday until the containment system has been cleaned.

   - Remove and discharge liquid runoff according to RIDEM or CRMC approval, only after a settling period of not less than six hours. Do not discharge hydrodemolition runoff into an area of RIDEM or CRMC jurisdiction or into any storm drain, without prior approval from RIDEM or CRMC. Obtain all such approvals and forward copies to the Engineer. Do not allow water to drain across unpaved surfaces. Pump or siphon the water or transport the water along a temporary paved waterway. Provide erosion control measures for any process that results in disturbing earth or discharges over unpaved surfaces.

   - Remove and properly dispose of any solid debris collected in the bottom of the basin.

b. Damaged Facilities. Replace, rebuild, or repair the basin, or its components, that is damaged or otherwise rendered inoperative such that it does not perform its intended function, at no additional cost to the Department. These repairs include snow fence repair, structure repair, and maintaining hay bales.

214.04 METHOD OF MEASUREMENT.

Containment System for Control of Hydrodemolition Runoff does not require a measurement for a lump sum payment.

Maintenance and Disposal of Hydrodemolition Runoff will be measured by the number of days where actual hydrodemolition occurs.

214.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Containment System for Control of Hydrodemolition Runoff	LS
Maintenance and Disposal of Hydrodemolition Runoff	DAYS

214.05.1 Containment System for Control of Hydrodemolition Runoff.

The price constitutes full compensation for establishing a suitable sedimentation basin for the hydrodemolition runoff, including all materials, labor, tools, equipment, and earthwork associated with providing the basin, erosion control, snow fence, removal of all materials and restoration of all ground surfaces disturbed in the installation and operation of the system, and all incidentals necessary for finishing the work, complete and accepted.

214.05.2 Maintenance and Disposal of Hydrodemolition Runoff.

The price constitutes full compensation for transportation and disposal of the hydrodemolition wastewater, including all materials, labor, tools, vehicles, any necessary permits and approvals required to complete the disposal, and all incidentals necessary for finishing the work, complete and accepted.

SECTION 215 — CONTROL OF IMPORTED SOILS

215.01 DESCRIPTION.

This work includes controlling and testing materials transported to the site by the Contractor unless otherwise approved by RIDEM and LRSMM. Ensure that all work complies with the applicable rules and regulations of local, State, and Federal authorities, and provide certified documentation that unacceptable levels of hazardous waste are not present in the material. Refer to the Soil Management Plan for the Project.

215.02 MATERIALS.

Ensure compliance with the following:

- All laws applicable to the materials (hazardous and non-hazardous) transported to the site by any agents, officers, employees, visitors, and Subcontractors
- Containment, storage, management, transport, and disposal of all soils according to all applicable environmental laws and permit approvals
- Payment to applicable recipients for all penalties, expenses, costs, damages (including to natural resources, property, or persons), and liability related to the imported soils

Test all imported soil used for backfilling, embankment construction, or topsoil, and ensure that the imported soil is free of contamination and meets RIDOT specifications. Provide the required testing in **Subsection 215.03** before delivery of the soil to the Project site.

The testing provisions for crushed stone, concrete sand, gravel borrow subbase, and special graded aggregate for shaping and trimming driveways or shoulders do not apply.

215.03 CONSTRUCTION METHODS.

215.03.1 Samples, Tests, and Cited Specifications.

Collect soil samples according to USEPA Publication No. SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. Ensure that the tests are performed by a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory approved to perform analytical testing in Rhode Island.

Collect samples for each type of imported soils to be used on the Project based on the stockpile volume as follows:

Volume of Import Soil	Samples Per Volume
Up to 1000 cu yd	1 sample per 250 cu yd
1001 to 5000 cu yd	4 samples for the first 1000 cu yd + 1 sample per each additional 500 cu yd
Greater than 5000 cu yd	12 samples for the first 5000 cu yd + 1 sample per each additional 1000 cu yd.

If imported soil will be derived from more than one source, attain the imported soil qualifications from each source according to the sampling frequency. Provide the geographic coordinates (latitude/longitude) of the imported soil sample location(s), and provide a general description of the soil type sample according to the Unified Soil Classification System (USCS) to the Engineer.

Document the following laboratory analyses to ensure that the imported soil is free from contamination:

Constituent	Test Method	Minimum Detection Level
Volatile Organic Compounds (VOC)	Method 5035	RIDEM Method 1 I/CDEC
Semi-Volatile Organic Compounds (SVOCs)	Method 8270D	RIDEM Method 1 I/CDEC
Total Petroleum Hydrocarbons (TPH)	Method 8015D	RIDEM Method 1 I/CDEC
Polychlorinated Biphenyls (PCBs)	Method 8082A	RIDEM Method 1 I/CDEC
Pesticides	Method 8081B	RIDEM Method 1 I/CDEC
Herbicides	Method 8151A	RIDEM Method 1 I/CDEC
SiRCRA Eight Metals	Method 6010D and 7471B	RIDEM Method 1 I/CDEC

CDEC = Rhode Island Commercial Direct Exposure Criteria
DEC = Rhode Island Direct Exposure Criteria

Provide laboratory analytical reports to the Engineer for all imported soil to verify that the soil is free from contamination. Provide a copy of the associated lab report to the Department for review and approval.

215.03.2 Failure to Maintain Control of Imported Soils.

If the source material for gravel backfill, embankment, or topsoil that originates outside of the Project limits is placed on the Project and is found to be contaminated with unacceptable levels of hazardous waste or substances, remove and properly dispose of the contaminated material from the Department's right-of-way. Secure the services of an environmental firm with the necessary experience and expertise to test the soil to ensure that the contamination has been removed. The selection of the firm is subject to the approval of the Engineer.

215.04 METHOD OF MEASUREMENT.

This item will not be measured for payment.

215.05 BASIS OF PAYMENT.

The cost of complying with this specification will be incidental to the work.

Part 300
AGGREGATE AND GRAVEL BASE AND SUBBASE COURSES

SECTION 301 — AGGREGATE AND GRAVEL BASE COURSES

301.01 DESCRIPTION.

This work includes providing one or more courses of graded aggregate or gravel borrow and fillers, if required, on prepared subgrade surfaces.

301.02 MATERIALS.

Use materials that conform to **SECTION M**:

- Gravel Borrow — **Subsection M01.09, Column I in Table**
- Crushed Stone or Gravel — **Subsection M01.09, Column II in Table**
- Fillers — **Subsection M01.08**

301.03 CONSTRUCTION METHODS.

301.03.1 Placing.

If the required compacted depth of base course exceeds 12 in., construct the base in two or more layers of approximately equal thickness. Ensure that the maximum compacted thickness of any layer does not exceed 12 in. Ensure that the maximum size of stone in the gravel borrow or aggregate placed does not exceed ¾ of the layer depth after compaction. This restriction determines the maximum size of stone in the gravel borrow specification in **Subsection M01.09.**

Ensure that all materials meet all specifications before placement. Do not cull deleterious or out of specification material after placement and/or grading in-place, unless directed otherwise by the Engineer.

301.03.2 Shaping and Compaction.

Continue compacting each layer until a density of not less than 95 percent of the maximum density as determined according to AASHTO T180 has been achieved. Maintain the surface of each layer during the compaction operations to produce reasonable uniformity. Ensure that the compacted surface has a tolerance of ±½ in. for the required grades. However, ensure that no deviation continues for more than 100 ft in any direction.

Adjust the field moisture content for gravel borrow to be no more than ±2 percent when compared to the optimum moisture content.

301.04 METHOD OF MEASUREMENT.

Aggregate Base Course and/or Gravel Borrow Base Course will be measured by the number of cubic yards according to **Subsection 109.01**.

301.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Aggregate Base Course	CY
Gravel Borrow Base Course	CY

The price constitutes full compensation for all labor, materials, equipment, and all incidentals, including trimming and fine grading, required to finish the work, complete and accepted.

SECTION 302 — GRAVEL BORROW SUBBASE COURSES

302.01 DESCRIPTION.

This work includes providing one or more courses of gravel borrow on prepared subgrade surfaces.

302.02 MATERIALS.

Ensure that gravel borrow meets the requirements of **Subsection M01.09, Column I in Table** before its final placement on the Project.

302.03 CONSTRUCTION METHODS.

302.03.1 Placing.

Use subbase materials that conform to **Subsection 301.03.1**. Ensure that all materials meet all specifications before placement. Do not cull deleterious or out of specification material after placement and/or grading in-place, unless directed otherwise by the Engineer.

302.03.2 Shaping and Compaction.

Use shaping and compaction of subbase materials that conforms to **Subsection 301.03.2**.

302.04 METHOD OF MEASUREMENT.

Gravel Borrow Subbase Course will be measured by the number of cubic yards placed.

302.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Gravel Borrow Subbase Course	CY

The price constitutes full compensation for all labor, materials, equipment, and all incidentals, including trimming and fine grading, required to finish the work, complete and accepted.

SECTION 303 — SPECIAL GRADED AGGREGATE FOR SHAPING AND TRIMMING DRIVEWAYS AND SHOULDERS

303.01 DESCRIPTION.

This work includes providing special graded aggregate as a surface course for driveways or shoulders.

303.02 MATERIALS.

Use special graded aggregate that meets the requirements of **Subsection M01.09**.

303.03 CONSTRUCTION METHODS.

303.03.1 Placing.

When used as a crushed aggregate surface course to provide a transition between existing gravel/aggregate surfaces and new asphalt, place the special graded aggregate in layers so that the maximum compacted thickness of any layer does not exceed 6 in.

303.03.2 Shaping and Compaction.

Shape and compact special graded aggregate according to **Subsection 301.03.2**.

303.04 METHOD OF MEASUREMENT.

Special Graded Aggregate will be measured by the number of cubic yards.

303.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Special Graded Aggregate	CY

The price constitutes full compensation for all labor, materials, equipment, and all incidentals, including trimming and fine grading, required to finish the work, complete and accepted.

Part 400
ASPHALT PAVEMENTS

SECTION 401 — DENSE GRADED HOT MIX ASPHALT (HMA) PAVEMENTS

401.01 DESCRIPTION.

This work includes constructing HMA pavements on prepared foundations.

HMA includes a mixture of aggregate, performance graded asphalt binder (PGAB), and filler if required. The aggregate is sized, graded, and combined in proportions necessary for the mixture to meet the gradation requirements of the job mix formula (JMF).

401.02 MATERIALS.

401.02.1 Aggregates.

Use aggregates that comply with **Subsection M03.02.2** and AASHTO M 323. Ensure that no more than 10 percent of the aggregate in the HMA is natural sand with the exception of Class 4.75 HMA, which must include no more than 20 percent.

401.02.2 Performance Graded Asphalt Binder (PGAB).

Use PGAB that meets AASHTO M 320, M 332, R 29, and R 92.

PGAB Requirements

Class of Mix	PGAB Requirement
4.75, 9.5, 12.5, 19.0, and Base Courses	PG 64S-28
19.0 and Base Course with less than 15 percent RAP required	PG 64S-22
19.0 and Base Course with 15 to 25 percent RAP required	PG 58S-22
All classes designated as “Modified”	PG 64E-28 with a minimum 2.5 percent SBS polymer

If a class of HMA is designated as “with WMA,” use a warm mix additive. Select the WMA from the RIDOT Approved Materials List.

Do not use re-refined engine oil bottoms (REOB) in any PGAB.

401.02.3 Mix Design.

Use HMA mixes that conform to AASHTO M 323, “Standard Specification for Superpave Volumetric Mix Design.” Follow the design procedure for AASHTO R 35, “Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA).” Determine the optimum binder content (OBC) as follows:

- Determine the OBC for Class 4.75, Class 9.5, and Class 12.5 when not designated as base course using PG 64S-28.
- Determine the OBC for Class 4.75, Class 9.5, and Class 12.5 when designated as base course with less than 15 percent RAP using PG 64S-22.
- Determine the OBC for Class 4.75, Class 9.5, and Class 12.5 when designated as base course with 15 to 25 percent RAP using PG 58S-28.
- Determine the OBC for Class 19.0 with less than 15 percent RAP using PG 64S-22.
- Determine the OBC for Class 19.0 with 15 to 25 percent RAP using PG 58S-28.

Provide the effective voids in the mineral aggregate ($VMA_{effective}$) for each asphalt content during the mix design process. An individual certified in mix design technology by the Asphalt Institute shall develop and sign the mix design. Provide new mix designs no later than two weeks before the date when production of the mixture is scheduled to begin, and provide a copy of the individual's certification. Do not produce a mixture for State projects until the mix design is approved by the Engineer. Provide mix designs on forms provided by the Engineer.

The following specific requirements and exceptions to AASHTO M 323 apply:

- Obtain the specific gravity, absorption, and consensus properties of the aggregates from RIDOT's most recent sampling and testing or from a laboratory accredited by AASHTO to perform AASHTO T 84 and T 85.
- Comply with the implementation of the recommendations of Section 4.2 of AASHTO R 35.
- Use a coarse-graded mix as defined in Section 6.1.3 of AASHTO M 323.
- Ensure that the dust to binder ratio ($P_{0.075}/P_{be}$) is 0.5 to 1.0. Use the effective binder content to calculate this ratio.
- In addition to the sieves listed in Table 3 of AASHTO M 323, use the 0.600 mm, 0.300 mm, and 0.150 mm sieves. The 50.0 mm and 37.5 mm sieves are not required.
- Design Class 19.0 and mixes designated as base course with a 0 percent, 10 percent, 15 percent, 20 percent, or 25 percent RAP content. Do not use RAP in any other mix.
- Ensure that $N_{initial}$ is 6, N_{design} is 50, and N_{max} is 75 gyrations.
- A moisture susceptibility test is not required.
- Ensure that the design VMA, VFA, air voids, and minimum optimum binder content (OBC) meet the criteria in the following Table.

HMA Properties

Class of Mix	VMA (minimum)	VFA	Air Voids	Minimum OBC
4.75	17.5%	70% – 80%	4%	7.0
9.5	16.5%	70% -–80%	4%	6.0
12.5	15.5%	70% – 80%	4%	5.5
19.0	14.5%	70% – 80%	4%	5.0

Comply with the following procedures for each mix design:

- Provide three aggregate trial blends for approval.
- After approval, blend the three trial aggregate blend gradations, and provide according to Section 4.2 of AASHTO R 35.
- Provide all trial mixture data and calculations determined per Section 9 of AASHTO R 35 on forms provided by the Engineer. The Engineer will determine which trial mixture will be used for the mix design procedure.
- After a new mix design is completed, provide to the Engineer for review and approval.
- The Engineer will provide the correction factors for each mix for each ignition furnace in the plant lab.

Provide the two gyratory cores (AASHTO T 312) and the theoretical maximum specific gravity sample (AASHTO T 209) at the optimum binder content to the Engineer.

Before beginning production of a new HMA mix, perform a successful plant trial batch for that mix. The Engineer will test a split of the sample taken by the Contractor. Provide notification of the date and time of the trial batch to the Engineer 24 hours in advance.

If there is a change in sources of materials, establish a new mix design before the new material is used. When the Engineer determines that unsatisfactory results or other conditions make it necessary, establish a new mix design and provide it to the Engineer for approval.

401.02.4 Quality Assurance.

a. Process Control. Exercise process control over all production operations. Provide constant monitoring of equipment, materials, and production activity such as testing and analysis to ensure that the HMA meets all applicable requirements and is produced within the allowable tolerances.

b. Acceptance Testing. The Engineer will conduct acceptance testing. Take samples at the direction and in the presence of the Engineer according to AASHTO T 168. The Engineer will take immediate possession of the samples. Samples not provided to the Engineer immediately will not be used for acceptance. Use personnel certified by NETTCP (Northeast Transportation Training and Certification Program) as an HMA Plant Technician and subject to RIDOT Independent Assurance sampling and testing.

   1. Gradation, Binder Content, and Air Void Content. Perform gradations according to AASHTO T 30. The requirements in the Table below apply to mixes with and without pay adjustments.

      During production of a specific mix, if two consecutive tests do not meet the gradation requirements of the above Table or if one test exceeds double the tolerance on the control sieve, cease production of that HMA mix. The Engineer will allow production to resume after the Contractor completes a successful trial batch for that class of mix. Acceptance sampling will resume with the subsequent sublot or as determined by the Engineer.

Gradation Requirements

	Class 19.0	Class 12.5	Class 9.5	Class 4.75
25.0 mm (1 in.)	100%	100%	100%	100%
19.0 mm (¾ in.)	90% – 100%	100%	100%	100%
12.5 mm (½ in.)	90% max	90% – 100%	100%	100%
9.5 mm (⅜ in.)	—	90% max	90% – 100%	95% – 100%
4.75 mm (#4)	—	—	90% max	85% – 100%
2.36 mm (#8)	±5% from design	±5% from design	±5% from design	—
1.18 mm (#16)	—	—	—	±5% from design
0.075 mm (#200)	≥ 2%	≥ 2%	≥ 2%	≥ 2%
Control Sieve	2.36 mm (#8)	2.36 mm (#8)	2.36 mm (#8)	1.18 mm (#16)

The Engineer will determine the binder content according to AASHTO T 308 and the air voids according to AASHTO T 269. The plant shutdown criteria in the Table below will apply for binder content and air voids that exceed the following tolerances.

Plant Shutdown Criteria

Pay Adjustments	Shutdown Criteria	One Test	Two Consecutive Tests
With Pay Adjustments	Optimum Binder Content	±0.6%	—
	Design Air Voids	±2.0%	—
Without Pay Adjustments	Optimum Binder Content	±0.6%	±0.4%
	Design Air Voids	±2.0%	±1.0%

Any combination of gradation, binder content, and voids that exceed specifications on two consecutive tests requires the Contractor to shut down the plant. Do not sample trial batches until acceptance testing is complete. The Engineer will allow production to resume after the Contractor completes a successful trial batch for that class of mix.

2. Mix Production — Lots and Sublots. A standard sublot is 600 tons for HMA sampled at the plant for each production run. A standard lot for each mix is 10 sublots. A sample will be randomly selected and tested for each sublot. At least five sublots will be used when calculating pay adjustments.

   If the quantity of HMA needed to finish a production run is projected by the Contractor to be less than the standard sublot size of 600 tons, the projected tonnage may be used to select a random sample. If the projected tonnage is not produced or a random sample is unable to be taken, the Engineer may select a sample at the end of the run or at the paver. If no sample is taken, the tonnage will be added to the previous sublot.

   Additional samples may be taken at the discretion of the Engineer.

   Gyratory cores and theoretical maximum density samples will be retained by the Engineer for two weeks after the results are reported to the Contractor.

3. Adjustments to Lots. If less than five sublots are tested after the end of the final standard lot, they will be added to that lot. Five or more sublots tested after the end of the final standard lot will constitute a separate lot.

4. Plant Pay Adjustments. If a class of HMA is designated with pay adjustments, the pay adjustments for deviation from the optimum binder content (established by the mix design) in the Table below and the design air void content in the second Table will apply.

OBC Pay Adjustments

Deviation from Optimum Binder Content	Pay Adjustment
Less than or equal to 0.1%	+2%
0.2%	+1%
0.3%	0%
0.4%	-5%
0.5%	-15%
0.6%	-30%
0.7%	-40%
Greater than 0.7%	-50% or Remove and Replace*

Air Void Pay Adjustments

Deviation from Design Air Void Content	Pay Adjustment
Less than or equal to 0.5%	+1%
0.6% to 1.0%	0%
1.1% to 1.5%	-5%
1.6% to 2.0%	-10%
2.1% to 2.5%	-30%
2.6% to 3.0%	-40%
Greater than 3.0%	-50% or Remove and Replace*

** The decision to make 50% payment or remove and replace will be made by the Engineer.*

Note: All deviation values will be rounded to the nearest 0.1 percent before applying pay adjustments.

5. Calculation of Pay Adjustments for Production Binder and Air Void Content. For each test, absolute deviations will be used when determining binder and air void content pay adjustments. Absolute deviations are the values of deviation regardless of sign (±). The average of the absolute deviations from the optimum binder content of all sublots in each lot will be used to determine the appropriate pay adjustments for the lots. The same will apply for air void content. No payment will be made for any pavement that is removed.

6. Independent Assurance Testing. The Department will perform this testing according to the RIDOT publication, “Schedule for Sampling, Testing, and Certification of Materials.”

401.03 CONSTRUCTION METHODS.

401.03.1 HMA Mixing Plant.

Ensure that the HMA plant complies with AASHTO M 156.

401.03.2 Hauling Equipment.

Ensure that trucks or other equipment used for hauling HMA have tight, clean, smooth, metal beds, which have been thinly coated with an approved release agent. Do not apply diesel fuel or other material to any portion of the vehicle that contacts the HMA. For each truck, provide a solid cover of canvas or other suitable material that protects the mixture from the weather.

Load tri-axle trucks using a minimum of two drops, front and back. Load trailers using a minimum of three drops with the center drop always occurring last.

Do not clean equipment (vehicles, truck beds, etc.) in areas to be paved.

A material transfer vehicle (MTV) is required for the construction of all HMA friction, surface, intermediate, and base courses on all limited access highways listed in the Table below. Use the MTV on travel lanes, auxiliary lanes, climbing lanes, acceleration and deceleration lanes, ramps, collector/distributor roads, service roads, and shoulder widths greater than 8 ft.

Adjust the speed of the paver and MTV to coordinate with the availability of HMA. Failure to keep the MTV supplied with HMA may be cause to cease paving operations.

Ensure that the MTV independently delivers HMA from the hauling equipment to the paving equipment. Install a paving hopper insert with a minimum capacity of 14 tons in the hopper of conventional paving equipment when a MTV is used.

As a minimum, use a MTV that has a high capacity truck unloading system that will receive HMA from the hauling equipment, a storage system in the MTV with a minimum capacity of 15 tons of HMA, and a discharge conveyor that can swivel to either side to deliver the mixture to the paver while allowing the MTV to operate from an adjacent lane. In addition, ensure that the paving operation contains a remixing system to blend the mixture before placement. Adjust the speed of the paver and MTV to coordinate with the availability of HMA. Failure to keep the MTV supplied with HMA may be cause to cease paving operations for this work. In addition, the Engineer will suspend paving operations if more than two stoppages occur.

When a MTV will be used on a Project, investigate the possible movement of the fully or partially loaded MTV on the Project. If there are any structures that the fully or partially loaded MTV will traverse, request an Overweight Permit Check from the Department. Provide a copy of the request in writing to the Engineer, and include the axle configuration, weights, and the Project limits. Do not restart operations until permission is received from the Engineer.

The following Table is a list of roadways requiring the use of a MTV.

Route Number	Limits
I-95	Connecticut State Line to Massachusetts State Line
I-195	I-95 to Massachusetts State Line
I-295	I-95 to Massachusetts State Line
US Route 1	Prosser Trail to Wakefield Cut-Off
RI Route 4	Route 1 to I-95
US Route 6	Route 102 to Route 101; Route 10 to I-295
RI Route 10	Park Avenue to Route 6
US Route 6/RI Route 10	Magnolia Street Bridge to I-95
RI Route 24	Route 114 to Massachusetts State Line
RI Route 37	Natick Avenue to Post Road
RI Route 78	Route 1 to Connecticut State Line
RI Route 99	Route 146 to Mendon Road
East Shore Expressway	I-195 to Wampanoag Trail
RI Route 114	East Shore Expressway to Forbes Street
RI Route 138	Route 1 to Admiral Kalbfus Road
RI Route 146	I-95 to Reservoir Road
RI Route 146	Route 146A to Massachusetts State Line
RI Route 403	Route 4 to Quonset Point
Airport Connector	I-95 to Post Road
Henderson Bridge Access Roadway	Waterman Street/So. Angell Street to Broadway

401.03.3 Pavers.

Spread mixtures using a self-powered paver capable of spreading to line, grade, and crown.

Use auger extensions when the end of the screed extension is more than 2 ft from the end of the augers.

Ensure that the screed and screed extenders continually vibrate while placing the mixture. Ensure that the screed is heated to maintain the HMA at the required placement temperature.

Ensure that the paver has been equipped with automatic screed controls with sensors for both sides of the paver, capable of sensing grade from an outside reference line, sensing the transverse slope of the screed and providing the automatic signals that operate the screed to maintain the desired grade and transverse slope. Ensure that the sensors can operate from a ski-type device or reference beam of not less than 25 ft in length. Ensure that the sensors can operate from a reference line, unless the ski-type device or reference beam can ride on an adjacent, newly placed lift of HMA.

Provide reference lines for the control of horizontal alignment, subject to the approval of the Engineer.

Ensure that the transverse slope controller can maintain the screed at the desired slope within ±0.1 percent. Ensure that the paver is equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of materials ahead of the screed.

Manual operation will be permitted in the construction of irregularly shaped and minor areas or where otherwise allowed by the Engineer.

401.03.4 Conditioning of Existing Surfaces.

Remove all striping on existing surfaces before applying the tack coat. Provide a thin, even coating of tack to surfaces of curbs, gutters, vertical faces of existing pavements, and all structures that will contact the HMA. Avoid the splattering of surfaces that will not contact the HMA.

When a tack coat is required, provide a type and grade and application method that conforms to **SECTION M03** and **SECTION 403**.

401.03.5 Spreading and Finishing.

Lay the mixture on an approved clean surface, which has been spread and struck off to the established grade and elevation. Use HMA pavers to distribute the mixture either over the entire width or over a partial width approved by the Engineer. Ensure that transverse joints are clean, smooth, uniform, vertical, and constructed using a fixed depth road saw.

Ensure that the practices and guidelines for placing HMA comply with the Asphalt Institute Publication MS-22, “Construction of Hot Mix Asphalt Pavements.”

Do not allow unnecessary walking on the uncompacted HMA mat.

Before beginning a new lane, heat the screed to the proper operating temperature and remove any clumps of cold material in the paver hopper.

Do not allow trucks or other equipment on freshly placed HMA, unless permitted by the Engineer.

Where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, place the mixture as close to its final position as possible. Spread, rake, and lute with hand tools to minimize segregation and provide the required compacted thickness.

Protect catch basins to prevent HMA from entering the basin and to enable the grate to be easily removed after paving. If paving results in HMA entering the catch basin or in bonding the grate to the frame preventing its normal removal, remove all HMA from the catch basin and clean the grate to debond the two.

If unforeseen circumstances cause the paving operation to cease, provide a minimum of three loaded trucks on site before paving will be allowed to resume.

401.03.6 Compaction.

Immediately after the HMA has been spread, struck off, and surface irregularities adjusted, uniformly compact by rolling.

Roll the surface when the mixture is in the proper condition and when rolling does not cause undue displacement, cracking, and shoving.

Compact HMA used on bridge decks with an oscillatory roller.

Compact HMA used as leveling course with a pneumatic roller.

Use two rollers for all paving operations that exceed a daily total of 500 tons, except for driveway, sidewalk, and bridge deck paving operations. Provide a number, weight, and type of roller(s) sufficient to compact the mixture to the required density before it reaches the minimum compaction temperature. Use rollers in the vibratory mode. Provide rollers used for compaction with a minimum operating weight of 10 tons or greater. Do not use equipment that results in excessive crushing of the aggregate.

Ensure that the speed of a roller does not exceed 5 mph.

Do not park rollers on HMA. Only stop rollers on HMA when reversing direction. When reversing direction, ensure that the action is smooth, not abrupt. Ensure that the drive wheel approaches the new mix, not the tiller wheel.

When a vibratory roller is used for finish rolling, use the roller in the static mode. Continue finishing rolling until all roller marks are eliminated. Do not allow traffic on newly placed pavement until the temperature falls below 130 degrees F.

Ensure that the motion of the rollers is sufficiently slow to avoid displacement of the hot mixture. Ensure that the wheels of steel-wheel rollers remain moist and clean to prevent adhesion of the fresh material; however, do not apply an excess of water.

If satisfactory density cannot be obtained in any lift, and if the Engineer determines that it is structurally inadequate and/or incapable of maintaining material integrity, remove and replace the area(s) at no additional cost to the Department.

Remove and replace any mixture that becomes loose and broken, mixed with dirt, or is otherwise defective and place fresh hot mixture, which must be compacted to conform to the surrounding area. Remove and replace any area demonstrating an excess or deficiency of PGAB.

a. In-Place Density for Classes of HMA **not** Designated as "with Pay Adjustments." For HMA not designated with Pay Adjustments, ensure that the in-place density is a minimum of 92 percent of the theoretical maximum density obtained at the plant.

   If a class of HMA is designated for bridge decks, use an oscillatory roller with a minimum operational weight of 8 tons. For HMA designated for bridge decks and with Pay Adjustments, the pay adjustments will only apply to binder content and air voids. In-place density will not be used for acceptance testing.

   If a class of HMA is designated for leveling, place the HMA with a paver. Use a pneumatic roller with a minimum operational weight of 8 tons. In-place density will not be used for acceptance testing. For HMA designated for leveling and with Pay Adjustments, the pay adjustments will apply only to binder content and air voids.

   If a class of HMA is designated for patching, miscellaneous work, or paved waterways, place the HMA by hand. Use a vibratory plate compactor or roller. A hand tamper may be used only if approved by the Engineer. In-place density will not be used for acceptance testing.

b. In-Place Density for Classes of HMA designated as "with Pay Adjustments." Compaction density will be measured using cores of in-place pavement extracted according to AASHTO R 67. Extract cores under the direction of and witnessed by the Engineer. Otherwise, the cores will not be used for acceptance. The Engineer will determine the location of all cores. Each lot and sublot for in-place density cores will be matched as near as practical to each production lot and sublot used at the plant.

Extract all cores after completion of rolling operations and before the paved section is open to traffic. The Engineer will take immediate possession of the cores upon extraction. If the Contractor does not obtain cores before a sublot is open to traffic, no bonus (pay adjustment resulting in more than 0 percent) will be paid for the sublot but disincentives will still apply.

Bulk specific gravities will be determined according to AASHTO T 166, regardless of whether the absorption exceeds 2.0 percent. The Engineer will retain the cores for four weeks after the results are reported to the Contractor.

For HMA designated as for bridge decks, cores will not be required or allowed.

The Contractor may extract its own cores for QC to monitor in-place density and production quality; however, these cores will not be used for acceptance.

1. Mat Density. A standard sublot is 600 tons. A non-standard sublot is the quantity of HMA placed if there is less than 600 tons produced after the final standard sublot.

   Under the direction of and witness by the Engineer, extract two stratified, randomly selected cores (diameters between 3.75 in. and 4 in.) from the mat for each standard sublot. One core is taken for sublots less than 450 tons. The Table below will be used to determine the minimum number of cores extracted from the mat. The center of each core used to determine mat density will be at least 1 ft away from the edge of pavement, transverse or longitudinal joints, or drainage structures.

MAT Density Core Quantities

Expected Daily Production Tonnage	Minimum Number of Mat Cores
450 or Less	1
451 – 750	2
751 – 1050	3
1051 – 1350	4
1351 – 1650	5
1651 – 1950	6
1951 – 2250	7
2251 – 2550	8
2551 – 2850	9
2851 – 3150	10

2. Joint Density. Extract one joint density core for every 3000 ft or less when a joint is formed. Extract joint cores so that the center is within 2 in. of the middle of the sloped

portion of a notched-wedge joint or within 1 in. of the middle of a butt joint. Ensure that cores taken from butt joints are 6 in. in diameter.

3. In-Place Density Pay Adjustments. In-place density will be measured and reported as a percent of theoretical maximum density. The pay adjustments from the Table below will be made for in-place mat density.

MAT Density Pay Adjustments

In-Place Mat Density	Pay Adjustment
95.0% and greater	+2%
94.0% to 94.9%	+1%
93.0% to 93.9%	0%
92.0% to 92.9%	-5%
91.0% to 91.9%	-15%
90.0% to 90.9%	-25%
89.0% to 89.9%	-35%
Below 89.0%	Remove and Replace

The pay adjustments from the Table below will be made for in-place joint density.

Joint Density Pay Adjustments

In-Place Joint Density	Pay Adjustment
93.0% and greater	+2%
92.0% to 92.9%	+1%
91.0% to 91.9%	0%
90.0% to 90.9%	-5%
89.0% to 89.9%	-15%
88.0% to 88.9%	-25%
87.0% to 87.9%	-35%
Below 87.0%	-100%

Note: All density values will be rounded to the nearest 0.1% before applying pay adjustments.

4. Calculation of Pay Adjustments for In-Place Density.

- Mat Density. For each sublot, the bulk specific gravity (Gmb) of the mat density core(s) will be averaged and then compared to the corresponding plant theoretical maximum specific gravity (Gmm) to calculate the in-place density for each sublot. The average of the sublot densities in a lot will be used to determine the appropriate pay adjustment for that lot. Lot pay adjustments will be applied to the respective quantity of HMA in each lot.
- Joint Density. For joint density pay adjustments, a joint lot will be defined as 10 joint density results. However, if less than five joint density results are remaining after the final full joint lot is formed, they will be added to the previous joint lot. Five or more joint density results remaining after the final full joint lot will constitute a separate joint

lot. A minimum of five joint density cores will be used to calculate pay adjustments. If five cores are not available, the joint density pay adjustments will not be used.

Calculation of in-place joint density will be determined using the Gmb of joint density cores and the project average plant Gmm of the respective mix. The average of the individual joint density results in a joint lot will be used to determine the appropriate pay adjustment for that joint lot. The calculation of material quantity used to construct the joints will be based on the joint core density, the specified thickness, a width of one ft and the total length of the joints on the Project. This quantity will be deducted from the total tonnage.

401.03.7 Joints.

Ensure that the placement of the HMA is as continuous as possible. Do not allow rollers to pass over the unprotected end of a freshly laid mixture, unless authorized by the Engineer.

Stagger both longitudinal and transverse joints in successive courses so that neither is above the other. Stagger longitudinal and transverse joints a minimum of 6 in., and arrange so that the longitudinal joint in the top course is at the location of the line dividing the traffic lanes. Rake any HMA that falls on the cold side of the mat onto the hot side during paving operations. Ensure that the material pushed onto the hot side of the joint remains in the joint area and is not broadcast over the pavement.

Use a notched wedge joint maker on all drop-offs, regardless of whether they are on the left, right, or both sides of the pavement. Construct joints so that the height of the notch is the same as the nominal maximum aggregate size. Provide a width of the sloped portion of the joint that is at least 6 in. for each inch of lift thickness if the joint will be exposed to traffic. However, ensure that the width is 12 in. minimum. Apply tack coat to the longitudinal notched wedge joint that covers the joint. If a distribution truck is used, apply the tack coat at twice the specified rate. Manually brush transverse joints and joints at intersections with tack coat, ensuring that the face is completely covered.

401.03.8 Pavement Samples.

As directed, cut samples from the compacted pavement for testing by the Engineer. Extract samples of the mixture for the full depth of the course at the locations directed by the Engineer.

Where samples have been taken, place and compact new material to conform to the surrounding area.

401.03.9 Weather Limitations.

Do not place HMA on any wet surface or when weather conditions otherwise prevent the proper handling or finishing of the HMA.

For lifts with a target compacted lift thickness less than or equal to 1.5 in., only place HMA when both the air and surface temperature in the shade is 45°F or greater. If an approved WMA (warm mix additive) is used, ensure that the temperatures are 40°F or greater. For lifts with a target compacted lift thickness greater than 1.5 in., only place HMA when both the air and surface temperature in the shade is 40°F or greater. Do not place HMA on frozen ground.

Ensure that the HMA mat is at least 265°F when placed. If, after mobilization, the weather limitations have an impact, assume all costs associated with the stopping, delaying, or canceling of operations.

401.03.10 Cold-Weather Paving.

If the existing pavement is removed before the winter shutdown, do not close the Project for the season until a new HMA layer has been placed and striped with temporary epoxy pavement markings. If paving cannot be performed because temperatures do not rise above 40°F, then the pavement will be designated as temporary. Repave that segment of roadway in the spring when temperatures exceed 40°F.

401.03.11 Drop-Offs.

a. Longitudinal Drop-Offs. A longitudinal drop-off is the difference in elevation between the top of recently placed or milled HMA pavement and the top of adjacent ground or pavement. Ensure that drop-offs on recently placed pavements conform to **Subsection 401.03.7**. Construct all longitudinal drop-offs using a notched wedge joint maker, unless otherwise approved by the Engineer. See the RIDOT *Standard Details*.

b. Transverse Drop-Offs. Transverse drop-offs occur as follows:

- Pavement Removal. A transverse drop-off occurs when pavement removal operations begin or end on a working day. The drop-off is the difference in elevation between the bottom of the excavated pavement and the top of the existing pavement.

- Pavement Overlay. A transverse drop-off occurs when pavement overlay operations begin or end on a working day. The drop-off is the difference in elevation between the top of the overlay pavement and the top of the underlying pavement. Construct drop-offs using a bond breaking material between the drop-off and the underlying pavement.

If traffic is allowed across any transverse drop-off before the resumption of pavement removal or pavement overlay operations, provide tapers as follows:

- Construct all slopes with HMA conforming to the requirements of **SECTION 401.**

- Place BUMP signs according to the *Manual on Uniform Traffic Control Devices* for each drop-off for each direction of traffic.

- Before the resumption of pavement overlay operations, remove the transition slope as follows: Saw cut the pavement overlay back approximately 6 in. to expose a fresh, full thickness vertical face. Brush paint or pressure spray this face with tack coat, after which the HMA paving may resume. The sawcut work will be considered incidental to pavement operations.

401.04 METHOD OF MEASUREMENT.

401.04.1 Measurement of HMA Pavement.

HMA pavements will be measured by the number of tons placed.

a. Determination of Thickness. Before the determination of the in-place thickness, ensure that the roadway exhibits acceptable workmanship and that all defects have been corrected. The placed thickness of HMA pavement will be determined by cutting or coring holes. For courses with in-place density cores specified, the average thickness of the density cores will be used to determine the in-place thickness. For courses placed on bridge decks, bike paths, or sidewalks, neither final nor density cores will be required.

   Cores will be measured according to ASTM D3549, "Standard Test Method for Thickness or Height of Compacted HMA Paving Mixture Specimens." The depth measurement will apply to the full width of the lane. Measurements will be made at random locations as determined by the Engineer.

   For the determination of thickness, a shoulder width of 8 ft or greater will be considered to be a separate lane of the roadway. A shoulder width of less than 8 ft will be considered part of the adjacent lane. For cores taken by the Contractor, fill all holes with a compacted, dense HMA that is acceptable to the Engineer. If required by the Engineer, maintain and control traffic while pavement samples are taken and while the holes are being filled and compacted.

b. Adjustment of Tonnage Quantity. The pavement thickness will be considered acceptable if both of the following requirements are met:

   - The total HMA tonnage delivered and placed does not exceed the tonnage calculated from the approved area measured from the final surface course width by the Project length and the specified pavement thickness by more than 5 percent.

   - When "Specification Conformity Analysis," FHWA Technical Advisory T5080.12," dated June 23, 1989, is applied to the entire roadway or sections thereof as determined by the Engineer, at least 80 percent of the total HMA pavement will have a thickness that meets the minimum pavement thickness. The minimum pavement thickness is that contained in the Contract minus ½ in. (e.g., a total pavement thickness of 7 in. will have a minimum pavement thickness requirement of 6.5 in.).

   If the first requirement is not met, no payment will be made for all tonnage exceeding 5 percent, unless unusual field conditions are present and documented (e.g., pavement rutting).

   If the second requirement indicates that the pavement thickness is deficient, place a correction course, with the permission of the Engineer, not less than 1 in. in depth after compaction, provided that an acceptable grade and cross section can be achieved. Where an acceptable grade and cross section cannot be achieved through the above means, reconstruct by cutting back and into the pavement a sufficient distance to permit the placement of an acceptable depth, and place new material to achieve the proper depth, cross section, and profile. Where a corrective course is placed or reconstruction of the pavement is performed, these areas will be measured again as though originally constructed. No compensation will be made for the material removed; or removal of materials and disposal thereof; or for restoration of the affected supporting base or adjacent construction; or for traffic control; or for adjusting all utility appurtenances in the roadway; or for correcting pavement striping. Compensation will be made for the additional pavement correction course accepted in place.

Determination of the quantity to be used for adjusted payment or exclusion for payment will be based on tons per square yard per inch thickness as determined using in-place density cores or 96 percent of the plant core (AASHTO T245) densities if in-place densities are not available. If both in-place and plant core densities are not available, 94 percent of the plant theoretical maximum density results will be used.

Sweeping and cleaning, as included in the items covered by this Section, only refers to the normal removal of dust, debris, etc.

Work described in **Subsection 401.03.4** will be paid for at the Contract unit prices for the material used.

c. Tolerance Limitation. Unless e-ticketing is used, when delivery tickets are directly collected by the Engineer from each truck before placing in the hopper, the delivery tickets will be used in the determination of total tonnage delivered and placed. Payment will be made at the Contract unit bid prices with pay adjustments for all accepted HMA up to 105 percent of the Contract quantity tonnage. Accepted HMA quantities above 105 percent and up to 110 percent of the Contract quantity tonnage will be paid at 50 percent of the Contract unit bid price and, with the resultant adjusted price, will be further modified by additional pay adjustments as applicable according to the following formula:

Pay adjustments will apply to 50 percent of the Contract unit bid price for quantities above 105 percent and up to 110 percent. No payment will be made for quantities above 110 percent.

401.04.2 Measurement of HMA Preparation.

HMA preparation will be measured by SY. This includes asphalt emulsion tack coat, cleaning and sweeping, removal and disposal, reclamation, micro milling, and removing pavement markings.

401.05 BASIS OF PAYMENT.

The Department will pay for the in-place, completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Hot Mix Asphalt	Ton
Hot Mix Asphalt Preparation – Partial Depth	SY
Hot Mix Asphalt Preparation – Full Depth	SY

The price for HMA constitutes full compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted. Includes labor & materials for asphalt berm.

The price for HMA Preparation – Partial Depth constitutes full compensation for all labor, materials, and equipment, including cleaning and sweeping, micro milling, removal & disposal of flexible pavement, removing pavement markings, saw cutting of pavement, placement and

subsequent removal of temporary covers and structures, tack coat, and all other incidentals required to finish the work, complete and accepted.

The price for HMA Preparation – Full Depth constitutes full compensation for all labor, materials, and equipment, including cleaning and sweeping, saw cutting of pavement, removal & disposal of flexible pavement and rigid base, scarifying, mixing, pulverizing, spreading, reshaping, calcium chloride and water for compaction and dust control, regrading, rolling, compacting, trimming and fine grading of subgrade and subbase, the removal and disposal of unsuitable materials, hauling or other handling of recyclable materials off-site, the movement of surplus asphalt-stabilized base material from one location to another within the Project limits, placement and subsequent removal of temporary covers and structures, tack coat, and all other incidentals required to finish the work, complete and accepted.

Pay adjustments for binder content, air voids, and in-place density will be added together to determine a final pay adjustment for both the mat and the joint. If more than one pay adjustment is negative, then only the most negative adjustment will be added to the remaining non-negative adjustments to determine the final pay adjustment. Pay adjustments will be addressed using Item Code 416.0100. Disincentives will be addressed using a Report of Change.

All construction associated with drop-offs and the installation and removal of tapers is incidental and is not paid for separately.

SECTION 402 — FRICTION COURSE

402.01 DESCRIPTION.

Produce and place Friction Course according to **SECTION 401** with the following exceptions and qualifications.

402.02 MATERIALS.

Ensure that all materials comply with **SECTION 401** with the following qualifications.

402.02.1 Performance Graded Binder.

Use a binder that complies with PG 64E-28 as specified in **SECTION 401**. If the friction course is specified as "for Shoulders," use a binder that complies with PG 64S-28 as specified in **SECTION 401**.

402.02.2 Mix Design.

Provide a mix design that is a 50-blow Marshall mix meeting the requirements of the Asphalt Institute Publication MS-2 and **SECTION 401** with the following exceptions: The Gradation and Asphalt Content Master Range is:

Sieve Size	Percent Passing
¾ in.	100
½ in.	95 – 100
⅜ in.	70 – 100
#4	25 – 45
#8	20 – 35
#30	8 – 15
#50	5 – 12
#200	2 – 6
% AC	6.0 – 7.0

Notes:
- *Marshall Stability: 750 Minimum*
- *Percent Voids: 5 Minimum*
- *Flow: 8 – 16*

402.02.3 Quality Assurance.

Quality assurance procedures will conform to **SECTION 401** with the following exceptions:

a. Acceptance Testing.

- Binder content will be as determined in **SECTION 401**. Marshall stability, flow, and voids will not be used for acceptance.

b. Plant Pay Adjustments.

- Pay adjustments for deviation from the optimum binder content (as established by the mix design) will be as determined in **SECTION 401**. No other pay adjustments for material properties will be assessed. For pay adjustments to apply, a minimum of 5000 tons must be placed.

- The Tables in **Subsection 401.02.4, paragraph b.4** will be used for pay adjustments.

Ensure that all other tolerances conform to **SECTION 401**.

c. Compaction.

- Use Intelligent Compaction for HMA when the quantity of friction course on the Project is greater than 5000 tons. See **SECTION 415.**

- When friction course is placed on bridge decks, use an oscillatory roller in oscillatory mode.

402.03 CONSTRUCTION.

402.03.1 Placement.

Placement will be as in **Subsection 401.03** with the following exceptions.

Produce the HMA at 300°F ±20°F. Use a material transfer vehicle (MTV) for the placement of friction course and the underlying layer in all travel lanes. Operate the MTV from an adjacent lane unless the Engineer approves its use in the same lane as the paver. The use and operation of a MTV may be waived with justification as approved by the Engineer. If unforeseen circumstances cause the paving operation to cease, provide a minimum of three loaded trucks on site before paving will be allowed to resume.

After placement, uniformly compact the mixture with powered vibratory or oscillatory steel drum rollers. If more than 500 tons of daily placement, operate a minimum of three rollers to handle the output of the plant. If less than 500 tons, operate a minimum of two rollers to handle the output of the plant. Operate rollers in vibratory mode on pavements and oscillatory mode on bridge decks.

Each lane may be paved so that a longitudinal drop-off remains until the next paving session. Proceed with each subsequent paving operation adjacent to the previous. Use a 12-in. notched wedge joint maker on all drop-offs, regardless of whether they are on the left, right, or both sides of the pavement. Spray notched wedge joints with tack coat at a rate of between 0.12 and 0.14 gal/sq yd. Manually brush transverse joints with tack coat. Ensure that transverse drop offs at the end of a paving session comply with **Subsection 401.03.11**.

Use RS-1 or RS-1h tack coat and uniformly apply at a rate of between 0.08 and 0.10 gal/sq yd to the underlying surface to be paved.

402.03.2 Weather Limitations.

Do not place friction course on a wet or damp surface or when the temperature of the surface to be paved, in the shade, is less than 55°F, measured before placement. Only place friction course when the air temperature, in the shade, is at least 55°F. If a WMA (warm mix additive) is used, ensure that both the air and surface temperature in the shade is 50ºF or greater.

If, after mobilization, the weather limitations have an impact, assume all costs associated with the stopping, delaying, or canceling of operations.

402.04 METHOD OF MEASUREMENT.

The method of measurement is the same as in **Subsection 401.04**.

402.05 BASIS OF PAYMENT.

The basis of payment is the same as in **Subsection 401.05**.

SECTION 403 — ASPHALT EMULSION TACK COAT

403.01 DESCRIPTION.

This work includes furnishing, delivering, and placing a liquid asphalt tack coat on asphalt concrete or Portland cement concrete before the placement of an asphalt concrete overlay.

403.02 MATERIALS.

For the asphalt emulsion, use RS-1, RS-1h, SS-1, or SS-1h.

403.03 CONSTRUCTION METHODS.

403.03.1 Equipment.

For application of the asphalt emulsion tack coat, use a pressure distributor that can produce a uniform continuous fine spray, through multiple nozzles, resulting in a uniform, continuous coat of asphalt emulsion over the entire section to be treated. Squeegee or broom out any puddles of tack coat, or correct by any method that will achieve the required surface treatment. Correct any areas not receiving the specified coverage of tack coat.

403.03.2 Application of Asphalt Material.

a. Application Rates. Ensure that the asphalt emulsion is uniformly applied at the following rates over the entire existing surface to be overlaid:

- Old Pavement. Use an application rate of 0.08 gal/sq yd, ±0.02 gal/sq yd.
- New Pavement. The following applies:
  - For new pavements less than seven days old that have not been opened to traffic or construction equipment, a tack coat is not required.
  - For new pavements at least seven days old or that have been opened to traffic, use an application rate of 0.06 gal/sq yd, ±0.02 gal/sq yd.

b. Nozzle Settings. Apply tack coat using the proper nozzle settings and the double coverage or triple coverage techniques as outlined in Chapter 5 of Asphalt Institute Publication MS-22, “Construction of Hot Mix Asphalt Pavements.”

c. Weather Limitations. Apply tack coat to a dry surface.

d. Additional Requirements. Allow the tack coat to cure (break) as determined by the Engineer before paving.

If the tack coat has not fully cured (break and set) after one hour, paving may proceed over the tacked area. Ensure that any material picked up by equipment is removed before it falls onto or affects the newly placed pavement layer. Eliminate or minimize equipment passage over tacked surfaces so as not to hinder or negate the tack’s effectiveness in the pavement bonding process. Correct sections not approved by the Engineer and receive the Engineer’s approval before paving. The Engineer may suspend paving and require the Contractor to provide a detailed action

plan outlining the steps to be taken to ensure the proper application of tack coat before the commencement of further paving operations.

403.04 METHOD OF MEASUREMENT.

Asphalt Emulsion Tack Coat will not be measured or paid for separately.

403.05 BASIS OF PAYMENT.

There is no payment for Asphalt Emulsion Tack Coat, which is considered incidental.

SECTION 404

This Section has been Reserved for Future Use.

SECTION 405

This Section has been Reserved for Future Use.

SECTION 406 — FULL DEPTH RECLAMATION WITH CALCIUM CHLORIDE

406.01 DESCRIPTION.

This work includes the rehabilitation of an existing pavement structure into a processed asphalt stabilized base (recycled) course. The existing asphalt pavement will be pulverized and mixed with the existing gravel borrow subbase to the depth specified.

406.02 MATERIALS.

406.02.1 Reclaimed Base.

Ensure that the processed asphalt stabilized base material conforms to the following gradation:

Sieve Designation	% Passing by Weight
3 in.	95 – 100
No. 200	2 – 15

Ensure that the maximum dimension of any stone, rock, asphalt-bound material, or cobble is not more than 4 in.

If additional material is required, add material from an external source that meets the gradation requirements. Ensure that the scarified pavement and the additional material are mixed, blended, and worked to meet the gradation requirements. The Contractor will be compensated for any additional material that is transported to the site.

406.02.2 Liquid Calcium Chloride.

Where designated, provide a manufacturer to supply the calcium chloride solution as a true solution, and do not reconstitute from flake calcium chloride. Ensure that the calcium meets AASHTO M 144 and the following:

Calcium Chloride	35% ± 1%
Alkali Chloride as NaCl	2% max.
Magnesium as MgCl	0.1% max.

Provide a certificate of compliance.

406.03 CONSTRUCTION METHODS.

406.03.1 Equipment.

406.03.1.1 Reclaimer.

For reclamation, use a traveling rotary reclaimer or equivalent machine capable of cutting and milling through existing asphalt and gravel at depths up to 12 in. with one pass. Ensure that the equipment can effectively pulverize, crush, mix, and blend the recyclable material and additional material, if required, to form a homogeneous mixture of processed base material that will form a

stable base when compacted. Use a self-propelled machine that is equipped with an adjustable grading blade that leaves its path generally smooth for traffic.

406.03.1.2 Calcium Pressure Distributor.

Spray the pulverized asphalt pavement and gravel with calcium chloride, processed, reshaped, rolled, compacted, and fine graded to the required cross sections and/or grades. Ensure that the distributor for calcium chloride can apply liquid calcium chloride in measured quantities at any rate between 0.1 to 2.0 gal/sq yd of roadway surface at any length of spray bar up to 20 ft. Ensure that the distributor can maintain a uniform rate of distribution of material regardless of the change in grade, width, or direction of the road. Equip the distributor with a digital volumetric accumulator meter capable of measuring gallons applied and distance traveled. Equip the volume and measuring device with a power unit for the pump so that the application is by pressure, not gravity. Ensure that the spray nozzles and pressure system provide a sufficient and uniform fan-shaped spray of material throughout the entire length of the spray bar at all times while operating, and ensure that the spray bar is adjustable laterally and vertically. Ensure that the spray covers the roadway surface receiving the treatment.

406.03.1.3 Rollers.

Use at least one vibratory sheepsfoot roller for initial compaction that has a compacting width of not less than 54 in. and a gross weight of not less than 12 tons. Provide a drum that has a minimum of 112 tamping feet. Accomplish the final rolling using a single drum vibratory roller.

406.03.2 Procedure.

Ensure that the pulverization and mixing blends the asphalt and gravel borrow subbase material into a homogeneous mixture. After the first pulverization, apply one application of calcium chloride solution at a rate of 0.75 gallon minimum per square yard to the reclaimed base. Re-pulverize and remix the reclaimed base to ensure complete blending of pulverized asphalt material, underlying gravel, additional material if any, and calcium chloride throughout its depth.

Ensure that the reclaimed base course is fine graded according to the required lines, grades, and typical cross sections. Compact the base course to a uniform density of not less than 95 percent of maximum density as determined by AASHTO T180, Method C.

Test the finished reclaimed base course for smoothness and accuracy of grade. Scarify, reshape, compact, and manipulate any portions that lack the required smoothness or accuracy.

Apply calcium chloride solution to the finished reclaimed base course surface at a minimum rate of 0.25 gal/sq yd.

406.04 METHOD OF MEASUREMENT.

Full Depth Reclamation with Calcium Chloride will be measured by the number of square yards of material placed/reclaimed.

406.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract price as follows.

Pay Item	Pay Unit
Full Depth Reclamation with Calcium Chloride	SY

The Contract price for Full Depth Reclamation with Calcium Chloride constitutes full compensation for all labor, materials, and equipment, including cleaning and sweeping, saw cutting of pavement, removal & disposal of flexible pavement and rigid base, scarifying, mixing, pulverizing, spreading, reshaping, calcium chloride and water for compaction and dust control, regrading, rolling, compacting, trimming and fine grading of subgrade and subbase, the removal and disposal of unsuitable materials, hauling or other handling of recyclable materials off-site, the movement of surplus asphalt-stabilized base material from one location to another within the Project limits, placement and subsequent removal of temporary covers and structures, and all other incidentals required to finish the work, complete and accepted.

SECTION 407

This Section has been Reserved for Future Use.

SECTION 408 — CLEANING AND SEALING CRACKS IN ASPHALT CONCRETE PAVEMENT

408.01 DESCRIPTION.

This work includes the cleaning and sealing of cracks and open joints for all sizes in asphalt concrete pavements. The terms “crack” and “open joint” are used synonymously.

408.02 MATERIALS.

408.02.1 Sealant.

Use one of the following:

a. Sealant. Use joint and crack sealant, hot applied, conforming to ASTM D6690 Type II.

b. Asphalt. Use fiber reinforced modified asphalt compound consisting of:

- Modified Asphalt Binder. Use a blend of modified PGAB and crumb rubber chemically bonded to produce a modified binder that meets the following:
  - Complies with AASHTO M 320, M 332, R 29 and R 92 and meets the requirements of PG 64E-28.
  - Ensure that the elastic recovery at 10°C (AASHTO T 301) is not less than 70 percent.
  - Consists of 7 percent crumb rubber from tires.
  - Provide certification of the composition and PG grade.
- Asphalt Cement. Ensure that the high temperature grade (AASHTO M 320) of the neat asphalt cement does not exceed PG 58-XX.
- Crumb Rubber. Ensure that the maximum size of the crumb rubber is 80 mesh.
- Chemical Bonding Agent. Ensure that the chemical bonding agent is heat stable and compatible with asphalt and rubber.
- Fibers. Use polyester, fully drawn fibers from the Approved Materials List. Use the following for fiber reinforced modified asphalt compound properties:
  - Fiber concentration — 6 percent to 8 percent by weight of modified asphalt binder
  - Uniform dispersion of fibers

  Blend the fibers with the modified asphalt binder according to the recommendations of the manufacturer.

408.02.2 Filler.

Use Class 4.75 HMA for filler.

408.02.3 Blotter Material.

Use 3060 granulated coal slag abrasive.

408.03 CONSTRUCTION METHODS.

408.03.1 Equipment.

Equipment will be subject to the approval of the Engineer and maintained in a satisfactory working condition at all times.

a. Air Compressor. Use air compressors that are portable and capable of furnishing not less than 100 cu ft of air per minute at not less than 120 psi at the nozzle. Ensure that the compressor is equipped with traps that will maintain the compressed air free of oil and water.

b. Hot Air Lance. Use a hot air lance for cleaning, drying, rejuvenating and heating sidewalls of cracks that provides clean, oil-free compressed air at a volume of 100 cubic feet per minute, a pressure of 120 pounds per square inch and a temperature of 2000°F. Ensure that the lance is designed such that the flame does not come in contact with the pavement.

c. Hand Tools. Hand tools such as brooms, shovels, metal bars with chisel shaped ends, tamping equipment and other miscellaneous tools which may be used to accomplish this work.

d. Melting Kettle. Use a unit to melt the sealant that is a double boiler, indirect fired type with a heating capacity of 550°F. Fill the space between the inner and outer shells with suitable heat transfer oil or substitute having a flash point of not less than 530°F. Equip the kettle with a satisfactory means of agitating the crack sealer at all times. This may be accomplished by continuous stirring with mechanically operated paddles and/or by a continuous circulating gear pump attached to the heating unit. Ensure that the kettle is equipped with thermostatic control calibrated between 200°F and 550°F with a +5°F accuracy and a temperature measuring device located such that the Engineer may safely check the temperature of the sealant material.

e. Wand Applicator. Use a wand applicator that is capable of applying the sealant to a minimum 2-in. wide overband. Connect the applicator to the holding tank through a heated applicator hose that ensures operator safety and allows operator control of material flow. Mount a device that can bypass material into a holding tank should the applicator nozzle shut off.

408.03.2 Preparation of Surface.

a. General. Apply material when the ambient temperature is 40°F or above and less than 90°F. Do not apply when the pavement is wet or when frost, snow, or ice is present. If such conditions are present, drying of the cracked areas to be sealed with a hot compressed air lance may be performed with the approval of the Engineer. Do not apply sealant to traffic loops, weigh-in-motion loops, or any other vehicular loop detectors in the roadway pavement. Replace damaged roadway loops at no cost to the Department.

b. Cleaning. Clean all cracks by removing all moisture, dirt, foreign material, and loose edges.

c. Debris Removal. Immediately remove all loose material and debris from the pavement surface.

408.03.3 Sealing of Cracks.

- Do not seal cracks less than 1/16-in. in width.
- Adhere to the following for cracks 1/16-in. to 2 in. in width.
  - Preparation of Sealer. Heat and apply at the temperature specified by the manufacturer.
  - Heating of Cracks. Apply within three minutes of the cracks being heated.
  - Installation of Sealer. Comply with the manufacturer's recommendations and the following. Fill the cracks completely and band with a 2-in. width of sealant centered directly over the crack. Ensure that the middle portion of the sealant band projects between 1/16 in. and 3/16 in. above the pavement profile. Feather the band until the edges are flush with the pavement. Apply additional sealant if it has sunk into the crack, leaving a crevice. Apply to prevent voids or entrapped air. Spread blotter material over the hot sealant to prevent lifting and tracking.
- Filling of Cracks 2-in. or Greater in Width. Coat all contact surfaces of cracks greater than a 1-in. depth with sealant material. Fill with Class 4.75 HMA, compacted by rolling and tamping, and seal with two or more adjacent passes of the wand.
- Alligator Cracks. Seal only the cracks on the perimeter or boundary of the alligator cracked area.

408.04 METHOD OF MEASUREMENT.

Cleaning and Sealing Cracks is measured by the linear feet of cracks sealed. Blotter material is not measured separately for payment.

408.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Cleaning and Sealing Cracks in Asphalt Concrete Pavement	LF

The price constitutes full compensation for furnishing and applying all materials; labor, equipment, and tools; cleaning of cracks and debris removal; maintenance and protection of traffic; and all incidentals necessary to finish the work, complete and accepted.

SECTION 409 — SAWING AND SEALING TRANSVERSE JOINTS IN ASPHALT CONCRETE PAVEMENTS OVER RIGID BASE

409.01 DESCRIPTION.

This work includes making a saw cut transversely across the finished asphalt surface pavement and filling cut with a hot poured asphalt rubber compound.

409.02 MATERIALS.

Use poured joint seal material that is a hot poured asphalt rubber compound conforming to AASHTO M173 and approved by the Engineer.

409.03 CONSTRUCTION METHODS.

409.03.1 Operation.

a. General. Make the saw cut directly over the existing underpavement of the transverse joints. Mark the existing joints to ensure the correct location.

b. Sawing Joints. Construct the joints no sooner than 30 days after the surface course has been applied.

Make the joint saw cut with a power-driven saw. Ensure that the cuts are ⅜-in. wide by ¾-in. deep. Make the saw cuts with an abrasive blade and saw dry.

Extend the completed cuts in a straight line transversely across the pavement equal to the extension of the existing underpavement's transverse joints. Reference each joint to be sawed.

c. Cleaning and Sealing Joints. Clean and seal the sawed joints immediately after the saw cut has been made. Do not allow traffic to knead together or damage the sawed joint. Ensure that each joint is dry before placement of the sealing compound.

The manufacturer shall provide the melting temperature of the sealer, which must not be exceeded by more than 10°F.

Ensure that all cracks are filled to refusal to eliminate all voids or entrapped air. Ensure that the hot seal fills the joint so that, after cooling, the level of the sealer will be flush with the pavement surface. Elevate any depressions in the seal to the specified limit by adding hot seal. Remove all excess or spilled sealer from the pavement by effective methods and discard.

409.04 METHOD OF MEASUREMENT.

Sawing and Sealing Transverse Joints in Asphalt Concrete Pavement will be measured by the number of linear feet of sealed joints installed.

409.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Sawing and Sealing Transverse Joints in Asphalt Concrete Pavement	LF

The Contract price constitutes full compensation for all labor, materials, equipment, and all incidentals required to finish the work, completed and accepted.

SECTION 410 — TEMPORARY PATCHING OF POTHOLES AND TRENCHES

410.01 DESCRIPTION.

This work includes repairing roadway potholes and patching utility and drainage trenches during roadway construction at the locations necessary to maintain a safe and passable transportation facility.

410.02 MATERIALS.

Provide temporary patching material that conforms to Class 4.75 or Class 9.5 hot mix asphalt as required or to high performance cold patching material in **Subsection M03.04**.

410.03 CONSTRUCTION METHODS.

410.03.1 Potholes.

Repair all potholes within the Project limits commencing 10 calendar days following the official notice to proceed.

For the repair, place asphalt patching material by hand in up to 2-in. lifts leaving the repair flush with the existing pavement when complete. Ensure that the pothole is free of loose asphalt, debris, and excess moisture.

410.03.2 Trenches.

Repair all trenches within the Project limits.

Ensure that the existing pavement is neatly cut on both sides. Compact the gravel backfill to the required density. Ensure that the subgrade is free of loose asphalt, debris, and excess moisture. Place the asphalt patch material in a compacted 2-in. lift. When completed, ensure that the patch is flush with the existing pavement.

410.04 METHOD OF MEASUREMENT.

410.04.1 Temporary Patching of Potholes.

Temporary Patching of Potholes will not be measured by a single unit of measurement but, instead, will be documented via the Force Account requirements in Subsection 410.05.1.

410.04.2 Temporary Patching of Trenches.

Temporary Patching of Trenches will be measured by the quantity of tons placed.

410.05 BASIS OF PAYMENT.

410.05.1 Temporary Patching of Potholes.

Temporary Patching of Potholes will be paid for on the Force Account basis of **Subsection 109.04**.

410.05.2 Temporary Patching of Trenches.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Temporary Patching of Trenches	TONS

The Contract price constitutes full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 411 — PAVER PLACED ELASTOMERIC SURFACE TREATMENT

411.01 DESCRIPTION.

This work includes providing a paver-placed elastomeric surface treatment (PPEST). Perform all work according to the provisions of **PART 400**, with the following additions and amendments.

411.02 MATERIALS.

411.02.1 Performance Graded Asphalt Binder (PGAB).

Use PGAB that conforms to AASHTO M 320, M 332, R 29, and R 92 and that meets the requirements of PG 76E-34. Ensure that the elastic recovery at 10ºC (AASHTO T 301) is not less than 75 percent. Do not use re-refined engine oil bottoms. The supplier of the modified asphalt binder shall certify the composition and PG grade of the modified asphalt binder.

Ensure that the high temperature grade (AASHTO M320) of the neat asphalt cement does not exceed PG 58-XX.

411.02.2 Aggregate.

Use an approved coarse aggregate that is virgin crushed quarry rock from the Approved Material List. Do not use processed gravel. Ensure that there is less than 10 percent flat or elongated particles (ASTM D4791). Ensure that the aggregate wear, from resistance to abrasion, is a maximum of 30 percent as determined by the Los Angeles Abrasion Test (AASHTO T 96).

Provide a fine that is crushed stone screenings, natural sand, or a blend of the two. No more than 10 percent of the total aggregate blend may be natural sand.

411.02.3 Mix Design.

Use a mix design that complies with **Subsection 401.02.3**, with the following exceptions:

a. Job-Mix Formula. Ensure that the job-mix formula is within the following master ranges:

Sieve Size	Percent Passing
½ in.	100
⅜ in.	91 – 95
#4	40 – 45
#8	22 – 26
#30	9 – 12
#50	6 – 8
#200	4.0

b. Asphalt Binder Content. Use a modified asphalt binder that is the same grade and consists of the same components in the same proportions as the asphalt binder that will be used in production. Ensure that the mixing and compaction temperatures are the same as those that will be used in production. Ensure that the optimum modified asphalt binder content is not less than 6.0 percent.

c. Mix Requirements. Compact the Marshall specimens with 50 blows on each side. Determine the moisture sensitivity according to AASHTO T-283. At the optimum modified asphalt binder content, ensure that the mix satisfies the following requirements:

Property	Requirements
Stability (lb)	1000 min.
Flow (1/100 in.)	8 – 16
Voids (%)	4 – 6
VMA (%)	18 min.
Moisture Sensitivity (%)	80 min.

411.03 CONSTRUCTION METHODS.

411.03.1 Surface Preparation.

Prepare the surface as described under **SECTION 401**. For the adjustment of drainage appurtenances (e.g., manholes, catch basins), see **SECTION 707**. For the reconstruction of drainage appurtenances, see **SECTION 704**.

411.03.2 Production Tolerances.

Ensure that the aggregate gradation and asphalt binder content of the production mix complies with the job-mix formula and optimum asphalt binder content, within the following tolerances:

Sieve Size	Tolerance
½ in.	—
⅜ in.	±5%
#4	±7%
#8	±4%
#30	±4%
#50	±3%
#200	±1.5%
Asphalt Binder	±0.3%

411.03.3 Mixing and Compaction Temperatures.

Ensure that the mixing and compaction temperatures are as recommended by the supplier of the modified asphalt binder.

411.03.4 Weather Limitations.

Only place the PPEST when the surface is dry and the surface temperature is at least 50°F and rising.

411.03.5 Time Limitation.

Do not place the PPEST before June 1 or after September 30.

411.03.6 Tack Coat.

Apply an SS-1, SS-1h, RS-1, or RS-1h asphalt emulsion tack coat uniformly over the surface on which the PPEST will be placed. Use an application of 0.10 ± 0.01 gal/sq yd. Apply the tack coat using the proper nozzle settings and the double coverage or triple coverage techniques outlined in Chapter 5 of the Asphalt Institute publication MS-22, "Construction of Hot Mix Asphalt Pavements."

411.03.7 Placement.

Use the mix placement temperature as recommended by the supplier of the modified asphalt binder. Ensure that the paver is equipped with thermostatically controlled heaters for the screed and screed extensions. Ensure that the heaters remain on throughout the paving process.

Ensure that the cold edge of longitudinal joints are as vertical and square as possible. Push back sloughed or disturbed material at the edge to form a vertical face in alignment with the joint.

411.03.8 Compaction.

Provide a compacted thickness of the PPEST of 1.0 in. ±¼ in.

411.04 METHOD OF MEASUREMENT.

Paver Placed Elastomeric Surface Treatment will be measured by the number of tons of paver-placed surface treatment completed in place.

411.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Paver Placed Elastomeric Surface Treatment	TONS

The Contract price constitutes full compensation for all traffic control, surface preparation; furnishing, transporting, handling, placing, and rolling the PPEST material; site cleanup; furnishing all labor, tools, equipment, and incidentals for the satisfactory completion of the work required to finish the work, complete and accepted.

SECTION 412 — RUBBERIZED ASPHALT CHIP SEALING

412.01 DESCRIPTION.

This specification covers all materials, equipment, construction, application, and post-placement procedures for the rubberized asphalt chip sealing of existing paved surfaces at the required locations. The work consists of an application of rubberized asphalt binder followed by an application of pre-coated cover aggregate.

412.02 MATERIALS.

412.02.1 Asphalt Cement.

Use neat asphalt cement that meets AASHTO M320 for PG 58-28. Ensure that the high temperature grade does not exceed PG 58.

412.02.2 Granulated Rubber.

Use granulated rubber that is vulcanized rubber from the ambient temperature processing of scrap pneumatic tires. Use granulated rubber that meets the following gradations; no substitutions will be accepted:

Sieve Size	Percent Passing
#10	100
#16	90 – 100
#30	25 – 100
#80	0 – 20

The use of rubber of multiple types from multiple sources is acceptable if the overall blend of rubber meets the gradation requirements. Ensure that the length of the individual rubber does not exceed ⅛ in. Ensure that the specific gravity of reclaimed vulcanized ground rubber is between 1.10 and 1.20. The rubber supplier shall supply the certification. Use rubber in the rubberized asphalt binder that is free of loose fabric, wire, and other contaminants. Up to 4 percent (by weight of rubber) calcium carbonate or talc may be added to prevent caking or sticking of the particles together. Ensure that the ground rubber is sufficiently dry to be free flowing and not produce foaming when blended with the hot PG binder.

412.02.3 Cover Aggregate.

Use cover aggregate that is virgin crushed quarry rock from a RIDOT approved source. Do not use processed gravel. For the material retained on the #4 sieve, ensure that not more than 10 percent of the particles have a flatness or elongation ratio greater than 3:1 (ASTM D4791). Ensure that the aggregate wear, from resistance to abrasion, is a maximum of 30 percent as determined by the Los Angeles Abrasion test (AASHTO T96). Pre-heat the aggregate to a temperature between 280°F and 320°F, and uniformly and completely precoat with a PG 64-28 or PG 58-28 before application. Determine the asphalt content for the precoating by laboratory and field testing that is approved by the Engineer. Ensure that the gradation meets the following limits.

Sieve Size	Percent Passing
½ in.	100
⅜ in.	85 – 100
#4	0 – 8
#8	0 – 4
#200	0 – 2

Note: *Determine a suitable location for stockpiling the required aggregate and ensuring that stockpiles do not become contaminated. Clean up at the stockpile sites and at all roads between the stockpile and the Project location. A minimum of 30 days before construction, provide a representative sample of the proposed aggregate to the asphalt rubber supplier for testing. Perform gradation testing to determine the design application rates for the asphalt rubber binder and the cover aggregate. Perform a coating and stripping test (AASHTO T 182) to ensure compatibility of the asphalt rubber binder with the processed aggregate. Provide a copy of the test results to the Engineer before the start of work.*

412.02.4 Rubberized Asphalt.

Add granulated rubber to the PG58-28 asphalt cement at a rate of 18 percent ±3 percent by total weight (i.e., asphalt cement plus granulated rubber). Ensure that the physical requirements of the rubberized asphalt meet ASTM D 6114 Type II.

The supplier of the rubberized asphalt shall certify the percent of granulated rubber in the blend.

Ensure that the temperature of the asphalt cement is between 325°F and 400°F at the time the granulated rubber is added. Combine and mix together the asphalt cement and granulated rubber in a blender unit and react for a minimum of one hour. Ensure that there are no agglomerations of rubber particles in excess of 2 in. in the least dimension in the mixing chamber. Maintain the temperature of the asphalt-rubber binder immediately after mixing between 325°F and 375°F for a minimum of 45 minutes before use.

When a job delay occurs after full reaction, the rubberized asphalt may be allowed to cool. Reheat the rubberized asphalt slowly just before application but not to a temperature exceeding 375ºF. An additional quantity of granulated rubber or additive not exceeding 3 percent by volume of the rubberized asphalt may be added after reheating.

412.02.5 Testing and Certification.

Sample the rubberized asphalt once per lot at the point of manufacture, tested and certified by an AASHTO resource (formally AMRL) accredited laboratory approved for asphalt rubber binder testing. The laboratory shall certify that the rubberized asphalt meets the requirements of ASTM D 6114 Type II specifications. A lot is defined as each batch produced but not to exceed the volume of the manufacturer's dedicated asphalt rubber reaction/storage tank.

In addition to the ASTM D 6114 Type II specification, to ensure adequate blending residence time and binder quality, test every lot as follows:

Test (on the produced asphalt rubber binder)	Result
AASHTO T315 Original Binder 2mm DSR @ 82	G*/sin (d) >1.00 kPA

Report all data to the Engineer.

412.02.6 Reporting.

Before starting work, submit a Quality Control Plan from the asphalt rubber supplier that meets the format requirements of AASHTO R 26. Submit a weekly manufacturer's report for each lot of asphalt rubber produced that includes the following as a minimum:

- Total quantity of asphalt binder in tons
- Tons and percentage of ground rubber based on total asphalt rubber binder
- ASTM D6114 certified test results
- AASHTO T 315 Original Binder 2mm DSR @ 82

412.02.7 Engineering.

Determine the asphalt content and mixing time of the pre-coated aggregate to obtain a uniform and complete pre-coating. Forward samples to the Engineer for approval.

Design the rubberized asphalt chip seal surface treatment. No later than two weeks before work commences, submit for the approval of the Engineer the surface treatment design with supporting test data, specifying the additives for the rubberized asphalt, application rate of the rubberized asphalt, and the source, composition, and application rate of the cover aggregate.

Include samples of each material with the submittal. Once the materials and design are approved, no substitution will be permitted unless approved by the Engineer.

412.03 CONSTRUCTION METHODS.

412.03.1 Equipment.

a. Mechanical Blender. Ensure that the method and equipment for combining the ground rubber and PG asphalt binder is designed to be accessible so that the Engineer can readily determine the percentage of each material being incorporated into the mixture.

   Use equipment in the production and proportioning of asphalt-rubber binder that includes the following as a minimum:

   - An asphalt heating tank or heat exchanger with hot oil heat transfer to heat the PG asphalt binder to the necessary temperature before blending with the ground rubber. Equip the unit with a thermostatic heat control device.

   - A mechanical blender for proper proportioning and thorough mixing of the PG asphalt binder and ground rubber. Ensure that the unit has a Coriolis type mass flow meter capable of measuring and recording the total quantity of asphalt binder in tons. Determine the quantity of ground rubber by weight using either a hopper equipped with load cells or a feeder equipped with a belt scale. Record the total weight in tons and

percentage of ground rubber based on total asphalt rubber binder. Report all data to the awarding authority as outlined in **Subsection 412.02.6**.

- A dedicated asphalt rubber reaction/storage tank equipped with a heating system to maintain the proper temperature of the binder and an internal mixing unit capable of maintaining a homogeneous mixture of asphalt and ground rubber.

b. Distributor Truck. On Projects exceeding 35 tons of rubberized asphalt, ensure that at least two pressure-type asphalt distributor trucks in good condition are available. Equip the distributor with an internal heating device capable of heating the material evenly up to 425ºF, an internal agitation unit capable of maintaining a proper mix of asphalt cement and granulated rubber, an adequate pump capacity to maintain a high rate of circulation in the tank and to spray the rubberized asphalt at a viscosity of 1500 to 5000 centipoise, and adequate pressure devices and suitable manifolds to provide constant positive cut-off to prevent dripping from the nozzles.

Equip the distributor with an electronically controlled computerized compensation unit for controlling application rates at various width and speed changes. Ensure that the application unit has electronic controls and a digital read-out installed and is operated from the inside of the cab of the distributor. Ensure that the distributor bar is fully circulating. Repair or remove any distributor that produces a streaked or irregular distribution of the material.

Use distributor equipment that includes a tachometer, pressure gauges, volume measuring devices, and thermometer for reading the temperature of the tank contents. Locate the controls for the width and rate of spray from the spray bar in the cab of the truck, and ensure that the controls enable a uniform application at the specified rate per square yard within a tolerance of 0.05 gal/sq yd.

Equip the distributor with a continuous mechanical means to ensure that all nozzles are clean at all times. If a continuous mechanical means is not present, use a bootman to accompany the distributor who rides in a position so that all spray bar nozzles are in full view and readily accessible for unplugging.

c. Hauling Equipment. Equip tank trucks used for the transportation of asphalt rubber with a heating system to maintain the proper temperature of the binder and an internal mixing/agitation unit capable of maintaining a homogeneous mixture of asphalt and ground tire rubber while in transit.

Use trucks for hauling cover aggregate that are rear discharge conveyor-fed or live bottom trucks that are equipped with a device to lock onto the hitch at the rear of the aggregate spreader to prevent spillage.

Ensure that sufficient hauling vehicles are available to ensure continuous operation of the distributor and aggregate spreader.

d. Aggregate Spreader. Use an aggregate spreader that is hydrostatically driven and self-propelled. Use a spreader that is equipped with a hydraulically controlled variable adjustable head that can spread cover aggregate in widths from 4.5 ft to 18 ft. Mount the spreader on pneumatic tires, and apply the cover aggregate on the road surface and

ensure that the tires do not contact the road surface until after the cover aggregate has been applied. Equip the unit with an electronic radar type sensor to measure ground speed and that will automatically adjust the cover aggregate application rate depending on the width of application and the speed of the spreader.

Ensure that the sensor can apply cover aggregate at a uniform coverage on any grade from 0 to 6 percent. Equip the spreader with an integral hopper with a minimum capacity of 5 tons of cover aggregate that can be filled by trucks to ensure that the truck tires never contact the rubberized asphalt treated road surfaces until the cover aggregate has been properly applied. To maintain constant cover aggregate application, use a self-locking truck hitch that permits towing of aggregate trucks without stopping the spreader and that can maintain positive engagement over irregular terrain.

e. Pneumatic Tire Rollers. Use a minimum of three self-propelled, multiple wheel pneumatic tire rollers. Ensure that each weighs a minimum of 10 tons, has a total compacting width of at least 56 in., and has a minimum tire pressure of 100 psi.

f. Self-Propelled Rotary Sweepers. Use a minimum of two self-propelled rotary pick-up sweepers that are designed, maintained, equipped, and operated so that the pavement surface can be swept clean. Equip the rotary sweepers with adjustable down pressure on the sweeper heads and that can temporarily store the picked up material from the surface of the pavement for disposal offsite.

g. Pilot Car. Provide a car that can guide traffic during chip seal work operations. Ensure that the vehicle meets Section 6C.13 and Section 6F.58 of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD).

412.03.2 Weather Limitations.

Do not apply the rubberized asphalt when weather conditions are unfavorable to obtaining a uniform spread. Only proceed with construction when the pavement surface temperature is at least 50°F and rising. Ensure that no water or moisture is present on the road surface.

412.03.3 Road Surface Preparation.

Sweep and clean the area to be sealed of vegetation, debris, loose aggregate, and soil, particularly soil that is bound to the surface. Complete the work to remove pavement markings and seal cracks before the application of asphalt rubber binder and cover aggregate. Raise to grade all localized depressions, trench cuts, utility settlements, and joint settlements with Class 4.75 HMA shim course produced according to **SECTION 401**. Apply a tack coat to the surface before the shim course is placed. Mill high spots, localized bumps, and joints to raise the surface to grade or by using other treatments as approved by the Engineer. At the limits of the work, ensure that there is a smooth transition of the profile between the existing pavement and the rubberized asphalt chip seal. Remove and properly dispose of all pavement markings, with the exception of temporary markings (waterborne paint). Use fast drying waterborne pavement markings to replace the removed existing pavement markings. Protect manholes, valve boxes, and other service entrances from the applied material. Cover and seal bridge joints, appurtenances, drainage openings, etc., to prevent clogging and prevent the entry of loose

aggregate. Do not begin application of the rubberized asphalt chip seal until the surface preparation has been approved by the Engineer.

412.03.4 Construction Procedures.

a. Rubberized Asphalt Application. Apply the rubberized asphalt uniformly at double coverage at a temperature of between 340°F to 400°F at the approved design application rate between 0.55 to 0.65 gal/sq yd. The actual rate of application within these ranges requires that the cover aggregate be embedded at 50 percent of the stone particle size into the asphalt rubber binder with minimal stone loss following compaction.

   Ensure that longitudinal joints are reasonably true to line and parallel to centerline. Where any construction joint occurs, broom and blend the edges back so that there are no gaps, the elevations are the same, and the joints are free from ridges and depressions. Overlap longitudinal joints from 4 in. to 6 in.

   During application, prevent the adjacent pavements, curbing, structures, vehicles, foliage, and personal property from any marring or discoloration.

   Limit each spray application to 3000 ft in length. Place, roll, and sweep cover stone. Then, drop back and square off the 3000-ft chip seal placement before proceeding.

b. Cover Aggregate Application. Ensure that the application of cover aggregate follows as close as possible behind the application of the rubberized asphalt. Ensure that the asphalt is not applied any further in advance of the aggregate spreader than can be immediately covered. Do not allow construction equipment or other vehicles to drive on the uncovered rubberized asphalt. Spread the hot-precoated cover aggregate uniformly and completely across the hot rubberized asphalt by a self-propelled spreader at the approved design application rate within a tolerance of +5 lb/sq yd. Ensure that the application rate is not less than 30 lb/sq yd. Cover any deficient areas with additional cover material to provide total coverage.

c. Rolling. Initiate rolling with pneumatic tire rollers immediately following the spread of pre-coated aggregate. Ensure that there are at least three passes of a roller to embed the cover aggregate particles firmly into the rubberized asphalt. To attain coverage, use as many passes as necessary to cover the entire width being spread. A pass is defined as one movement of a roller in either direction. Ensure that the roller speed does not exceed 6 mph. Do not allow any steel wheel rollers.

d. Initial Sweeping. When the maximum amount of aggregate has been embedded into the asphalt rubber binder and the pavement has cooled, sweep or otherwise remove all loose material. Perform the removal to avoid the displacement of any embedded aggregate or any damage to the new surface. Remove all loose cover material from the paved surface by sweeping when the chip sealed surface has cooled to below 120°F after application; however, if the Engineer determines that conditions are not conducive to obtaining the best results due to weather, temperature, or other reasons, discontinue sweeping until the Engineer has determined the best time for removal. Collect the sweeping accumulations and dispose of properly off site.

e. Site Clean Up. Uncover and unseal all drainage openings and clean any covers or grates that the cover aggregate and rubberized asphalt may have adhered to and remove any excess material in areas such as driveways, gutters, and intersections as specified by the Engineer. On a daily basis, remove any debris associated with the performance of the work.

f. Protection of Surface. Do not allow traffic on the chip sealed road surface until all rolling has been completed and the asphalt rubber binder has cooled and set as satisfactory to the Engineer. Ensure that traffic does not exceed 25 mph by the use of a pilot car. Use the pilot car to control traffic flow at all points during chip seal work operations. Post "Loose Stone" signs at the beginning limit of the chip seal operation and at every one-mile interval. Ensure that the speed limit and other required signing meets all Department and Contract requirements. Ensure that the signs remain in place for a minimum of 24 hours after the chip seal has been placed. Do not remove signing until the loose aggregate is removed from the roadway and all other Contract requirements are fulfilled (e.g., line striping) so that the original posted speed limit can be reinstated. The Contractor shall be responsible for any damage done to vehicles as a result of the operation.

g. Post Placement Sweepings. Conduct post placement sweepings at the following times:

- Five to seven days after the rubberized asphalt chip sealing operation
- Between October 15 and November 15 after the rubberized chip sealing operation
- Starting April 1st at the end of the first winter after the rubberized asphalt chip sealing operation

For each sweeping, remove all loose cover aggregate from the pavement surface, including the shoulders. Collect and properly dispose of the accumulations of sweepings off site.

412.04 METHOD OF MEASUREMENT.

Rubberized Asphalt Chip Sealing will be measured by the number of square yards of rubberized asphalt chip seal placed.

Removal of pavement markings will be measured by the LF.

412.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Rubberized Asphalt Chip Sealing	SY

The price constitutes full compensation for traffic control and pilot car; mobile cell phones; surface preparation; furnishing, transporting, handling, placing, and rolling the material specified; all

sweeping and removal of excess aggregate; site cleanup; and furnishing all labor, tools, equipment, and incidentals required to finish the work, complete and accepted.

The shim course will be paid for under separate items in the Contract. The cost of tack coat for shim course is incidental and not paid separately.

Removal of pavement markings is paid under **Subsection T20.05**.

Include the cost for the temporary waterborne pavement markings to replace the removed pavement markings in the unit bid price for “Remove Existing Pavement Marking Lines.”

SECTION 413 — RIDEABILITY – SURFACE COURSE

413.01 DESCRIPTION.

This specification addresses pavement rideability as determined by the Engineer according to the rating scale, based upon post-paving rideability determination.

Standard roads are roadways with posted speed limits above 30 mph. For roads with speed limits that vary based on time of day (e.g., school zones), the higher speed limit applies to this specification. Any reclaimed road will be evaluated as a 35-mph road or at its posted speed limit (whichever is greater) for rideability pay adjustments. Low-speed roads are roads with a posted speed limit of 30 mph or below.

A travel lane is the primary traveled portion of the roadway excluding non-normally traveled pavement surfaces.

Leave-out sections include:

- Roundabouts and bridge decks
- Areas 25 ft before and after pavement segments with catch basins in the travel lane and 15 ft before and after pavement segments with manholes or other structures in the travel lane
- Areas 25 ft before and after bridge joints
- Areas 25 ft after and before the Project paving limits

all as determined by the Engineer. Additional areas may be excluded from testing in the interest of obtaining data safely.

413.02 MATERIALS.

N/A

413.03 CONSTRUCTION METHODS.

Pavement rideability, or ride quality, will be determined by the Engineer using a profiler on all travel lanes. The profiler will meet all equipment requirements of AASHTO M 328 and R 56.

413.03.1 Rideability for Standard Roads.

The surface course ride quality acceptance will be based on a) the average International Roughness Index (IRI) from three tests using a profiler established for each wheel path for 528-ft (0.1 mile) standard fixed intervals, and b) a simulated 10-ft rolling straightedge analysis for the width of each travel lane from one representative test. The testing will be conducted by the Engineer. The selected tests will be chosen based on the data correlation between tests, profile lengths, and any factors noted during data collection or evidenced upon review to better qualify or disqualify a test. The representative tests will be selected at the Engineer's discretion.

An IRI number in inches per mile will be established following Department procedures using ProVAL or software supplied by the manufacturer of the profiler for each 528-ft (0.1-mile)

longitudinal section for each wheel path in each travel lane. A 300-ft long-wavelength (high-pass) filter will be applied during testing. A 250mm short-wavelength (moving average) filter will be applied during analysis using ProVAL or other aforementioned profiling software.

A sublot will be each single wheelpath for each 0.1-mile section of each travel lane. Therefore, each 0.1-mile section of travel lane will consist of two sublots. A standard lot is defined as 20 consecutive sublots. If a road segment has less than 20 but more than six consecutive sublots for each wheelpath, a lot will be comprised of all sublots from one wheelpath. If a road segment has six or fewer consecutive sublots for each wheelpath, a lot will be comprised of all sublots from the road segment. If the final lots include 10 or more sublots for each wheelpath, they will be considered their own lots. If the final lots are fewer than 10 sublots, they will be added to the preceding or adjacent lots. Lots may be combined with adjacent lots in the following order of preference — with previous lot of the same wheelpath in the same lane, with opposite wheelpath of the same lane, with both wheelpaths of adjacent lane in the same direction or similar lane in the opposite direction within the same road segment, or as determined by the Engineer. If the Project paving limits for one roadway segment including all lanes consist of fewer than 0.46 lane-miles, the roadway segment paved will be considered a pavement patch (**Subsection 413.03.2**).

Leave-out sections are excluded from rideability analysis for pay adjustments.

All areas included in the paving limits (including leave-out sections) will be tested using a 10-ft rolling straightedge simulation analysis using ProVAL or other profiling software. The variation of the surface between any two contacts along the simulated straightedge shall not be more than 0.25 in., except for manholes, catch basins, and other structures in the travel lane, which shall not deviate from the surface by more than 0.30 in. below final grade or 0.10 in. above final grade of pavement as tested with a 10-ft straightedge or rolling straightedge simulation. Humps, depressions, and utility structures (as adjusted or remaining) exceeding the specified tolerances shall be subject to correction. Provide the corrective work plan including method of correction to the Engineer for approval. Do not perform any corrective work without the approval of the Engineer.

Sections before leave-out sections and the section at the end of the paving limit will be added to the previous sublot or subsequent section(s) if they are less than 0.05 miles or may be considered a full sublot if they are greater than or equal to 0.05 miles. For roadways with numerous utility structures, with successive sections before or between leave-out sections, or at the end of the paving limit that are less than or near to 0.05 miles, the sections will be combined to best approximate 0.10 miles for each sublot. No sublot will exceed 0.15 miles.

413.03.2 Rideability for Low-Speed Roads and Pavement Patches.

The Department will measure from 10 ft before to 10 ft after the paving limits of low-speed roads or permanent pavement patches in the lane and test this road segment using a 10-ft rolling straightedge simulation analysis in ProVAL or other profiling software. If the variation of the surface between any two contacts along the simulated straightedge exceeds 0.25 in. at any distance from 2 ft before to 2 ft after the paving limits or pavement patch, provide a corrective work plan, and perform the corrective action. Do not perform any corrective work without the approval of the Engineer. In addition, the -0.30-in. to +0.10 in. surface deviation tolerances noted in **Subsection 413.03.1** will apply for any manholes or other structures in the lane that are within the paving limits of the low-speed road or pavement patch.

Ensure that permanent pavement patches and structures, including any corrective work, continue to comply with the tolerances described above for the longer of one year after installation or one year after completion of any required corrective work, or additional corrective work will be required.

413.03.3 Rideability for Bridges.

The Department will measure the entire length of each bridge section using a 10-ft rolling straightedge simulation analysis in ProVAL or other profiling software. The bridge section a) starts 10 ft before the initial bridge pavement cut and match or 25 ft before the initial bridge joint, whichever is farther, and b) stops 10 ft beyond the terminal bridge pavement cut and match or 25 ft beyond the terminal bridge joint, whichever is farther. The bridge section includes the approach pavement, entry approach slab, bridge deck, exit approach slab, and exit pavement. If only the bridge deck is paved (no approaches), the section of new pavement will be considered a pavement patch.

Perform corrective work when the variation of the surface between any two contacts along the simulated straightedge exceeds 0.25 in. in any profile within the full width of a marked traffic lane along the measured length of the bridge section. Provide a corrective work plan to the Engineer for approval before performing corrective work. This plan may include mill and overlay, PCC overlay, diamond grinding, or a combination thereof. Any costs associated with structural review of added loads to the bridge will be tracked by the Department and reimbursed by the Contractor as a disincentive using a Report of Change. To produce a uniform cross section, the Engineer may require corrections to the adjoining lanes and shoulders. Do not perform any corrective work without the approval of the Engineer.

413.04 METHOD OF MEASUREMENT.

The Table below provides the pay adjustment and corrective action criteria for standard roads based upon the posted speed limit of the roadway and the IRI of each sublot. IRI values will be rounded to the nearest integer value for each sublot before assessing the pay adjustment.

When corrections to the pavement surface are required, provide the corrective work plan including method of correction to the Engineer for approval. Limit the method of correction to diamond grinding, flat tooth grinding or removing, and replacing the affected pavement. If grinding is selected, provide a grinding simulation using ProVAL to the Engineer for approval. To produce a uniform cross section, the Engineer may require corrections to the adjoining lanes and shoulders. Corrections will be at no additional cost to the Department. Do not perform any corrective work without the approval of the Engineer.

Where corrections are made after the official Department test, the pavement will be retested by the Engineer to verify that corrections have produced an acceptable ride surface. No incentives will be provided for sections on which corrective actions are performed.

Posted Speed Limit (mph)				Pay Adjustment (Percent)
35	40 – 45	50	55 – 65	
IRI (Inches per Mile)				
55 and Under	45 and Under	40 and Under	35 and Under	+5%
56 – 62	46 – 52	41 – 48	36 – 40	+4%
63 – 70	53 – 62	49 – 55	41 – 48	+3%
71 – 80	63 – 70	56 – 65	49 – 55	+1%
81 – 100	71 – 85	66 – 75	56 – 65	0%
101 – 120	86 – 95	76 – 82	66 – 72	-5%
121 – 135	96 – 110	83 – 92	73 – 82	-10%
136 – 150	111 – 125	93 – 105	83 – 95	-20%
151 – 170	126 – 140	106 – 120	96 – 110	-30%
Over 170	Over 140	Over 120	Over 110	Corrective Action Required*

* *Corrective action will be required additionally for any section or segment with surface deviation(s) exceeding 0.25 in. when tested with a 10-ft rolling straightedge simulation analysis.*

If the corrective action(s) results in an IRI greater than the corrective action threshold for any sublot in any wheel path of a standard road, the Contractor will be assessed an adjustment based on the following Table.

Posted Speed Limit (MPH)				Pay Adjustment (Percent)
35	40 – 45	50	55 – 65	
IRI After Correction (Inches per Mile)				
171 – 190	141 – 155	121 – 135	111 – 125	-50%
191 – 210	156 – 175	136 – 150	126 – 140	-75%
Over 210	Over 175	Over 150	Over 140	-100%

The pay adjustment for each sublot will be applied to the theoretical tonnage of each respective sublot. The theoretical sublot tonnage will be obtained by taking the sublot length, multiplied by half of the width of the travel lane (11 ft will be used for lane width unless otherwise indicated), multiplied by the design thickness of the surface course, multiplied by the unit weight. The Department will use a unit weight of 150.0 lb/CF for dense graded mixes and 145.0 lb/CF for friction course and PPEST. Theoretical tonnage values will be rounded to two decimal places.

413.05 BASIS OF PAYMENT.

All corrective action required under this Section will be at no additional cost to the Department.

A pay adjustment will be determined for each sublot based upon the IRI of that sublot as described above. The theoretical tonnages of all the sublots in one lot (as defined in **Subsection 413.03.1(3)** will be totaled to yield the theoretical lot tonnage. The sublot tonnage adjustments will be obtained by multiplying the theoretical tonnage of a sublot by the pay adjustment of that sublot. Tonnage adjustments will not be rounded. The sublot tonnage adjustments will be totaled to determine the lot tonnage adjustment. The lot tonnage adjustment will be divided by the theoretical lot tonnage to obtain the unit price adjustment for that lot. The unit price adjustment will be rounded to six absolute decimal places for each lot (i.e., XX.XXXX%). This unit price

adjustment will be multiplied by the unit price of the surface course HMA and applied to the theoretical tonnage of the lot for pay purposes.

The Department may use the Weighted Average Unit Price (WAUP) for the respective surface course HMA for rideability pay adjustment purposes if the Contract does not:

- Have an item number exclusively for the surface course HMA because it has been grouped with related work such as tack coat, base course HMA, or micro-milling, or
- the surface course HMA does not otherwise have an explicit price basis, or
- the Contractor has not submitted an accepted exclusive unit price basis for the surface course HMA before beginning any resurfacing or paving activity,

Incentives and disincentives will be addressed using Item Code 416.0001.

SECTION 414 — WARM MIX ADDITIVE

414.01 DESCRIPTION.

This work includes incorporating a Warm Mix Additive (WMA) in Hot Mix Asphalt (HMA).

414.02 MATERIALS.

Add one unit of WMA to each ton of HMA. Select all WMA from the RIDOT Approved Materials List, and add at a dosage rate recommended by the manufacturer.

414.03 CONSTRUCTION METHODS.

If HMA is designated as “with WMA,” use a WMA. If HMA is not designated as “with WMA,” the Contractor may request to use a WMA at its own expense. The Engineer may direct the Contractor to use a WMA. If a WMA is used, it must be for an entire day’s production for that class of HMA.

414.04 METHOD OF MEASUREMENT.

WMA will be measured by the number of units used.

414.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit price as follows.

Pay Item	Pay Unit
Warm Mix Additive	EA

SECTION 415

This Section has been Reserved for Future Use.

SECTION 416 — PAY ADJUSTMENTS

416.01 DESCRIPTION.

This specification provides a mechanism for the payment of performance incentives (positive pay adjustments) for binder content, air voids, in-place density, and/or rideability.

416.02 CONSTRUCTION METHODS.

N/A.

416.03 METHOD OF MEASUREMENT.

Pay Adjustments will be measured using the Method of Measurement section of the applicable HMA and/or rideability specification.

416.04 BASIS OF PAYMENT.

Pay adjustments will be paid at the only acceptable price of $1.00 per each unit. The price constitutes full compensation using the requirements in the Basis of Payment section of the applicable HMA and/or rideability specification.

Part 500
CONCRETE PAVEMENTS

SECTION 501

This Section has been Reserved for Future Use.

SECTION 502 — CLEANING, SEALING, AND REPAIRING JOINTS AND CRACKS BETWEEN 1/16 INCH AND 1 INCH WIDE IN PORTLAND CEMENT CONCRETE PAVEMENT

502.01 DESCRIPTION.

This work includes performing all operations required for cleaning, sealing, and/or repairing 1/16 in. to 1 in. wide cracks and joints in existing Portland cement concrete pavement.

502.02 MATERIALS.

Use joint seal material that is hot poured asphalt rubber compound conforming to ASTM D6690 and **Subsection M02.09.2**.

502.03 CONSTRUCTION METHODS.

502.03.1 Preparation of Cracks and Joints.

Place the joint seal by using hot extrusion with a wand type instrument. Use a system that includes a flow control valve that allows all cracks to be filled to refusal.

Seal all transverse and longitudinal joints and cracks. Just before sealing, clean each joint or crack to the full depth of the concrete pavement to remove all foreign material.

Do not seal joints if frost, snow, or ice is present.

502.03.2 Application.

Place the joint seal using hot extrusion with a wand type instrument. Use a system that includes a flow control valve that fills all cracks to refusal.

Fill all joints or cracks to refusal to eliminate all voids or entrapped air so that, after cooling, the level of the sealer is flush with the pavement surface. Raise all depressions in the seal to the surface with additional hot seal.

Ensure that the final appearance is uniform. Do not overfill joints. Remove and discard all excess or spilled sealer from the pavement.

502.04 METHOD OF MEASUREMENT.

Cleaning, Sealing, and Repairing Joints and Cracks Between 1/16 Inch and 1 Inch Wide in Portland Cement Concrete Pavement will be measured by the number of linear feet of sealed joints or cracks repaired.

502.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Cleaning, Sealing, and Repairing Joints and Cracks Between 1/16 Inch and 1 Inch Wide in PCC Pavement	LF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 503 — REPAIRING DETERIORATED/DAMAGED JOINTS BETWEEN 1 INCH AND 8 INCHES WIDE IN FINISHED PORTLAND CEMENT CONCRETE PAVEMENT

503.01 DESCRIPTION.

This work includes performing all operations required for cleaning, saw cutting, concrete removal, rebuilding, and sealing joints in existing Portland cement concrete pavement that are between 1 in. and 8 in. wide at designated locations.

503.02 MATERIALS.

a. Joint Seal. Use a joint seal material that conforms to ASTM D6690 and **Subsection M02.09.2.**

b. Epoxy Resin Bonding Agent. Select an agent that is on the AML.

c. Fast Set Repair Mortar. Select an agent that is on the AML. Ensure that the use of the material meets the manufacturer's recommendations.

If the Contractor proposes a repair material not previously accepted by the Department, and the Department approves its use through the Shop Drawing procedure, provide a field representative of the manufacturer or distributor at the work site before any mixing of components. Ensure that the field representative instructs the work crews in the proper mixing and application procedures and remains at the job site until he/she and the Engineer are satisfied that the crew has mastered the technique of installing the system. Provide the service at no additional cost to the Department.

d. Preformed Asphalt Joint Filler. Use preformed asphalt joint filler that conforms to **Subsection M02.09.1**.

e. Storage. Store materials according to the manufacturer's recommendations.

503.03 CONSTRUCTION METHODS.

503.03.1 Removal of Existing Concrete.

a. Saw Cutting. Provide a ¾-in. deep saw cut parallel to the joint on both sides of the joint a distance of 3 in. back from the edge of the deteriorated concrete.

Do not damage the freshly saw cut edge and the slab reinforcing during the concrete removal operations.

b. Removal. Remove the concrete to the full depth of the existing pavement and to a minimum width of 3 in. by a method approved by the Engineer. Do not use jack hammers heavier than the nominal 30-lb class. Do not use chipping hammers heavier than the nominal 15-lb class to remove concrete from beneath any reinforcing bar. Use hand tools such as hammers and chisels for removal of final particles of unsound concrete or to achieve the required depth. Do not place pneumatic tools in direct contact with reinforcing steel. For any load transfer devices encountered, clean and leave in place, if the device

is still a competent part of the concrete slab. If the load transfer device has failed as determined by the Engineer, remove and dispose of the device.

503.03.2 Preparatory Work.

Just before sealing, clean each joint or crack to the full depth of the concrete pavement to remove all foreign material. Ensure that the exposed concrete and reinforcing steel surface is free of rust, oil, solvent, grease, dirt, dust, bitumen, loose particles, and other foreign matter before the application of the epoxy bonding agent. Correct any disturbance of the gravel subbase or any undermining of the existing concrete slab at no additional cost to the Department.

503.03.3 Joint Filler Placement.

Before placement of the fast-set repair mortar, install one 1-in. or two ½-in. thick lengths of a preformed asphalt joint filler in a straight line, perpendicular to the reinforcing steel for the full width of the existing concrete slab(s). Extend the preformed asphalt joint filler in a plumb vertical direction from the gravel subbase to the surface of the existing concrete slab.

503.03.4 Application of the Epoxy Bonding Agent.

For cracks greater than 1 in., apply an epoxy bonding agent to the prepared concrete surface to be repaired to a thickness of approximately 20 mils or according to the manufacturer's recommendations. Do not coat the reinforcing steel with epoxy.

Follow the manufacturer's recommendations for curing the epoxy bonding agent before placing the concrete repair material. Do not place the repair material if the bonding agent has passed the manufacturer's recommended contact time. If the time has been exceeded, follow the manufacturer's recommendations for re-application.

Use an epoxy bonding agent with an extended contact time if required by the timing of concrete placement and/or weather conditions.

503.03.5 Application of Fast Setting Mortar.

a. Application, Mixing, and Batching. Perform the application, priming, curing, clean-up, and protection of freshly patched areas according to the manufacturer's recommendations.

   Mix no more material than can be placed within the specified working time recommended by the manufacturer.

   Ensure that the mix conforms to AASHTO M43, Size 8. Do not use crushed limestone.

b. Weather Limitations for Application of the Epoxy Bonding Agent and Fast Setting Mortar. Do not apply concrete repair mortar when the ambient temperature is below 45°F and/or when not recommended by the manufacturer.

503.03.6 Sealing Joints.

Upon placement and proper curing of the fast set concrete repair mortar, remove the top 1 in. of preformed asphalt joint filler and replace with a joint sealer. Clean and dry each joint before placing the sealing compound. Perform any required cleaning by blowing out all dirt, dust, or deleterious matter. Do not place the hot extruded joint sealing material unless approved by the Engineer.

Remove all material and debris exiting from the joint from the pavement surface.

Apply the joint seal by hot extrusion with a wand type instrument. Use a system that includes a flow control valve that fills all cracks to refusal. Fill all cracks to refusal to eliminate all voids or entrapped air. Ensure that the hot seal completely fills the joint so that, after cooling, the level of the sealer is flush with the pavement surface. Raise all depressions in the seal to the surface with additional hot seal.

Seal the joints so that the final appearance presents a neat fine line. Do not overfill the joints and avoid spillage of the sealer. Remove and discard all excess or spilled sealer from the pavement.

Do not seal joints if frost, snow, or ice is present.

Store materials according to the manufacturer's recommendations.

503.04 METHOD OF MEASUREMENT.

Repairing Deteriorated/Damaged Joints Between 1 Inch and 8 Inches Wide in Finished Portland Cement Concrete Pavement will be measured by the number of cubic feet of fast set concrete repair mortar placed in the repaired joints.

503.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Repairing Deteriorated/Damaged Joints 1″ to 8″ Wide in Finished PCC Pavement	CF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Part 600
CONCRETE

SECTION 601 — PORTLAND CEMENT CONCRETE

601.01 DESCRIPTION.

This work consists of furnishing, placing, curing, and finishing Portland cement concrete for bridges, pavements, structures, and incidental construction.

Concrete consists of a homogeneous mixture of Portland cement, coarse aggregate, fine aggregate, air entrainment, water, chemical and mineral admixtures (when used), mixed in the required proportions.

Proportion Portland cement concrete with the required cement content for each class and mix to the consistency specified.

Use the classes of concrete required for the work. The Engineer will approve all concrete mixes.

Various sizes of coarse aggregate for the classes of concrete may be combined during the batching operation in each fraction of aggregate size required to obtain the specified gradation. When testing aggregates to determine compliance with a specified gradation, fractions will be tested separately and combined mathematically or combined mechanically in predetermined proportions and tested.

601.02 MATERIALS.

601.02.1 Portland Cement.

Provide Portland cement that conforms to **SECTION M02** and is listed on the Department's Approved Materials List.

For bridge projects, provide one brand of Portland cement and use for all visible portions of a structure; however, this is not required for interior deck slabs, beams, or corresponding elements that are semi-exposed.

Provide suitable means for storing and protecting the cement against dampness.

Supply all Portland cement from mill silos that have cement that has been tested. Provide a copy of a certified Mill Test Report to the Engineer for the cement being used. Deliveries may be directed to the site or through a regional distribution base.

In addition, comply with the following:

a. Provide a manufacturer's Mill Test Report, signed by the company representative having legal binding authority, with each shipment of cement. Copies of a standard form are available from the Department upon request.

b. Under all steps and conditions, make delivery in weatherproofed and sealed transporting equipment. Protect all cement from moisture and contaminants. Any cement that fails to meet any of these requirements will be rejected and removed from the work. Retest any

hydraulic cement stored for a period longer than 120 days according to AASHTO M85. An independent laboratory shall perform the retest at no cost to the Department, which must be approved by the Engineer before being used on the work.

601.02.2 Chemical Admixtures.

Use admixtures in Portland cement concrete that conform to **SECTION M02**. Perform all work according to the recommendations of the manufacturer. Do not use admixtures unless approved by the Engineer.

Ensure that the physical and chemical properties of admixtures are uniform throughout their use in the work. If an admixture as furnished is not uniform in properties, discontinue its use.

If more than one admixture type or brand is used, ensure that admixtures are compatible with one another so that the desirable effects of all admixtures used will be realized.

When using a brand and type of admixture on the Department's Approved Materials List, furnish a Certificate of Compliance from the manufacturer, certifying that the admixture furnished conforms to the chemical and physical requirements. The Engineer may take samples for testing at any time.

Dispense chemical admixtures, including air-entraining admixtures, in liquid form. If more than one chemical admixture is used in the concrete mix, provide a separate dispensing measuring unit for each admixture. Ensure that dispensers for chemical admixtures have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Ensure that each dispenser includes a graduated measuring unit into which liquid admixtures are measured to within ±2 percent of the prescribed quantity (volume or weight, as applicable) for each batch of concrete. Locate and maintain dispensers so that the graduations can be accurately read from where proportioning operations are controlled to permit a visual check of batching accuracy before discharge. Mark each dispensing unit for the type and quantity of admixture.

Equip each liquid admixture dispensing system with a sampling device consisting of a valve located in a safe and readily accessible position so that a sample of the admixture may be withdrawn by the Engineer.

For all types of admixtures, incorporate the water content as determined by the manufacturer's recommendations when calculating the total amount free water of the concrete mix.

601.02.3 Mineral Admixtures.

Mineral admixtures such as fly ash, blast furnace slag, and silica fume may be permitted as a partial replacement of Portland cement in any concrete as approved by the Engineer. Ensure that mineral admixtures conform to **Subsection M02.06** and are listed on the Department's Approved Materials List.

Provide suitable means for storing and protecting the mineral admixtures against moisture. Mineral admixtures that become partially hydrated or contain lumps will be rejected.

Ensure that the handling and storage of all mineral admixtures conform to **Subsection 601.02.1**.

Provide the manufacturer's Mill Certificate, signed by a company representative having legal binding authority, with each shipment of mineral admixtures.

Retest any mineral admixture stored for a period longer than 120 days for compliance with the required specifications. An independent laboratory shall perform the retest at no additional cost to the Department, which must be approved by the Engineer before use on the work.

601.02.4 Aggregates.

Provide coarse and fine aggregates that conform to **Subsections M01.05** and **M02.02**.

Obtain aggregates from sources that have been previously tested by the Department. Results and information on the tests may be obtained from the Engineer upon request. If the Contractor proposes to obtain aggregates from sources that have not been tested by the Department, comply with the following:

- Notify the Department three months in advance of use, including test results according to **SECTIONS M01** and **M02**. An AASHTO accredited laboratory shall perform the test, which must be signed by a Rhode Island Registered Professional Engineer.
- Submit the results of tests based on ASTM C295, Petrographic Examination of Aggregates for Concrete for the proposed aggregates. An AASHTO accredited laboratory shall perform the tests, which must be signed by a Rhode Island Registered Professional Engineer.
- Provide a sufficient quantity of aggregate samples to the Engineer for verification testing three months in advance of use.
- Assume all costs for sampling and testing, except for the cost of verification testing, which will be borne by the Department.

Test all proposed aggregates and produce concrete that has freeze-thaw durability of 80 percent as determined by the relative dynamic modulus (ASTM C215, Transverse Method) at 300 cycles as tested according to ASTM C666 - Procedure A, as modified by the Department. Copies of the modifications may be obtained from the Engineer upon request.

Handle and transport aggregates from stockpiles or other sources to the batching plant to ensure a uniform grading of the material.

Ensure that the batch plant site, layout, equipment, and provisions for transporting material provides a continuous supply of material to the work. Buildup stockpiles in layers of not more than 3 ft in thickness. Ensure that each layer is in place before beginning the next. Do not allow any layer to cone down over the next lower layer.

Provide safe and suitable facilities for obtaining and storing samples of aggregates. Ensure that the facilities provide safe access to the samples.

Do not stockpile aggregates together from different sources and of different gradings. Do not use aggregates that have become segregated, mixed with foreign materials, or contaminated by aggregates of different gradings. Stockpile or bin for draining all aggregates produced or handled by hydraulic methods at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the

aggregates contain a high or nonuniform moisture content, the Engineer may require storage or stockpile periods in excess of 12 hours.

601.02.5 Water.

Ensure that water used in mixing and curing concrete conforms to **Subsection M02.07**.

601.03 CONSTRUCTION METHODS.

601.03.1 Proportioning.

a. General. Ensure that all concrete used on State of Rhode Island projects is air entrained. Adhere to the classes and proportions of materials per cubic yard of concrete in the following Table.

Classes and Proportions of Concrete Materials

Class[1,5,9]	B	A	XX	HP	MC[2]	Z	X
Minimum Cementitious Content[3], lb/cu yd	400	400	500	500	500	500	500[11]
Maximum Cementitious Content[6], lb/cu yd	700	700	700	700[6]	600	700	700
Maximum w/cm	0.55	0.45	0.42	0.40	0.40	0.42	0.40
Acceptance Criteria							
Consistency Range[4], AASHTO T119 Slump, in.	2 - 4	2 - 4	2 - 4	2 - 4	2 - 4	< 1	2 - 4
AASHTO T23 Minimum, Compressive Strength, psi							
28 days	3000	3000	4000	5000	3500	5000	5000
56 days	—	—	—	—	5000	—	--
Air Content Range, AASHTO T152, %	5 - 9	5 - 9	5 - 9	5 - 9	5 - 9	—	5 - 9
Concrete Prequalification Criteria[7]							
Surface Resistivity, (4 in. × 8 in. cylinder) AASHTO T358, k-cm (minimum)							
28-day standard cure	—	—	—	15	15	—	--
56-day standard cure	—	—	—	21	21	—	--
Maximum 28-day drying shrinkage,[8], AASHTO T160, %	—	—	—	-0.04	-0.04	—	--
Aggregate Prequalification Criteria[9]							
Maximum 14-day expansion ASTM C1567, %	—	0.1	0.1	0.1	0.1	0.1	0.1

Footnotes:

1. *A single concrete mixture may be used for multiple classifications if performance and prequalification criteria are satisfied.*
2. *Class MC concrete may have a total supplementary cementitious content of 75 percent by weight of total cementitious material when using either ground-granulated, blast-furnace slag meeting the requirements of AASHTO M 302, or combinations of slag and other supplementary cementitious materials. Maximum cement replacement by fly ash or other mineral admixture meeting requirements of AASHTO M 295 is 30 percent by weight. Maximum cement replacement by silica fume meeting the requirements of AASHTO M 307 is 7 percent by weight.*
3. *Portland cement and all other mineral admixtures.*

4. *Slump range measured at the point of discharge. Do not exceed a slump of 4 in. for surfaces sloped greater than 4 percent. If additional workability is desired, the Engineer may allow an increase of the maximum specified slump to 6 in. if an AASHTO M 194 Type A - Water Reducing Admixture is used, or an increase of up to 9 in. if an AASHTO M 194 Type F or G - High Range Water Reducing admixture is used.*
5. *AASHTO M 194 Type F or G - High Range Water Reducing Admixture is required when concrete will be placed by pumping equipment.*
6. *The maximum cementitious content for Class HP may be exceeded for the fabrication of precast/prestressed concrete structures as approved by the Engineer.*
7. *Concrete prequalification testing will not be required for the following concrete items — Flared Ends, Highway Bounds, Fence Post Footings, Guardrail Anchorage, Unreinforced Footings, Paved Waterways, Thrust Blocks, Precast Elements for Collars, Catch Basins, Manholes, Drop Inlets, Sumps, Electrical Handholes, Curbing, Pipe, Headwalls, End-walls, High Capacity Inlets, and Temporary Traffic Barriers.*
8. *Drying shrinkage prequalification is not required for precast/prestressed structures.*
9. *Aggregate prequalification is required for all concrete classifications.*
10. *Self-Consolidating Concrete (SCC) may be used for all classes of concrete except for Classes B and Z. Ensure that SCC meets all mix performance requirements listed in the Table for the respective concrete class. Test SCC for slump flow according to ASTM C1611; ensure that the visual stability index (VSI) is 0 in. or 1 in.*
11. *Class X is used only for precast drainage structures.*

b. Design and Approval of Concrete Mixtures. Design the concrete mixtures for each class of concrete specified. Proportion the concrete mix components using the absolute volumes method according to the requirements for each class as specified herein and methods in the American Concrete Institute's *Manual of Concrete Practice*, latest edition; Standard 211.1, "Recommended Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"; and Standard 301, "Specifications for Structural Concrete in Buildings – Section 4.2.3."

- Step 1. Laboratory Testing. At least 60 days before production, submit in writing the concrete mix design on Department forms and trial batch reports supported by laboratory test data from an AASHTO accredited laboratory to the Engineer for review.

  Provide the following information in the trial batch test reports:

  - Contractor/testing laboratory name
  - The coarse and fine aggregate gradations and sources
  - The fine aggregate fineness modulus (FM)
  - Any other pertinent information (e.g., aggregate specific gravities, unit weights, absorptions, any other material properties)
  - Date of mixing
  - Mixing equipment and procedures used

- The size of batch in cubic yards
- Weight/volume, type, source/manufacturer of all ingredients used in the mix
- Slump/spread
- Air content of the mix
- Concrete temperature
- Unit weight of fresh concrete
- Curing method, age at time of testing, and compressive strength of concrete

Note: Ensure that all testing conforms to the applicable AASHTO and/or ASTM requirements listed in these Specifications.

For original copies of concrete mix designs and trial batch reports submitted for approval to the Department, provide an original Rhode Island Professional Engineer's stamp and signature.

- Step 2. Trial Runs. Once the concrete mix design has been reviewed and no exception taken by the Engineer, conduct trial runs before production using the mix design's component materials and proportions, including the amount of admixtures that will be necessary to meet the specifications and produce concrete of the required plasticity, workability, air content, compressive strength, flexural strength, or any other specified concrete property. Conduct the trial runs by employing the concrete batch plant, mixer, and handling equipment proposed to use in production. Calibrate all equipment employed in the batching, mixing, transporting, and testing, and meet the requirements listed herein before initiating the trial runs. Pursue the goal of producing concrete using the maximum amount of water and air content specified in the submitted mix design during the trial runs. Notify the Engineer at least 48 hours in advance of performing the trial runs so that the test procedures can be witnessed.

  Once the concrete temperature, slump, and air content are tested and compliance with the Specifications has been established, the Engineer will fabricate compressive strength specimens to be tested by the Engineer.

  When all specified concrete parameters have been met, the Engineer will accept the proposed mix design for production.

  The accepted mix design proportions will govern during the progress of the work.

  Do not make any changes in the sources or proportions of the materials, including aggregate size, without written approval of the Engineer. Do not use new materials until the Engineer approves a revised mix design and new proportions based on a trial batch and laboratory tests and a minimum 3 cu yd batch plant trial run. Trial batch laboratory testing shall be conducted by an AASHTO accredited laboratory at no additional cost to the Department. The testing requirements are:

- No testing is required for changes in admixture dose provided that the proposed dose does not exceed the manufacturer's recommendations.

- Slump, air content, concrete temperature, and unit weight are required for all modifications.

- 28-day (56-day for Class MC) compressive strength is required for all modifications.

- AASHTO T358 and AASHTO T160 testing is required for any change to cementitious material source, cementitious material proportion, or water quantity for concrete Classes HP and MC.

- ASTM C 1567 is required for all concrete classes for the following changes:

  + aggregate source
  + aggregate size
  + single aggregate proportions greater than 300 lb/cu yd
  + cementitious material source
  + cementitious material proportions
  + water content

- Heat development, as determined by Adiabatic Temperature Rise or calorimetry, is required for any change in cementitious material content or source for Class MC concrete.

c. Concrete Prequalification Requirements. Proportion all concrete mixtures to meet the minimum prequalification requirements in the Table in Para. a. The Concrete Producer shall conduct all prequalification trial batches and prequalification testing using the materials in the submitted mix design. Trial batch and prequalification testing shall be performed by an AASHTO accredited laboratory. The Concrete Producer shall submit complete mixture proportions and prequalification test results of all plastic and hardened concrete properties in Para. b and the Table in Para. a to the Engineer for review. The Engineer reserves the right to perform testing for any of the specified prequalification properties.

- Ensure that concrete mixtures have an AASHTO T358 surface resistivity greater than or equal to the value in the Table in Para. a for the class of concrete. Report a minimum of two 4 in. × 8 in. cylinder specimens for the AASHTO T358 testing.

- Ensure that concrete mixtures have a 28-day drying shrinkage value less than the value in the Table in Para. a for the class of concrete. Determine drying according to the procedure in AASHTO T160 with the following clarifications: Specimens are 3 in. × 3 in. × 11.25 in. prisms. Moist cure all specimens in a saturated lime water bath for seven days before exposure to the drying environment. The specimen length is taken upon demolding after the curing period and weekly for 28 days while placed in the drying environment. Calculate the shrinkage value after 28 days of drying as the percent change in length from the time the specimen is removed from curing.

- Ensure that all combinations of aggregate and cementitious materials used in concrete mixes are innocuous to alkali-aggregate reactivity as demonstrated by a mean expansion not greater than or equal to 0.10 percent after 14 days of soaking using the ASTM C 1567 test method. Ensure that this requirement is satisfied for an aggregate if the mean expansion in an AASHTO T303 test after 14 days of soaking is less than or equal to 0.10 percent.

Test coarse and fine aggregates separately.

A series of tests with the reactive aggregate and different cement replacement levels may be required to determine the minimum cement replacement level necessary to mitigate expansion for a given combination of materials. Do not determine the minimum replacement level by interpolation between tested levels.

601.03.2 Batching Plants and Equipment.

a. General. Ensure that batching plants meet AASHTO M 157 and are certified by the National Ready Mix Concrete Association (NRMCA). Weigh cement independently on a separate scale. Ensure that the weighing hopper is properly sealed and vented.

b. Cement Silos. Provide separate silos or holding bins for each cement type and mineral admixture. Ensure that the bins protect the cement and mineral admixture from rain and moisture.

On a weekly basis, maintain a log documenting deliveries, which will include the brand, supply, location, type, quantity, and date to document the cement on hand. Ensure that all received cement conforms to the specified quality requirements. Ensure that the log also contains data on the quantitative distribution of all cement used on both private and State projects. Submit copies of the log to the Engineer upon request, attested to by the Contractor or its representative.

c. Scales. Calibrate all plant scales and water meters, including truck scales, involved in the plant operation using a registered scale company as follows:

- Annually before use in State work
- At intervals of not more than 180 calendar days
- At any time ordered by the Engineer

Note: Every 180 days, the plant owner shall submit to the Engineer a certificate from the registered scale company making the checks attesting to the accuracy of all plant scales. The certificate shall be signed by the technician or a responsible representative of the scale company making the check.

d. Automation and Recordation. Ensure that plants producing Portland cement concrete for the Department conform to the following plant equipment requirements:

- Automatic Proportioning. Produce Portland cement concrete in batch type mixing plants equipped with approved automatic proportioning devices. Ensure that the devices include equipment for accurately proportioning batches of the various components of the mixture by weight or volume in the proper sequence. Proportion

cement and aggregates by weight. Proportion water and admixtures by weight or volume. Adjust the batch weights as needed when aggregate moistures change to account for the actual moisture content of the aggregates at time of use. Equip plants automatically to control the batching sequence and timing of operations. Provide an auxiliary interlock cutoff circuit to interrupt and stop the automatic cycling of the batching operations when an error in weighing occurs, when an aggregate bin becomes empty, or when there is a malfunction of any portion of the control system.

- Recording Equipment. Equip the plant with a recording device that automatically prints the following data on delivery tickets and reproduces the reading of the scale being recorded within ±0.1 percent of scale capacity:

    - Approved mix design
    - Batch weights and storage bins for each size aggregate
    - Total weight of aggregates in batch; ensure that the weight printed for the last aggregate batched is the total weight of aggregate in the batch when cumulative weights are used
    - Weight of cement and/or mineral admixtures and storage silo designation
    - Weight or volume of water
    - Weight or volume of admixtures
    - Date batched
    - Time of each batch or load
    - Tare zero balance to within ±0.3 percent of scale capacity
    - Total size of batch
    - Name of customer
    - Name of Project and RI Project Contract Number
    - Name of trucker and truck number

    Include the following information on the delivery ticket:

    - Signature of Materials Inspector (Plant)*
    - Amount of water and/or admixtures added at the point of delivery
    - Signature of Construction Inspector (Site)*

    * *Signatures do not indicate "acceptance" of the material but only signify that the required inspection/witnessing has been accomplished.*

Provide sufficient copies of delivery tickets to provide a copy for the plant inspector and a copy for the Construction Manager for the permanent Project record.

- Equipment Failure. If at any time the recording devices become inoperative, the plant may be allowed to batch materials for a period of not more than one work day from the time of breakdown, if approved by the Engineer. Written permission of the Engineer will be required for periods of operations without automatic proportioning facilities longer than one work day. As a condition for continued use with inoperative recording devices, manually record all required information on all delivery tickets.

- Batching Controls. Ensure that batching controls are electrically interlocked with the scales to prevent cycling or recycling of batching until scales tare zero. Ensure that the batching controls meet the following tolerances with respect to the various components weighed in each batch:

  - Coarse Aggregate: ±2.0 percent of required weight of the total coarse aggregate being weighed

  - Fine Aggregate: ±2.0 percent of required weight of the total fine aggregate being weighed

  - Portland Cement: ±1.0 percent of required weight of cement being weighed

  - Mineral admixtures: ±1.0 percent of required weight of mineral admixtures being weighed

  - Water: ±1.0 percent of required weight or volume of water being weighed

  - Admixtures: ±3.0 percent of required weight or volume of each admixture being used

  Ensure that the total weight of the batch does not vary more than ±1.0 percent from the theoretical design weight.

601.03.3 Concrete Mixing, Delivery, and Discharge.

Concrete may be mixed at the site of construction, at a central point, or in transit mixers, all according to the Specifications.

a. Equipment — Mixers and Agitators. Provide mixers and agitators that meet the requirements of AASHTO M 157. When the concrete is truck-mixed, ensure that the volume of concrete mixed per batch does not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer. An exception is that an overload of up to 10 percent above the mixer's nominal capacity may be permitted, if the concrete test data for strength, segregation, and uniform consistency are satisfactory and if no spillage of concrete occurs.

   Equip truck mixers and agitators so that the number of revolutions of the drum, blades, or paddles may be readily verified. Ensure that truck mixers can measure the amount of water added during retempering such as a water meter or other method.

b. Mixing and Delivery. Mix and deliver ready-mixed concrete according to AASHTO M 157. Ensure that ready-mix concrete delivery trucks are National Ready Mixed Concrete Association (NRMCA) (nrmca.org) certified via a non-expired certificate affixed to the truck in a location readily visible to the inspector (see Section 5 of NRMCA Plant Inspector's Guide).

c. Discharge.

- Time and Rate. Ensure that the elapsed time from when water is added to the mix until concrete is discharged into the forms at the site of work does not exceed 90 minutes when hauled in truck-mixers or truck agitators or 30 minutes when concrete is hauled by non-agitating equipment. Waste any concrete that is not discharged into its final place within 90 minutes (30 minutes when using non-agitating equipment) after batching.

  Approved set-control admixtures may be used to extend the maximum time of discharge for ready-mixed concrete delivered in truck mixers to 120 minutes, if the Contractor submits trial mix data subject to the following conditions:

  - The concrete mixture proportions and prequalification test results have been approved according to **Subsection 601.03.1(b)**.
  - Set-control admixture usage is according to the admixture manufacturer's instructions and guidelines.
  - Trial batches of the concrete mixture without the admixture (control) and additional batches covering the anticipated range of admixture doses are conducted. Ensure that trial batch volume is a minimum of 3 cu yd and that trial batches are conducted at the maximum water content for the approved mixture.
  - For the control batch, only sample after initial mixing.
  - For batches containing the set-control admixture, sample after initial mixing and after 30, 60, 90, and 120 minutes. Keep the truck mixer in motion between sampling intervals.
  - Include for each trial batch data for plastic properties (slump, air content, unit weight, and temperature) after initial mixing and after 30, 60, 90, and 120 minutes of slow mixing. Report the number of drum rotations at each sampling interval.
  - If plastic properties are outside of the specification limits at any time interval, retesting after high speed mixing for up to five minutes will be allowed.
  - Provide data for each trial batch that includes seven-day and 28-day (56 days for Class MC concrete) compressive strength results sampled after initial batching for the control and after initial batching and 120 minutes of slow mixing for batches containing the set-control admixture.

- Ensure that trial batch test results that indicate the concrete properties of mixtures containing the set-control admixture meet specification requirements after 120 minutes of slow mixing.

- Retempering. Retempering is defined as adjusting concrete properties by the addition of water or chemical admixtures after initial batching. Retempering concrete by adding water or other means may be permitted only 1) after concrete arrival and initial testing on the jobsite, 2) when delivered in truck mixers, and 3) if permitted by the Engineer. When authorized, additional water or chemical admixtures may be added to the batch materials with additional mixing to increase slump or air entrainment to meet the specified requirements, if:

  - The maximum water-cementitious materials ratio is not exceeded.

  - The admixture doses do not exceed the manufacturer's recommendations.

  - All retempering and retesting operations are completed at least 30 minutes before the maximum allowable discharge time limit.

  Add all admixtures at the plant. The Engineer may approve the addition of withheld mixing water at the jobsite with a metered pressurized wand. Do not add admixture during retempering that is not present in the approved mixture.

  Before allowing retempering with water-reducing admixtures on the Project, conduct trial batches to simulate the impact of delayed additions as follows:

  - Both the control and retempered batch contains the same plant-added admixture dose.

  - The retempered batch has the second dose of admixture added at least 30 minutes before the maximum discharge time.

  - The combination of plant added admixture dose and retempered admixture dose does not exceed the maximum manufacturer's recommended dose.

  - Plastic properties are sampled initially at the time of retempering and maximum discharge time.

  - Specimens for strength and time of set for both the control and retempered mixture are sampled at the maximum allowed discharge time.

No trial batches are required for retempering with air entrainment admixtures.

If additional water will be incorporated into the concrete, revolve the drum not less than 30 revolutions at the mixing speed immediately after retempering the concrete and before discharge is commenced.

If additional admixtures are incorporated into the concrete, revolve the drum between 30 to 60 revolutions at the mixing speed immediately after retempering the concrete and before discharge is commenced.

Do not use concrete that is not within the specified slump or air content limits at the time of placement. Retemper the concrete at the site as permitted by the Engineer. Retempering with admixtures will be permitted only with the approval of the Engineer or when specifically provided for in the Contract.

601.03.4 Limitations for Mixing and Placement.

Do not mix, place, or finish concrete when the natural light is insufficient, unless an adequate artificial lighting system is operational.

During and immediately after placement, protect the concrete from the adverse effects of rain.

When there is a probability of air temperature 40°F or less at the time of placement, or when there is a local forecast indicating that the temperature will be below 40°F during the five-day (cast in place masonry) or 14-day (bridge deck) curing period, cold weather concreting, as defined in **Subsection 601.03.5**, will apply. At least 24 hours before placement, submit a request for approval by the Engineer to use a cold weather concreting and curing plan detailing the methods and equipment to ensure that the concrete temperature does not fall below 50°F during the curing period after placement, which is considered the protection period. Ensure that concrete mixing operations conform to **Subsection 601.03.5.**

601.03.5 Cold Weather Concrete.

a. Plant Procedures. When concreting is authorized during cold weather, the aggregates and/or water may be heated by either steam or dry heat before being placed in the mixer. Ensure that the apparatus heats the mass uniformly and is arranged to preclude the possible occurrence of overheated areas that might damage the materials. Ensure that the temperature of the mixed concrete is not less than 50°F and not more than 90°F at the time of placement in the forms.

   Do not use frozen aggregates in the concrete.

   Stockpiled aggregates may be heated by the use of dry heat or steam. Do not heat aggregates directly by gas or oil flame or on sheet metal over fire.

   When aggregates are heated in bins, steam-coil, water-coil heating, or other methods that will not be detrimental to the aggregates may be used. Do not use live steam on or through binned aggregates without the approval of the Engineer.

b. Concrete Placement Procedures. Do not place concrete on frozen subgrade. Install sufficient heating devices under an enclosure or covering that are capable of maintaining at all times and under all weather conditions during the protection period a uniform concrete temperature of not less than 50°F. From days 8 to 14 of the concrete bridge deck curing period, maintain a minimum concrete temperature of not less than 40°F. Arrange heating devices to prevent overheating any forms or concrete. Before any concrete is placed, ensure that the enclosure and heating apparatus are as nearly complete as the placement of concrete will permit. Ensure that the minimum temperature is continuously maintained around deposited concrete for the curing period of five days (cast in place masonry) or 14 days (bridge deck) or 56 days (Class MC concrete)

immediately after concrete has been placed and then reduced gradually so that the concrete will not be subjected to a sudden change in temperature. The heating period may be reduced when the concrete units will not be subjected to any appreciable bending stress from dead or live load until after seasonal conditions have permitted normal curing.

A steam heating system may be used to supply heat during the protection period to ensure a minimum temperature of 40°F before concrete placement.

Heat for protection may be supplied by any method that will maintain the required concrete temperature of not less than 50°F. When methods other than live steam are used, make provisions in the enclosure being heated to maintain a humid condition of sufficient vapor (maintain humidity of 100 percent) content to prevent evaporation of the moisture in the concrete.

Provide adequate fire protection when heating is in progress and provide watchmen or other attendants to keep heating units in continuous operation. Do not use open fires.

Maintain a daily permanent record of the concrete surface temperatures throughout the curing period with the use of a 24-hour, continuous temperature recording device. The Engineer will retain these records.

During freezing weather, seal all keyways, anchor bolt holes, or other depressions in exposed horizontal concrete surfaces against the admission of water. Repair damage to the concrete from freezing water in the depressions if practical, or replace the concrete as directed by the Engineer.

601.03.6 Hot Weather Concrete.

Hot weather is defined in The American Concrete Institute, Standard 305. During concreting operations in hot weather, take appropriate measures to reduce the hazards of an increased rate of cement hydration, flash set, loss of water due to evaporation, high concrete ingredient temperatures, and the increased difficulty of concrete placing and finishing. Comply with the following requirements during concrete placement operations in hot weather:

a. Concrete Temperature. Ensure that the temperature of the concrete at the point of discharge does not exceed 90°F.

b. Cooling Materials. The Contractor may reduce the temperature of the concrete by cooling one or more of several ingredients. Use chipped or crushed ice in the mix as a portion of the mixing water on a pound for pound basis, provided that the measurement is determined at the time of placement in the mix.

   If used, melt all ice before the batch is discharged from the mixing unit.

c. Concrete Placement. Immediately before the concrete is placed, cool the forms and reinforcement steel by spraying with water. Do not allow any standing water in the concrete forms from the spraying procedures. Ensure that sufficient skilled staff and adequate equipment are available to place the concrete without delays.

d. Finishing. To prevent thermal and shrinkage cracking resulting from moisture loss, use effective means to supply moisture. Ensure that finishing operations follow as closely as practical behind the placing operation so that curing may begin as soon as possible.

601.03.7 Curing.

a. Curing. Ensure that the temperature on the surface of the hardened concrete does not fall below 50°F at any time during the first five days of curing.

Initiate curing operations on all exposed surfaces immediately after the placing and finishing operations have been completed. Select a method of curing that does not damage the concrete surface before final set occurs and continue its use throughout the work, unless the Engineer determines that the curing plan results in unsatisfactory concrete curing.

Any changes in the method of curing must be authorized in writing. When curing requires the use of water, ensure that the curing has priority for all water supply or suppliers. Failure to provide sufficient cover material or lack of water to adequately protect both curing and other requirements will result in immediate suspension of concreting operations. Do not allow the concrete to remain exposed for more than ½ hour between stages of curing and during the curing period.

b. Water Method. Ensure that the concrete remains continuously wet by the application of water for a minimum period of seven days after the concrete has been placed.

A curing medium meeting the requirements of **Subsection M02.04** may be used to retain the moisture during the curing period. When a curing medium will be used to retain the moisture, ensure that the entire surface of the concrete remains damp by applying water with a nozzle so that the flow is atomized in the form of a mist rather than a spray until the surface of the concrete is covered with the curing medium. Do not apply the moisture from the nozzle under pressure directly upon the concrete and do not allow moisture to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface.

c. Curing Compound Method. Use a curing compound that complies with **Subsection M02.04**. For concrete that is treated with any additional coatings or overlays, do not cure as provided in this Section.

Spray the surfaces of the concrete that are exposed to the air uniformly with a curing compound.

Apply the curing compound according to the manufacturer's recommendation.

Evaluate runs, sags, thin areas, skips, or holidays in the applied curing as evidence that the application is not satisfactory. If a clear color curing compound is used, add a fugitive dye to the curing compound to ensure complete coverage.

Apply the curing compound to the concrete following the surface finishing operation immediately before the moisture sheen disappears from the surface, but before any drying, shrinkage, or craze cracks begin to appear. If any drying or cracking of the surface is evident, immediately apply water with an atomizing nozzle as specified above for the

Water Method, and continue until application of the compound is started or resumed. However, do not apply the compound over any resulting freestanding waters. If the film of compound is damaged from any cause before the expiration of seven days after the concrete is placed for structures and 72 hours for pavement, repair the damaged portion immediately with additional compound.

Do not dilute or alter the curing compound after manufacture.

When the curing compound is shipped in tanks or tank trucks, provide a shipping invoice with each load. Ensure that the invoice contains the same information as that required for container labels.

Curing compounds may be sampled by the Engineer at the source of supply, at the job site, or at both locations.

Use the curing compound within 120 days of its manufacture.

All tests will be conducted by the Engineer according to the latest test methods of the American Society for Testing Materials.

d. Waterproof Membrane Method. Spray the exposed finished surfaces of concrete with water, using a nozzle that atomizes the flow so that a mist and not a spray is formed, until the concrete has set, after which place the curing membrane. Ensure that the curing membrane remains in place for a period of not less than 72 hours.

Use sheeting material for curing concrete that conforms to **Subsection M02.04.2**.

Use sheeting material that has been fabricated into sheets of a width to provide a cover for the entire concrete surface. Securely cement together all joints in the sheets to provide a waterproof joint. Ensure that the joint seams have a minimum lap of 6 in.

Securely weigh down the sheets by means satisfactory to the Engineer. Do not use rocks, sand, or loose debris as ballast.

Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, repair the broken or damaged portions with new sheets properly secured into place.

Do not use sections of membrane that have lost their waterproof qualities or have been damaged that renders them unfit for curing the concrete.

e. Forms-In-Place Method. Formed surfaces of concrete may be cured by retaining the forms in place. Ensure that the forms remain in place for a minimum period of seven continuous days after the concrete has been placed, except that, for members over 20 in. in least dimension, ensure that the forms remain in place for a minimum period of five continuous days. Remove the forms no later than three weeks after the concrete has been placed.

Ensure that all joints in the forms and the joints between the end of forms and concrete remain moisture tight during the curing period. Reseal any cracks in the forms and cracks between the forms and the concrete by methods approved by the Engineer.

601.03.8 Quality Assurance (QA).

a. Concrete Manufacturing Plant Quality Control (QC).

- General. The Concrete Producer shall establish, implement, and maintain a QC program to control all equipment, materials, and processes during concrete production. The Concrete Producer's QC program shall include sampling, testing, inspection, monitoring, documentation, and corrective action procedures during the handling, blending, and mixing operations. Develop a written Quality Control Plan (QCP) that details the Concrete Producer's QC program. Do not produce concrete without an approved QCP and a QC technician present at the plant for production. QC is not required for optionally tested items in the latest edition of the RIDOT Master Schedule of Testing. Failure to comply with the provisions of this Subsection will result in the rejection of the concrete produced until the Concrete Producer's operations comply.

- Personnel. At a minimum, the QC staff shall include the following personnel:

  - QCP Administrator. The Concrete Producer shall employ a QCP Administrator with five years minimum of Materials QC experience and meeting one or more of the following criteria:

    + Professional Engineer licensed in the State of Rhode Island

    + Certification by the National Institute for Certification of Engineering Technologies (NICET) at Level III or above for concrete

    + Certification by the North-East Transportation Training and Certification Program (NETTCP) as a QA Technologist

  - For prestress concrete facilities, employ a QCP Administrator with five years minimum of prestress concrete production QC experience and meeting one or more of the following criteria:

    + Precast/Prestress Concrete Institute (PCI) Level III Certification for prestressed concrete production (PCI Level II for non-prestressed precast)

    + Certification by the National Institute for Certification of Engineering Technologies (NICET) at Level III or above for concrete

    + Certification by the North-East Transportation Training and Certification Program (NETTCP) as a QA Technologist

  - The QCP Administrator shall have the authority to direct all actions necessary for the successful implementation of the QCP, including administering, implementing,

monitoring, and adjusting processes as necessary to ensure compliance with the Contract Documents.

- QC Technicians. The Concrete Producer shall employ QC Technician(s) who test concrete specimens and concrete materials. QC Technicians shall possess a current certification as American Concrete Institute (ACI) Concrete Laboratory Testing Technician Level I or NETTCP Concrete Technician.

  + For precast/prestressed concrete facilities, employ additional QC technician(s) who sample and test concrete at the point of placement. QC technicians shall possess a current certification as ACI Concrete Field Testing Technician Grade I or NETTCP Concrete Technician.

  + QC technicians shall report directly to the QCP Administrator and shall be responsible for performing required QC activities and preparation of associated QC documentation.

- QC Testing Facilities and Equipment. The Concrete Producer shall maintain a separate QC laboratory and associated sampling, testing, and measuring equipment necessary to perform the required QC activities. Provide sampling, testing, and measuring devices according to specified standards and properly calibrated and verified. The Concrete Producer shall maintain records of the calibration and maintenance of all sampling, testing, and measuring equipment.

  Use back-up equipment if a device is found to be defective. Ensure that defective equipment is clearly tagged and/or removed from the site until repaired and the calibration is verified. If non-standard or alternative sampling methods, testing procedures, or equipment are proposed to be used, detail these in the QCP and approved by the Engineer before use.

- QC Activities. Implement QC activities for monitoring, inspection, sampling, and testing, which will cover all aspects that affect the quality of the concrete, including:

  - Component materials:
    + Fine and coarse aggregates
    + Portland cement
    + Mineral and chemical admixtures
    + Water
  - Production and delivery equipment
  - Mixing and transportation
  - Formwork (precast/prestress plants only)
  - Prestressing steel, reinforcement, inserts (precast/prestress plants only)
  - Tensioning prestressing steel (precast/prestress plants only)
  - Plastic and hardened concrete properties (precast/prestress plants only)
  - Placement and consolidation (precast/prestress plants only)
  - Finishing and curing (precast/prestress plants only)
  - Finished product (precast/prestress plants only)

  The two following Tables provide the minimum QC activities and frequencies.

Minimum Production Equipment QC Requirements

Equipment	Control Requirement	Minimum Frequency
1. Plant Central Mixer Blades	Visual Inspection	Annually
2. Plant Scales and Meters	Calibrate	Every 180 days
3. Batch Plant and Mixer Trucks	NRMCA Certification	Annually
4. Truck Water Meters	Calibrate	Annually
5. Tensioning Gauges	Calibrate	Precast/Prestressed Concrete — Every 180 days
6. Hydraulic Jacks	Calibrate	Precast/Prestressed Concrete — Every 180 days

Minimum Materials QC Requirements

Item	Control Requirement	Minimum Frequency
1. Fine and Coarse Aggregates	Gradation Moisture Content Visual Inspection of stockpiles and bins for segregation and contamination	Ready Mix Concrete – Daily/before start of production and randomly every 160 cu yd of concrete.
		Precast/Prestressed Concrete – Daily/before start of production and randomly every 50 cu yd of concrete.
2. Portland Cement	Mill Text Report – Verify conformance to specifications	Each delivery
3. Mineral Admixtures	Certificate of Compliance – Verify conformance to specifications	Each delivery
4. Chemical Admixtures	Certificate of Compliance – Verify conformance to specifications	Each delivery
5. Concrete Batching	Verify Mix Proportions and Batch Weights Computer maximum allowable retempering water and maximum discharge time	Each batch
6. Plastic Concrete	Air Content Yield (Unit Weight) Slump/Spread Concrete Temperature Air Temperature	Precast/Prestressed Concrete — First two loads then randomly every 50 cu yd for each concrete class delivered and placed on a calendar day from a single supplier.
	*Compressive Strength Specimens	Precast/Prestressed Concrete — One set for the first 50 cu yd inclusive and one set for each additional 50 cu yd or fraction thereof and as necessary for formwork removal, stress transfer and shipping (include concrete temperature, air content and slump test results)

* *The Concrete Producer shall determine the quantity of cylinders necessary for process control of construction operations.*

- Concrete Producers Quality Control Plan (QCP). The Concrete Producer shall submit a detailed written QCP to the Engineer for approval annually, at least 60 days before the first concrete placement. Provide a QCP that details the Concrete Producer's plans, policies, procedures, and organization deemed necessary to measure and control materials, equipment, and concrete production processes.

  Ensure that the QCP reflects the current status of the operations; submit proposed changes to the QCP to the Engineer. Changes must be approved by the Engineer before implementation.

  At a minimum, provide a QCP that details the following:

  - Scope of QC Plan. Reference all applicable specifications, including the latest revision of the *Standard Specifications* plus all applicable compilations and supplements.

  - QC Organization. Include a QC organizational chart identifying all personnel responsible for implementing the QCP and how staff integrate and communicate within the Concrete Supplier's management structure and with the Engineer. Include a list of QC personnel and their names, qualifications, responsibilities, levels of authority, certifications, telephone contact number(s), and e-mail addresses.

  - QC Testing Facilities and Equipment. Include the location and qualifications of QC testing facilities and a list of all QC testing equipment with the frequency of calibration and verification.

  - Materials Control. Include the source(s) for all materials used in the production of Portland cement concrete and receiving, storage, and handling practices. For fine and coarse aggregates, describe stockpile management practices, including stockpile identification, separation, segregation mitigation, and loading.

  - Concrete Production. Provide a description of the concrete plant and concrete batching operations, including:

    + Plant location and layout
    + Production equipment
    + Method and sequence of batching
    + Mixing capacity and minimum mixing time
    + Method of monitoring ingredients and recording batches
    + Methods of delivery

  - QC Activities. Describe QC activities deemed necessary to control all aspects of concrete production. Include the locations, methods, frequency, and personnel responsible for conducting QC sampling, testing, and inspection. Identify lot/sublot sizes, the sample identification system, and sample storage/retention procedures. The minimum required QC activities are listed in the preceding Tables.

  - Pre-Placement (Precast/Prestressed Plants only). Include source, storage, and handling procedures for steel reinforcement, prestressing strand, hardware, and

inserts. Describe procedures and equipment for tensioning and detensioning of prestressing steel strands.

- Concrete Placement (Precast/Prestressed Plants only). Describe methods, equipment, and materials for placement, consolidation, finishing, and curing of concrete. Include sequencing of work and maximum discharge times. Include procedures for determination of concrete strength for formwork removal and application of load. See **Subsection 809.03.8** for the curing of precast and prestressed concrete members.

- Post Production (Precast/Prestressed Plants only). Describe procedures for post-production inspection, including product condition assessment, measurement of product geometry, and camber (as applicable). Include procedures for handling and storage of finished products.

- Documentation. Describe documentation and reporting procedures for all QC activities. Include samples of all QC forms, reports, and control charts.

- Non-Conformance and Corrective Action. Establish and maintain an effective and positive system for controlling non-conforming material and products as indicated by inspection and test results. Investigate the cause of any non-conformance to prevent recurrence, and take prompt corrective action to correct conditions that have resulted, or could result, in the incorporation of non-conforming materials and products into the work. Positively identify all non-conforming materials and products to prevent use, shipment, and intermingling with conforming materials and products. Provide segregated holding areas, subject to the approval of the Engineer.

  Include criteria for identifying non-conforming materials and products and procedures for isolation, disposition, and documentation. Include procedures and personnel responsible for directing corrective action, including suspension of work, disposal, and reclaiming or reworking of non-conforming materials and products. Detail how the results of QC inspections and tests will be used to determine corrective actions, and define rules to gauge when a process is out of control and the associated corrective action to be taken. At a minimum, establish corrective action procedures for each control requirement listed in the preceding Tables**.**

- Records and Documentation. The Concrete Producer shall maintain complete records for all QC tests and inspections. Ensure that the QC records contain all test and inspection reports, forms and checklists, equipment calibrations, component material certificates of compliance and mill test reports, and non-conformance and corrective action reports. Ensure that the QC records will document the nature and number of observations made, the number and type of deficiencies found, the quantities of conforming and non-conforming, and the nature of corrective action taken, as appropriate. Make the QC records available to the Engineer at all times, and retain the records for the life of the Contract. The Concrete Producer's documentation procedures will be subject to approval by the Engineer before the start of the work and to compliance checks by the Engineer during the progress of the work.

- Forms and Reports. Document all QC inspection and test results on NETTCP forms and reports or equivalent as approved by the Engineer. Additionally, generate a non-conformance and corrective action report for each instance where test or inspection results indicate a non-conformance. Ensure that the report indicates the nature of the non-conformance and corrective actions taken to resolve it. Prepare forms and reports that are complete and on a standardized, publicly used format, and submit to the Engineer as the work progresses (or weekly, at a minimum).

- Control Charts. Document all conforming and non-conforming test results on control charts, and ensure that they are complete and available to the Engineer at all times during production. Present test data for Portland cement concrete on control charts, including critical gradation(s) (i.e., passing No. 4, No. 100, No. 200 sieves), air content, unit weight, and 28-day compressive strength for precast/prestressed concrete. Provide control charts that indicate lots and sub-lots, target values, and control limits, all in chronological order with a legend. The Concrete Producer may use other types of control charts as deemed appropriate and as approved by the Engineer. Complete testing and charting within 24 hours after sampling.

- Certification. At the conclusion of the Project, the Concrete Producer shall certify to the Engineer that all Portland cement concrete and precast/prestressed products have been produced, inspected, and tested according to the requirements of the Contract specifications.

- Engineer's Acceptance Sampling, Testing, and Inspection. The Engineer is responsible for sampling, testing, and inspection for acceptance, except for furnishing the necessary materials, which shall be the Contractor's responsibility as directed by the Engineer and at no additional cost to the Department. Acceptance is based on the Engineer's inspection of the construction, monitoring of the Contractor's Quality Control Program, and acceptance test results.

  Provide the Engineer with reasonable access to the records without charge.

  Samples of fresh concrete for testing will be taken after all concrete retempering is performed. When sampling from within the forms is impractical, samples will be taken at the nearest accessible point in the conveyance system before placement into the forms.

  Acceptance sampling and testing will meet the requirements of the Contract and the Master Schedule for the Preparation of a Project Schedule for Sampling, Testing, and Certification of Materials.

  Compressive strength test specimens will be standard 4 in. × 8 in. cylinders for all placements.

b. Engineer's Acceptance, Sampling, Testing, and Inspection. The following is the acceptance plan necessary to obtain samples, perform tests, and provide inspection of the work. The terms used in this acceptance plan are defined as follows:

- Placement. For a given class of concrete, the portions of a concrete structure constructed during one continuous concrete operation.

- Acceptance Plan. The method of taking measurements of samples to determine the acceptability of a placement of material or construction. Acceptance plans include random sampling plans.

- Random Sample. A sample chosen so that each increment in the lot has an equal probability of being selected. The Engineer reserves the right to take more samples in addition to the samples taken according to the random sampling plan.

- Acceptance. As defined in Para. c below.

- Rejection. When used in this context, “rejection” means remove, dispose, and replace at no cost to the Department or, at the discretion of the Engineer, “rejection” means acceptance at a lower price determined by Pay Factors, as specified herein.

- Lot. An isolated quantity of material from a single source or a measured amount of construction produced by the same process. For placements less than 750 cu yd, the Lot is 150 cu yd or less. For placements of 750 cu yd or greater, the Lot is 250 cu yd or less.

  Lots will be determined as follows:

  - The total cubic yards for the placement will be divided by 150 for placements less than 750 cu yd, and 250 for placements greater than or equal to 750 cu yd.

  - The result will be rounded up to the next whole number. This number is the number of Lots in the placement.

  - The total cubic yards for the placement in the first bullet will be divided by the number in the second bullet to determine Lot size.

  - Each Lot size will be adjusted by rounding to the nearest 10 cu yd (or other number representing one truck load), and this adjusted Lot size will be used to determine the number of trucks in the Lot.

  - For the acceptance plan, the total cubic yards of concrete placed for all Lots will be the placement volume.

- Sublots. Equal divisions or portions of a Lot are as defined below. The Sublot size for each Lot will be calculated by dividing each Lot into thirds rounded to the nearest truck.

  - Cylinders will be cast for each placement less than or equal to 150 cu yd of concrete delivered for each class of concrete according to the following:

    \+ 1 truck = 4 cylinders from the truck
    (6 cylinders for Class MC concrete)

    \+ 2 trucks = 4 cylinders from 1 randomly selected truck
    (6 cylinders from 1 randomly selected truck for Class MC concrete)

+ 3 trucks = 2 cylinders from each of 2 randomly selected trucks
(3 cylinders from each of 2 randomly selected trucks for Class MC concrete)

+ 4 thru 10 trucks = 2 cylinders from 1 randomly selected truck from the first half of the placement and 2 cylinders from 1 randomly selected truck from the second half of the placement.

(3 cylinders from 1 randomly selected truck from the first half of the placement and 3 cylinders from 1 randomly selected truck from the second half of the placement for Class MC concrete).

+ 11 thru 15 trucks = 2 cylinders from 1 randomly selected truck from the first third of the placement, 2 cylinders from 1 randomly selected truck from the second third of the placement and 2 cylinders from 1 randomly selected truck from the final third of the placement.

- Cylinders will be cast for each placement greater than 150 cu yd and less than 750 cu yd of concrete delivered for each class of concrete according to the following:

+ 2 cylinders from 1 randomly selected truck from the first third of the Lot, 2 cylinders from 1 randomly selected truck from the second third of the Lot, and 2 cylinders from 1 randomly selected truck from the final third of the Lot.

- Cylinders will be cast for each placement greater than or equal to 750 cu yd of concrete delivered for each class of concrete according to the following:

+ 2 cylinders from 1 randomly selected truck from the first third of the Lot, 2 cylinders from 1 randomly selected truck from the second third of the Lot, and 2 cylinders from 1 randomly selected truck from the final third of the Lot.

Sidewalk placements will have a minimum of one set of four cylinders taken from one randomly selected truck per Project per day.

c. Placement Acceptance Compressive Strength Evaluation. The 28-day or 56-day compressive strengths (f'_c) specified in the Table in **Subsection 601.03.1** are the strengths used in the design calculations. The Engineer will verify design strengths by tests made during the progress of the work according to AASHTO T23 (Standard Practice for Making and Curing Concrete Test Specimens in the Field) and AASHTO T22 (Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens). Acceptance for Class MC concrete will be based on a 56-day compressive strength test.

Three cylinders randomly selected from each set of 4 or 6 cylinders, as determined under "Sublots," will be tested for either 28-day or 56-day compressive strengths.

Case A: Single Lot Placement.

The average 28-day or 56-day compressive strength of 3 cylinders selected from a set of 4 or 6 cylinders will be used to calculate the acceptance of the Single Lot Placement. The following

formulas will be used to calculate the Placement Acceptance Test Result (PATR). The Engineer has the authority to use Formula – B for any Lot size when more than one set of 3 cylinders are tested.

Formula – A

$$PATR = \overline{X} = \frac{X_1 + X_2 + X_3}{3}$$

Symbols:

X = individual test value, which is the 28-day or 56-day compressive strength of each cylinder tested

$\overline{X}$ = the mean (average) 28-day or 56-day compressive strength of a set of 3 cylinders

PATR = Placement acceptance test result

Case B: Multiple Lot Placements.

For Multiple Lot Placements, 3 cylinders from each set of 6 cylinders from each Lot will be tested for 28-day or 56-day compressive strength. The mean value of the sum of the average compressive strengths will be used to calculate the acceptance of the placement. The following formula will be used to calculate the Placement Acceptance Test Result (PATR).

Formula – B

$$PATR = \overline{X} = \frac{\overline{X}_1 + \overline{X}_2 + \cdots \overline{X}_n}{n}$$

Symbols:

$\overline{X}$ = the mean (average) 28-day or 56-day compressive strength of a set of 3 cylinders for each Lot.

X = the mean (average) of the sum of the average 28-day or 56-day compressive strength test result of each Lot.

n = number of sets

Strength Pay Factors

PATR % of (f'_c)	Placement Pay Factor (PPF) (%)
95 or greater	1.00 (100)
90 to 94.9	0.90 (90)
85 to 89.9	0.85 (85)

When the PATR of structural concrete falls below f'_c submit an investigative plan stamped by a Professional Engineer holding a valid license to practice engineering in the State of Rhode Island outlining how to demonstrate that the in-place concrete's compressive strength is structurally adequate. The Engineer will approve the investigative plan before the execution of the investigation. After the investigation is completed, submit a report to the Engineer presenting the results of the Professional Engineer's analysis, testing, and conclusions and any recommended actions proposed for the concrete that did not meet the specified strength requirements.

If the Engineer's analysis demonstrates that the in-place concrete is structurally inadequate, remove the concrete and replace it at no additional cost to the Department.

The Contractor may elect to remove and dispose of any non-conforming material and replace it with new material to avoid a PPF of less than 1.00. Any such new material will be sampled, tested, and evaluated for acceptance according to the applicable requirements of **SECTION 601**.

The Engineer may reject any quantity of material that appears to be non-conforming based on visual inspection or test results. Do not use the rejected material in the work. The results of the tests on the rejected material will not be included in the calculation of the Placement Acceptance Test Results.

601.04 METHOD OF MEASUREMENT.

Portland Cement Concrete will be measured as provided for in the Contract for the specific item or items under which it is paid. If the measurement is not stipulated elsewhere in the Contract, it will be measured by the cubic yard.

601.05 BASIS OF PAYMENT.

Portland Cement Concrete, complete and accepted, will be paid for as provided in the Contract. If not stipulated elsewhere in the Contract, it is paid by the cubic yard. The payment constitutes full compensation for furnishing all labor, materials, equipment, tools, and incidentals to produce, place, and protect the concrete as specified, in addition to any requirements for specific use, except that a reduction in payment will be made for each placement of concrete not fully accepted. This reduction in payment for placement will be based on the following:

Case 1: For concrete for which a unit price is provided in the Proposal:

Unit price reduction = PPF × number of cu yd that the PATR represents × the unit bid price in the Proposal

Case 2: For concrete that is paid for as part of a lump sum item or lump sum items as listed in the Proposal:

PPF × number of cu yd that the PATR represents × the price of the various items of concrete per cubic yard as provided in the approved Contractor's lump sum breakdown

PPF is the pay factor determined in **Subsection 601.03.8(c).**

SECTION 602

This Section has been Reserved for Future Use.

SECTION 603 — CONTROLLED LOW STRENGTH MATERIAL (CLSM)

603.01 DESCRIPTION.

This work includes furnishing and placing Controlled Low Strength Material (CLSM) as a self-consolidating, self-leveling, rigid setting, low density material to be substituted for compacted gravel, structural fill, and any incidental construction directed by the Engineer.

CLSM consists of a homogenous mixture of Portland cement, fine aggregate, water, and mineral admixtures (when used), mixed in proportions to attain the specified properties.

603.01.1 Classification.

There are two main categories for CLSM — excavatable and non-excavatable. The consistency of these two main categories can be subdivided as flowable and very flowable. The following Table presents each classification required for the specific work.

Description	Flowable	Very Flowable
Excavatable	Class I	Class II
Non-Excavatable	Class III	Class IV

a. Definitions.

- Very Flowable. Exhibits characteristics needed for small or confined areas and required to flow over long distances.
- Flowable. Where the above flowability characteristics are not required.
- Classes I and II. Excavatable, that may be removed in the future if required, may be used (but not limited to) in types of applications such as backfill, void filler, fill around manholes and catch basins, and utility cut backfill.
- Classes III and IV. Non-excavatable, used in areas not expected to be removed in the future, such as (but not limited to) fill between median barriers, under approach slabs, and mat foundations.

603.02 MATERIALS.

Provide materials that conform to **SECTION 601**.

603.02.1 Chemical Admixtures.

In addition to the requirements of **SECTION 601**, the CLSM may contain air entrainment. The amount and type of air entraining admixture is dependent upon the design of the CLSM. Submit the type of air entrainment to be used, and specify if an air entrainment admixture is used or if a high-range, air-inducing, or foaming type of admixture is used within the mix design.

603.02.2 Mineral Admixtures.

Provide a mineral admixture, if used, that consists of, but is not limited to, Fly Ash Type F that complies with ASTM C618, including the supplemental chemical and physical requirements. The use of high or low carbon content (i.e., loss of ignition) fly ash may be allowed if submitted for approval to the Engineer on a project specific basis. Ensure that the lime (CaO) content is less than 10 percent by weight for Classes I and II.

603.03 CONSTRUCTION METHODS.

603.03.1 General.

Ensure that the CLSM produced by a Department-approved ready-mix concrete supplier familiar with the design, production, and transport of CLSM. Follow the guidelines in the ACI 229R Report "Controlled Low Strength Materials (CLSM)," except do not use non-standard materials (Section 3.7 of the ACI Report). Ensure that the methods and tolerances conform to **SECTION 601**.

603.03.2 Proportions.

a. General. Design the CLSM to conform to the following end result properties (AASHTO test method referenced if applicable):

Property	Criteria
Modified Slump; performed in accordance with Para. b. below	Class I and III: 6 in. to 8 in. diameter Class II and IV: 9 in. to 14 in. diameter
Air Content (T 152)	0 percent to 35 percent* (see below)
Unit Weight (T 121)	±5.0 pcf from that stated on mix design

* *The maximum air content may be adjusted, if it is demonstrated to the Engineer that no deleterious effects would be incurred. Ensure that the air content in the mix design is within ±5 percent.*

Ensure that the CLSM develops a 28-day compressive strength (T22, T23, or T106) as indicated below:

Mix	Specification Range (psi)	Maximum psi
Classes I and II	30 - 100	100 at 28 days; 200 at 6 months
Classes III and IV	100 - 1200	1200 at 28 days

b. Modified Slump Test. Ensure that the test is performed according to ASTM C1611.

c. Design and Approval of CLSM Mixtures. Design and obtain approval of CLSM mixtures according to **Subsection 601.03.1**.

603.03.3 Batching Plants and Equipment.

Ensure that batching plants and equipment conform to **Subsection 601.03.2**.

603.03.4 CLSM Mixing, Delivery, and Discharge.

In addition to the requirements of **Subsection 601.03.3**, ensure that CLSM is discharged within three hours from the original batching.

603.03.5 Curing.

Protect the CLSM from freezing until it is hardened. Ensure that the temperature of the CLSM is a minimum of 40°F upon placement. Otherwise, no curing is required.

603.03.6 Testing of CLSM.

In addition to the requirements of **Subsection 601.03.7(b)**, cast six, 4-in. × 8-in. cylinders per each day's production and type of mix used (6-in. × 12-in. cylinders are also acceptable). Rodding of specimen is not required. Once the specimen is full, lightly strike the exterior of the mold 8 to 12 times to consolidate the CLSM. Ensure that specimens remain in the molds until time of testing. Exercise care in the handling and transportation of CLSM specimens. The age of compressive strengths will be tested at the discretion of the Engineer.

Paras. c, d, e, f, and g of **Subsection 601.03.8** do not apply to CLSM.

603.03.7 Plant Field Laboratory.

Ensure that the plant field laboratory conforms to **Subsection 930.03.7,** except for the following which do not apply:

- The 45-kg digital platform beam scale
- The gravity drying oven
- The Gilson TS-1 sieve shaker
- The sample splitter 2½-in. chute width

603.03.8 Placing CLSM by Pumping.

Ensure that the requirements for pumping CLSM conform to **Subsection 808.03.6** with the following exception: The discharge height may exceed 5 ft and is limited only if the mixture becomes segregated. Pumping may be suspended if the Engineer observes any deleterious materials in the discharge.

Ensure that the CLSM can be pumped without appreciable loss or consistency of air content.

603.03.9 Traffic/Paving.

Resumption of traffic onto CLSM or the asphalt paving over CLSM, when required by the Engineer to expedite the overall operation, will require an initial set time and early strength development. The initial time for the CLSM to set will be a maximum of three hours. During the mix design approval process, demonstrate that the mix design will achieve the initial set time and early strength development for opening to traffic.

The Engineer may require that the area be completely covered by steel plating or protected according to the latest edition of the MUTCD.

603.04 METHOD OF MEASUREMENT.

Controlled Low Strength Material will be measured by the number of cubic yards placed.

603.05 BASIS OF PAYMENT.

The accepted quantity of Controlled Low Strength Material will be paid for at the Contract unit price per cubic yard. The price constitutes full compensation for all labor, materials, equipment, testing, and all other incidentals required to finish the work, complete and accepted.

SECTION 604

This Section has been Reserved for Future Use.

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SECTION 607 — MASS CONCRETE

607.01 DESCRIPTION.

This specification addresses the requirements for concrete used in mass concrete elements. Provide concrete proportioned for mass concrete applications that conform to **PARTS 600** and **800** and the additional provisions in SECTION 607.

607.01.1 Definition.

Mass concrete is defined as any elements for which the concrete dimensions in three directions is 4 ft or greater.

Requirements for mass concrete construction include laboratory testing, thermal modeling, temperature monitoring, and providing concrete temperature control before, during, and after placement. Perform all testing at a laboratory with recognized AASHTO accreditations for performing the required tests (AASHTO T22, AASHTO T23, AASHTO T121, AASHTO T152, ASTM C1064, ASTM C1074).

The peak temperature is defined as the average of the values measured at any given time by the two temperature sensors placed at the location of the highest temperature as determined by the thermal model for the structural element. The highest acceptable peak temperature is 155°F.

The differential temperature is defined as the difference in values measured at any given time between the temperature sensor(s) in any given location (or the average, if two sensors are placed in the location) in the structural element and the peak temperature as defined above. The highest acceptable differential temperature until the completion of temperature control is 35°F.

The performance-based differential temperature is defined as a limit that changes as the concrete gains strength, determined as a function of the established maturity curve for the mix. This option may be considered by the Engineer, with the proper submission of an implementation plan for the process.

607.02 MATERIALS AND EQUIPMENT.

607.02.1 Concrete.

Use concrete that meets **SECTION 808** and **SECTION 601**. Do not use calcium nitrite-based corrosion inhibitor. Any proposed mixture adjustment that meets **SECTION 601** for a new approval of the mix design will also require a new approval of the mass concrete temperature control plans per this specification.

607.02.2 Temperature And Maturity Recording.

Design primary temperature measuring loggers specifically for determining the maturity of concrete according to ASTM C1074. Operate the loggers in the range of 30°F to 212°F to an accuracy of ±1°F and internally record the time and temperature at a minimum of one-hour intervals for a minimum of 90 days. Ensure that each logger has a unique serial number and, upon download of the information using the compatible reader or other appropriate data connection, produce a secure, (unalterable) Windows PC-readable file that identifies the logger

by its serial number and the start date. Provide software to develop maturity curves to predict strength, and display the temperature versus time data for all loggers in a given placement.

Size the data leads to reach from the logger's installed location to an accessible site where a handheld reader can be employed. A data cable that can connect the loggers to a notebook computer or other standard mobile device will be considered equivalent to a handheld reader, provided that a Windows PC-readable file can be created that can be transferred to a Windows PC. Provide a reader and necessary software for the exclusive use of the Engineer, which will become the property of the Department at the completion of the Project.

Provide loggers that can use battery operated Wireless Remote Boxes for downloading of data. Ensure that the transmission range of the system can provide a reliable connection to both the Contractor's and Engineer's field offices. Provide a Windows PC-Compatible Wireless System Radio Base Station that can download the data file as described above. Maintain the Wireless System Radio Base Station for monitoring the mass concrete placement. Provide an additional Wireless System Radio Base Station for the Engineer's field office, which will become the property of the Department at the completion of the Project.

The Engineer may waive the requirement for a wireless communications system, if the Engineer determines that access to the placement is not warranted.

Provide the Engineer with recording equipment that will allow intermediate downloading of measurements to a computer without restarting the logger, which will become the property of the Department at the completion of the Project. Provide an automatic temperature monitoring system with email, phone, or text message alarm capability to notify the Contractor when temperature control limits are about to be exceeded.

Submit technical literature on the complete maturity logger system, including the loggers, handheld reader, wireless system, software, and any other components to the Engineer for approval before the first mass concrete placement. This includes manufacturer contact information for the responsible technical representative and product performance history showing at least one year of successful use of the complete system on a minimum of three projects with mass concrete placements comparable to those within the scope of the Project. Provide contact information for the Project owners. Do not proceed with mass concrete placements until approval of the maturity logger system has been provided by the Engineer.

607.03 CONSTRUCTION.

Comply with the applicable construction requirements for **SECTION 808** and **SECTION 601**, with the following additions.

607.03.1 Submittals.

607.03.1.1 Mass Concrete Temperature Control Plans.

Submit a Mass Concrete General Temperature Control Plan for approval before the first mass concrete placement, stamped by a Rhode Island Registered Professional Engineer. Include the general procedures proposed for temperature control. Prepare a Mass Concrete Specific Temperature Control Plan for each unique placement, based on the general plan. For each specific temperature control plan, provide guidance, developed based on a concrete hydration

temperature model to indicate when the peak and differential temperatures might exceed the specification limits. Provide specific concrete placement temperature restrictions based on anticipated ambient temperatures and other environmental factors, passive and active cooling, and insulation practices that could produce peak or differential temperatures that require remedial action. Provide guidance on appropriate remedial actions when concrete temperatures approach specification limits. At a minimum, ensure that the guidelines become effective when:

- The concrete peak temperature reaches 3°F below the specification limit of 155°F.
- The differential temperature reaches 2°F below the specification limit or the temperature value at the specified maturity for the variable differential limit (if approved).

Submit each plan for approval before placement, stamped by a Rhode Island Registered Professional Engineer.

Approval of any Mass Concrete Temperature Control Plan by the Engineer will not relieve the Contractor of its responsibility to maintain concrete temperatures within specification limits.

a. General Mass Concrete Temperature Control Plan. Provide a General Mass Concrete Temperature Control Plan that includes the following:

    - Concrete mixture proportions, indicating aggregate sources and physical properties, cementitious material sources, and admixture product names and doses for each concrete mixture. Submit the Class MC concrete mixture design and prequalification test results for approval separately.

    - Anticipated mass concrete placement schedule, including proposed concrete mixture adjustments for the full range of conditions that may occur during placement and curing operations.

    - Test concrete temperature rise for each mixture directly in an adiabatic concrete calorimeter cast from laboratory trial batches using the same material sources and proportions as intended for use on the Project.

    - Concrete compressive strength development in standard moist curing environment (73.5° ±3.5°F) at 3, 7, 14, 28, and 56 days for each mixture, based on the average of three 6 in. × 12 in. cylinders for each age. Cure the cylinders and test per AASHTO T22. Cast a temperature sensor in the center of two additional cylinders, and cure these cylinders alongside those used for compressive strength. Record the average temperatures of the cylinders hourly. Report the compressive strength and maturity for each specimen at each test age and the average values.

    - Calculate and report the concrete strength development-maturity equation for each mixture from the standard cured strength results as described in ASTM C1074, Estimating Concrete Strength by the Maturity Method.

    - Perform demonstration mock-up(s) at least 60 days before the first scheduled mass concrete placement. Cast at least one mock-up to verify that the concrete thermal properties and temperature control procedures required for the Mass Concrete General Temperature Control Plan are adequate to meet the specification limits. For the mock-up(s), use the same concrete mixture proportions and materials, form

materials, curing materials, and monitoring devices defined in the General Temperature Control Plan, and use the same batching and placing operation to be used for the Project. Ensure that the mock-up is a cube or other element measuring 4 ft or more in the least dimension. Ensure that the temperature monitoring of the mock-up is as specified in the General Mass Concrete Temperature Control Plan, and continue for at least seven days. At a minimum, insulate the demonstration mock-up with R-20 insulation on all sides. If alternative insulation, cooling, or curing options are proposed, cast a separate demonstration mock-up cube, instrumented for each alternative. The Engineer responsible for the design of the temperature control plan shall be present at the placement for each mock-up.

For sensor placement, comply with the following:

- Locate two sensors at the center of the mock-up. Use the average of the two.
- Locate two sensors within 1 in. from the top surface located directly above the center of mass sensors. Use the average of the two.
- Locate two sensors within 1 in. from the center of a vertical face. Use the average of the two.
- Locate two sensors in an upper corner of the cube. Use the average of the two.
- Use one sensor to record the ambient temperature. Place this sensor at approximately 10 ft from the placement in a shaded area.

Note: For a 5°F or greater variation between sensors of a paired set, or erratic variations or outright failure of a sensor, notify the Engineer immediately upon discovery of the problem. At the time of the notification, provide the Engineer with a course of corrective action for approval. If the approved corrective action requires that the data from one sensor in a pair no longer be used, use the other functioning sensor solely for the peak and maximum differential temperature measurements.

From the concrete batched for the mock-up, conduct tests for air content (AASHTO T152), placement temperature (ASTM C1064), and unit weight (AASHTO T121), and fabricate cylinders (per AASHTO T23) from the same concrete by an ACI Certified Concrete Field Technician Level I. Test the cylinders for compression strength by an AASHTO-accredited independent concrete testing laboratory (AASHTO T22) at 3, 7, 14, 28, and 56 days. Coordinate the mock-up with the Engineer, and provide the Department with at least one week advance notice of the casting date. Provide the Engineer with the opportunity to witness the placement and functioning of temperature recording sensors before casting, and perform concrete property tests on companion samples selected by the Engineer.

If a mix design has been approved for mass concrete placement before the scheduled first placement and the testing conforms to these standards, the Engineer may waive the requirements of **Subsection 607.03.1.1(a)** (first six bullets). However, perform any requirements for testing/analysis added after the aforementioned mix design was approved, with the exception that mix designs previously approved using data derived from semi-adiabatic testing will not require re-testing per the above requirements. If the approved mix design has already had a mock-up performed previously and the criteria

matches that for the applicable temperature control plan, the Engineer may accept the results of the previous mock-up instead of running a new one.

Submit a letter report documenting the concrete properties and temperatures developed in the mock-up compared against the thermal analysis contained in the General Mass Concrete General Temperature Control Plan models as part of the General Temperature Control Plan. Outline any revisions/corrections required to the General Mass Concrete Temperature Control Plan for differing ambient conditions in the letter report. Strength results may be submitted separately.

If the Project involves four or fewer unique mass concrete placement designs, the Engineer may waive the requirement for a General Mass Concrete Temperature Control Plan. If waived, ensure that the Specific Mass Concrete Temperature Control Plans meets all above requirements.

b. Specific Mass Concrete Temperature Control Plans. For each Specific Concrete Temperature Control Plan, include the following:

- Form and form liner R-value and anticipated time of form removal.
- Insulating material(s) R-value and anticipated periods of use.
- Curing procedure and duration.
- Provide thermal modeling analysis for typical placement scenarios. Ensure that the analysis incorporates:
    - A range of anticipated ambient placement temperatures
    - Anticipated water temperatures for active cooling
    - Effects of water temperature for placements in water
    - Effects of convection cooling in locations where high winds may be a factor
    - Anticipated concrete placement temperatures
    - Assumed R-values for concrete forms and insulation
    - Calculated maximum core and surface temperatures vs. time after placement

  Include the impact of planned construction activities, such as form removal, in the analysis. Estimate the concrete strength at form removal from the maturity relationship using the lowest calculated maturity value shown by the sensors placed within the concrete.

- Provide drawings that identify the temperature monitoring locations for each placement and product data for all sensors and recording instrumentation. With the exception of the ambient sensor, install the sensors in pairs for the redundancy. Ensure that the minimum number of automated temperature monitoring locations is nine per element for placements less than 500 cu yd and 17 per element for placements 500 cu yd or larger. Minimum sensor locations are noted below. Place each of the sensors in a pair in separate locations, no less than 6 in. and no more than 18 in. apart. For the mock-ups, the relative locations are as shown.

- Place two sensors in the center of thermal mass of the placement, where the peak temperature will occur. Determine this location based on the isocurves developed for the model, with the approval of the Engineer. Use the average of the two to determine the peak temperature at any given time and to measure the maximum temperature differential in the placement based on the difference between the peak temperature and each sensor location at any given time. Use the average of the two sensors.

- Place two sensors at the location as determined by isocurves developed for the model that shows the point where the lowest temperature is predicted during temperature control. Use the average of the two sensors.

- Locate two sensors within 1 in. from the top surface located directly above the center of thermal mass sensors. This location may be adjusted, based on the isocurves developed for the model, with the approval of the Engineer. Use the average of the two sensors.

- Locate two sensors within 1 in. from the center of vertical formed surfaces at mid-height. This location may be adjusted, based on the isocurves developed for the model, with the approval of the Engineer. Use the average of the two sensors.

- Use one sensor to record the ambient temperature. Place this sensor at approximately 10 ft from the placement in a shaded area.

- Provide up to four additional sensor pairs to be located at the discretion of the Engineer.

- Use similar sensor distribution for placements greater than 500 cu yd.

Note: For a 5°F or greater variation between sensors of a paired set, or erratic variations or outright failure of a sensor, notify the Engineer immediately upon discovery of the problem. At the time of the notification, provide the Engineer with a course of corrective action for approval. If the approved corrective action requires that the data from one sensor in a pair no longer be used, use the other functioning sensor solely for the peak and maximum differential temperature measurements.

Provide procedures for achieving temperature restrictions including contingencies for severe weather events. Procedures may incorporate either active (cooling pipes) or passive control methods (insulation, tenting, venting, etc.) or both. Ensure that the Temperature Control Plan identifies the expected duration of all temperature control measures for each model condition provided.

If cooling pipes are proposed, submit a detailed description of the system describing the:

- Layout and size of pipes
- Anticipated coolant flow rate
- Temperature of the raw coolant source
- Pump size
- Flow and recirculation control equipment

- Instrumentation
- Coolant temperature control procedure
- Contingency plans

607.03.1.2 Performance-Based Variable Temperature Differential Limit.

After the Contractor has established that proper control can be maintained of the concrete mix properties, including curing temperatures, the Contractor has the option of submitting a plan to use performance-based criteria for a variable differential limit, based on the concrete strength as determined by the maturity at any given time. This will supersede the 35°F limit. Failure to maintain proper temperature control under this plan will result in reversion to the 35°F limit for subsequent placements until the Contractor demonstrates to the Engineer that causes for the loss of control have been identified and corrected. Temperature control will be considered to have failed if one of the following conditions occurs:

- The differential exceeds the variable value by more than 3°F at any time during the first 40 hours after placement.
- The differential exceeds the variable value by more than 5°F at any time after the first 40 hours after placement during temperature control.
- The differential exceeds the variable value by 2°F or more for any period of eight hours or more at any time during temperature control.
- Cracking of the placement determined to be the result of thermal issues will also be considered to be a failure of the temperature control and will result in reversion to the 35°F limit, and will trigger the provisions specified in **Subsection 607.03.2.4**.

607.03.1.3 Plan Submission Requirements.

Provide a written implementation plan that includes complete back-up data such as:

- Listing of all assumptions used in the analysis
- Published reference documents
- Coefficient of the thermal expansion for the mix being placed
- Tensile strength development versus maturity equations for the mix being placed
- Elastic modulus versus maturity equations for the mix being placed
- Example implementation of the method using a predicted thermal gradient analysis
- Complete test data justifying the prediction equations for the proposed mixture

Ensure that each placement also includes a specific plan with an assumed restraint factor, consideration of the placement geometry, and other factors that can affect the differential limit. The other factors include:

- Anticipated concrete placement temperature
- Ambient temperatures
- Cooling water temperature (if active cooling is used)
- Convection effects from wind and design elements of the temperature control plan

For acceptable demonstration of the submission of an implementation plan, the Contractor may use a mass concrete pour defined and conducted using the 35°F differential limit. Ensure that the gradients predicted in the thermal model for the performance-based temperature limit match the actual temperatures. Ensure that there are at least eleven temperature/maturity sensors. Locate sensors as follows:

1. At the location of the maximum temperature, place at least one sensor as defined in **Subsection 607.03.1.1(b)** (5th closed bullet, 1st open bullet).

2. Near the formed surface, place at least one sensor as defined in **Subsection 607.03.1.1(b)** (5th closed bullet, 2nd open bullet)**.**

3. Near the top surface, place at least one sensor as defined in **Subsection 607.03.1.1(b)** (5th closed bullet, 3rd open bullet).

4. Place a minimum of two equally spaced between the location of the maximum temperature and top surface sensor in an approximate straight-line configuration.

5. Locate a minimum of two equally spaced between the location of the maximum temperature and formed surface sensor in an approximate straight-line configuration.

6. At the location of the minimum temperature, place at least one sensor as defined in **Subsection 607.03.1.1(b)** (5th closed bullet, 4th open bullet).

7. Locate a minimum of two equally spaced between the location of the maximum temperature and the location of the minimum temperature in an approximate straight-line configuration.

8. Use one sensor to record the ambient temperature remote from the placement, as defined in **Subsection 607.03.1.1(b)** (5th closed bullet, 5th open bullet).

For Items 1, 2, 3, and 6, the sensors may be the same as those used for the actual temperature control of the placement as specified in **Subsection 607.03.1.1(b)**. Although redundant sensors are not required, failure at any of the required locations without a backup will invalidate the results.

Submit the performance-based temperature limit plan for approval before the first placement for which it is proposed to be used, stamped by a Rhode Island Registered Professional Engineer. If the plan is approved by the Engineer, this will become the standard sensor distribution for as long as the plan is in effect. Use the plan to verify the accuracy of the performance-based temperature limit plan thermal model for each placement. Ensure that the plan identifies the relationship between the maturity and the appropriate maximum acceptable temperature differential that will prevent cracking of the concrete. Present the relationship in tabular form, at intervals of 1°F for the first 40 hours after placement and 2°F for more than 40 hours after placement for a minimum of 14 days. Ensure that the maturity value used to determine the appropriate differential at any given time is the lowest measured within the placement.

607.03.2 Temperature Control Requirements.

607.03.2.1 Temperature Control.

Monitor mass concrete temperature control by maturity loggers cast into the concrete, as described in **Subsection 607.03.1.1**. The use of low heat concrete mixtures, pre-cooling of the concrete, insulated curing blankets, insulated forms, cooling pipes, and other measures may be necessary to satisfy the temperature control requirements.

Notify the Engineer immediately when temperature control limits are exceeded.

Provide complete concrete temperature records for each placement including the secure files generated by the automated temperature sensors to the Engineer. Provide the Engineer with unobstructed access to temperature sensors at any time to verify compliance with temperature control criteria.

a. When forms are placed in water, waterproof the forms and insulation or otherwise protect against water absorption. Determine the required combined form and insulation R-Value through thermal analysis before placement using forecasted temperatures to meet the requirements to maintain the maximum peak and differential temperatures within the required limits.

b. Do not allow the temperature of the concrete at placement to exceed 65°F for cold weather placements nor 85°F for hot weather placements, unless active temperature control precautions are employed. Ensure that all active temperature control piping is non-metallic and filled with a non-shrink grout on the RIDOT Approved Products List upon completion of cooling operations. Ensure that the temperature of the concrete at placement is within the acceptable range of values shown in the temperature control plan for the structural element.

c. Provide temperature sensors that are maturity loggers as described in **Subsection 607.02.2**. Program the logger with the appropriate datum temperature.

d. Secure wiring for loggers that must be cast into the concrete to reinforcing or otherwise protected to prevent damage during concrete placement. The Engineer will approve the method of protection of the wires cast into the concrete. Clearly label wiring for loggers to identify the location within the form at both ends before being placed into the form. Locate ambient temperature sensors to be no closer than 10 ft from the mass concrete placement and be placed to provide an accurate measurement of the environmental condition. Encase wire runs outside of concrete in conduit where necessary to prevent damage during subsequent construction operations.

e. Do not perform installation and verification checks for operation of any loggers unless the Engineer is present. Provide as-built versions of the temperature control plans showing the location of the loggers as identified by the unique serial numbers. Upon completion of monitoring, remove all visible wires from the concrete and any conduit penetrations filled with a non-shrink grout on the RIDOT Approved Products List.

f. Program each logger with notes identifying the placement and relative location within the placement. Secure loggers into position, and verify function at least one day before concrete placement. Start temperature recording for each placement no less than two

hours before the initial concrete placement. Provide the Engineer safe access to the locations where readings will be taken to observe the initialization of the loggers and record relevant information. Include each logger serial number, location in the placement, and start time. Provide access as needed for subsequent readings.

g. Connect each logger for each placement to the wireless remote boxes. Provide as many wireless remote boxes as necessary to monitor all loggers simultaneously. Ensure that a sufficient quantity of wireless remote boxes are on hand to monitor all loggers for all placements being actively monitored at any given time during the Project. Maintain two spare remote boxes or 10 percent of the total on hand, whichever is larger, in operating condition at all times.

h. Protect the units from damage due to the environment and other factors to ensure that the remote boxes can retrieve and transmit data on a daily basis for the duration of the specified monitoring period for the concrete placement.

i. Provide at the Contractor's field office a wireless system radio base station compatible with the wireless remote boxes and provide the same model to the Engineer, as described in **Subsection 607.02.2**. Configure both wireless system radio base stations to access all active wireless remote boxes at any time without reconfiguration of any component. Upon setup of each wireless remote box and before placement of the concrete, test the remote operation of the system to verify that it works properly and that all loggers connected to the wireless remote box can be accessed. The Contractor may, at its discretion, have a handheld reader for the loggers. However, do not use the handheld reader except to configure the loggers initially or to collect data if a problem with a wireless remote box occurs. Correct any problem within 24 hours. Upon connection/reconnection of a wireless remote box, test the operation as described above.

j. Download automated temperature measurements within one hour of the start of each calendar day when any element of temperature control is in place. Provide secure data files from each logger to the Engineer on a daily basis.

k. Do not allow the peak concrete temperature at any location within the mass to exceed 155°F at any point in time. Failure to maintain a maximum peak concrete temperature less than or equal to 155°F will be cause for rejection of the concrete placement by the Engineer.

l. Do not allow the temperature differential to exceed 35°F or the value of the variable limit (if approved) at any point in time. Failure to control the maximum concrete temperature differential to less than or equal to the specified limit may be cause for rejection of the concrete placement by the Engineer. Exclude malfunctioning sensors from the differential calculation.

m. Protect the placement from exposure to precipitation to prevent cooling of the surface. Maintain the protection until temperature control is no longer required.

n. Allow the forms to remain in place until the estimated strength of the concrete surface exceeds 2500 psi based on the lowest indicated maturity from the data loggers and until the differential between the mean center temperature and ambient temperature is less than 30°F and decreasing. Ensure that ambient temperatures are rising at the time of

form removal. Do not remove forms before meeting all other requirements listed elsewhere in the Contract Documents.

o. Tenting, erecting windbreaks, covering with plastic, curing blankets, or other means may be necessary to protect the concrete surface from rapid cooling after form removal.

p. Protect concrete surfaces when the temperature differential between the peak temperature and ambient temperature is greater than 30°F.

q. Allow mass concrete temperature control procedures to remain in effect until the temperature differential between the average peak temperature and the three-day mean ambient low temperature is less than 35°F.

r. Ensure that mass concrete elements exposed to water reach at least the 28- day compressive strength as indicated by the approved maturity curve and has a peak temperature-to-water temperature differential less than 35°F before exposure.

s. Obtain written approval from the Engineer before removing temperature control.

607.03.2.2 Curing.

Meet the curing requirements of **Subsection 601.03.8** and **Subsection 808.03.9**, except as follows.

Continuously moist cure mass concrete placements for at least 14 days and until the 28-day compressive strength as indicated by the approved maturity curve is achieved. Maintaining moisture on the top surface with forms in place shall be considered adequate moist curing. If strength and thermal control are achieved before 14 days, forms may be removed but continue moist curing.

Ensure that water used for curing is fresh water and does not contain any salts or other components harmful to concrete. Control the temperature of water used for moist curing to within 30°F of the peak concrete temperature.

607.03.2.3 Temperature Control Failure.

Failure to meet the temperature control requirements may be cause for rejection of the concrete. Halt subsequent mass concrete placements immediately. Investigate the events that produced the failure, and submit a written report to the Engineer. Ensure that the investigation includes a thorough examination of the concrete placement and the reasons for non-compliance with these requirements, and document the width and extent of all visible cracks (if any) after cleaning the surface to fully expose them. Measure surface crack intensity after monitoring shows that the temperature, as measured by all sensors near the concrete surface, has dropped to within 10°F of the concrete temperature, as measured by the sensors at the center of thermal mass. Ensure that a licensed Rhode Island Professional Engineer conducts the investigation, and present crack repair options for approval by the Engineer according to **Subsection 607.03.2.4**.

Remove all equipment and materials from the mass concrete element and clean the surface for the Engineer to verify the measurements of the crack intensity. Provide safe access for the Engineer’s inspection.

At the discretion of the Engineer, repair or removal and replacement of the rejected placement may be required of the Contractor. If required, perform the repair or removal and replacement of the rejected placement.

At the discretion of the Engineer, submit a revised Mass Concrete General Temperature Control Plan to address any deficiencies identified by the investigation.

Do not resume subsequent mass concrete placements without written approval by the Engineer.

607.03.2.4 Crack Repairs.

Repair thermal cracking by approved methods. Determination of when cracking is caused by thermal issues will be solely by the Engineer. Do not initiate repairs until the Engineer has approved the repair plan.

For thermal cracking, suspend further work on members of similar size and configuration, submit a written explanation of the thermal cracking and proposed additional steps to eliminate future thermal cracking, and submit the proposed modifications to the Engineer for review. Do not resume concrete placement until the Engineer approves the proposed modifications.

607.04 METHOD OF MEASUREMENT.

Mass Concrete will not be measured for payment.

607.05 BASIS OF PAYMENT.

No separate payment will be made for this item. Compliance with the above requirements will be considered incidental to the placement of mass concrete. Costs for this item will be included in the bid prices of the appropriate items as listed in the Contract.

Costs related to the development of Mass Concrete Temperature Control Plans will be considered incidental to the Project and will not be paid for separately.

There shall be no claims for additional payment by the Contractor nor will there be an extension of the Project Completion Dates for any corrective actions required as a result of the rejected concrete and subsequent corrective measures to address any deficiencies identified by the investigation.

Part 700
DRAINAGE AND SELECTED UTILITY ACCESSORIES

SECTION 701 — PIPE CULVERTS AND STORM DRAINS

701.01 DESCRIPTION.

This work includes the construction or reconstruction of pipe culverts and storm drains in reasonably close conformity with the required dimensions and details.

This work also includes providing and installing a drainage hood at the outlet of a drainage structure (pipe inlet) at the required locations.

701.02 MATERIALS.

701.02.1 Non-Metallic Pipe.

Provide concrete, fiber, and plastic pipe that complies with **Subsection M04.01**.

Provide smooth interior, corrugated polyethylene pipe and smooth interior, corrugated polypropylene pipe that complies with **Subsection M04.01.7**.

701.02.2 Metal Pipe.

Provide ductile iron pipe that conforms to **Subsection M04.02.1**.

701.02.3 Flared End Sections.

Ensure that concrete flared end sections are manufactured according to the required details. Provide Class X concrete that conforms to **SECTION 601**.

701.02.4 Inspection of Pipe Materials and Manufacturing Plants.

Submit a Quality Control Plan for manufacturing plants for review and approval by the Engineer.

When the location of a plant permits, the Engineer may inspect the plant for compliance with the approved QCP and these Specifications.

701.02.5 Bedding Materials.

Class A Bedding consists of Class B plain Portland cement concrete that conforms to **SECTION 601**.

Class B Bedding consists of gravel borrow that conforms to **Subsection M01.04**.

Class C Bedding consists of crushed stone or crushed or screened gravel that conforms to **Subsection M01.04**.

701.02.6 Portland Cement Mortar.

Provide mortar that conforms to **Subsection M04.03.5**.

701.02.7 Drainage Structure Hood.

Use materials that conform to the following criteria, appear on the RIDOT Approved Materials List, and/or be an approved equal:

- Ensure that the metal hood complies with **SECTION M04** and the manufacturer's requirements.
- Use plastic hoods made of high-density polyethylene (HDPE) pipe grade material or approved equal.
- The hoods may be glass reinforced resin composite. Ensure that the hoods are an appropriately sized product.
- The use of hood units from alternative manufacturer(s) are subject to approval by the Engineer. Hoods not meeting all standards of this specification will not be considered. All expenses incurred to verify that an alternative hood performs equally to the above referenced product shall be borne by the Contractor.

701.03 CONSTRUCTION METHODS.

701.03.1 Layout.

Ensure that the engineering layout, whether furnished by the Department or the Contractor, includes offset staking for the proposed trench every 50 ft or less from structure to structure. Field conditions may require exceptions for the distance between stakes. Mark stakes with stationing on the pipe line side of the stake parallel to the installation, offset distance on the side opposite the pipe line, and depth of cut marked on the side facing the open trench. Transfer this information to transverse batter boards every 50 ft with line and grade clearly marked and the target set.

The Contractor, at its option, may perform pipe layout using the laser beam method. When site conditions preclude the use of traditional survey methods, use the laser beam method.

Grade, for the purpose of this Section, is defined as the design invert elevation for all pipelines.

701.03.2 Trench Excavation.

Excavate trenches according to **SECTION 205**.

701.03.3 Bedding.

Ensure that pipe bedding conforms to one of the classes specified in **Subsection 701.02.5**.

Class A bedding consists of a continuous concrete cradle.

Shape Class B and Class C bedding to fit the bell of the pipe to the height specified. Install the pipe in compacted bedding material at least 12 in. in thickness and pre-shaped to accommodate

the bell of the pipe. After the pipe has been installed, backfill the trench and compact with bedding material to a height equal to at least one-half the diameter of the pipe.

701.03.4 Laying Pipe.

Begin the pipe laying at the downstream end of the pipe line. Place the bell or groove ends of pipe facing upstream to allow for proper overlap of the pipe seams. Place flexible pipe with the longitudinal laps or seams at the sides.

Lay paved or partially lined pipe so that the longitudinal centerline of the paved segment coincides with the flow line.

When elliptical pipe with circular reinforcement or circular pipe with elliptical reinforcement is used, install the pipe so that the manufacturer's marks designating top and bottom of the pipe are not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. Ensure that pipe is properly secured and covered when using flowable fill or in areas of stormwater storage to avoid pipes rising or lifting.

701.03.5 Joining Pipe.

Rigid pipe may be a bell and spigot or tongue and groove design unless one type is specified. Use a method of joining pipe sections so that the ends are fully entered and the inner surfaces are reasonably flush and even.

Use mortar joints that have an excess of mortar to form a bead around the outside of the pipe and that is finished smooth on the inside to the spring line of pipe larger than 30 in. For grouted joints, use molds or runners to retain the poured grout. Install rubber ring gaskets to form a flexible watertight seal.

Install reinforced concrete pipe 36 in. or greater in diameter with both rubber gaskets and a Portland cement mortar joint.

When Portland cement mixtures are used, protect the completed joints against rapid drying by suitable cover material.

Join ductile iron pipe according to the recommendations of the manufacturer.

Join plastic pipe by plastic sleeve couplings, welded to the pipe by applying an appropriate adhesive as recommended by the manufacturer.

Inspect pipe before any backfill is placed. For any pipe determined by the Engineer to be out of alignment, unduly settled, or damaged, remove the pipe and re-lay or replace at no additional cost to the Department.

701.03.6 Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe.

The following additional requirements apply to these classifications of pipe.

a. Limitation of Use. Only use polyethylene and polypropylene pipe where the top of the pipe is at least 3 ft below the finished grade.

b. Bedding. Ensure that the bedding for pipe diameters less than or equal to 24 in. is Class B or Class C as defined in **Subsection 701.02.5**, except ensure that Class B has 100 percent pass the 3-in. sieve. The Engineer will approve the choice of material in writing.

   Ensure that the bedding for pipe diameters greater than 24 in. is excavatable Class I controlled low strength material (CLSM), as defined in **Subsection 603.01.1**.

c. Trench Excavation and Backfill. Ensure that trench excavation conforms to **SECTION 205**.

   - Where the Engineer determines that the excavation is in an area with a high water table, place a separation filter fabric that complies with **Subsection M20.01** against the bottom and sides of the excavation to completely enclose the pipe embedment material, with a minimum 12-in. overlap to a minimum height of 12 in. above the top of the pipe. After the Class C pipe embedment material is placed and compacted, lap the filter fabric to enclose the material.

   - Excavate the trench to a minimum depth of 4 in. below the specified bottom invert of the pipe in soil trenches and 6 in. in rock trenches. Place and compact bedding to a height of 1 in. above the specified bottom invert of the pipe. Shape the surface of the bedding to fit the contour of the pipe. Install the pipe and support or constrain the pipe to prevent its movement as the trench is filled and the material compacted. Place and compact bedding material simultaneously on both sides of the pipe within the pipe zone. Use hand tamping as needed to fill and compact the haunch zone of the pipe. Ensure that the placement and compaction occur simultaneously on both sides of the pipe to prevent damage to or movement of the pipe. Place the bedding material in 6-in. compacted lifts to a minimum of 12 in. above the top of the pipe (initial backfill). Place the final backfill in lifts no greater than 6 in. after compaction.

   - With the approval of the Engineer, CLSM, Classification I, as defined in **Subsection 603.01.1**, may be used as pipe embedment and for the remaining backfill.

d. Testing. No sooner than 30 days after the completion of the compaction of the backfill, conduct mandrel testing or hand measurements of the pipe under the direction of the Engineer. Testing may be required for up to 25 percent of the total length of pipe. The Engineer will determine the actual sections of pipe to be tested.

   Conduct mandrel testing for pipe diameters of 24 in. or less. Ensure that the mandrel is rigid steel, with a pulling ring at each end, an odd number of legs (nine legs minimum), and an effective diameter at least 95 percent of the base inside diameter. The base inside diameter is the nominal pipe size less a 1.5-percent fabrication tolerance. Remove any pipe through which the mandrel fails to pass, and replace the pipe.

   Conduct mandrel testing or hand measurements for diameters greater than 24 in. up to and including 36-in. diameter pipe.

Conduct hand measurements of deflection for pipe diameters greater than 36 in. every 5 linear feet of a selected length of pipe. The following Table presents the minimum diameter measurements, which are based on a 5-percent maximum deflection and a 1.5-percent manufacturer's fabrication tolerance.

Nominal Pipe Diameter	Allowable Deflected Diameter
27 in.	25.26 in.
30 in.	28.07 in.
36 in.	33.69 in.
42 in.	39.30 in.
48 in.	44.92 in.
54 in.	50.53 in.
60 in.	56.15 in.

Removed pipe may be reused as the replacement pipe only if approved by the Engineer. Otherwise, remove the damaged pipe from the work site. All costs associated with mandrel or hand measurement testing, including the replacement of deflected pipe and any delays that are incurred, will be at no additional cost to the Department.

701.03.7 Backfilling.

After the pipe is installed, backfill the trench with material according to **SECTION 205**.

When the top of the pipe is exposed above the top of the trench, place and compact the embankment material for a distance on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe or 12 ft, whichever is less, and to a minimum height of 3 ft above the pipe. Place and compact the material simultaneously on both sides of the pipe for the full width of the roadbed according to **SECTION 205**. Do not allow construction traffic over the pipe until 3 ft of compacted backfill is in place over the pipe. Above this elevation, place and compact the embankment according to **Subsection 202.03.2**.

701.03.8 Replacement of Unsuitable Material.

When the Engineer determines that the material at the bottom of trenches is unsuitable for the support of drainage pipes, provide additional excavation. Remove unsuitable material to a depth not to exceed 3 ft. When the unsuitable material has been removed, level and refill the bottom of the excavation with the appropriate class of bedding.

Place Class B bedding in 8-in. lifts, and compact to 90 percent of its maximum dry density according to **Subsection 205.03.5**. Grade the final compacted lift in the replacement operation to the original design elevation of the bottom of trenches.

701.03.9 Unauthorized Excavation.

If the bottom of any trench has been excavated below the required grade indicated, restore the grade by refilling with a well-compacted bedding material.

No payment will be made for unauthorized excavation. Furnish, place, and compact the bedding material to refill the trench to grade at no additional cost to the Department.

701.03.10 Drainage Structure Hood.

Perform the construction according to the manufacturer's requirements and with **SECTIONS 701** and **702**.

Use a hood that forms a baffle that prevents debris and reduces pollutants from flowing out of the catch basin. Ensure that the drainage structure hood protrudes a minimum of 6 in. or one-third of the effluent pipe diameter below the invert. Securely attach the hood to the catch basin and/or pipe, and seal the hood to the structure per the manufacturer's requirements. Provide vent holes at the top of the hood to allow airflow.

Provide Shop Drawings, computations, and any necessary documentation for the drainage structure hoods. Drainage structure hoods will be approved by the Engineer in writing 14 days before its delivery onsite.

701.04 METHOD OF MEASUREMENT.

701.04.1 Pipe Culvert and Storm Drain.

Pipe Culvert and Storm Drain, both new and re-laid, including Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe, will be measured in linear feet of continuous runs of pipe installed. Pipe with sloped or skewed ends will be measured along their inverts.

701.04.2 Flared End Section.

Flared End Section will be measured by the number of units installed.

701.04.3 Branch Connections and Elbow.

Branch Connections and Elbow will be included in the length of measurement for pipe. If stated in the Contract documents, branches and elbows may be measured by the number of pieces installed.

For measurement, the end of pipe in closed structures will be considered flush with the inside face of the structures. At masonry headwalls, the end of pipe will be considered flush with the face of headwalls.

701.04.4 Bedding Material.

Class A, B, C, and CLSM Bedding Material will be measured by the number of cubic yards of each type of bedding placed. When bedding is specified and no measurement method is shown in the Contract, bedding material will be measured within the horizontal pay limits specified for Trench Excavation under **Subsection 205.04.2(a),** and vertically from 12 in. below grade to a height of 50 percent of the diameter of the pipe, excluding the volume occupied by the pipe.

Class A, B, or C bedding material placed to backfill authorized excavation of unsuitable material below grade will be measured within the horizontal pay limits as referenced above and vertically to the depth of authorized excavation.

701.04.5 Drainage Structure Hood.

The Drainage Structure Hood will be measured by the number of each drainage structure hood installed.

701.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Pipe Culvert and Storm Drain	LF
Smooth Interior Corrugated Polyethylene Pipe	LF
Smooth Interior Corrugated Polypropylene Pipe	LF
Flared End Section	EA
Branch Connection and Elbow	EA
Class A Bedding	CY
Class B Bedding	CY
Class C Bedding	CY
Drainage Structure Hood	EA

701.05.1 Pipe Culvert and Storm Drain.

The Contract prices constitute full compensation for:

- All trench excavation (except for Trench Excavation – Rock, Trench Rock Excavation – Mechanical, and excavation of unsuitable material below grade) to a depth equal to the invert of the proposed pipes when bedding material is not required or to a depth sufficient to receive the appropriate layer of bedding material when this material is required
- The shaping of either the bottom of the trench or the top of bedding material to receive the bell of the pipe
- All dewatering, including pumping, draining, or bailing
- Laying, setting, and jointing all pipe, pipe couplings, fittings, and gaskets, including connections to existing drainage structures or pipes
- Filter fabric
- Placing and compacting backfill
- Design, furnishing, placing, and removing all temporary timber or steel sheeting, bracing, shoring, or trench protection
- The disposal of all excess or unsuitable excavated materials
- All incidentals required to finish the work

701.05.2 Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe.

In addition to the above for Pipe Culverts and Storm Drains, the Contract price constitutes full compensation for all pipe embedment material, CLSM, buoyancy constraint, post-installation mandrel testing or hand measurements, remedial work, including all labor, equipment, tools, and incidentals required to finish the work.

701.05.3 Trench Excavation Rock, Trench Rock Excavation − Mechanical.

Trench Excavation – Rock, Trench Excavation – Mechanical, and excavation of unsuitable material below grade will not be included in the Contract unit prices for the various types and sizes of Pipe Culverts and Storm Drains but will be paid for separately as set forth in **Subsection 205.05.2**.

701.05.4 Flared End Section.

The price constitutes full compensation for all labor, materials, and equipment for furnishing and placing the units and for all incidentals required to finish the work.

701.05.5 Branch Connection and Elbow.

The price constitutes full compensation for all labor, materials, and equipment for furnishing and placing the units and for all incidentals required to finish the work.

701.05.6 Bedding Material.

Class B bedding material, and all Class C and CLSM used for the installation of Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe, will be paid for under the applicable Pipe Culvert, Storm Drains, or Flared End Sections Contract items and will not be paid for separately. An exception relates to the replacement of unsuitable material, for which Class B bedding will be paid for separately as set forth in **Subsection 205.05.4**.

The Contract prices constitute full compensation for all labor, materials, and equipment for providing the bedding material(s) and for all incidentals required to finish the work.

701.05.7 Drainage Structure Hood.

The price constitutes full compensation for all labor, materials, equipment, tools, furnishing and placing each hood, and all other incidentals necessary to finish the work, complete and accepted.

SECTION 702 — MANHOLES, INLETS, AND CATCH BASINS

702.01 DESCRIPTION.

702.01.1 Manholes, Catch Basins, and Inlets.

This work includes the construction of manholes, inlets, and catch basins in reasonably close conformity to the required dimensions and details.

702.01.2 Deep Sump Catch Basin.

This work includes constructing deep sump catch basin according to the required dimensions and details.

702.01.3 Leaching Catch Basin.

This work includes constructing leaching catch basin according to the required dimensions and details. The catch basin includes perforated vertical walls and/or an open or perforated bottom.

702.01.4 Sediment Removal Device.

This work includes the installation of a sediment removal device (SRD) to the required lines and grades.

702.01.5 Stormwater Discharge Structure.

This work includes constructing stormwater discharge structures according to the required dimensions and details.

702.02 MATERIALS.

702.02.1 Masonry Unit Construction.

a. General. Provide clay brick, concrete masonry units, lime, mortar, frames, grates, covers, and ladder rungs that conform to **Subsection M04.03**.

b. Gravel Borrow. Provide gravel borrow that conforms to **Subsection M01.02**.

c. Concrete. Provide concrete for the structures that conforms to **SECTION 601**.

d. Reinforcing. Provide reinforcing bars that conform to **Subsection M05.02**.

e. Wire Fabric Reinforcing. Provide wire fabric reinforcing that conforms to **Subsection M05.03.1**.

All materials used in the construction of drainage structures will be subject to acceptance testing by the Engineer. Provide sufficient time for the Engineer to test and inspect the materials before their incorporation into the work.

702.02.2 Precast Concrete Construction.

a. General. Precast concrete drainage structures are acceptable alternatives to the corresponding masonry unit structures when the latter are specified in the Contract documents.

b. Precast Concrete Structures. Provide precast concrete that conforms to **SECTIONS 601** and **809**.

c. Precast Concrete Catch Basins and Manholes. Provide precast concrete that is designed and manufactured according to ASTM C478, Precast Concrete Manhole Sections. Provide a concrete mix design that conforms to Class XX in **SECTION 601**.

d. Other Materials. Materials and their inspection as specified under **Subsection 702.02.1**, Paras. a, b, d, and e also apply to precast concrete drainage structures.

702.02.3 Deep Sump Catch Basin.

Unless otherwise indicated on the Plans, use a deep sump catch basin that conforms to the applicable material requirements of **Subsection 702.02**.

702.02.4 Leaching Catch Basin.

Unless otherwise indicated on the Plans, use a leaching catch basin that conforms to **Subsection 702.02**.

702.02.5 Sediment Removal Device.

Use precast concrete for the sediment removal device that conforms to **SECTION 701**.

Ensure that the sediment removal device or the approved equal meets the following requirements:

- Ensure that the wall thickness is not less than 6 in. or as shown on the dimensional drawings. Ensure that the wall thickness is not less than the minimum thickness necessary to sustain the loading requirements.
- Use sections that have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTM C 990.
- Use Class XX concrete with a minimum 28-day compressive strength of 4000 psi that conforms to **SECTION 601**.
- Ensure that all sections are cured by an approved method. Do not ship the sections until the concrete has attained a compressive strength of 4000 psi or until five days after fabrication and/or repair, whichever is longer.
- Size the pipe openings to accept pipes of the specified size(s) and material(s), and ensure that the openings are sealed as specified in **SECTION 701**.
- Use brick or masonry to build the manhole frame to grade that conforms to ASTM C 32 or ASTM C 139.

- Provide casting for manhole frames and covers that comply with ASTM A48, CL.35B, and AASHTO M105.
- Ensure that the structures have a 30-in. minimum manhole frame and cover. Use frames, covers, and grates that conform to **SECTION 702**.
- Use pipes and fittings that conform to **SECTION 701**.
- Provide steps within the chamber pit for access that are steel reinforced copolymer, polypropylene plastic step that comply with ASTM C478 or approved equal.
- Ensure that all components and appurtenances conform to the manufacturer's recommendations, applicable ASTM technical standards, US Federal specifications, and RIDOT Specifications and are approved by the Engineer.

702.02.6 Stormwater Discharge Structure.

Use a stormwater discharge structure that is precast reinforced concrete and that conforms to the required lines, grades, dimensions, and elevations. Comply with the following:

- Concrete. Use Class XX concrete that has a minimum 28-day compressive strength of 4000 psi and that conforms to **SECTION 601**.
- Pipe and Fittings. Use pipes and fittings that conform to **SECTION 701**.
- Manhole Cover. Provide stormwater discharge structures with a 30-in. minimum frame and cover that conforms to **SECTION 702.**
- Manhole Steps. Provide steps within the chamber pit that are steel reinforced copolymer polypropylene plastic step that comply with ASTM C478 or approved equal.
- Filter Fabric. Ensure that the filter fabric is non-woven material that conforms to **Subsection 703.02.2**.
- Trash Racks. Provide trash racks that conform to the required lines, dimensions, material, and elevations.
- Diversion Weir. If applicable, install the diversion weir at the required elevations and dimensions. Use a diversion weir made of reinforced concrete, masonry, or metal as approved by the Engineer.

702.03 CONSTRUCTION METHODS.

702.03.1 Masonry Unit Construction.

a. Location. If obstructions are encountered at drainage structure locations that cannot be conveniently removed, the Engineer will direct that the structures be constructed at either slightly revised or alternative locations. If the drainage is associated with directing stormwater to a STU, provide a Shop Drawing.

b. Excavation. Perform excavation for drainage structures according to **SECTION 203**. Excavate to the required horizontal cross section and to a sufficient depth to accommodate the concrete bases and/or bedding of the various drainage structures. Grade and compact the bottom of the excavation before placing concrete bases.

c. Replacement of Unsuitable Material. If the excavation cannot support the drainage structures, the Engineer will order additional excavation. When the unsuitable material has been removed, compact the bottom of the excavation by hand and refill with compacted gravel borrow.

d. Concrete Bases. Construct applicable concrete bases of drainage according to **Subsection 808.03.2**.

e. Restrictions on Certain Masonry Units. Do not provide concrete brick as a construction material for drainage structures. Concrete masonry block will only be allowed for the vertical riser portions of structures and will not be allowed in the corbeling portions. Use clay brick for corbeling up to the bottom of the metal frames.

f. Precast Concrete Sump. Where applicable, use a precast concrete sump section for standard 4-ft round catch basins.

g. Backfill. After construction of the drainage structures has proceeded to their design heights, backfill and compact the excavation according to **Subsection 203.03.5(c)**.

h. Unauthorized Excavation. If the bottom of any drainage structure excavation is below the required grade, correct the grade by filling with appropriate material.

i. Final Cleanup. Upon completion of construction, clean and maintain each drainage structure of any accumulation of silt, earth, debris, or foreign matter until final acceptance of the work. Catch basins, manholes, and inlets that require subsequent cleaning through no fault of the Contractor will be paid according to **SECTION 708**.

702.03.2 Precast Concrete Construction.

a. Testing and Inspection. The Engineer will inspect precast concrete drainage structure units both at the point of manufacture and at the Project site. Remove and replace any units exhibiting defects or damage that cannot be corrected to the satisfaction of the Engineer at no additional cost to the Department.

b. Other Construction Requirements. Adhere to the construction methods in **Subsection 702.03.1,** paras. a, b, c, d, g, h**,** and i equally to precast concrete drainage structures.

702.03.3 Deep Sump Catch Basin.

Ensure that construction is according to **SECTION 702**. Install the deep sump catch basins according to the Contract or as directed by the Engineer.

Ensure that sumps are a minimum of 4 ft below the lowest invert in the catch basin.

702.03.4 Leaching Catch Basin.

Ensure that construction is according to **SECTION 702**. Install the leaching catch basins according to the Contract or as directed by the Engineer.

Wrap the structure around all exterior sides and bottom with filter fabric and surrounded by a crushed stone layer to prevent clogging.

Install the crushed stone per the Contract or as specified by the manufacturer. Ensure that the crushed stone has minimum dimensions of 6-in. bedding stone below the structure and 12-in. stone surrounding the structure.

Provide complete Shop Drawings, and any necessary documentation for the leaching catch basins. Leaching catch basins and all materials will be approved by the Engineer in writing 14 days before being brought onsite.

702.03.5 Sediment Removal Device.

Construct the sediment removal device according to the Contract or as directed by the Engineer.

Place the structure on a compacted granular subbase as shown in the Contract, as determined by the manufacturer's specifications, and/or as directed by the Engineer. Check the granular subbase for level before setting and check for level at all four corners after it is set. If the slope from any corner to another corner exceeds 0.5 percent, remove the base section and relevel the granular subbase material.

Before setting subsequent sections, place sealant in conformance with **SECTION M04** and/or as required by the manufacturer.

Ensure that the holes for installation of ladder steps line up to allow for continuous access from top to bottom.

After setting the precast roof section of the sediment removal device, set precast concrete manhole riser sections to the height required to raise the cast iron manhole covers to grade so that the sections are vertical and in true alignment, with a ¼-in. maximum tolerance allowed. Backfill in a careful manner, raising the fill up in 6-in. lifts on all sides. If leaks appear, clean the inside joints and caulk with lead wool to the satisfaction of the Engineer. Set precast sections so that the joint is watertight. Ensure that the installation of the sediment removal device conforms to ASTM specification C 891 "Standard Practice for Installation of Underground Precast Utility Structures."

Plug holes made in the concrete sections for handling or other purposes with a non-shrink grout or by using grout in combination with concrete plugs.

Where holes must be cut in the precast sections to accommodate pipes, perform all cutting before setting the sections in place to prevent any subsequent jarring which may loosen the mortar joints.

702.03.6 Stormwater Discharge Structure.

Ensure that construction is according to **SECTION 702**. Install the leaching catch basins according to the Contract or as directed by the Engineer. Wall, ceiling and floor thicknesses may be increased as necessary by the precast manufacturer to meet the design criteria in this Subsection. Ensure that the inside dimensions of the stormwater discharge chambers are not reduced. Use joints for riser sections that are the shiplap type sealed with a field formed, fiber

reinforced joint sealant system. Install the stormwater discharge structures on a crushed stone base that is wrapped in filter fabric.

Provide complete Shop drawings and design computations for each stormwater discharge structure stamped by a Professional Engineer registered in Rhode Island. Provide complete Shop Drawings, computations, and any necessary documentation as part of the submittal documents.

702.04 METHOD OF MEASUREMENT.

702.04.1 Manhole, Catch Basin, and Drop Inlet.

New Manhole, Catch Basin, and Drop Inlet of the various types and sizes and between zero to 12 ft in depth will be measured by the number of drainage structures installed.

The Additional Depth of Manhole, Catch Basin, and Drop Inlet (Over 12 ft) will be measured by the vertical height in linear feet of drainage structure from the 12-ft depth to the top of the base slab.

702.04.2 Metal Frame and Grate and/or Cover.

Metal Frames and Grates and Metal Frames and Covers of the various types and sizes will be measured by the number of assemblies installed.

702.04.3 Precast Concrete Inlet and Apron Stone.

Precast Concrete Inlet Stone and Precast Concrete Apron Stone of the various types will be measured by the number of units installed.

702.04.4 Deep Sump Catch Basin.

Deep Sump Catch Basin will be measured by the number of each catch basin installed.

702.04.5 Leaching Catch Basin.

Leaching Catch Basins will be measured by the number of each leaching catch basin installed.

702.04.6 Sediment Removal Device.

Sediment Removal Device will be measured by the number of each device installed.

702.04.7 Stormwater Discharge Structure.

Stormwater Discharge Structure will be measured by the number of each unit installed.

702.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Manhole, Catch Basin, and Drop Inlet (between 0.0 and 12 ft in depth)	EA
Additional Depth of Manhole, Catch Basin and Drop Inlet (over 12 ft)	Vertical LF
Metal Frame and Grate	EA
Metal Frame and Cover	EA
Precast Concrete Inlet Stone	EA
Precast Concrete Apron Stone	EA
Deep Sump Catch Basin	EA
Leaching Catch Basin	EA
Sediment Removal Device	EA
Stormwater Discharge Structure	EA

702.05.1 Manhole, Catch Basin, and Drop Inlet.

For new Manhole, Catch Basin, and Drop Inlet between zero and 12 ft in depth, the prices constitute full compensation for the new frames and grates (all types), frames & covers (all types), all adjustments to grade, which includes all interim adjustments during construction and adjustments to final grade, including all labor, materials, and equipment for providing structures, including excavation (except rock excavation), placing and compacting backfill, steps, ½-in. thick cement mortar coating on both the inside and outside wall surfaces (except for precast structures), the disposal of all surplus excavated and/or unsuitable material, and all incidentals required to finish the work, complete and accepted.

For Additional Depth of Manhole, Catch Basin, and Drop Inlet over 12 ft, the price constitutes full compensation for all labor, materials, and equipment for providing the additional structure depth, complete and accepted.

702.05.2 Metal Frame and Grate and/or Cover.

For Metal Frame and Grate and Metal Frame and Cover the prices constitute full compensation for all adjustments to grade, which includes all interim adjustments during construction and adjustments to final grade, including all labor, materials, and equipment for providing the assemblies and for all incidentals required to finish the work, complete and accepted.

702.05.3 Precast Concrete Inlet and Apron Stone.

For Precast Concrete Inlet Stones and Precast Concrete Apron Stone, the prices constitute full compensation for all labor, materials, and equipment for providing the units and for all incidentals required to finish the work, complete and accepted.

Structure Excavation – Rock and Structure Excavation; Rock – Mechanical will not be included in the Contract unit prices but will be paid for separately as set forth in **Subsections 203.04.1** and **203.05**.

702.05.4 Deep Sump Catch Basin.

The price constitutes full compensation for all labor, materials, equipment, and tools for furnishing and placing each deep sump catch basin and all other incidentals necessary to finish the work, complete and accepted.

702.05.5 Leaching Catch Basin.

The price constitutes full compensation for all labor, materials, equipment, and tools, for furnishing and placing each basin, crushed stone, bedding, filter fabric, installing the frame and cover or frame and grate, and all other incidentals necessary to finish this work, complete and accepted.

702.05.6 Sediment Removal Device.

The price constitutes full compensation for all labor, materials, and equipment for furnishing and placing the units including excavation, dewatering, stone bedding, backfill, compaction, and all other incidentals required to finish the work, complete and accepted.

702.05.7 Stormwater Discharge Structure.

The price constitutes full compensation for all excavation (except for Trench Excavation – Rock, Trench Rock Excavation – Mechanical) and excavation of unsuitable material below grade to a depth equal to the invert of the proposed structure; for the manhole frame and cover, manhole steps, trash racks, pipes and fittings, and laying, setting, and jointing all sections, including connections to existing drainage structures or pipes; for placing and compacting backfill and for furnishing, placing, and subsequently removing all temporary sheeting, bracing, or shoring; for the proper disposal of all excess or unsuitable excavated materials; and for all labor, materials, equipment, tools, and all other incidentals necessary to finish the work, complete and accepted.

SECTION 703 — UNDERDRAINS AND COMBINATION DRAINS

703.01 DESCRIPTION.

This work includes constructing underdrains and/or combination drains in reasonably close conformity with the required dimensions and details.

703.02 MATERIALS.

703.02.1 Pipe.

Ensure that the following types of pipes conform to **SECTION M04**:

- Perforated concrete pipe (**Subsection M04.01.3**)
- Perforated corrugated polyethylene drainage pipe (**Subsection M04.01.5**)
- Perforated corrugated polyvinyl chloride pipe (**Subsection M04.01.6**)
- Perforated, smooth interior, high-density polyethylene (HDPE) pipe (**Subsection M04.01.7**)

703.02.2 Filter Fabric.

Use a filter fabric material suitable for underdrain applications. Ensure that the material complies with **Subsection M20.02**. Do not use heat set or heat calendared fabrics.

703.02.3 Filter and Bedding Materials.

Use filter stone, fine aggregates, and bedding stone that conform to **SECTION M01**.

Use gravel sump /filter stone that conforms to **Subsection M01.07** and **Subsection M01.09**, Column V of the Table.

703.02.4 Impermeable High-Density Polyethylene (HDPE) Liner.

Use impermeable plastic liner that is nonwoven high-density polyethylene (HDPE) liner specifically designed for use in subsurface lining/containment applications. Ensure that the liner complies with **Subsection M04.01.8**.

Ensure that the liner has been fabricated and delivered in rolls, not sheets. To keep the number of overlay joints to a minimum, provide the liner in sections not less than 15 ft in width, unless otherwise approved by the Engineer before delivery on site.

703.03 CONSTRUCTION METHODS.

703.03.1 General.

Construct the specified sizes and types of underdrains and/or combination drains according to the required lines and grades. Do not interchange or interconnect the various types of pipe except through the introduction of appropriate manholes or catch basins.

Ensure that manholes and catch basins required for underdrain and/or combination drain installation conform to **SECTION 702**.

703.03.2 Installation of Pipe.

a. Layout. Ensure that the pipe layout conforms to **Subsection 701.03.1**.

b. Trench Excavation. Excavate trenches according to the **SECTION 205**. Extend the trench excavation to the required width, or as directed by the Engineer, to allow for the compaction of both the bedding and backfill material under and around the pipe. Ensure that the trench walls are either vertical or as near vertical as conditions permit.

c. Bedding and Filter Fabric. Place a bedding layer of specified filter stone, fine aggregate, or filter fabric within the trench for its full width and length.

d. Laying Drains. Embed underdrains and combination drains firmly in the filter stone.

   Place perforated pipe with the perforations down for underdrains and up for combination drains. Join the pipe with the appropriate coupling fittings or bands.

   Close the upgrade ends of all underdrain pipe with plugs to prevent entry of soil materials.

   After the pipe installation has been inspected and approved, place filter stone to the required height above the top of pipe. Fill any remaining portion of trench above the filter stone with fine aggregate as specified. Compact the fine aggregate using moderate compactive effort by making two passes with a vibratory compactor.

e. Outlets. Place outlet pipes in trenches with all ends securely jointed as recommended by the pipe manufacturer. After inspection of the outlet pipe installation by the Engineer, backfill the trench with material meeting the applicable requirements of **SECTION M01**. Place the material in 12-in. layers and compact with moderate compactive effort with vibratory equipment.

703.03.3 Unauthorized Excavation.

If the bottom of any trench has been excavated below the required grade, restore the bottom to grade by refilling with a well-compacted bedding material as selected by the Engineer in writing.

703.04 METHOD OF MEASUREMENT.

Underdrain and Combination Drain, including their outlets, will be measured in the linear feet as installed.

703.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Underdrain	LF
Combined Drain	LF

The Contract prices constitute full compensation for all labor, materials, and equipment for providing the underdrains and combination drains including all trench excavation (except Trench Excavation – Rock and Trench Rock Excavation/Mechanical), bedding, filter stone, filter fabric, placing and compacting backfill, and all incidentals required to finish the work, complete and accepted.

Trench Excavation – Rock and Trench Rock Excavation – Mechanical will not be included in the Contract unit prices for underdrains and combination drains but will be paid for separately as set forth in **Subsections 205.04.2** and **205.05.1**.

No payment will be made for unauthorized excavation. Furnish, place, and compact the bedding material used to refill the trench to grade at no additional cost to the Department.

SECTION 704 — RECONSTRUCT DRAINAGE STRUCTURES

704.01 DESCRIPTION.

This work includes reconstructing existing drainage structures to the required dimensions and details.

Reconstruction is defined as follows — The change in vertical elevation of the drainage appurtenance is greater than 6 in. and/or the change in horizontal location is greater than 6 in. See **Subsection 707.01** for the definition of adjusting drainage structures.

704.02 MATERIALS.

Provide materials used in reconstructing existing drainage structures that conform to **Subsection 702.02.1**.

704.03 CONSTRUCTION METHODS.

Thoroughly clean the drainage structures, remove and stockpile on site the cast iron frames and covers (or grates) for subsequent reuse. Remove the tops of the structure immediately below the castings and a portion of the vertical walls to a sufficient depth to make the transition to the required lines, grades, and dimensions.

Do not disturb the surrounding area and those portions of the existing structure that will remain.

For construction methods to be employed, conform to **Subsection 702.03.1**.

704.04 METHOD OF MEASUREMENT.

Reconstruct Drainage Structure will be measured by the number of tops of units reconstructed.

704.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Reconstruct Drainage Structure	EA

The Contract price constitutes full compensation for all labor, materials, and equipment for reconstructing drainage structures including removing, stockpiling, and resetting castings, excavation and backfill, examining and cleaning the existing basin before and after reconstruction, the disposal of all surplus excavated and/or unsuitable materials, and all incidentals required to finish the work.

SECTION 705

This Section has been Reserved for Future Use.

SECTION 706 — PLUG AND CAP PIPE – ALL SIZES

706.01 DESCRIPTION.

This work includes providing plugs and caps for various sizes and types of pipe.

706.02 MATERIALS.

Provide plugs and caps for pipe that are the type approved by the utility company.

Provide cement or brick masonry plugs that consist of cement or brick masonry units securely bedded with cement mortar.

Provide cement mortar that conforms to **Subsection M04.03.5**.

706.03 CONSTRUCTION METHODS.

Place the plugs in all lines where required when such lines are broken into during construction. Ensure that all plugs produce watertight joints.

Ensure that all plugs and caps installed in pressure lines are properly strapped and blocked to withstand the anticipated back pressure.

Ensure that cement or brick masonry are properly set in place, blocked and protected to preclude infiltration or exfiltration due to hydrostatic pressure.

706.04 METHOD OF MEASUREMENT.

Plug and Cap Pipe All Sizes will be measured by the number of each unit installed regardless of the size or type.

706.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Plug and Cap Pipe All Sizes	EA

The Contract price is full compensation for all labor, materials, and equipment required to provide the plugs or caps and for all incidentals required to finish the work, complete and accepted.

SECTION 707 — ADJUST DRAINAGE OR UTILITY STRUCTURES

707.01 DESCRIPTION.

This work includes adjusting drainage or utility structures, such as telephone, electrical, and sanitary manholes, to the required new grades and details.

Adjusting is defined as follows — The change in vertical elevation of the drainage appurtenance is 6 in. or less and the change in horizontal location is 6 in. or less.

707.02 MATERIALS.

Provide materials that conform to the applicable paragraphs of **Subsection 702.02.1**.

707.03 CONSTRUCTION METHODS.

707.03.1 General.

In addition to the applicable paragraphs of **Subsection 702.03.1**, comply with the following special requirements.

When structures will be adjusted in paved areas, cut and match the existing pavement according to **SECTION 932**. When paved areas are open to traffic, paint the exposed vertical faces of adjusted structures with iridescent orange reflective paint if less than or equal to 1¾ in. Provide an asphalt ramp where the exposed vertical face exceeds 1¾ in.

Sawcut the perimeter to allow for removal of the castings. Remove and store castings and adjust the walls of the structure to the required line and grade by the removal or addition of bricks and mortar. Plaster walls with ½-in. cement mortar where required.

Reset castings to the proper line and grade in a bed of mortar. Before the placement of the final asphalt concrete course and following the secondary asphalt concrete course binder, remove an area of 1 ft outside the top of the frame to a depth of 9 in. below the surface course. Compact and replace the area with a Class A concrete collar to the level of the secondary asphalt course.

Maintain access to all catch basins and utility manholes at all times.

707.04 METHOD OF MEASUREMENT.

Adjust Drainage or Utility Structure will be measured by the number of structures adjusted.

707.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Adjust Drainage or Utility Structure	EA

The Contract price constitutes full compensation for all labor, materials, equipment and all incidentals required to finish the work, accepted by both the Engineer and the representative of the specific utility company involved.

For Adjust Narragansett Bay Commission Sanitary Manholes, the Contract unit price also includes the application fee for the Sewer Facility Permit.

Adjust Telephone Manholes will be paid according to **Subsection 104.05**.

SECTION 708 — CLEANING AND FLUSHING PIPES AND DRAINAGE STRUCTURES

708.01 DESCRIPTION.

This work consists of cleaning stormwater and drainage assets such as catch basins, drainage manholes, stormwater treatment units (STU), pipes and surface water culverts of all types and sizes as required when applicable for preservation and rehabilitation techniques.

708.02 MATERIALS.

708.02.1 Equipment.

Equipment for cleaning drainage assets includes hoses, rodding machines, balls, hydraulic cleaners, root cutters, small clam shell buckets, steel porcupines, pumps, vacuums (trailer and/or truck mounted) or other suitable and approved means.

708.02.2 Water.

Ensure that the water used for cleaning and flushing drainage pipes is fresh and free of oil, acid, salt, alkali, organic matter, or any other deleterious substances. Provide all water required for the cleaning operation. If the Contractor uses a public water supply, obtain all necessary permissions and approvals from the respective water supply before usage. Provide proof of permission and approval to the Engineer before the start of work via the Shop Drawing process.

708.02.3 Vacuum System.

Use a truck mounted or trailer mounted system capable of removing sediment and debris from pipes, drainage manholes, catch basins, and stormwater treatment units. Equip the system with sufficient water capacity, lines, hoses, nozzles, tanks and other required equipment to provide for cleaning multiple structures per operation. Ensure that the system can store wastewater until a proper decanting site can be reached and be equipped with a hand-held high-pressure spray nozzle.

708.02.4 Qualifications.

The Contractor shall be qualified to perform pipeline, catch basin, manholes and stormwater treatment unit cleaning, with a minimum of three active years of experience in performing pipeline cleaning. Provide proof of the qualifications to the Engineer before the start of work via the Shop Drawing process.

708.03 CONSTRUCTION METHODS.

708.03.1 Operation of Drainage System During Cleaning.

Ensure the proper operation of the storm drainage system during the cleaning operations. During stormwater drainage system cleaning operations, take satisfactory precautions to:

- Protect the drainage system pipelines and vertical structures from damage that might be inflicted by the improper or overuse of the cleaning equipment

- Prevent water build up in the system to cause back flow, contamination, water damage, injury, and/or flooding to persons or public or private property
- Protect any environmentally sensitive areas from impacts of the operation; ensure that all cleaning operations conform to the Project SWPPP and/or SESC

708.03.2 Cleaning Methods.

Clean and flush all drainage assets as required by use of pressure hoses, suction pumps, and/or any other methods required to perform the work. Perform cleaning by mechanical means, vacuum, and/or high velocity hydraulic jet cleaning equipment. Select equipment based on field conditions such as physical accessibility, condition, asset size, type of asset, and type of debris to be removed. Ensure that the pipes and other drainage assets that will be rehabilitated (lined or cured in place) meet the cleaning requirements of the rehabilitation treatment selected. Equip the hydraulic jet cleaning equipment with the appropriate nozzles for cleaning the various pipe sizes and material types identified in the Contract.

Construct a suitable weir or dam in the nearest downstream manhole or catch basin so that debris material will be trapped. Do not allow the material to pass on from one section to the next.

Clean each manhole or catch basin independently of other portions of the storm drainage system.

Submit daily worksheets indicating the location and quantity of pipes, catch basins, and manholes cleaned. Reclean any pipe as needed to obtain satisfactory results at no additional cost to the Department.

708.03.3 Cleaning and Flushing Pipes.

Ensure that the equipment and methods selected do not cause damage to the pipe. Use a high velocity hydraulic jet cleaning nozzle based on the conditions of the pipe at the time the work commences. Use equipment for cleaning that can remove soil, rocks, sand, other deleterious materials, and obstructions from the assets. Proceed so as to prevent the migration of debris or sediment to previously cleaned segments or assets, and do not allow debris or sediment to be discharged from the outfall.

Provide suitable screening and containment of waste and wash water in the downstream manhole or catch basin to prevent wash water and waste material from passing downstream into previously cleaned pipe, environmentally sensitive areas, or other parts of the system. Ensure that the pipe is cleaned sufficiently to provide full access to a CCTV inspection system.

708.03.4 Root Removal.

Remove all invasive roots and vegetation in all sections of pipes as identified in the Contract. Use a method of chemical root treatment with an EPA approved herbicide in conjunction with mechanical root removal to aid in root removal and to mitigate future root growth. Ensure that the handling and application of the herbicide complies with the manufacturer's instructions and applicable certification and application regulations to ensure safety and to preclude any damage to surrounding vegetation. Replace any damage to surrounding vegetation at no additional cost to the Department. Submit the proposed method(s) and material(s) in advance via the Shop Drawing process.

708.03.5 Cleaning and Flushing Vertical Structures.

Clean vertical structures such as catch basins, drainage manholes, and stormwater treatment units of debris using a vacuum system. Clamshell excavating equipment may be used for initial cleaning, if it can be done without damaging the structure; however, a vacuum system is required for compliance with cleaning specifications and payment. Use a vacuum system that can remove debris to the bottom of the sump or outfall apron. After vacuum removal of debris, clean the structure by pressure washing the frame or cover, grate, and inside surface of the structure from top to bottom. Vacuum the water and debris resulting from the high-pressure spraying from the structure using appropriately sized hoses and nozzles, including on all sides of weirs, hoods, or baffles. Clean the area around the structure to be free from materials that may have been ejected by the cleaning process. Reset all sound grates and covers into the existing frame. Replace any cracked or broken frames, grates, or covers at the direction Engineer, which will be paid for separately or under another item of the Contract.

708.03.6 Disposal of Debris Collected.

Properly dispose of all material displaced and removed by the cleaning operation, including grit, sediment, dirt, sand, rock, grease, roots, vegetation, organic mass, or solid material contained therein. Test in accordance with **PART 200** and properly dispose of any waste material removed from the drainage according to State and Federal requirements. Testing of the material will be at the Contractor's expense. Submit all test results to the Engineer. Notify the Engineer of the proposed disposal location and requirements of that facility to allow disposal of the waste material. Store waste material until all testing requirements including that of the proposed facility have been met. Ensure that temporary storage and handling facilities, including stockpiles and decanting areas, conform to the Project SWPPP and/or SESC.

708.04 METHOD OF MEASUREMENT.

708.04.1 Cleaning and Flushing Pipe.

Cleaning and Flushing Pipe will be measured in linear feet from center-to-center of drainage structures for all pipe lines cleaned, regardless of the pipe sizes. This includes pipes and surface water culverts.

708.04.2 Root Removal.

Root Removal will be measured in linear feet of pipe cleaned, regardless of the pipe sizes, type of root removal, or method employed.

708.04.3 Cleaning and Flushing Vertical Structure.

Cleaning and Flushing Vertical Structure will be measured by the number of drainage structures cleaned, regardless of size or type. This includes catch basins, drainage manholes, and stormwater treatment units (STU).

708.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Cleaning and Flushing Pipe	LF
Root Removal	LF
Cleaning and Flushing Vertical Structure	EA

The Contract prices constitute full compensation for all labor, materials, and equipment required to conduct the operation by normal methods and for all incidentals required to finish the work, complete and accepted.

SECTION 709 — CONCRETE FOR THRUST BLOCKS, HEADWALLS AND MISCELLANEOUS PURPOSES

709.01 DESCRIPTION.

This work includes providing Portland cement concrete for thrust and bearing blocks, headwalls, and other miscellaneous purposes at the required locations.

709.02 MATERIALS.

Subsection 601.03.1 identifies the classifications of concrete for thrust blocks, headwalls, and other miscellaneous purposes. Provide concrete that also conforms to **SECTION 601**.

709.03 CONSTRUCTION METHODS.

709.03.1 Thrust or Bearing Blocks.

The installation of thrust blocks includes concrete placement and any additional excavation as required. Provide straps associated with thrust blocks.

709.03.2 Headwalls.

Perform concrete construction that conforms **SECTIONS 808** and **702**.

709.04 METHOD OF MEASUREMENT.

Concrete for this Section will be measured by the number of cubic yards placed.

709.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Concrete	CY

The Contract price constitutes full compensation for all labor, materials, and equipment, thrust blocks, and all incidentals required to finish the work, complete and accepted.

SECTION 710 — CUT-INS FOR MANHOLES, CATCH BASINS AND PIPE

710.01 DESCRIPTION.

This work includes cutting into existing manholes, catch basins, and pipe to accommodate new construction at the required locations.

710.02 MATERIALS.

Provide materials for brickwork that conform to **Subsection M04.03**.

710.03 CONSTRUCTION METHODS.

710.03.1 Manhole and Basin Cut-Ins.

Cut into the existing manholes and/or catch basins at the required grade. Make the cut-in with the approval and acceptance of the Engineer. Restrict overbreakage to not more than 2 in. beyond the outside circumference of the connecting pipe.

Lay brick as headers on the edge around the pipe and mortar in place.

Perform excavation for cut-ins according to **SECTION 205**.

Plaster the outside face of brick walls to a thickness of ½ in. with mortar proportioned as specified in **Subsection M04.03.5**. Trowel the mortar to a smooth hard finish. Do not place backfill until the mortar has hardened.

710.03.2 Pipe Cut-Ins.

Locate pipe cut-ins where a new manhole or catch basin will be inserted on an existing line. Perform pipe cut-ins by one of the following methods:

- Cutting the Pipe Before Performing Any Work in Constructing the New Manhole. In exercising this option, provide the Engineer with the proposed methods to maintain the flow or service provided by the pipe to be cut. The Engineer must approve the methods before commencing work.
- Constructing the Manhole on and Around the Pipe Before Making the Cut. Under this method, excavate around the pipe to the outer limits of the new manhole. Support and brace the pipe to ensure against breakage or misalignment that will result in leakage. The Engineer must approve the method for accommodating the pipe flow should breakage occur. The manhole invert may be constructed using the lower half of the existing pipe. Ensure that the jointing between the pipe and manhole wall is watertight.

Perform excavation for pipe cut-ins according to **SECTION 203**.

710.04 METHOD OF MEASUREMENT.

Not applicable.

710.05 BASIS OF PAYMENT.

710.05.1 Manhole and Catch Basin Cut-Ins.

Payment for Manhole and Catch Basin Cut-Ins will not be made separately but will be included in the Contract unit price per linear foot of the specific pipe involved as set forth in **SECTION 701**.

710.05.2 Pipe Cut-Ins.

Payment for Pipe Cut-Ins will not be made separately but will be included in the Contract unit price per each of the specific drainage structure involved as set forth in **SECTION 702**.

SECTION 711 — WATERWAYS

711.01 DESCRIPTION.

This work includes constructing ditches, flumes, or gutters with Portland cement concrete, asphalt concrete, or other materials or combinations thereof, in reasonably close conformity with the required lines and grades.

711.02 MATERIALS.

- Use gravel borrow base that conforms to **Subsection M01.02**.
- Use Class A Concrete that conforms to **SECTION 601**.
- Use Class 9.5 HMA surface course material, that conforms to **Subsection M03.02**.
- Use cement mortar conforming to **Subsection M04.03.5**.
- Use bedding sand that is natural or manufactured material conforming to AASHTO M6.

711.03 CONSTRUCTION METHODS.

711.03.1 Excavation.

Perform excavation for waterways according to **SECTION 202** or **205**.

711.03.2 Asphalt Mixture Paving.

Place a 6-in. layer of gravel borrow on a prepared subgrade to ensure that the layer conforms to the required grade and cross section after compaction.

Spread the asphalt mixture on the prepared gravel borrow base, and compact by tamping or rolling to a finished depth of 3 in. Ensure that the finished surface conforms to the required lines, grades, and cross section.

711.03.3 Cement Concrete Paving.

Place a 6-in. layer of gravel borrow on a prepared subgrade so that it conforms to the required grade and cross section after compaction.

Place the cement concrete on the gravel borrow base to the designated thickness. Ensure that the finished concrete surface conforms to the required lines, grades, and cross section. Construct expansion joints at the indicated locations and to the required dimensions.

711.04 METHOD OF MEASUREMENT.

Waterway will be measured by the number of square yards provided. Widths and lengths are measured in the horizontal plane.

711.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Waterway	SY

The Contract price constitutes full compensation for all labor, materials, and equipment, including excavation (except Rock Excavation or Rock Excavation/Mechanical), trimming and fine grading including existing subgrade, Class 9.5 HMA, concrete or stone headers, if required, and for all incidentals required to finish the work, complete and accepted.

Trench Excavation – Rock, Trench Rock Excavation – Mechanical, or Channel Excavation Rock will be paid for separately as set forth in **SECTION 202** or **205**.

SECTION 712 — GATE BOX

712.01 DESCRIPTION.

This work includes removing and disposing existing water or gas gate boxes and subsequently providing new water or gas gate boxes at the required locations.

712.02 MATERIALS.

712.02.1 Castings.

Use iron castings that conform to **Subsection M05.05.9(f)**.

712.02.2 Fabrication.

Document that the water and gas gate boxes conform to the requirements of the respective manufacturers, utility companies, and municipalities.

Clean the gate boxes, including covers, and thereafter coat, paint, or dip all surfaces in an asphalt or asphalt base paint or coating.

712.03 CONSTRUCTION METHODS.

712.03.1 Removal of Existing Boxes.

Remove the existing gate valve boxes to not damage or disturb the valves or appurtenant fittings that remain. After the gate boxes have been removed, the boxes shall become the property of the Contractor.

712.03.2 Installation.

Set the boxes to the required line and grade. All installations shall be approved by the applicable gas and/or water company.

Fit the boxes to the valve and secure the boxes during backfilling. Tamp the backfill material in place. Construct the boxes to prevent the separation of the upper section from the lower section to prevent the upper section from turning when removing the lid.

712.04 METHOD OF MEASUREMENT.

Gate Box will be measured by the number of assemblies installed.

712.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Gate Box	EA

The Contract prices constitute full compensation for all labor, materials, and equipment for providing the assemblies, including removal and disposal of existing gate boxes, excavation, backfill, concrete collar, and all incidentals required to finish the work, complete and accepted.

SECTION 713 — ADJUST CURB STOP AND UTILITY BOXES

713.01 DESCRIPTION.

This work includes adjusting existing utility gate boxes and curb stops to the new grades indicated.

713.02 MATERIALS.

Provide materials required for the adjustment of boxes that conform to **Subsection 712.02**.

713.03 CONSTRUCTION METHODS.

Loosen utility gate boxes and curb stops from the surrounding material and adjust to the required new grades. The use of gate box adapters will be allowed. Place approved granular material around the gate boxes and curb stops and hand tamp this material until well compacted. When paved areas are open to traffic, paint the exposed vertical faces of exposed utility structures with iridescent reflective orange paint if less than or equal to 1¾ in. Provide an asphalt ramp where the exposed vertical face exceeds 1¾ in.

Maintain access to the curb stops and utility gate boxes at all times.

When an existing gate box or curb stop is determined by the Engineer to be unadjustable, furnish and install a new gate box or curb stop according to **SECTION 712**.

713.04 METHOD OF MEASUREMENT.

Adjust Curb Stop or Utility Box will be measured by the number of units adjusted.

713.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Adjust Curb Stop or Utility Box	EA

Each adjustment authorized by the Engineer will be paid for. The Contract prices constitute full compensation for all labor, materials, equipment, concrete collars, and all incidentals required to finish the work, as accepted by both the Engineer and the representative of the specific utility company involved.

SECTION 714 — POST TYPE HYDRANTS

714.01 DESCRIPTION.

This work includes installing or removing and relocating post type hydrants to the required locations.

714.02 MATERIALS.

Ensure that all materials conform to the applicable requirements established by both the water company or municipality that owns the specific system involved and these Specifications. For all new and relocated post type hydrants, use a breakaway type. Document that the hydrants, fittings, and all appurtenances conform to the requirements of the respective manufacturers, water companies, and municipalities.

714.03 CONSTRUCTION METHODS.

Notify the applicable water company and/or municipality and the local fire company at least 24 hours in advance of any work involving the hydrants. All installations for new and relocated hydrants shall be approved by the applicable water company or municipality. Perform additional requirements for the installation of hydrants, including pressure testing, disinfection, inspection, and thrust block installations, according to the AWWA and the established practices and requirements of the owner.

714.03.1 Relocation of Post Type Hydrant.

Remove and transport hydrants to be relocated to a stockpile location as directed by the Engineer. Upon removal of the hydrant, record the depth of the standpipe section so that the proper height can be placed to ensure that the breakaway coupling is at the proper height. At the stockpile area, clean the hydrants and make ready for use. Relocate and install hydrants according to the established practices of the water company or municipality that owns the water system.

714.03.2 New Hydrant Installation.

Set the seating flange/breakaway coupling above finished grade.

714.04 METHOD OF MEASUREMENT.

Remove and Relocate Post Type Hydrant and Post Type Hydrant will be measured by the number of assemblies relocated or installed. Hydrants that have been set with the seating flange/breakaway coupling outside the limits shown on the Plans will not be accepted.

714.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Remove and Relocate Post Type Hydrant	EA
Post Type Hydrant	EA

The Contract prices constitute full compensation for all labor, materials, tools, and equipment, including excavation, removal, hauling, stockpiling, backfill, compaction, piping, plugs, disinfection, testing, thrust blocks, bedding materials, and all incidentals required to finish the work as accepted by the Engineer and the respective water company or municipality.

If the relocated or newly installed hydrant requires a tapping sleeve and valve, these items will be paid for separately under the appropriate water service item in the Proposal.

Hydrants to be removed and disposed will be paid for separately under the appropriate item(s) in the Proposal.

SECTION 715 — GABION CHECK DAM

715.01 DESCRIPTION.

This of work consists of the construction of a gabion check dam in the required dimension, details and materials.

715.02 MATERIALS.

Use gabions that have been fabricated, assembled, and installed according to the Contract.

Provide basket units as specified with a dimension tolerance of plus or minus 5 percent and that conform to ASTM A-974-97 and US Federal Specification QQ-W-461H and that have been coated according to ASTM A641, Class 3, Finish 5, soft tempter. Use wire for basket units that has been hot-dipped galvanized steel and that has a minimum tensile strength of 60,000 psi.

Ensure that the gabions have mesh openings with nominal dimensions not to exceed 4.5 in. and that the maximum area of any mesh openings does not exceed 10 sq in.

Ensure that the welded wire mesh has a uniform square or rectangular pattern with a resistance weld at each connection and that each welded connection has a minimum shear that complies with ASTM A185.

Use a twisted wire mesh that has a non-raveling, double twisted hexagonal wire mesh two twisted together in three 180i-degree turns

Ensure that the wire for gabions has been fabricated from wire having the following minimum diameters:

Type of Wire	Diameter after Galvanization
Mesh Wire	0.105 in.
Selvedge Wire	0.132 in.
Spiral Binders, Lacing Wire, or Internal Connecting Wire	0.086 in.

Submit any proposed alternative gabion wire coating to the Engineer for approval.

Use rip-rap gabion check dams that is R-3 minimum.

Ensure that crushed stone has been clean washed and conforms to the gradation listed in **Subsection M01.09**, Column II of the Table.

Use filter fabric that is a non-woven material and conforms to **Subsection 703.02.2** and is listed on the RIDOT Approved Materials List.

715.03 CONSTRUCTION METHODS.

Excavate the subgrade for the gabion check dam to the required line and grade. Remove any buried debris protruding from the subgrade that will impede the proper installation and final

appearance of the gabion check dam, and backfill the voids to provide a level subgrade. Upon inspection and approval of the subgrade by the Engineer, install filter fabric and crushed stone bedding in preparation for placement of the gabions. Place the gabions according to the Contract and/or per the manufacturer's recommendations as approved by the Engineer.

Anchor the check dams into side slopes by extending the ends a sufficient length, height, and depth to prevent flow bypass as required. Extend the side slope anchor length a minimum of 8 in. on each end.

Provide Shop Drawings and any necessary documentation for the gabion check dam. The Engineer must approve all materials to be used with the gabion check dam 14 days before being transported onsite.

715.04 METHOD OF MEASUREMENT.

Gabion Check Dam will be measured by the number of cubic yards installed.

715.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Gabion Check Dam	CY

The price constitutes full compensation for all labor, materials, and equipment; excavation, filter fabric and crushed stone; providing and installing the wire mesh gabions, riprap inside the gabions, fasteners, connection wires and ties; and all other incidentals required to finish the work, complete and accepted.

SECTION 716 — OPEN CELL CONCRETE BLOCK

716.01 DESCRIPTION OF WORK.

This work includes furnishing Open Cell Concrete Blocks (OCB) at the required lines and grades and includes preparing the subbase and providing the filter fabric materials.

716.02 MATERIALS.

716.02.1 General.

Use open cell concrete blocks that have been pre-manufactured as an assembly of concrete blocks. Ensure that the open cell of the blocks have vertical openings and a void space ratio equal to as required with a sufficient wall thickness to resist breakage during shipping and installation.

Ensure that each block incorporates interlocking surfaces and/or manufacturer requirements that prevent lateral and vertical displacement of the blocks. Ensure that the interlocking surfaces do not protrude beyond the perimeter of the blocks such that they reduce the flexibility or articulation capability or become damaged or broken. Once in place, ensure that the interlocking surfaces prevent the lateral displacement of the blocks.

Provide OCB that conforms to **SECTION M01** and **Subsection M18.17** that conform to the following:

- Cementitious Materials. Use materials that conform to the following applicable standards:
  - Portland Cements – ASTM C 150 for Portland cement
  - Blended Cements – ASTM C 595 for blended hydraulic cements
  - Hydrated Lime Types – ASTM C 207 for hydrated lime types
  - Pozzolans – ASTM C 618 for fly ash and raw or calcined natural pozzolans for use in Portland cement concrete
- Aggregates. Use aggregates that conform to the following, except that grading requirements may not apply:
  - Normal Weight – ASTM C 33 for concrete aggregates
- Porous Media Beds. When applicable, use material layers underlying the OCB, including chocker course, crushed stone, reservoir course, and filter course, that conform to the gradation requirements in the Table in **Subsection M01.09**.
- Physical Requirements. Provide an OCB that at a minimum meets the loading requirements of H-20 or as specified in the Contract.
- Durability. The manufacturer shall certify that the concrete units have adequate durability when subjected to a freeze-thaw environment.
- Visual Inspection. Ensure that all units are sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. The following will be rejected:

- Cracks exceeding 0.25 in. in width and/or 1.0 in. (2.54 cm) in depth
- Chipping resulting in a weight loss exceeding 10 percent of the average weight of the blocks

Replace blocks rejected before delivery from the point of manufacture at the manufacturer's expense. Repair blocks rejected at the job site to the satisfaction of the Engineer with structural grout at no additional cost to the Department.

- Sampling and Testing. Provide proper access to the Engineer to facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.
- Expense of Tests. Perform any additional testing other than that provided by the manufacturer at no additional cost to the Department.

716.02.2 Filter Fabric.

Provide filter fabric, if required, as specified in the Contract and as approved by the Engineer.

716.02.3 Subbase Material.

Provide, prepare, place, and grade the subbase material as required in the Contract.

716.03 CONSTRUCTION METHODS.

716.03.1 Submittals.

a. Shop Drawings. Submit the manufacturer's product data, including installation instructions, to the Engineer. Ensure that the Shop Drawings include the layout, layout sequence, and details for edging, anchoring, junctions, and grade change.

b. Representative Samples. Select the sources proposed to obtain in advance of the time when the materials will be required in the work. Submit the product literature and suitable samples of the OCB, anchors, and filter fabric to the Engineer for approval before the delivery of any material to the work site. Submit the OCB revetment system and manufacturer's certification that the revetment system and components meet the requirements of the Contract.

716.03.2 Foundation Preparation.

a. General. Construct areas on which filter fabric and cellular concrete blocks will be placed to the required lines and grades. Protect all native materials from over compaction and properly compact the subbase materials.

b. Grading. Grade the application area to a smooth plane surface to ensure that intimate contact is achieved between the slope face and the geotextile (filter fabric) and between the geotextile and the entire bottom surface of the cellular concrete blocks. Regrade or remove all slope deformities, roots, grade stakes, and stones that project normal to the local slope face. Do not allow any holes, pockmarks, slope board teeth marks, footprints, or other voids greater than 1.0 in. in depth normal to the local slope face. Do not allow any grooves or depressions greater than 0.5 in. in depth normal to the local slope face with a dimension exceeding 1.0 ft in any direction. As necessary, raise any surfaces to

grade by placing compacted homogeneous material. Ensure that the slope and slope face are uniformly compacted and that the depth of layers, homogeneity of soil, and amount of compaction are as required.

Perform the excavation and preparation for anchor trenches, side trenches, and toe trenches or aprons according to the required lines, grades, and dimensions. Uniformly grade the anchor trench hinge-point at the top of the slope so that no dips or bumps greater than 0.5 in. over or under the local grade occur. Uniformly grade the width of the anchor trench hinge point to ensure intimate contact between all concrete blocks and the underlying grade at the hinge point.

c. Inspection**.** The Engineer, Design Engineer, and manufacturer's representative will inspect the prepared subgrade area before placement of the open cell concrete blocks and filter fabric if required. Provide a minimum of 72 hours notice before the placement of the concrete blocks. Do not place anything until the areas have been approved by each of the parties.

716.03.3 Placement of Geotextile Filter Fabric.

a. General. Place filter fabric or filtration geotextile, when specified, below all OCB within the required limits.

b. Placement. Place filter fabric directly on the prepared surface in intimate contact with the subgrade and free of folds or wrinkles. Do not walk on or disturb the filter fabric if this results in a loss of intimate contact between the open cell concrete block and the fabric or between the fabric and the subgrade. Place the filter fabric so that the upstream strip of fabric overlaps the downstream strip. Overlap the longitudinal and transverse joints at least 2 ft and at least 1 ft beyond the top and bottom revetment termination points or as required by the manufacturer.

716.03.4 Placement of Concrete Blocks.

a. Placement. Place the OCB on the filter fabric, if required, to produce a smooth plane surface in complete contact. Do not allow any individual block within the plane of placed cellular concrete blocks to protrude more than ½ in. To ensure that the cellular concrete blocks are flush and develop complete contact with the subgrade, seat the blocks with a roller or other means as approved by the Engineer.

Place the OCB side by side and/or end to end or as described by the manufacturer. Where distinct changes in grade that result in a discontinuous revetment surface in the direction of flow occur, install a seam per the manufacturer at the grade change location to produce a continuous surface.

Backfill anchor trenches and side trenches and compact flush with the top of the blocks. Ensure that the integrity of a soil trench backfill is maintained to ensure a surface that is flush with the top surface of the concrete blocks for its entire service life. Complete the backfilling and compaction of trenches in a timely fashion.

b. Finishing. Backfill the cells or openings in the concrete blocks following the placement of the OCB. Spread the backfill material over the surface of the OCB to ensure that there are no voids and that the backfill material extends from the filter fabric to the surface of the concrete blocks.

716.04 METHOD OF MEASUREMENT.

Open Cell Concrete Block will be measured by the number of square yards installed.

716.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Open Cell Concrete Block	SY

The price constitutes full compensation for all labor, materials, and equipment necessary to install the open cell concrete block, including providing, preparing, placing, and grading the subbase; placing and installing filter fabric; and all other incidentals required to finish the work, complete and accepted.

Part 800
BRIDGE STRUCTURES

SECTION 801 — GENERAL

801.01 DESCRIPTION.

801.01.1 AASHTO Specifications.

The currently adopted edition of the AASHTO *LRFD Bridge Construction Specifications,* including all current Interim Specifications, are considered as part of the Rhode Island *Standard Specifications for Road and Bridge Construction*.

801.02 MATERIALS.

801.02.1 Reports.

Submit all material reports electronically, either from the Contractor or materials supplier, and provide the following identifying information:

- RI State Contract Number
- Bridge number or numbers involved
- Manufacturer's name
- Supplier's name
- Product identification, name, type, class, lot, drawing number, catalogue number, or other reasonably complete identification that establishes the relevance of the submitted reports to the products involved and the date of their manufacture
- Shipping identification by bill of lading, including number of pieces, markings, packaging, addressee, shipping date, and route (when there is no inspection of mill or shop)

801.02.2 Mill Reports.

Ensure the delivery of mill reports, certificates of compliance, tests, or other evidence as required by **SECTION 106.**

Prepare mill reports that properly attest to the manufacturer's production quality control tests reports or comparable tests performed by an approved laboratory. Provide reports that include the test results required by specifications or the test results required by the Standard Designation (e.g., AASHTO or ASTM) for establishing the chemical and physical properties of the material.

Submit Certificates of Compliance, when approved by the Engineer in lieu of RIDOT acceptance testing, according to **Subsection 106.03**.

801.02.3 Materials Schedule.

Perform sampling, testing, and certification of materials according to the Project Schedule for each Project.

801.02.4 Inspection by Others.

When Department inspection work is contracted to an independent inspection agency, furnish the reports required to the representative of that agency.

801.03 CONSTRUCTION METHODS.

For any changes to the original erection plan, the Contractor's Professional Engineer will be required to prepare and stamp the revisions and to inspect and provide written approval for the final erection installation before allowing vehicles or pedestrians on or below the bridge. In addition, stamp all changes to the Contractor's original erection plan, and submit all proposed changes to RIDOT for review and approval before implementation.

SECTION 802 — TEMPORARY BRIDGES

802.01 DESCRIPTION.

This work includes the construction, maintenance, load rating, and subsequent removal (including area restoration) of temporary bridges.

802.02 MATERIALS.

Ensure that the materials used for the construction of temporary bridges conform to **PART M.**

802.03 CONSTRUCTION METHODS.

802.03.1 General.

Submit a load rating to the Bridge Engineering Section before opening the bridge to traffic according to the latest RIDOT *Bridge Load Rating Guidelines*. Provide the Department with 45 days notice before opening the bridge.

802.03.2 Approaches.

Construct approach embankments, excavation, surfacing, and other incidental work as necessary to ensure that the temporary structure is ready for traffic. After temporary safety appurtenances are installed on approaches where necessary to protect vehicular and pedestrian traffic, open the temporary facility to traffic before any work that could interfere with existing traffic.

802.03.3 Removal of Temporary Bridge.

When the permanent structure is completed, remove and properly dispose of the temporary structure. Demolish the approach surfaces and remove and properly dispose of the surplus material, and trim and grade the disturbed areas as specified. Perform structure removal work according to **SECTION 803**. Materials from the temporary structure shall become the property of the Contractor.

802.04 METHOD OF MEASUREMENT.

This item does not require a measurement for payment.

802.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Temporary Bridges	LS

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted. The price also includes the load rating requirement, maintenance, removal, and area restoration.

Partial payment for the temporary structure will be paid at 75 percent when it is available for use and a load rating has been submitted and accepted. The remaining 25 percent will be paid when all materials have been removed, and the site has been restored.

SECTION 803 — REMOVAL OF EXISTING STRUCTURES

803.01 DESCRIPTION.

803.01.1 Removal of Existing Bridge-Related Structures.

This work includes the removal, in whole or in part, of existing structures (including culverts), which includes either the salvage and storage or the disposal of resulting materials, together with the restoration of disturbed areas.

803.01.2 Removal and Disposal of Existing Concrete Masonry.

The work pertains to the removal and disposal of existing concrete masonry including all elements cast within or attached to the concrete. The work also includes cutting reinforcing steel, where required, and the surface preparation of reinforcing steel and concrete before placing new concrete. This item of work does not include removal of deteriorated concrete for deck repairs.

803.01.3 Temporary Deck Underside & Side Protective Shielding.

This work includes designing, furnishing, fabricating, erecting, maintaining, removing, and disposing of temporary deck underside and deck side protective shielding at locations shown on the Plans and/or as directed by the Engineer.

Ensure that the temporary deck underside and deck side protective shielding provides for the safe passage of vehicles and pedestrians and provides protection for utilities. The use of the protective shielding will ensure that no debris falls to the roadway, sidewalks, or waterways below the structure. The protective shielding will be used for or in conjunction with deck demolition.

803.02 MATERIALS.

803.02.1 Removal of Existing Bridge-Related Structures.

Not applicable.

803.02.2 Removal and Disposal of Existing Concrete Masonry.

Not applicable.

803.02.3 Temporary Deck Underside & Side Protective Shielding.

Deck underside and side protective shielding may be constructed from timber, steel, or aluminum. Use steel and aluminum that conforms to **SECTION M05**.

Use timber and hardware that conforms to **SECTIONS M11** and **M05**. Use structural lumber that meets the National Design Specifications for stress graded lumber recommended by the National Forest Products Association (NFPA). Use a grade of F_b = 1200 psi minimum. Use a minimum lumber size for underside shielding of 3 in. × 8 in.

803.03 CONSTRUCTION METHODS.

803.03.1 Removal of Existing Bridge-Related Structures.

803.03.1.1 Salvaged Materials.

Remove materials that are designated to be salvaged for subsequent reuse by the Department and that the Engineer deems suitable for the reuse so as to ensure safe handling and transportation.

Dismantle all structure components scheduled for reuse, matchmark with paint, and remove to avoid damage to any member. Furnish the Engineer a diagram showing the matchmarking of all dismantled members.

803.03.1.2 Disposable Materials.

Materials that will not be salvaged or stockpiled for reuse by the Department shall become the property of the Contractor.

803.03.1.3 Partial Removal of Structures.

Remove the portions of existing structures that will not be reused without damaging the portions of the structure that will remain to be reused. Repair any damage to the portions remaining in service at no additional cost to the Department.

803.03.1.4 Restoration of Disturbed Areas.

Restore all areas disturbed by the removal of existing structures to the level of the surrounding ground and compacted according to **Subsection 202.03.3**. Grade and blend the areas with adjacent areas to provide a clean and safe condition.

803.03.2 Removal And Disposal of Existing Concrete Masonry.

803.03.2.1 Disassembly.

Saw cut the concrete in squares to a minimum depth of ¾ in. along the limits of the concrete removal. Remove all concrete, specified reinforcement, bridge curbs, deck joint hardware, and other embedded items by means of suitable power and hand tools that will not cause over-breakage, and properly dispose of the material. Perform all repairs resulting from over-breakage to the satisfaction of the Engineer at no additional cost to the Department. Perform the removal of concrete adjacent to the fixed or expansion joints, and all associated hardware, in the required stages.

803.03.2.2 Equipment Plan.

Submit to the Engineer for written approval, before the commencement of work according to **Subsection 105.02**, the methods and equipment to be used for removal and disposal, including any special removal methods adjacent to existing utility lines, and the methods and Shop Drawings for temporary shielding. These approvals, however, shall not relieve the Contractor of sole liability for damages resulting from his operations.

803.03.2.3 Temporary Shielding.

When required, erect and maintain a temporary shielding system to ensure that no materials, debris, or equipment will fall to the ground, water, or below the structure or damage the structure or utilities supported beneath the deck. Submit Shop Drawings for written approval describing the details and design of the shielding system. Design for the anticipated weight of all material to be supported but not less than a live load of 100 lb/sq ft. Use a Professional Engineer licensed in the State of Rhode Island for the design. Immediately retrieve and dispose of any materials, debris, or equipment that accidentally falls to the ground or water below the structure. Do not allow the temporary shielding system to extend below the bottom of the bottom flanges of the beams within the travel lanes of the roadway below. Do not initiate any concrete removal operations where shielding is required until the shielding is installed.

803.03.2.4 Removal.

Remove the designated portions of the structure to avoid damaging the portions that will remain. Ensure that the pneumatic hammer used to remove concrete adjacent to reinforcing steel that will remain is not heavier than the nominal 30-lb class. Ensure that chipping hammers or mechanical chipping tools to remove concrete near or beneath reinforcing steel are not heavier than the nominal 15-lb class. Do not place the power-drive hand tools in direct contact with the reinforcing steel that will remain. If the removal operation causes excessive damage to portions of the concrete that will remain, suspend operations until an alternative removal method has been proposed (within seven days) and approved by the Engineer. Any resulting delays in the schedule due to the suspension is a non-excusable delay and is the sole responsibility of the Contractor.

803.03.2.5 Utilities.

Provide all Utility Companies advance notice (according to the Contract Specification pages) for concrete removal operations that will be performed adjacent to their utility lines. This notice also applies if there are any deactivation of utility lines that are required. Confirm the location, materials, and status of each utility line with the Utility Companies before any concrete removal.

Use special concrete removal methods during the locating and removal of concrete around existing utilities. These methods may be limited to chipping hammers or small pneumatic hammers that pose minimal risk of damage to the utility lines. Submit the special removal methods to the Engineer for approval before any concrete removal. The Contractor may, at the discretion of the Engineer, leave a minimal cover of existing concrete around the ducts (thereby leaving the ducts in place), if the new concrete section has adequate thickness (minimum 4 in. from top of existing concrete to top of proposed sidewalk) and if a suitable bonding agent is applied at the interface of the old and new concrete. When required, provide temporary supports for any utility ducts that remain unsupported during construction.

Repair all ducts, including inactive or empty ducts, that are damaged as a result of the Contractor's operations to the satisfaction of the Engineer and the respective Utility Company at no additional cost. This repair work may include the installation of expansion fittings, backwall sleeves, and other incidental hardware, as required.

Ensure compliance with any Utility Companies' requirements or specifications for real time vibration monitoring.

803.03.2.6 Operations.

Clean the remaining concrete surfaces of oil, solvent, grease, dirt, dust, bitumen, laitance, loose particles, and other foreign matter. Roughen all sound concrete surfaces on which new concrete will be placed by mechanical means approved by the Engineer.

Clean loose and small concrete fragments from reinforcing steel, stud connectors, and girder top flanges that remain in place by sandblasting and vacuuming. Before sandblasting, remove all petroleum contamination by appropriate solvent or detergent cleaning operations. Sandblast reinforcing steel and girder top flanges according to SSPC-SP-6, Commercial Blast Cleaning, to remove all contaminants, rust, and rust scale. Remove any surface contamination not removed during sandblasting according to SSPC-SP-1, Solvent Cleaning. When using sandblasting equipment, shield all work to protect the public.

Do not bend or damage existing reinforcing steel that will be embedded in new concrete during the removal operations. Repair or replace all damaged reinforcing steel, under the direction of the Engineer, at no additional cost to the Department. Cut reinforcing steel by a method approved by the Engineer. Do not flame cut reinforcing steel.

Properly dispose of all removed materials from the site as the work progresses. Do not store or bury material/debris on site except with the prior approval of the Engineer. Provide a means of dust control satisfactory to the Engineer, including the use of water and/or any alternative methods.

803.03.3 Temporary Deck Underside & Side Protective Shielding.

Erect the deck underside and side protective shielding at the required locations and limits. Ensure that all shielding meets or exceeds the following requirements:

- Design and detail the protective shielding according to applicable AASHTO design codes and all Federal, State, and local laws and regulations.
- Ensure that the shielding extends under concrete decks, safety walks, and safety barriers to be removed. Ensure that the shielding extends horizontally a minimum of 3 ft beyond the bridge railings or safety barriers and that it extends vertically to a point 2 ft above the top of the bridge parapet or to a point 4 ft above the top of bridge safety walks or decks, whichever is higher.
- Submit Shop Drawings to the Engineer for approval, stamped by a Professional Engineer registered in Rhode Island, according to **Subsection 105.02** for all proposed shielding before installation. Provide Drawings that include details of all connections, brackets, and fasteners. Design the various components of the deck underside protective shielding system for the anticipated weight of all material and debris to be supported, based on the Contractor's method and sequence of removal. The minimum design is for 150 lb/sq ft. Design vertical shielding for anticipated loads or a minimum of 30 lb/sq ft, whichever is higher.
- Place and secure the shielding to prevent the shielding from being dislodged by wind. If the shielding is not secure, remove and correctly reinstall.
- Place shielding to maintain the existing vertical clearance under the bridge.

- The Contractor may use the existing steel or prestressed concrete beams as supports. However, do not drill or weld to any existing or new beams.
- Ensure that the protective shielding does not contain any gaps or openings that could allow debris to pass through, and ensure that the shielding is sufficiently strong to support any debris or section of demolished concrete from falling onto the roadway or walkway below.

If any existing portions of the bridge are damaged that are not within the scope of the Contract, repair the damage at no additional cost to the Department.

803.04 METHOD OF MEASUREMENT.

803.04.1 Removal of Existing Bridge-Related Structures.

This item does not require a measurement for payment.

803.04.2 Removal and Disposal of Existing Concrete Masonry.

Removal of Existing Concrete Masonry will be measured for payment by the cubic yards of concrete removed and disposed.

803.04.3 Temporary Deck Underside & Side Protective Shielding.

Temporary Deck Underside and Side Protective Shielding will be measured for payment by the square foot of shielding installed, including the deck side protective shielding, as required by the stage construction sequences.

803.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Removal of Existing Bridge-Related Structures	LS
Removal and Disposal of Existing Concrete Masonry	CY
Temporary Deck Underside and Side Protective Shielding	SF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted. The transportation of salvaged material and the removal of asbestos materials or lead based paint, if required, is incidental to the work.

For Temporary Deck Underside and Side Protective Shielding, the actual square foot measurement will be determined by the pay limits specified. No payment will be made for additional shielding beyond these pay limits, regardless of the approved design.

Removal of concrete for deck repairs is paid for separately under the applicable deck repair items.

SECTION 804 — DRIVEN PILES

804.01 DESCRIPTION.

This work includes furnishing and installing foundation piles at the required locations. Ensure that the work also conforms to the applicable requirements of Section 4, Driven Foundation Piles of the AASHTO *LRFD Bridge Construction Specifications*. This work also includes wave equation analysis, static pile load and dynamic pile testing, and vibration monitoring as required.

804.01.1 Pile Types Included.

Driven piles include timber, steel H-section, open-end and closed-end steel pipe, micropiles, drilled shafts, mandrel-driven or self-supporting driven steel casings, precast-prestressed concrete piles, and composite piles consisting of two or more sections of differing materials. See **SECTION 844** for micropiles and **SECTION 845** for drilled shafts.

Furnish and install piles driven for soldier-pile retaining walls according to **SECTION 805**.

804.01.2 Wave Equation Analyses and Pile Load Testing.

Submit a wave equation analysis for each pile type and capacity to be installed and for each driving hammer and system proposed for use. See **Subsection 804.03.8**.

804.01.3 Pile Load Testing.

As required, perform pile load tests according to ASTM D1143, “Piles Under Static Axial Compressive Load.” Perform dynamic pile tests as required. See **Subsection 804.03.8**.

804.01.4 Pile Lengths.

Provide production piles in sufficient lengths to be driven to the required minimum tip elevations that meet the required driving criteria established by the wave equation analysis and to the design cut-off elevation. Production pile lengths shown on the Contractor’s order list generally includes only those lengths anticipated for use in the final structure. In addition to pile lengths shown or ordered, furnish increased lengths of production or preliminary test piles to provide for fresh heading and the additional pile lengths as needed to fit the method of operation.

When preliminary test piles are required, production pile lengths shown on the Plans are for estimating purposes only. Provide the actual pile lengths for production piles as required to reach the minimum tip elevations and to develop the required capacities, subject to the Engineer’s written approval after driving preliminary piles. Furnish preliminary piles in lengths greater than the estimated production pile lengths. The Engineer will approve the increased pile lengths before the Contractor orders the preliminary piles. Drive preliminary test piles at the required locations to the minimum tip elevations and based on the driving criteria established for production piles. Preliminary piles may be incorporated into the work as permanent piles, if approved by the Engineer.

804.01.5 Defective Piles.

Repair or remove and replace all unsatisfactory piles.

804.02 MATERIALS.

Use materials that conform to the following.

Material	Standard Specification Reference
Timber Piles	**Subsections M07.05/M.07.06**
Steel H-Piles	**Subsection M07.09**
Open-end and Closed-end Steel Pipe Piles	**Subsection M07.10**
Concrete-Filled Steel Casing Piles	**Subsection M07.08**
Precast-Prestressed Concrete Piles	**Subsection M07.07**
Portland Cement Concrete	**SECTION 601/Subsection M02**
Steel Reinforcement and Prestressing Steel	**Subsections M05.01/M05.03**
Steel Closure Plates, Driving Shoes, and Points, Lugs, and Splicers	**Subsections M07.11/M07.12**
Protective Coatings	**SECTION M06**
Wood Preservatives and Treatment	**SECTION M07** and AASHTO M133, "Preservatives and Pressure Treatment Process for Timber"

804.03 CONSTRUCTION METHODS.

Ensure compliance with all requirements in **Subsection 104.15**.

804.03.1 Pile Lengths and Order Lists.

When preliminary test piles are not specified, furnish production piles of sufficient length to be driven to the minimum tip elevation, to meet the approved driving criteria determined from the wave equation analysis, and to provide the required cut-off elevation.

In determining the lengths of production piles to be ordered, ensure that the lengths in the order list are based upon the lengths that are assumed to remain in the completed structure. Calculate these pile lengths from the design cut-off elevation to the estimated tip elevation. Increase the lengths to provide for fresh heading and for such additional length as necessary to accommodate the method of operation.

For preliminary test piles, drive piles of lengths and at the required locations. The lengths of production piles indicated on the Plans are for estimating purposes only. For actual production pile lengths, ensure that these are as required to reach minimum tip elevations and deeper, if necessary to develop required capacities, subject to the approval of the Engineer in writing, after test piles have been driven. Provide test piles that are in lengths, subject to the Engineer's approval, greater than the estimated lengths of production piles, and drive at least to the minimum

tip elevations and deeper, if necessary, to develop required capacities established for production piling.

804.03.2 Timber Piles.

- General. Do not use cant hooks, dogs, or pike poles. Ensure that the butt ends of timber piles are sawn square to the longitudinal axis of the pile before driving.
- Collars, Bands, or Strapping. Ensure that collars, bands, or strapping are affixed at the butt, intermittently along the length, and near the tip of each pile.
- Trimming and Drive Points. Ensure that the tips of timber piles are sawn square or tapered to a diameter of not less than 4 in. If required, provide timber piles with metal boots or steel point attachments. Trim pile tips to fit the type of boot or point attachment specified.

804.03.3 Precast-Prestressed Concrete Piles.

a. Manufacture. Use concrete for precast/prestressed piles that conforms to **SECTION 601**. Provide precast/prestressed piles that are manufactured and prestressed according to both the AASHTO *LRFD Construction Specifications*, Section 10, "Prestressing," and **SECTION 809**.

b. Prestressing. Submit Shop Drawings for the Engineer's written approval according to Para. b of **Subsection 809.03.3**. In addition, ensure that the Shop Drawings identify the pile dimensions, materials, prestressing methods, tendon arrangement, and prestressing forces proposed for use, and any addition or positioning of reinforcing steel differing from that shown on the Plans. Do not initiate the manufacture of the piles until the Shop Drawings have been approved by the Engineer in writing.

c. Curing, Storage, and Handling. Ensure that the removal of forms, storage, transport, and handling of precast/prestressed concrete piles prevent any excessive bending stresses, cracking, spalling, or other injurious results. Submit a curing plan as specified in **Subsection 809.03.8**. When lifted or moved, support the precast/prestressed concrete piles at the quarter points or other designated pick-up points. Do not drive piles until the specified curing period is completed and the concrete has attained the specified 28-day compressive strength.

d. Extensions. When required, make extensions for precast/prestressed concrete piles by removing concrete at the end of the pile end to clear 40 diameters of reinforcement steel and to produce a face perpendicular to the axis of the pile. Fasten the reinforcement of the same size as that used in the pile to the projecting steel. Place the necessary formwork to prevent leakage along the pile.

   Immediately before placing concrete, clean and wet the tops of piles and cover with a thin coating of approved suitable bonding material. Use concrete of the same mix design and quality as that used in the pile. Ensure that forms remain in place for not less than seven days. Cure and finish extensions according to **SECTION 809**. Do not drive extended precast/prestressed piles.

804.03.4 Concrete-Filled Steel Casing Piles.

a. General. Construct concrete-filled steel casing piles by driving the casings, with or without a mandrel, placing reinforcement steel, and filling the driven casings with concrete.

b. Steel Casings. Provide steel casings that comply with **Subsection M07.08.1** and that have a sufficient thickness and strength to hold the original form and demonstrate no harmful distortion after driving adjacent casings or after withdrawal of the driving core. Casing designs other than that shown on the Plans will be approved by the Engineer before use. Ensure that the thickness of steel casings driven without a mandrel are a minimum No. 9 gauge for fluted casings and 3/16 in. for pipe casings. Ensure that casings driven with a mandrel have a thickness not less than No. 18 gauge.

c. Cleanout and Dewatering. Remove accumulated soil cuttings and water from driven casing piles before placement of any concrete. Cleanout and dewater the casing and ensure that this work does not result in damage to the steel casing. Provide equipment and facilities for containment, temporary storage, and separation of soil cuttings, and properly dispose of debris/sediment/soils and water accumulations.

d. Inspection of Driven Casings. Inspect each driven casing pile, which must be approved by the Engineer before any concrete is placed. Provide access to the pile and furnish a suitable illuminating device for inspection of the casing interior throughout its length.

e. Placement of Reinforcement and Concrete. Remove accumulated soils and water from driven casings before concrete is placed. Use concrete that complies with **Subsection M07.08.2**. Fabricate and secure the reinforcing steel cages, and lower the casing pile to ensure proper placement throughout the length of the pile and to provide the required pile cap connections.

   Place and consolidate the concrete in steel-reinforced casing piles by vibration throughout the length of the pile interior.

   Do not place concrete until all other casing pile driving within a radius of 20 ft of the driven pile has been completed. Alternatively, if approved by the Engineer or where allowed, discontinue all driving within the specified limits until concrete in the last casing driven has set for at least five days.

804.03.5 Steel Pipe Piles.

a. General. Where practical, furnish steel piles in full length.

b. Protective Coating. When specified, before being driven or placed, apply a protective coating in the shop to steel pipe piles, closure plates, and splices with zinc-silicate primer. When specified, after piles are driven and all bracing members, concrete caps, and encasements are in place, apply one complete field coating to all exposed steel.

c. Drive Points, Drive Shoes, and Closure Plates. When specified, fit steel pipe piles with closure plates and/or drive points. Furnish closed-end steel pipe piles with flat closure plates of the required thickness and weight of steel. When specified, provide end closure

plates that are single-piece cast steel, 60-degree conical points (ASTM A27), with an external flange.

When specified, furnish open-end or closed-end steel pipe piles with one-piece, cast steel (ASTM A27) drive shoes, provided with a thickened ridge along the bearing surface between the pile tip and the shoe. Ensure that shoe flanges are external and are of the required dimensions and weight of steel.

Ensure that plates, drive points, and shoes provide full bearing with pile tips and are affixed to the piles using 5/16-in. continuous fillet welds along the flange or ridge contact with the pile tips.

d. Cleanout and Dewatering. Clean out steel pipe piles that are driven open-ended to remove accumulated soil materials and then dewater the pile. Use methods to remove the soil materials from the interior of the pile that do not result in damage to the driven pipe pile.

Contain and separate soil cuttings and accumulated water. Properly dispose of water and accumulated soil cuttings.

e. Inspection of Driven Pipe Piles. Provide access and facilities for the Engineer to inspect the interior of each driven pipe pile. The Engineer will not accept any driven steel pipe pile unless inspected and approved by the Engineer as described in **Subsection 804.03.4(d)**. Correct or replace improperly driven, damaged, or defective piles at no additional cost to the Department.

f. Placement of Concrete and Steel Reinforcement. Where driven steel pipe piles are concrete-filled and no interior steel reinforcement will be installed except within 5 ft of the cut-off elevation, place the concrete in one continuous operation with the concrete installed from the lowest point of the pile by tremie. Do not allow the concrete to free fall. Use vibration or rodding only to a depth of 5 ft below the design cut-off elevation. Use the class of concrete as specified in **Subsection M07.10.2**.

For all steel pipe piles at each structure footing or within the required radius, drive, clean out, and inspect before placement of concrete. Alternatively, if approved by the Engineer, discontinue all driving within the specified limits until concrete in the last pile driven has attained its 28-day compressive strength.

g. Holes in Piling. Pile segments with one drilled hole with a diameter of ⅞ in. or less in any cross section may be incorporated into the finished structure. Cut off pile segments with more than one hole in the cross section, flame cut hole(s), or a hole greater than ⅞ in. to remove the hole(s). This requirement does not apply to holes drilled for attaching dynamic testing equipment, holes shown in the Contract, or holes within 12 in. of the cutoff elevation.

804.03.6 Steel H-Section Piles.

a. Dimensions and Section Thicknesses. Where practical, furnish steel H-sections in full lengths.

b. Drive Points. Fit H-section piles with drive points that are cast in one-piece steel conforming to ASTM A27 Grade 65-35. Ensure that the drive points have sufficient flange and continuous web vertical backups to provide proper alignment and a secure fit with the pile. Flange surfaces to bear on rock or in soil may be horizontal or sloped (minimum 15 degrees to maximum 30 degrees) and may be provided with individual or continuous cutting teeth.

c. Protective Coating. Where specified, provide steel H-section piles with a shop application of one coat of zinc-oxide primer. Additionally, apply one or more field-applied surface coats to exposed sections of piles as driven. Do not apply field coats to lengths of pile to be concrete encased.

d. Concrete Encasement. Where specified, encase exposed lengths of driven steel H-section piles in concrete. Furnish and place concrete encasements according to **SECTIONS 601** and **808**.

e. Holes in Piling. Pile segments with one drilled hole with a diameter of ⅞ in. or less in any cross section may be incorporated into the finished structure. Cut off pile segments with more than one hole in the cross section, flame cut hole(s), or a hole greater than ⅞ in. to remove the hole(s). This requirement does not apply to holes drilled for attaching dynamic testing equipment, holes shown in the Contract, or holes within 12 in. of the cutoff elevation.

804.03.7 Splices and Splicing Piles.

a. General. Where splicing is permitted, ensure that the splice develops the full strength of the unspliced pile. Only one splice may be used throughout the pile length unless specifically approved by the Engineer. Ensure that splices are fabricated and installed as shown on the Plans. Ensure that any alternative method of splicing or commercial splice proposed for use provides equal results and has been approved by the Engineer before use.

b. Steel Pipe, Steel Casing, and H-Section Piles. Where practical, use full length piles. Use full penetration electric arc welding for splices. Use proprietary or other fabricated steel splicers that match the grade of the piles being spliced and that develop the full strength of the unspliced pile. The Engineer will approve the splices before use. Chamfer the flanges of fabricated splicers to enable effective welding.

Before splicing, cut off the top of any pile that is bent, deformed, or twisted by driving or trueing up to normal with the axis of the pile before placing the next pile section. Ensure that the end surfaces of piles provide full bearing with the next pile section or splicers. Ensure that axes of all spliced sections are in a straight alignment.

Provide flanges of H-section piles that are either spliced by butt welding or with plates that are welded or bolted. Prefabricated splicers may be used if the splice can develop the net section of the pile in compression, tension, shear, and bending. Splice pipe piles either by butt welding or using welded sleeves.

Ensure that the surfaces to be welded are smooth, uniform, and free from loose scale, slag, grease, or other material that could prevent proper welding. Steel may be oxygen cut. Carbon-arc gouging, chipping, or grinding may be used for joint preparation.

Welding is permitted for splicing steel casings. Use welding for splicing steel piles, attaching pile points, and attaching bracing or other steel members to steel piles. Ensure that all welding and qualifications for welders conforms to **Subsection 824.03.6**.

c. Precast/Prestressed Concrete Piles. Do not splice precast/prestressed concrete piles except to produce short extensions as permitted herein. Dowels or other mechanical splices must be approved by the Engineer before incorporation into the work. Design splices to develop the full axial and moment capacity of the unspliced cross section.

804.03.8 Determination of Bearing Capacity.

a. General. Drive piles to the required bearing capacity.

b. Wave Equation Analysis. For design loads less than or equal to 50 tons, a Rhode Island Registered Professional Engineer shall prepare a wave equation analysis to determine the ultimate bearing capacity of the piles. The Contractor shall be responsible for retaining a Professional Engineer registered in the State of Rhode Island to perform the wave equation analysis. Submit the results of the analysis, driving system specifications and data, and the proposed driving criteria to the Engineer for written approval.

Perform a separate wave equation analysis for each design pile type, load, and length, and for each driving system proposed for use. Ensure that the analysis accounts for the proposed hammer assembly, pile cap, blocks, cushion characteristics, pile properties and estimated lengths, and anticipated soil properties. Use the pile driving equipment properties as recommended or provided by the manufacturer. Ensure that the design bearing capacity of a pile is 0.364 of the calculated ultimate bearing capacity as determined by a wave equation analysis alone. The analysis may, at the discretion of the Engineer, be used to establish design capacities of greater than 50 tons if similar piles have been installed in similar soil conditions in close proximity to the site.

c. Wave Equation Analysis Calibrated with Dynamic Pile Tests. Submit for review and approval by the Engineer a wave equation analysis (WEAP) for each pile that will be installed. Ensure that the analysis demonstrates that the driving forces developed by the pile hammer equipment and driving methods will not overstress the pile section and any splices.

The Contractor's Engineer or testing consultant shall supply all equipment, including the Pile Driving Analyzer (PDA), and perform the dynamic pile analyses during the driving of the indicator piles. Within three days of completion of the dynamic testing, submit the results of the field data for review and approval by the Engineer.

Furnish the electrical power required for dynamic testing of the piles. Equip field generators with functioning meters for monitoring voltage and frequency. Provide a temporary shelter of adequate size to protect the dynamic test equipment from the elements.

- General Procedures.

  - Before Driving. Provide equipment, personnel, or labor as required to perforate the pile and attach and remove the PDA transducers to and from the pile as directed by the Engineer. Provide a man-lift or other suitable equipment for the Engineer to access the PDA instrumentation during driving. Attach a minimum of four strain and acceleration transducers (two each minimum) to the pile at the locations specified or directed by the Engineer. The Contractor's Engineer will provide the transducers.

    Locate the transducers at equal radial or cross-sectional distances on diametrically opposite sides of the piles. Locate the transducers at the same axial distance from the top of the pile, and attach them at least 1½ pile diameters below the top of the pile but no closer than 2 ft below the lowest point of the pile hammer and sleeve. Relocate the transducers satisfying these conditions before driving each new pile section. Ensure that the transducers remain above water level during installation and driving. Align and protect the transmission cables to suit the Contractor's method of operation but maintain the operation of the equipment during driving.

    Position and align the pile so that the hammer impact is applied axially and concentrically with the pile.

  - Driving. Drive the piles to the tip elevation or deeper to a driving resistance determined by the WEAP analysis and as confirmed by PDA measurements on the indicator piles.

    Within each substructure unit, drive the indicator piles first. Drive and restrike all indicator piles within a given substructure unit shown on the Contract Drawings with monitoring by PDA before the Engineer establishes the final tip elevations for friction piles or driving resistance for end-bearing piles for the remaining non-indicator piles within the substructure unit. In the Contractor's schedule, allow time for a two-day evaluation at each substructure unit by the Engineer following the end of restrikes on the indicator piles at each substructure unit so that the Engineer can establish final criteria for the remaining production piles. While waiting for restrike of the indicator piles, the Contractor may begin installation of other non-indicator piles; do not drive to completion any non-indicator piles before the Engineer establishes the final tip elevation or driving resistance.

    Where friction piles are used, drive the indicator piles to the required design tip elevation and to the required resistance as measured by dynamic monitoring. Drive the indicator piles deeper than the design tip elevations to meet the required resistance, if necessary. The Engineer will determine the final tip elevations for the remaining non-indicator piles at each substructure unit following the indicator pile installation and restrike and analysis of the PDA results performed on the indicator piles.

    At the substructure units supported by end-bearing piles, initially drive the indicator piles to a penetration resistance expressed as a minimum number of blows per inch for six successive inches as determined by WEAP or other

alternatives. Ensure that the final driving of the indicator piles satisfies one of the two following criteria:

+ The final required penetration resistance determined by dynamic monitoring (PDA)

+ To refusal (defined as > 20 blows with less than 1 in. of penetration)

Drive the remaining end-bearing production piles to the minimum tip elevation and to whichever of the following criteria is satisfied first:

+ The required penetration resistance as determined by the Engineer after driving the indicator piles and analyses of the PDA results of the indicator piles

+ The pile has refused (defined as > 20 blows with less than 1 in. of penetration)

Adjust the driving energy to maintain acceptable stresses in the pile, and realign the driving system if the testing equipment indicates that the hammer impact is not delivered axially to the pile. Monitor and record:

+ Ram travel length

+ Bounce chamber pressure and/or steam or air pressure at the inlet to the hammer as appropriate for the driving system used

+ Blow counts for specific intervals of penetration during driving of piles

+ Complete the restrike driving of the indicator piles. During restrike operations, the Engineer will perform PDA monitoring. During restrike, the Engineer may direct the Contractor to apply individual hammer blows to the pile to provide for dynamic records and analyses. Before restriking, wait a minimum of three days after the end of the initial driving. The Engineer will determine the amount of penetration during restrike not to exceed 1 ft.

d. Static Pile Load Tests. When the design capacity of piles is greater than 50 tons, establish the driving criteria and ultimate load capacity for each pile type and capacity following the procedures in ASTM D1143, “Piles Under Static Axial Compressive Load,” using 1) the quick load compression test, except take the test to failure as described below, or 2) three times the design load, or 3) 1000 tons, whichever first occurs. Use testing equipment and measuring systems that conform to ASTM D1143. Install telltales and/or elastic strain gauges, appropriately sheathed, in or along piles at the intervals specified, and monitor vertical movements or incremental strain measurements. Use calibrated dial gauges capable of reading increments of 0.001 in. to monitor relative movements or strains at the pile tip, head, or specified interval along the pile length.

Submit for the Engineer’s approval a wave equation analysis for each type and capacity of pile to be tested and detailed plans of the proposed pile load test apparatus, including:

- Load frame and reference members
- Load cell or jacking apparatus

- Reaction system
- Proposed method and intervals for telltale installation and protection

A Rhode Island Registered Professional Engineer, retained or employed by the Contractor, shall prepare the wave equation analysis and pile load test plans. Design and construct the load test apparatus to allow the various load increments to be placed gradually without causing vibration to the pile. Ensure that the wave equation analysis demonstrates that the piles will not be damaged during driving, and determine the blow count necessary to achieve the required ultimate static capacities. The Engineer will review and approve in writing the proposed driving criteria.

The design bearing capacity is defined as 50 percent of the failure load. The failure load of a pile under axial compressive load is that load that produces a settlement of the pile head at failure equal to:

$$S_f = S + (0.15 + 0.008D)$$

Where:

S_f = Settlement at failure, inches
D = Pile diameter or width, inches
S = Elastic deformation of total unsupported pile length, inches

Furnish piles to be used for load tests with telltales and protective sleeves incorporated into or along the length of the pile. Submit the proposed telltale design and method of installation to the Engineer for written approval before the manufacture or furnishing of piles. Ensure that the telltales are sleeved and protected during driving and are functional throughout the pile load test. Secure the sleeves and cast them in the interior of precast or cast-in-place concrete piles, secured to the interior walls of steel pipe piles, or affixed to the faces of steel pipe, timber, and precast piles or the web of H-section piles as required.

For the telltales, provide solid, flush-joint sections of steel rods that extend to and screw into threaded steel mounts affixed to or cast into the pile at the specified points along the pile length. For the telltale sleeves, use plastic or steel tubing as specified, which are properly aligned, installed, and affixed to the screw mounts so that the telltale rods can be lowered into the sleeves entirely under their own weight. Where permitted by the dimensions of the test pile, the Contractor may choose to protect the tubes by installing them inside steel or PVC pipe.

Provide sleeves and rods with end caps that provide protection during pile driving. Before installation of the telltale rods, fill the sleeves with a sufficient quantity of oil or grease to fully occupy the annular space between the sleeve and the rod. Install telltale rods into sleeves under the inspection of the Engineer. For any telltale rod installed without the Engineer's inspection, remove, measure, and re-insert the rod under the inspection of the Engineer.

Drive load test piles to the minimum tip elevations and at the driving criteria determined based upon the wave equation analysis. Determine the elevation of the top of the test pile immediately after driving, after driving anchor piles, and just before load testing to

determine heave. Redrive or jack any test pile that has heaved more than ¼ in. to the original tip elevation before load testing. Observe a minimum three-day waiting period between the driving of any anchor piles or the load test pile and the initiation of the pile load test.

Prevent eccentric loading of the pile. If the test fails due to eccentric loading, no payment will be made for the test and no future test will be performed on the eccentrically loaded pile.

When the approved test method requires the use of tension (anchor) piles that will later be used as permanent piles in the work, use the tension piles that are the same type and diameter as the production piles and are driven in the location of the permanent piles. Test piles must successfully test (i.e., did not fail during testing) to be used as permanent piles. Do not incorporate test anchor piles into the permanent work should a failure of the test occur.

Perform the Boot Strap method by jacking down on the test pile or piles with a calibrated hydraulic jack placed beneath a girder. Anchor the girder to tension piles located at least 6 ft from the test pile or piles. Do not allow piles to be closer than 6 ft from the test pile or allow piles to be used to assist in anchoring the girder. Ensure that connections of the girder to the anchors and hydraulic jack are tight when the test is initiated, and ensure that the jack can move the test pile or piles a vertical distance of at least 5 in. during the test.

If the load is applied to the test pile or piles by jacking against a dead load, do not provide supports to this dead load that are closer than 6 ft from the test pile or piles. Ensure that the jack can move the test pile or piles a vertical distance of 5 in.

Always provide a qualified employee to be present during the performance of the test to maintain the required load. If the test is stopped before completion and the load is entirely or partially removed from the pile or piles due to defects in the jack, yield of connections, insufficient load or travel capacity of the jack, or for other mechanical reasons, the Engineer will order that the load test be abandoned and replaced by a new test to be conducted on another pile or piles at an adjacent location.

804.03.9 Pile Driving Equipment.

a. Submittals. Submit a description of the proposed equipment, including hammers and appurtenances, according to **Subsection 105.02** before starting work. When the bearing capacity of piles will be determined by a wave equation analysis, submit calculations based on the wave equation analysis (WEAP or other equivalent analysis) that demonstrate that the piles can be driven to the required length with a driving energy without damage to the piles. The required number of hammer blows to achieve pile capacity shall be between 4 and 10 blows per inch for the equipment to be considered acceptable for the pile installation. The required number of hammer blows indicated by the calculations for the required bearing capacity shall be between 4 and 10 blows per inch for the equipment to be considered acceptable.

In addition, acceptable driving equipment requires that calculated pile stresses corresponding to the driving criteria and required pile capacity are less than the stress

level that will result in damage to the pile. For steel piles, compressive driving stresses must not exceed 90 percent of the yield point (0.9 F_y) of the pile. For concrete piles, tensile stresses must not exceed three times the square root of the concrete compressive strength, f'_c, of the pile plus the effective prestress value; i.e., [3 x $(f'_c)^{½}$ + prestress]. Compressive stresses in concrete piles cannot exceed 85 percent of the concrete compressive strength minus the effective prestress (0.85 f'_c – prestress). For timber piles, compressive stresses must not exceed three times the allowable static design strength.

In-water or near-water pile driving locations, comply with the most recent soft-start State and Federal programmatic and consultation requirements.

Before any change in the driving system or equipment will be considered, submit the revised pile driving equipment data and calculations for corresponding driving criteria and pile stresses.

The Engineer's written approval of the pile driving equipment does not relieve the Contractor of its responsibility to drive piles, free of damage, to the required bearing and tip elevations.

b. Hammers. Piles may be driven with drop hammers, single-, double- or differential-action compressed air or steam operated hammers, or diesel or hydraulic hammers.

- Gravity or Drop Hammers. Gravity or drop hammers may be used for driving timber piles, but do use gravity hammers for precast concrete piles or for piles with design capacities greater than 30 tons. When gravity hammers are allowed, ensure that the ram weight is at least equivalent to the combined weight of the drive cap and the pile. Ensure that the ram weight is less than 3000 lb and that the fall height does not exceed 12 ft. Equip all drop hammers with hammer guides to ensure concentric impact on the drive head or pile cushion.

- Hydraulic Hammers. Use a power plant having sufficient capacity to maintain, under working conditions, the volume and pressure specified by the manufacturer. Equip the power plant and equipment with accurate pressure gauges that are easily accessible to the Engineer.

- Diesel Hammers. Equip open-end (single-acting), diesel hammers with a device to permit the Engineer to determine hammer stroke at all times during pile driving operations. Submit a copy of the manufacturer's chart that equates the stroke and blows per minute. Equip closed-end (double-acting), diesel hammers with a bounce chamber pressure gauge that is easily read from ground level. Provide a correlation chart of bounce chamber pressure and delivered hammer energy.

- Vibratory Pile Drivers. Vibratory pile drivers may be used, subject to the Engineer's approval, provided that sufficient correlated data is developed and furnished to permit a satisfactory evaluation of pile load-carrying capacity and performance. Establish these characteristics by direct comparison to the penetration and performance of the same type(s) of pile, driven with conventional impact hammers under similar conditions and in corresponding locations.

If a vibratory hammer is used, redrive each pile for a minimum of two pile diameters with an impact hammer that has the energy to verify the required bearing resistance during driving.

Delays and additional costs resulting from load tests or other extra work required to verify approval of the vibratory hammer or driving aids are at no additional cost to the Department.

Drive a number of length-determination piles as ordered by the Engineer using a conventional hammer to determine with reasonable accuracy the depth of acceptable penetration throughout the area of each foundation or trestle bent. Drive the subsequent piles using the accepted alternative method to the corresponding depths of penetration with minor adjustments if driving conditions change.

Load test a representative number of such piles as designated by the Engineer and indicated on the Project Plans to the required capacity, plus a corresponding number of those piles driven using the alternative method and equipment. Record and correlate load test data. Perform a sufficient number of load tests on piles driven using the alternative method as required to verify the results and ensure design capacity.

No payments will be made to the Contractor for pile load tests in excess of those that would be required for piles driven by conventional methods, unless field conditions are such that the alternative methods must be used to advance piles. In these cases, the additional load tests will be measured for payment if the Engineer has ordered the tests in writing, and the tests are completed.

804.03.10 Driving Appurtenances.

a. Hammer Cushions. Equip all impact driving equipment except gravity hammers with a suitable thickness of hammer cushion material to prevent damage to the pile or hammer and to ensure uniform driving behavior. Place a striker plate on the hammer cushion to ensure uniform compression of the cushion material.

b. Pile Drive Head. Fit piles driven with impact hammers with an adequate drive head to distribute the hammer blow to the pile head. Ensure that the drive head is axially aligned with the hammer and pile. Ensure that the drive head is guided by leads, and do not allow the head to be free swinging. Fit the drive head around the pile to prevent the transfer of torsional forces during driving while maintaining proper alignment of hammer and pile.

c. Pile Cushion. Protect concrete piles with a pile cushion that ensures that the hammer energy is uniformly distributed to the pile head.

d. Leads. Use pile driving leads throughout the pile driving operation, and support the pile and hammer in proper positions. Construct leads that affords freedom of movement of the hammer while maintaining alignment of the hammer and pile to ensure concentric impact for each blow. Ensure that the leads have sufficient length to negate the need for a follower, and design the leads to permit proper alignment of batter piles.

e. Followers. Do not use followers.

804.03.11 Preparation for Driving.

a. Preconstruction Survey and Vibration Monitoring. A Rhode Island Registered Professional Engineer, employed or retained by the Contractor and submitted to the Engineer before beginning work, shall perform a preconstruction survey of any structure within 200 ft of pile driving. Ensure that the survey documents the existing preconstruction condition of structures so that potential impacts due to pile driving can be assessed. Comply with **SECTION 841**.

During pile driving, monitor vibrations at structures within 200 ft of pile driving using a seismograph capable of measuring vibration accelerations, velocities, and amplitudes in three mutually perpendicular directions. A Rhode Island Registered Professional Engineer shall supervise the vibration monitoring. Adjust the pile driving operations to limit construction vibration peak particle velocities to 1 in. per second, unless a lower limit is warranted based on the preconstruction survey. Submit daily summaries of peak particle velocities and vibration records to the Engineer on a weekly basis.

b. Layout and Elevation and Location Control. Perform the layout of all pile locations using offsets from the Project baselines. Establish ground surface elevations at the proposed driving locations to the nearest 0.1 ft, referenced to the Project elevation datum. Set tide boards as required when driving piles on water. Determine mudline elevations at each pile location on water before initiating driving.

Verify the tip elevation of driven piles to the nearest 0.01 ft relative to the Project elevation datum. Where foundation or trestle piles are driven in groups, or where piles will be restruck, check each pile tip elevation before and after restriking as required by the Engineer.

c. Excavations and Sheeting. In general, do not drive piles until after the excavations are completed. Restore any material forced up between or around piles resulting from driving to the correct elevation. Compact the surface before any foundation concrete is placed.

Where sheeting or cofferdams will be constructed, and where piles will be driven within sheeting alignments, submit the proposed sequence of operations for the Engineer's written approval before beginning any driving of sheeting or piles. Ensure that the sheeting installation does not interfere with, obstruct, damage, or otherwise impact the function of bearing piles.

d. Preboring. When required, prebore holes at pile locations to the required depths. Ensure that prebored holes are generally smaller in diameter than the diameter or diagonal of the cross section of the pile, except where preboring is specified where driving vibrations are not permissible. Ensure that preboring has sufficient depth to allow penetration of the pile to the specified depth. If subsurface obstructions are encountered, the hole diameter may be increased to the least dimension that is adequate for pile installation. Fill any void space remaining around the pile after completion of driving or other installation with sand or other approved material. Do not use spuds to make a hole for inserting a pile in lieu of preboring.

Drive piles to be driven through newly constructed embankments in holes drilled or spudded through the embankment when the embankment is more than 5 ft in height.

Ensure that the hole has a diameter of not less than the greatest dimension of the pile cross section plus 6 in. After driving the pile, fill the space around the pile to the surface of the embankment with dry sand or fine gravel. Properly dispose of material resulting from drilling holes.

e. Templates and Support Spuds. Furnish and fabricate the templates as deemed necessary to align and maintain piles at their proper location, alignment, or batter throughout driving. Securely affix these templates using temporary spud piles or other appropriate bracing. Situate template configurations and support piles to not damage or displace driven piles nor interfere with pile driving or other portions of the work. Maintain templates in place after initial driving and until restriking has been completed. Dismantle and remove templates and temporary supports or piles to not damage or misalign the completed production piling.

f. Measurement and Marking of Piles. Measure the total length of each pile to be driven, and mark each pile in the increments using the required marking material. Notify the Engineer of the total measured length of each pile, and allow the Engineer time to verify the length and to approve the pile marking before placing piles in the leads for driving.

During driving, provide markings on the leads or provide a graduated gauge that is clearly marked and situated at ground level to allow verification of the final driving resistance for each pile driven.

g. Jetting. Do not use water jetting unless specifically authorized in writing by the Engineer. Secure any necessary permits before initiating work. When water jetting is used, determine the number of jets and volume and pressure at the jet nozzles that are sufficient to freely erode material adjacent to the pile without affecting the lateral stability of the final in-place pile. Restore or repair all damage to the site resulting from jetting. When jetting is specifically required, ensure that the plant has sufficient capacity to deliver at all times a pressure of 100 lb/sq in. at two, ¾-in. jet nozzles. Cease jetting and remove the jets when the pile tip is at a minimum of 5 ft above the required tip elevation. Drive the pile by impact hammer to the required tip elevation and bearing capacity. Control, treat as necessary, construct, and maintain appropriate settlement basins, and properly dispose of sediments and expended jetting water. See **SECTION 208** for specific guidance.

804.03.12 Driving Piles.

a. Pile Driving Records. Maintain records for the number of blows required for each pile driven for each foot of penetration for the entire pile and for the penetration under the final series of blows (blows per inch for a minimum of the last 12 in. of driving). Ensure that the records include the type and size of hammer used, rate of hammer operation, and type and dimensions of driving helmet and cushion block. Ensure that the records include the:

- Date
- Starting time
- Total driving time
- Pile location and identification number
- Pile type and size

- Ground elevation from which the pile is driven
- Final elevation of the pile tip and butt

Ensure that the records also indicate the quantity of concrete that is placed in the pile.

b. General. Where underground utilities are located in the immediate vicinity, ensure that the first pile driven is the one nearest the utility. If the Engineer agrees that an obstruction cannot be economically removed, the Contractor has the option of driving an alternative pile (or piles) at a location designated by the Engineer. Remove or cut off the initial pile as directed by the Engineer.

c. Driving Test Piles. Drive preliminary test piles and piles designated for dynamic or static load tests at the locations and to the depths directed by the Engineer before other production piles are ordered or driven in the area represented by the test. Drive all test piles with equipment identical to that which will be used for production piles.

Drive test piles to a hammer blow count determined by the WEAP Analysis and approved by the Engineer at the estimated tip elevation. Allow test piles that do not attain the specified hammer blow count at a depth of 1 ft above the estimated tip elevation to set up for a period determined by the Engineer before being redriven. If practical, warm up the hammer before redriving begins by applying at least 20 blows to another pile. If the specified hammer blow count is not attained upon redriving, the Engineer may direct the Contractor to drive a portion or all of the remaining pile length and repeat the set up and redrive procedure. When ordered by the Engineer, drive test piles to plan tip elevation without attaining the required hammer blow count, and splice and drive until the required blow count is attained.

d. Use of Preliminary Test Piles and Loaded Test Piles. Loaded test piles may be used in the permanent structure if the Engineer determines they are satisfactory for this use. Preliminary test piles driven to the required capacities may similarly be used in the permanent structure. Remove loaded test piles or preliminary piles that are determined not suitable for use in the permanent structure, or cut off the piles a minimum of 2 ft below ground and below the base of footing or pile cap elevation.

e. Penetration of Piles. Drive all piles to a penetration so that the minimum pile tip elevation is attained and that the pile bearing value, determined as specified, is not less than that indicated in the Contract.

Drive piles located offshore, alongshore, in stream beds, or along stream banks to the penetration as indicated on the Project Plans necessary for scour protection.

If, after a test pile or production pile is driven through and below a hard stratum, the bearing value of the pile drops below the required capacity, drive permanent piles through the hard stratum to the required capacity.

When production friction piles fail to achieve design bearing capacities after driving the full finished lengths, when approved by the Engineer, wait a minimum of 24 hours and then redrive one representative pile in each pile group to check the gain in bearing upon soil setup. Determine the soil setup bearing based on the number of redriving blows

necessary to drive the pile an additional 3 in. These piles may be accepted without splicing if they exhibit the required bearing capacities upon redriving.

f. Driven Pile Location and Alignment Tolerances. Drive piles to within an axial tolerance not to exceed ¼ in. per ft variation from the vertical or from the design batter orientation. Drive piles for trestle bents so that the bent cap may be constructed in its design location without inducing excessive stresses in the piles. Ensure that the final position of the axial center of driven foundation piles, measured in the plane of the cut-off elevation, does not deviate from the design location by more than 6 in. or ¼ of their diameter, whichever is greater, if all of the following criteria are met:

- The average deviation along a line of piles in any direction within the bent does not exceed 3 in. from the line through the required pile center locations.
- The nearest edge of any pile is not closer than 9 in. from the design position of the edge of footing or pile bent cap.
- The minimum distance between the centers of any two adjacent piles is not less than 24 in. at the cut-off elevation.
- The center of gravity of the pile group at any trestle bent or foundation, as calculated at the cut-off elevation, does not exceed the tolerances specified in the Contract for that pile group.

Considering driven pile location and alignment tolerances, if there are complications driving a pile and the pile alignment tolerances are exceeded, immediately stop operations, and contact the Engineer to determine the appropriate course of action.

If the location of any pile exceeds these tolerances, then provide appropriate calculations to show the center of gravity of the pile group at the cut off elevation as driven. If the center of gravity of any pile group exceeds the limits specified, or that otherwise presented in the Contract, submit a detailed remedy, including all relevant engineering calculations, for review and approval by the Engineer. Perform the approved corrective action, including replacement of misaligned piles and/or furnishing materials and constructing any required increase in footing dimensions, at no additional cost to the Department.

Do not manipulate piles after driving attempting to force the pile into proper position. Remove or, if space allows and as allowed by the Engineer, cut off misdriven piles and redrive, or replace mislocated piles to the satisfaction of the Engineer.

g. Pile Heave and Restriking. Determine the top elevation of each pile head immediately after driving and again after completion of the driving of all piles within any foundation or trestle pile group. Redrive any pile that heaves more than ¼ in. to the design tip elevation and to the required driving resistance.

For concrete-filled piles, restrike heaved casings or steel pipe piles before placing concrete in any pile within that pile group that has not evidenced heave.

804.03.13 Defective, Damaged, or Broken Piles.

Ensure that the driving operations and procedures do not subject piles to excessive or undue damage or stresses that produce:

- Spalling and crushing of concrete
- Splitting, splintering, or brooming of timber piles
- Splitting or excessive deformation of steel piles and casings
- Bending, crushing, torsional rotations, etc. (especially for steel H-piles)

Correct any pile damaged by reason of internal defects, improper driving, driven out of position, or driven below the required butt elevation by one of the following methods as approved by the Engineer:

- Replace the pile with a new and, if necessary, longer pile.
- Cut-off the defective or low pile below the base-of-footing elevation, and drive a second pile adjacent to the defective or low pile.
- Splice, or otherwise build up, the pile as provided for herein, or extend and reinforce the footing sufficiently to properly embed the pile.

Perform all remedial materials and work at no additional expense to the Department.

804.03.14 Pile Dewatering, Cleanout, and Spoil/Water Containment and Disposal.

Remove soil materials, debris, and/or accumulated water from driven steel pipe piles and steel casing piles to allow inspection of pile interiors and before placement of any concrete. Provide for the control, containment, separation of sediments, and proper disposal of sediments and water volumes removed from the piles. Restore or repair any damage to the site incurred by dewatering and cleanout of piles according to the Contract requirements.

804.03.15 Pile Cut-Offs.

Do not cut-off piles until:

- The driven pile as-builts have been reviewed and approved by the Engineer
- All piles within a pile group or within the area specified have been checked for heave
- Any required restriking or redriving has been completed

Cut-off all piles perpendicular to the longitudinal axis of the pile at the required elevations. For piles that support timber caps or grillages, saw or otherwise cut off the pile to conform to the plane of the bottom of the superimposed structure. Ensure that the amount of cut-off length is sufficient to remove any portion of the pile top that has been trimmed for driving, bruised, or otherwise deformed or damaged during driving. Anchor cut-off piles to the structure or otherwise protect the pile until incorporated into the remainder of the work.

Retain the cut-off portions of all piles, including test piles, and make available for use in splicing or building up piles as required until the pile driving is complete. Upon completion of the work,

piling cut-off lengths shall become the property of the Contractor and shall be properly disposed of off-site at the Contractor's expense.

Trim cut-off pile heads, cuts for bracing, and exposed abrasions of treated timber piles, and apply the required field coatings of preservatives. Coat predrilled bolt holes with the required field preservative. If treated holes will remain open, install field-treated wood plugs or other approved temporary plugs in the holes.

Where specified, after trimming and applying the preservative, bend down over the top of the pile a sheet of three-ply roofing felt, or a sheet of galvanized iron, not lighter than 24 gauge and of sufficient area to project at least 6 in. outside and completely around the pile head to fit tightly around the pile. Trim and fasten the edges of this cover to the pile face with large-headed galvanized roofing nails or bound with galvanized wire.

Clean the tops and faces of precast concrete piles that will be embedded in the structure and remove minor chipping or spalling.

Cut off steel pipe piles and steel casings at the design elevation before emplacement of concrete fills. If steel pipe or steel casing piles will remain unfilled, install the required protective caps.

804.04 METHOD OF MEASUREMENT.

804.04.1 Piles Furnished.

Piles Furnished will be measured to the nearest linear foot of pile, calculated from the tip elevation to the specified cut-off elevation.

Measurement for Preliminary Test Piles will be made for that length authorized by the Engineer in writing before delivery of piles based on the Plans and discussions with the Contractor and Construction Manager.

The additional footage of production or preliminary piles furnished at the Contractor's option will not be included in the quantity measured for payment. Piles furnished by the Contractor to replace piles that were previously accepted by the Engineer, but subsequently damaged before completion of the Contract, will not be measured for payment.

804.04.2 Piles Driven.

Piles Driven will be measured to the nearest linear foot of pile, calculated from the tip elevation to the specified cut-off elevation.

804.04.3 Pile Cut-Offs.

Pile cut-offs will not be measured separately for payment.

804.04.4 Pile Load Tests.

Pile Load Tests will be measured by the number of pile load tests performed.

804.04.5 Protective Coating.

Protective Coating will be measured by the linear foot of coated pile.

804.04.6 Related Items.

- Steel reinforcement for steel casing piles or steel pipe piles and steel reinforcement cages for pipe piles will be measured for payment under the provisions of **SECTION 810**. Reinforcing steel for pile connections into pile caps is incidental to the Piles Furnished pay item.
- Concrete for steel casing piles or steel pipe piles will be measured for payment under the provisions of **SECTION 601** and **SECTION 808**.
- Excavations for foundations dug before pile installation will be measured for payment under the provisions of **SECTION 203**.
- Sheeting driven before installation of piles will be measured for payment under the provisions of **SECTION 805**.
- Test piles driven before the installation of production piles and used for pile load tests that pass the testing without damage and are accepted by the Engineer will be measured for payment by the linear foot as production pile under **Subsection 804.04.2**.
- Preconstruction and Post Construction Surveys will be measured for payment under the applicable provisions of **SECTION 841**.

804.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Timber Piles Furnished	LF
Precast/Prestressed Concrete Piles Furnished	LF
Steel Piles Furnished	LF
Composite Piles Furnished	LF
Timber Piles Driven	LF
Precast/Prestressed Concrete Piles Driven	LF
Steel Piles Driven	LF
Mobilization & Demobilization of Pile Driving Equipment	LS
Composite Piles Driven	LF
Static Pile Load Tests	EA
Dynamic Pile Load Tests	EA
Protective Coating	LF (of pile coated)

The prices constitute full compensation for all labor, materials, tools, equipment, and all incidental items of work necessary to finish the work, complete and accepted.

Remove and replace any broken, improperly driven, or otherwise defective shell pile as directed by the Engineer at no additional cost to the Department. Where a loading test is abandoned because of reasons for which the Contractor is responsible, there will be no payment for the abandoned test.

Templates and support piles will remain the property of the Contractor, and no separate payment will be made for furnishing materials or labor to construct templates or for support piles.

There will be no payment for the initial pile or for any costs of attempting to remove the obstruction. The Department will pay for the alternative pile or piles (due to an unmovable obstruction) at the Contract unit prices. However, the Contractor shall have no claim for delay if this contingency should arise and no claim for moving his equipment to and from the pile location.

Pile dewatering, cleanout, and spoil/water containment and disposal will be considered included in the installation of the pile types. No separate measurement or payment will be made for this work.

For Pile Load Tests, anchor, or tension piles installed at the Contractor's option for use in conducting pile load tests will not be paid for separately.

Metal boots, drive points, drive shoes, and closure plates are incidental to the work and will not be paid for separately. When these items are not specified in the Contract Documents, but ordered by the Engineer, they will be paid for under **Subsection 104.05**. No payment will be made for splicers or splicing made at the Contractor's initiative.

Preboring is incidental to the work and will not be paid for separately.

Reinforcement pile cages for pipe piles will be paid separately under **SECTION 810**.

The Department will only pay once for mobilization and demobilization, regardless of the number of phases.

SECTION 805 — EARTH RETAINING SYSTEMS

805.01 DESCRIPTION.

This work includes the provision of temporary and/or permanent sheet piling; temporary and/or permanent sheet piling with ground anchors; and soldier piles and lagging at the required locations.

Provide sheet piling that is in rolled steel sections.

For sheet piling in cofferdams, comply with **Subsection 203.03.2** and **SECTION M07**.

Provide soldier piles that are steel HP sections. Drive or install in pre-drilled shaft excavations. Provide lagging that contains timber or steel sections that span adjacent soldier piles.

Use a Rhode Island Registered Professional Engineer for any work performed on the design of earth retaining systems.

805.01.1 Permanent Sheet Piling.

Ensure that permanent sheet piling and supports are furnished, installed, cut-off and left in place as part of the finished structure.

805.01.2 Temporary Sheet Piling and Temporary Sheet Piling Abandoned in Place.

a. Temporary Sheet Piling. Install, maintain, and remove from the job site either after its function has been accomplished or when ordered to do so by the Engineer.

b. Temporary Sheet Piling Abandoned in Place. This is defined as sheeting used during construction but that is not a necessary structural component of the completed highway facility or bridge structure. Furnish, install, cut off, and leave in place temporary sheet piling abandoned in place. Cut off supports to below grade or as indicated in the Contract.

805.01.3 Soldier Pile-and-Lagging.

Furnish, install, cut off, and leave in place soldier piles-and-lagging, unless indicated otherwise in the Contract.

805.01.4 Design and Approval of Sheet Piling and Soldier Pile-and-Lagging.

The Contractor is responsible for the design of sheet piling and soldier pile-and-lagging. Submit complete design drawings, computations, and layout drawings for the temporary or permanent sheeting. Prepare all drawings and computations, stamped by a Rhode Island Registered Professional Engineer. Submit Shop Drawings that conform to **Subsection 105.02**. The Department will conduct a cursory review of the submission; the Contractor is responsible for the engineering design of the earth retaining system. Submit sheet piling or soldier pile-and-lagging located adjacent to railroad property to the railroad company for its review and approval.

805.02 MATERIALS.

805.02.1 General.

Use materials that conform to the following.

Material	Standard Specification Reference
Steel Sheet Piling	**Subsection M07.04**
Steel Soldier Piles	**Subsection M07.09**
Timber Lagging, Walers, and Bracing	**Subsection M11.01**
Steel Lagging, Walers, and Bracing	**Subsection M05.05**
Hardware – Fixtures, Bolts, and Lag Screws	**Subsection M05.05.4** or **Subsection M05.05.13**

805.02.2 Anchors.

Use anchor materials that conform to the following:

a. Anchor Material. Use either single or multiple elements as follows:

- Uncoated seven-wire, stress-relieved strand conforming to ASTM A416
- Uncoated high-strength steel bars conforming to ASTM A722

b. Bearing Plates, Brackets, Stiffeners, and/or Rolled Steel Shapes. Use materials that conform to the requirements of ASTM A709, Grade 36 or Grade 50.

c. Sheathing. Use sheathing of the unbonded length of a tendon as follows:

- Seamless polyethylene tube with a minimum wall thickness of 50 mils
- Seamless polypropylene tube with a minimum wall thickness of 50 mils
- Corrugated polyvinyl chloride tube with a minimum wall thickness of 30 mils

d. Anchor Grout. Use grout for anchorage that includes a pumpable mixture of Types I, II, or III Portland cement, sand, water, and admixtures that can reach a minimum cube compressive strength of 3500 psi in seven days when tested according to ASTM T106 or as specified on the Plans, whichever is greater.

e. Centralizers. Use centralizers that are fabricated from plastic or steel for the anchor tendon. Do not use wood. Use centralizer that maintains the position of the tendon so that a minimum of ½ in. of grout cover is obtained on the tendons.

f. Spacers. Use spacers for the separation of elements of a multi-element tendon that permit the free flow of grout and are fabricated from plastic or steel for the anchor tendon. Do not use wood.

805.03 CONSTRUCTION METHODS.

805.03.1 General.

The Engineer may order the use of additional or stronger bracing and supports at any point where, based on his/her evaluation, sufficient bracing and supports have not been provided.

The Engineer may order additional temporary sheet piling to be installed when, based on his/her evaluation, field conditions make it necessary to properly protect the work under construction or any existing installation affected by the construction. Use washout areas for concrete, excavatable fill, grout, etc., as directed by the Engineer.

805.03.2 Driving Sheet Piling and Soldier Piles.

Perform the preconstruction survey of adjacent structures and submit the findings to the Engineer for review. Do not initiate any driving until the Engineer has approved the preconstruction survey. Perform the vibration monitoring during the driving of sheeting or piles. Ensure that the preconstruction survey and vibration monitoring work conform to **Subsection 804.03.11(a)**.

Drive the sheet piling and soldier piles reasonably true to the required line and depth. Remove any material that interrupts the driving.

Drive the soldier piles to the location and axial tolerances specified in **Subsection 804.03.12(f)**.

805.03.3 Pre-drilled Soldier Pile Installation.

Install soldier piles in pre-drilled or pre-augered holes 1) when required by the Plans or Special Provisions; or 2) when vibratory or impact driving is not permitted; or 3) when obstructions prevent driving, and the Engineer authorizes pre-drilling or pre-augering in writing. For 3), resume standard driving when the obstruction has been removed or bypassed.

To reach the required depth for drilled or augered holes, use methods and equipment that maintain the sidewalls of the excavated shaft. Clean out and remove soil materials, cuttings, and water from the shaft excavation before the installation of soldier piles and concrete backfill. If stockpiles are created, comply with all environmental requirements in **Subsection 104.15**. This work and equipment are not considered for additional compensation.

Place soldier piles into the shaft to ensure that the piles do not sustain damage. Vertically center and align the piles to ensure that their final position, when backfilled, meets the specified location and axial tolerances. Remove and reinstall/replace damaged or out-of-tolerance soldier piles.

Place concrete, lean concrete, or other approved backfill in the shaft to encase the soldier pile. Place the concrete from the bottom of the drilled shaft up to the specified elevation or ground surface. Dewater the shaft before placing concrete backfill. Comply with **SECTION 208**. If dewatering is not feasible, use a tremie. If during pumping, excessive water inflow is encountered, the Engineer may require alternative methods to reduce inflow, alter the concrete mix, or approve alternative backfill materials.

Allow concrete backfill to cure for a minimum of five days before excavation and lagging installation begins. Do not allow equipment or other construction operations that might disturb the concrete in the vicinity of the installed pile until the concrete has cured.

805.03.4 Earthwork and Installation of Lagging.

Ensure that excavation conforms to **Subsection 202.03** or **203.03**. Conduct the placement and securing of lagging to closely follow excavation in front of pile-and-lagging to ensure that the loss of ground is minimized. Install lagging horizontally between soldier piles. Allow excavation to proceed only as required to set one row of lagging. When one row of lagging has been placed, initiate the excavation for the next lower row.

805.03.5 Openings and Cut-Offs.

Prepare and cut openings within the sheet piling or piles-and-lagging to permit the passage of all necessary utilities.

Cut off sheet piling, whether temporary or permanent, as necessary during construction to allow work to proceed. Cut off permanent sheet piling in a straight line at the required elevations.

Cut off soldier piles cleanly and horizontally at the required elevations. Remove concrete backfill, lagging, and other supports to the required elevations.

805.03.6 Installation of Ground Anchors.

Select the drilling method, the grouting procedure, and the grouting pressure to be used for the installation of the ground anchor as necessary to satisfy the load test requirements. Use a method of drilling that prevents loss of ground above the drilled hole that may be detrimental to the structure or existing structures. If water is used in the drilling operation, control and dispose of the water so that it is not harmful to the site, environment, or adjacent property. Repair any damage caused by loss of ground or inadequate control of water at no additional cost to the Department.

Ensure that the hole diameter in free length is not less than 3 in. nor greater than 12 in. and that the hole remains open until grouting begins. Remove casing, if used, as grouting progresses unless permitted by the Engineer to remain in place. When the tendon cannot be completely inserted, remove the tendon and clean the drill hole or re-drill the hole to permit insertion of the tendon without difficulty. Do not force partially inserted tendons into the hole.

Provide inclination and alignment to be within ±3 degrees of the design angle at the bearing plate and within ±12 in. of the planned location at the ground surface (point of entry).

The Contractor is responsible for determining the anchor bond length necessary to develop adequate load capacity to satisfy anchor testing acceptance criteria for the design load. Ensure that the drilled anchor hole does not extend outside of the right-of-way limits. Provide a minimum bond length of 10 ft in competent rock, 15 ft in soil, or the minimum in the Contract documents. Ensure that the anchor hole extends a minimum of 1 ft beyond the tendon length to be installed.

Produce a grout free of lumps and undispersed cement. Equip a positive displacement grout pump with a gauge to monitor and record grout pressures. Ensure that the pressure gauge is capable of measuring pressures of at least 150 psi or twice the actual grout pressures anticipated, whichever is greater. Size the grouting equipment so that the grout is pumped in one continuous operation. Use a mixer that can continuously agitate the grout.

Inject the grout at the lowest point of the drill hole. Fill the hole with grout progressively from the bottom to the top to prevent air voids. The grout may be pumped through grout tubes, casings, hollow-stem augers, or drill rods. Place the grout after the insertion of the tendon into the drill hole. Record the quantity of grout and the grout pressures. Control the grout pressures and quantities to prevent heave of the ground or fracturing of rock formations.

Except where modified below, the grout above the top of the bond length may be placed at the same time as the bond length grout. Do not place the grout under pressure. Ensure that the grout at the top of the hole stops a minimum of 6 in. from the back of the structure or trumpet, whichever is lowest. If the ground anchor is installed in fine grained soil using a drilled hole larger than 6 in. in diameter, place the grout above the top of the bond length after the ground anchor has been successfully load tested. If the grout is placed in two stages, ensure that the initial stage completely fills the hole to a point 2 ft above the bond length portion of the ground anchor. The entire drill hole may be grouted at the same time if the Contractor's Rhode Island Professional Engineer can demonstrate that the ground anchor system does not derive a significant portion (less than 5 percent) of its load resistance from the soil above the bond length portion of the ground anchor. Upon completion of grouting, the grout tube may remain in the drill hole if filled with grout. Also, after grouting, do not load the tendon for seven days, unless otherwise approved by the Engineer.

Ensure that tendons are free of dirt, detrimental rust, or other deleterious substances. Before installation, handle and store tendons to avoid corrosion and physical damage. Tendons with damage such as abrasions, cuts, nicks, welds, weld splatters, or heavy corrosion and pitting will be rejected. Tendons with a slight rusting, if it is not sufficient to cause pits visible to the unaided eye, will not be rejected. Do not ground welding leads to the tendon. Degrease the bond length of the tendon before installation in the hole. Do not allow solvent residue to remain on the tendon.

Load test each ground anchor according to the currently adopted edition of the PTI "Recommendations for Prestressed Rock and Soil Anchors." Do not apply a load greater than 10 percent of the design load to the ground anchor before load testing. Place the stressing equipment over the ground anchor so that the jack, bearing plates, load cell, and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment. Apply the test simultaneously to the entire tendon. During all testing, record the movement of the tendon at each load increment to the nearest 0.001 in. with a dial gauge or vernier scale. Take measurements from a fixed reference point, and provide adequate travel clearance so that the total ground anchor movement can be measured without resetting the device. Monitor the jack load with a load cell. Apply each load increment as rapidly as practical (preferably in less than 30 seconds after the jack pump is started).

When the theoretical elastic elongation of the total anchor length at the maximum test load exceeds the jack's ram length, the Engineer must approve the procedure for recycling the jack ram. Proceed with the load testing by incrementally loading the ground anchor according to the

following schedule. Raise the load from one increment to another immediately after recording the ground anchor movement.

Test Load Schedule
AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL
1.20 DL
1.33 DL
1.0 DL – LO

Where:

AL = Alignment Load
DL = Design Load
LO = Lock Off Load

Except for the 1.33 DL load, hold each load until the movement stabilizes for a minimum of one minute, and measure the ground anchor movement to the nearest 0.001 in. from a fixed reference point. Hold the maximum test load (1.33 DL) constant for a minimum of five minutes with movement measurements made at 0, 0.5, 1, 3, and 5 minutes. If the difference between the 0.5- and five-minute measurements is greater than 0.08 in., then hold the 1.33 DL constant for an additional 50 minutes with measurements taken at 15, 20, 30, 45, and 60 minutes. Construct a graph that plots the ground anchor movements versus load for each load increment in the test. At the completion of a successful load test, reduce the anchor load to 1.0 DL and transfer the load to the permanent stressing anchorage. The ground anchor may be completely unloaded before lock-off. After transferring the load and before removing the jack, record the lift-off load reading. Ensure that the lift-off load is within 10 percent of the specified lock-off load. If the load is not within 10 percent of the lock-off load, reset the anchorage and make another lift-off reading. Repeat this process until the desired lock-off load is obtained.

The acceptance criteria for proof loading testing at the maximum specified test load (1.33 DL) are:

- Ensure that the total movement measured at the anchor head is greater than 80 percent of the theoretical elastic elongation of the stressing length.
- Ensure that the total movement measured at the anchor head is less than the theoretical elastic elongation of the tendon length measured from the head of the jack to the center of the installed bond length.
- Ensure that the creep movement measured at the anchor head is less than 0.08 in. between the 0.5- and five-minute readings or less than 0.08 in. between the five- and 60-minute readings. Measure the stressing length from the stressing anchorage to the bond length top.

If any anchor fails to meet acceptance criteria #1, either release the tension on the anchor, or remove the anchor and provide an additional anchor.

If any anchor fails to meet acceptance criteria #2 or #3, retest the anchor and determine the actual capacity that will produce the acceptance criteria. Install an additional anchor according to this Specification at a location specified by the Engineer, and test to verify that the total capacity of the two anchors exceeds the 1.33 DL load. If the anchor failure is through no fault of the Contractor, then compensation will be made for additional anchor(s) and for the required subsequent testing.

805.04 METHOD OF MEASUREMENT.

805.04.1 Permanent Earth Retaining Systems.

Permanent Earth Retaining Systems are measured by the square foot of exposed face. Exposed face is measured from the bottom of foundation level or approved excavation level, whichever is deeper, to the top of the adjacent ground surface to be maintained.

805.04.2 Temporary Earth Retaining Systems.

Temporary earth retaining systems are incidental to the work items that require the retaining system and are not measured separately for payment.

805.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Permanent Earth Retaining Systems	SF

805.05.1 Permanent Earth Retaining Systems.

The accepted quantity of Permanent Earth Retaining Systems will be paid for at the Contract unit price per square foot. The price constitutes full compensation for all labor, materials, and equipment, including driving, bracing, cutting and removal of excess quantities, removal of temporary sheet piling, and all incidentals required to finish the work, complete and accepted. The price includes drilling or augering, piles, lagging, walers, bracing, anchors, and hardware.

The cost of preparation of openings for passing utilities will be included in the applicable unit bid price for sheet piling or soldier pile-and-lagging.

805.05.2 Drilling or Augering to Remove Obstructions.

When obstructions prevent driving using standards methods, notify the Engineer before proceeding. The Engineer will determine if a differing site condition exists according to **Subsection 104.03**. The additional work will be paid according to **Subsection 109.04**.

SECTION 806 — TIMBER CONSTRUCTION

806.01 DESCRIPTION.

This work includes heavy timber construction for bridge superstructures, roadway decks, sidewalks, railings, and other similar applications.

806.02 MATERIALS.

806.02.1 Timber.

Use sawn lumber, structural glued laminated timber, and wood preservative treatment that conforms to **SECTION M11.**

806.02.2 Hardware.

Use metal fastenings required for timber connections or for connecting timber to concrete or steel work that conform to **Subsection M05.05.13**.

806.03 CONSTRUCTION METHODS.

806.03.1 Workmanship.

Ensure that all timber is cut and framed to a close fit so that the joints have even bearing over the entire contact surfaces. Drive nails and spikes sufficiently to set the heads flush with the surface of the wood. Evidence of deep hammer marks in wood surfaces will be sufficient cause for rejection of the work. Remove timber scraps from cuts from the site on a regular basis to keep the work site neat and orderly.

806.03.2 Preservative Treatment of Timber and Lumber.

For all timber and lumber designated for treatment, use the pressure-treated process according to the standard practices of the American Wood Preservers Association (AWPA). Use the appropriate standards and specifications from AWPA for the Project conditions. Use the “empty cell” pressure-treated process, followed by an expansion bath where applicable, vacuum to 22 in. of mercury at sea level, and perform a final steam cleaning.

806.03.3 Handling of Timber and Lumber.

a. Untreated Timber. Open-stack untreated timber and lumber at the site of the work on supports at least 12 in. above the ground. Stack and strip the timber to permit free circulation of air between the tiers and courses. When required by the Engineer, protect the timber from the weather by suitable covering.

b. Treated Timber. Close-stack and place treated timber and lumber to facilitate thorough drainage of any preservative remaining on the material. Use timber that conforms to AWPA Standard M4. Comply with the following:

- Handling. Handle treated timber without sudden dropping, bruising, breaking of outer fibers, or penetrating the surface with tools. Handle with rope or web slings. Do not

use cant hooks, peaveys, pikes, or hooks. Provide corner protectors to prevent damage to timber bundled with metal bands or straps.

- Cuts and Abrasions. Perform all cutting, framing, and boring of treated timber before treatment as practical. Apply three brush coats of hot preservative oil to all cuts and abrasions made after treatment. Allow each coat to dry before the next coat is applied.

- Holes. Treat with preservative oil all holes, bored after treatment, with an AWPA-approved pressure bolt hole treater or with hot preservative oil by other methods approved by AWPA. Plug any unfilled holes, after being treated with preservative oil, with treated plugs.

- Temporary Attachments. Forms or temporary braces may be attached to treated timber with nails or spikes only when approved by the Engineer. Upon their removal, fill the holes by driving galvanized nails or spikes flush with the surface or by plugging as required for holes.

806.03.4 Installation of Connectors.

Install the split ring and the shear plate types in precut grooves of dimensions as recommended by the manufacturer. Force spike grids into the wood so that timbers are in firm contact. Use pressure equipment that does not damage the wood.

Cut connector grooves in timber concentric with the bolt hole, conforming to the cross-sectional shape of the rings and providing a snug fit. Ensure that the inside groove diameter is larger than nominal ring diameter so that the ring will expand slightly during installation.

Perform the fabrication of all structural members using connectors before preservative treatment. When prefabricated from templates or shop details, ensure that the location of bolt holes is not more than 1/16 in. from the required placement. Ensure that bolt holes are 1/16 in. larger than the finished bolt diameter. Bore the bolt holes perpendicular to the face of the timber.

Store the timber after fabrication to prevent changes in the dimensions of the members before assembly. Ensure that timber is cured before fabrication so that its dimensions remain stable. Timber that shrinks during storage causing predrilled grooves for split rings or plates to become elliptical or causing bolt hole spacing to change will be rejected.

806.03.5 Countersinking.

Perform countersinking where smooth faces are required. Treat recesses formed in treated timber for countersinking as required for cuts and abrasions.

806.03.6 Hardware.

- Rods. Thread rods connecting only sawed timbers at each end to provide tight connections, allowing only for permissible variations in the dimensions of material.

- Bolts. The length specified is the length measured under the head. Bolts may be substituted for rods for timber connections where the length of the threaded portion provided by the bolt is sufficient.
- Lag Screws. Install lag screws by turning them into place. The screws may be driven sufficiently to start them into the holes and hold them firmly in place for turning. Perform pre-drilling according to **Subsection 806.03.7.**
- Nuts and Washers. Use washers or plate washers under all nuts, bolt heads, and lag screws that would otherwise contact with wood, except under large diameter heads of specially designed flat head bolts. Always use standard square nuts. Tighten the nuts to prevent the rods or bolts from becoming loose during service. After being tightened, secure the nuts from backing off by the burring of the rod or bolt threads.
- Nails and Spikes. Do not allow nails to extend through all material into which they pass unless approved by the Engineer. Ensure that distance and spacing adhere to the currently adopted versions of the AASHTO *LRFD Bridge Design Specifications* and the *National Design Specification (NDS) for Wood Construction*.

Drive nails or spikes through the thinner member into the thicker member. Ensure that the nails and spikes are flush or countersunk to the member surface. Drill pre-bored holes according to Subsection 806.03.7.

806.03.7 Holes for Bolts, Dowels, Rods, Lag Screws, Nails, and Spikes.

Bore holes for round drift bolts and dowels with a bit sized 1/16 in. less in diameter than the bolt or dowel to be used. Ensure that the diameter of holes for square drift bolts or dowels is equal to the least dimension of the bolt or dowels.

Bore holes for machine bolts with a bit of the same diameter as the bolt up to 1/16 in. greater than the bolt diameter. Bore holes for rods with a bit 1/16 in. greater in diameter than the rod.

Bore holes for lag screws with a bit not larger than the body of the screw at the base of the thread. To prevent splitting or stripping of the threads, bore a lead hole for the shank with a bit of the same diameter and to the same depth as the shank. Ensure that the depth of holes for lag screws are 1 in. less than the length under the thread. Do not drive lag screws into the lead hole with a hammer. Instead, turn the screw in with a wrench.

Spikes and nails are generally hand-driven but may be power driven for the smaller diameters and lengths. Pre-bore holes for large diameter spikes and nails (generally greater than ¼ in.) to prevent the wood from splitting during driving. Ensure that the diameter of the lead hole does not exceed 0.9 times the diameter of the fasteners for wood species with specific gravities greater than 0.6 and no more than 0.75 times the diameter of the fastener for wood species with specific gravities less than 0.6. Do not allow pre-bored holes to extend into the members that will be holding the point of the nail or spike.

806.03.8 Framing.

Cut and frame all lumber and timber to a close fit so that the joints have even bearing over the entire contact surfaces. Ensure that mortises are true to size for their full depth and that tenons fit snugly. Do not use shimming to make joints. Open joints will be rejected.

806.03.9 Framed Bents.

- Mud Sills. Firmly and evenly bed mud sills to solid bearing and tamp in place. Use pressure preservative treated mud sills for ground contact. Where untreated timber is permitted for mud sills, use heart cedar, heart cypress, redwood, or other durable timber as approved by the Engineer.
- Concrete Pedestals. Finish concrete pedestals for the support of framed bents so that the sills or posts will take even bearing. Ensure that dowels for anchoring sills or posts are not less than ¾ in. in diameter and project at least 6 in. above the tops of the pedestals. Cast the dowels into the concrete pedestals.
- Sills. Install sills that have true and even bearing on mud sills, piles, or pedestals. Ensure that sills are drift-bolted to mud sills or piles with bolts of not less than ¾-in. diameter and extend into the mud sills or piles at least 6 in. When practical, remove all earth from contact with sills so that there is free air circulation around the sills.
- Posts. Fasten posts to pedestals with dowels of not less than ¾-in. diameter, extending at least 6 in. into the posts.

  Fasten posts to sills by one of the following methods as indicated on the Plans:

  - By dowels of not less than ¾-in. diameter, extending at least 6 in. into posts and sills
  - By drift-bolts of not less than ¾-in. diameter driven diagonally through the base of the post and extending at least 9 in. into the sill. Drive drift bolts into holes at a 45-degree angle to enter the post at least 6 in. above the post base.
  - By other types of connectors as detailed on the Plans.

- Caps. Place timber caps, with ends aligned, to secure an even and uniform bearing over the tops of the supporting posts or piles. Secure all caps by drift-bolts of not less than ¾-in. diameter, extending at least 9 in. into the posts or piles. Ensure that the drift bolts are approximately in the center of the post or pile.
- Bracing. Bolt bracing through the pile, post, or cap at the ends and at all intermediate intersections using a bolt of not less than ⅝ in. in diameter. Ensure that bracing has sufficient length to provide a minimum distance of 8 in. between the outside bolt and the end of the brace.

806.03.10 Stringers.

Size the stringers at bearings and place them in position so that knots near edges are in the top portions of the stringers.

Other stringers may have butt joints with the ends cut on a taper, but lap interior stringers to take bearing over the full width of the floor beam or cap at each end. Separate the lapped ends of

untreated stringers at least ½ in. for the circulation of air, and secure the lapped ends fastened by drift-bolting. Where stringers are two panels in length, stagger the joints.

Place timber stringers in position so that the deck has an even bearing on all stringers and so that any knots near edges are in the top portions of the stringers. Outside stringers may have butt joints, centered over caps or floor beams, but lap interior stringers so that each rests completely over the full width of the cap or floor beams at each end. Toenail the stringers to caps, and spike together the intermediate stringers of adjoining spans where they lap.

Properly frame the cross bridging between stringers, and ensure that the framing is securely toe-nailed with at least two nails in each end. Ensure that all cross-bridging members have full bearing at each end against the sides of stringers. Place 2 in. × 4 in. cross bridging at the center of each span.

806.03.11 Plank Floors.

Use planks for flooring that is surfaced four sides (S 4 S).

Use single plank floors that include a single thickness of plank supported by stringers or joists. Lay the plank's heart side down, with ¼-in. openings between them for seasoned material and with tight joints for unseasoned material. Securely spike each plank to each joist. Ensure that the planks are graded as to thickness and laid to ensure that no two adjacent planks vary in thickness by more than ⅛ in.

Use two-ply timber floors that include two layers of flooring supported on stringers or joists. Lay the top course either diagonal or parallel to the centerline of roadway, and securely fasten each floor piece to the lower course. Stagger joints at least 3 ft. If the top flooring is placed parallel to the centerline of the roadway, securely fasten the ends of the flooring. At each end of the bridge, bevel these members.

806.03.12 Nailed or Glued Laminated Strip Floors.

Use nailed or glued laminated strip floors that include individual lumber strips. Place the strips on edge as described in the Plans to the previous strip to form a continuous surface. Construct the laminated strip floors either on top of stringers at right angles to the centerline of roadway or on top of floor beams running parallel to the roadway centerline.

Use spikes that are of sufficient length to pass through two strips and at least one-half of the third strip. If timber supports are used, toenail every other strip to every other support. If steel supports are used, securely fasten the strips to the supports at the required locations and spacing.

Ensure that each strip is vertical and tight against the preceding strip and bears evenly on all supports.

806.03.13 Laminated Panel Decks.

Use laminated panel decks that include stress laminated sawn lumber strips. Place the strips with their wide side vertical and fastened together to form panels. Provide fastening as described in the Plans. Panels may be interconnected using spliced, bolted, or doweled ship-lap joints, steel

dowels, or high strength steel stressing rods. Alternatively, panels may be assembled in a non-interconnected fashion.

Panels may be used longitudinally with stringers, composite stringers, without stringers, or transversely across steel or wood stringers.

806.03.14 Wheel Guards and Railings.

Frame the wheel guards and railings and erect them true to line and grade. Use wheel guards, rails, and rail posts that are surfaced on four sides (S 4 S). Lay the wheel guards in sections not less than 12 ft long, except where necessary to match expansion joints or end joints.

806.03.15 Trusses.

Ensure that the trusses, when completed, have no irregularities of line. Ensure that the chords are straight and true from end to end in horizontal projection and, in vertical projection, present a smooth curve through panel points conforming to the correct camber. Ensure that all bearing surfaces fit accurately. Uneven or rough cuts at the points of bearing will result in rejection of the piece containing the defect.

806.04 METHOD OF MEASUREMENT.

Timber Construction will be measured by the number of board feet placed in various parts of the completed structure. The computation of quantity will be based on the nominal commercial widths and thicknesses of the respective materials.

806.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Timber Construction	BF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 807 — MASONRY CONSTRUCTION

807.01 DESCRIPTION.

This work includes the construction of masonry structures and masonry portions of composite structures of various types at the required locations. Ensure that the work complies with the currently adopted editions of the AASHTO *LRFD Bridge Construction Specifications,* the AASHTO *Historic Bridge Preservation Guide,* and **SECTION 939**.

807.01.1 Cut Stone Masonry (Ashlar).

Use cut stone masonry or masonry veneer that is dressed and tooled to the required fixed dimensions and laid in range or random courses in a cement mortar bed.

807.01.2 Split Face Masonry.

Use split face masonry or veneer that is composed of quarry stone laid in range or random courses in a cement mortar bed and set substantially level. Use materials that include coping, quoin, and belt stones shaped to line and grade. Splay a reasonable proportion of the joints from the vertical as indicated. Split faced masonry may include a fascia wall one stone thick backed with concrete or constructed of solid stone masonry.

807.01.3 Rubble Masonry.

Use rubble masonry that is composed of irregular stones laid as coursed or uncoursed rubble in a cement mortar bed. Rubble masonry may include either a fascia wall one stone thick backed with concrete or constructed of solid stone masonry.

807.01.4 Dry Rubble Masonry.

Use dry rubble masonry that is composed of irregular stones laid as coursed or uncoursed rubble without the use of cement mortar.

807.01.5 Concrete Block or Brick Masonry.

Use concrete block and brick masonry that includes concrete blocks or brick laid in cement mortar and may be unreinforced or reinforced with steel reinforcing. Block or brick pavements and catch basin/manhole masonry construction/repairs are not included under this designation.

807.02 MATERIALS.

807.02.1 Stone.

Use stone that conforms to **SECTION M14**.

807.02.2 Block and Brick.

a. Concrete Block. Use Type I, moisture-controlled units (Grade N-I) concrete blocks that meet the requirements of ASTM C90.

   Protect concrete block units from rain, snow, or other moisture during storage on or off the job site to ensure that the units will meet the Type I moisture requirements at the time they are placed.

b. Brick. Use brick for masonry construction that conforms to the Specification for Building Brick (solid masonry units made from clay or shale) (ASTM C62), Concrete Building Brick (ASTM C55), or Load-Bearing Concrete Masonry Units (ASTM C90).

   Use bricks that have a fine-grained, uniform, and dense structure, free from lumps of lime, laminations, cracks, checks, soluble salts, or other defects that may impair their strength, durability, appearance, or usefulness. Ensure that bricks emit a clear, metallic ring when struck with a hammer.

807.02.3 Mortar.

Use mortar that conforms to **Subsection M04.03.5**.

807.02.4 Lead, Dowels, and Cramps.

Use leaded joints, wrought iron, and galvanized or stainless steel dowels or cramps that conform to **SECTION M05**.

807.02.5 Concrete.

Use concrete backing of stone fascia walls that is Class A. Use concrete that conforms to **SECTION 601**.

807.02.6 Reinforcing Steel.

Use reinforcing steel that conforms to **Subsection M05.02**.

807.02.7 Grout.

Use grout for filling voids in hollow masonry units that conforms to ASTM C476.

807.03 CONSTRUCTION METHODS.

807.03.1 Weather Limitations.

Do not construct stone, brick, or block masonry using mortar or grout when the atmospheric or surface temperature is below 40°F, when the respective units contain frost, or when the temperature is expected to drop below 40°F within 24 hours of placement, except with the written permission of the Engineer subject to any required conditions. Remove and replace all work damaged by cold weather at no additional cost to the Department. In hot or dry weather, protect

the masonry from the sun, and cure by keeping the masonry or its covering wet for a period of three days after completion.

807.03.2 Mixing of Mortar and Grout.

Proportion the mortar and grout for masonry construction as specified in **Subsections 807.02.3** and **807.02.7**.

Either hand or machine mix the mortar, as required by the Engineer. In the preparation of hand-mixed mortar, thoroughly mix the sand and cement together in a clean, tight mortar box until the mixture has uniform color. Add sufficient clean water to form a stiff plastic mass. Prepare the mortar mix for not less than three minutes nor more than 10 minutes. Do not mix the mortar on the roadway surface.

Add sufficient water to provide a mortar consistency that can be handled easily and spread with a trowel. Ensure that the water is fresh, clean water, which is not used from a stormwater conveyance system.

Mix mortar and/or grout only in those quantities required for immediate use. Discard mortar not used within 45 minutes after water has been added or before initial set begins, whichever occurs first.

807.03.3 Stone Masonry Construction.

a. Manufacture of Stone for Masonry.

1. General. Ensure that each stone is free from depressions and projections that could weaken or prevent the stone from proper embedment. Provide a shape to meet the requirements for the class of masonry specified.

   - Furnish stones in the sizes and face areas necessary to produce the required characteristics and appearance.
   - Ensure that the thickness of courses, if varied, diminish regularly from bottom to top of wall.
   - Use header lengths that are not less than the width of bed of the widest adjacent stretcher plus 12 in.

2. Rubble Masonry.

   - Size. Use individual stones that have a thickness of not less than 8 in. and a width of not less than 1½ times the thickness. Do not use stones, except headers, that have a length less than 1½ times their width.
   - Shape. Use stones that are roughly squared on joints, beds, and faces. Use selected stone, roughly squared and pitched to line, at all angles and ends of walls. If specified, finish all corners or angles in exterior surfaces with a chisel draft.

- Bed Surface. Ensure that bed surfaces of face stones are normal to the faces of the stones for approximately 3 in. From this point, ensure that surfaces depart from normal not more than 2 in. in 12 in. Provide joint surfaces of face stones that form an angle with the bed surfaces of not less than 45 degrees.

- Laying Stone in Wall. Perform all shaping or dressing of stone before the stone is laid in the wall. Do not allow dressing or hammering to loosen the stone after it is placed.

- Dressing. Dress the stone to remove any thin or weak portions. Dress face stones to provide bed and joint lines with a maximum variation from true line of 1½ in.

- Other. Construct rubble masonry and dry rubble masonry according to the applicable requirements of **SECTION 911** and **SECTION 912**.

3. Ashlar Masonry.

   - Size. Use individual stones that are large and well proportioned. Provide stones that are not less than 12 in. nor more than 30 in. in thickness.

   - Dressing. Dress stones to the exact sizes and shapes before being laid. Cut the stones to lie on their natural beds with top and bottom truly parallel. Do not use hollow beds. Ensure that the bottom bed is the full size of the stone and that no stone has an overhanging top. In rock-face construction, ensure that the face side of any stone does not present an undercut contour adjacent to its bottom arris that yields a top-heavy, unstable appearance when laid.

     Fine finish the beds of face stone for a depth of not less than 12 in.

     Fine finish the vertical joints of face stone, which must be full to the square for a depth of not less than 9 in.

     Provide exposed surfaces of the face stone with edges pitched to true lines and exact batter. Cut chisel drafts 1½-in. wide at all exterior corners. Rough finish face stone forming the starling or nosing of piers.

     Do not allow holes for stone hooks to be visible in exposed surfaces.

   - Stretchers. Use stretchers that have a width of bed of not less than 1½ times their thickness. Ensure that the stretchers have a length of bed not less than twice nor more than 3½ times their thickness and not less than 3 ft.

4. Arch Ring Stones. Ensure that the arch ring stone joint surfaces are radial and at right angles to the front faces of the stones. Dress the surfaces for a distance of at least 3 in. from the front faces and the soffits, from which points they may depart from a plane normal to the face not to exceed ¾ in. to 12 in. Ensure that the back surface in contact with the concrete of the arch barrel is parallel to the front face and is dressed for 6 in. from the intrados. Cut the top perpendicular to the front face, and dress the top for a distance of at least 3 in. from the front.

When concrete will be placed after the masonry has been constructed, ensure that the adjacent ring stones vary at least 6 in. in depth.

Ensure that the stratification in arch ring stones is parallel to the radial joints and, in other stones, is parallel to the beds.

Lay out a full-size template of the arch ring near the quarry site, showing face dimensions of each ring stone and thickness of joints. The Engineer will the template before the shaping of any ring stone is started. Do not place the ring stone in the structure until all ring stones have been shaped, dressed, and approved by the Engineer.

b. Selection and Placing of Stone.

1. General. When masonry is placed on a prepared foundation bed, ensure that the bed is firm and normal to, or in steps normal to, the face of the wall, and approved by the Engineer before any stone is placed. When it is placed on foundation masonry, clean the bearing surface of the foundation masonry and ensure that the surface is in a saturated-surface dry condition when the mortar bed is spread.

   Set face stones in a random bond to produce the required effect.

   Prevent the bunching of small stones or stones of the same size. When weathered or colored stones or stones of varying texture are being used, distribute the various kinds of stones uniformly throughout the exposed faces of the work. Use large stones for the bottom courses and use large, selected stones in the corners. In general, ensure that the stones decrease in size from the bottom to the top of work.

   Clean and saturate each stone with water before being set. Ensure that the bed that will receive the stone is clean and well moistened. Bed all stones securely in freshly made mortar. Ensure that the mortar joints are full and the stones settled in place before the mortar has set. Any spalls in the beds will result in rejection. Do not pin up any stones with spalls in beds.

   Do not drop any stones on or slide them over the wall. Do not hammer, roll, or turn the stones on the wall. Set the stones without jarring the stone already laid, and handle with an appliance that will not cause disfigurement.

   If any stone is moved or the joint broken, remove the stone, clean the mortar from the bed and joints, and reset the stone in fresh mortar.

2. Rubble Masonry. Lay rubble masonry to line and in courses roughly leveled up. For the bottom or foundation courses, use large, selected stones and lay all courses with bearing beds parallel to the natural bed of the material. Ensure that the vertical joints in each course of rubble masonry break with those in adjoining courses at least 6 in. Do not locate a vertical joint directly above or below a header.

3. Ashlar Masonry. For all range cut stone masonry, lay the stone with alternating stretchers and headers. Place stones in any one course of ashlar masonry to form bonds of not less than 12 in. with the stones of adjoining courses. Place headers over

stretchers and, in general, ensure that the headers of each course equally divide the spaces between the headers of adjoining courses. Do not place a header over a joint, and do not install a joint over a header.

4. Split Face. For all split faced masonry, use selected stones, squared and pitched to line, at all angles, wall expansion and contraction joints, and other arrises. Dress copings and belt stones for the required jointing, and pitch exposed corners parallel to each other. Ensure that exposed surfaces have projections of not more than 1 in. Cut the bed and interior ends normal to the pitch lines.

5. Sample Section. If required, construct at a designated location a sample section of wall not less than 5 ft high and 8 ft long, showing examples of the face wall and method of forming joints. The Engineer must approve the sample section before the start of wall facing. If approved, the sample section may be incorporated into the final product, subject to final inspection and acceptance.

c. Beds, Joints, and Pointing.

1. Beds and Joints. Do not allow face joints for all cut stone to exceed ½ in.; face joints for split face masonry to exceed 1 in.; and face joints for rubble masonry to exceed 1½ in. Ensure that the joints in the interior of the wall average not more than 1½ in. for rubble masonry.

   The thickness or beds in ashlar masonry may vary as shown from the bottom to the top of the work. However, in each course, ensure that the beds have a uniform thickness throughout.

   Do not allow beds to extend in an unbroken line through more than five stones.

   Provide vertical joints in ashlar masonry. In all other masonry, joints may be at angles with the vertical from 0 degrees to 45 degrees.

   Ensure that each face stone bonds with all contiguous face stones at least 6 in. longitudinally and 2 in. vertically. Ensure that ring stone joints on the faces and soffits are not less than ¾ in. nor more than 1½ in. in thickness.

   Provide level cross beds for vertical walls. Battered walls may vary from level to normal to the batter line of the face of the wall. Fill all joints with mortar.

2. Pointing. Do not perform pointing in freezing weather or when the stone contains frost.

   When practical, point face joints before the mortar sets. Prepare joints that cannot be immediately pointed for pointing by raking the joints out to a depth of 2 in. before the mortar has set. Ensure that the stone face surfaces are not smeared with any mortar.

   Wet joints not pointed at the time the stone is laid with clean water and fill with mortar. Ensure that the mortar is driven into the joints and finished with an approved pointing tool. Slightly crown the mortar in joints on top surfaces at the center of the masonry to provide drainage. Ensure that walls remain wet while pointing is being performed.

In hot or dry weather, protect the pointed masonry from the sun and keep the walls wet for at least three days after completion.

After the pointing is completed and the mortar set, thoroughly clean the wall.

d. Headers. Ensure that headers hold in the heart of the wall the same size as shown in the face and that they extend not less than 12 in. into the core. Ensure that headers occupy not less than one-fifth of the face area of the wall and are evenly distributed.

Provide headers in walls 3 ft or less in thickness that extend entirely through the wall.

Place headers in ashlar masonry in each course that has a width of not less than 1½ times their thickness. In walls having a thickness of 4 ft or less, extend the headers entirely through the wall. In walls of greater thickness, provide a length of headers that is not less than 2½ times their thickness when the course is 18 in. or less in height and not less than 4 ft in courses of greater height. Space the headers not further apart than 8 ft center to center. Provide at least one header to every two stretchers.

e. Cores and Backing.

1. General. Provide cores and backing that consist either of compactly laid and interlocked stones including headers and stretchers or of concrete.

Provide headers and stretchers in walls that have a thickness of 3 ft or less that have a width or length equal to the full thickness of the wall. Do not use backing or core.

2. Stone. When stone is used for cores or backing, ensure that at least one-half of the stone is the same size and character as the face stone and that the remaining stones have sizes and shapes that facilitate proper interlocking with face stones. Ensure that all courses are less than 8 in. thick.

Lay stone backing in the same manner as specified for face stone, with headers interlocking with face headers when the thickness of the wall permits. Lay backing to break joints with the face stone. Lay stone cores in full mortar beds to bond not less than 12 in. with face and backing stone and with each other. Ensure that bed joints in cores and backing do not exceed 1 in. in thickness and that vertical joints do not exceed 2 in. in width.

3. Concrete. Place and consolidate concrete adjacent to the ashlar masonry facing to ensure that all spaces around the stones are filled and that provide full contact and efficient bond with all stone surfaces.

4. Leveling Courses. Ensure that the elevation of stone cores and backing are approximately level with the face course before the succeeding course is started.

5. Concrete Backing. Construct the stone masonry before placing concrete.

6. Use steel anchors. To improve the bond between the stone masonry and the concrete backing, install the back of the masonry as unevenly as the stones permit.

After the stone facing has been laid and the mortar has attained sufficient strength, clean all surfaces against which concrete will be placed, and remove all dirt, loose material, and accumulations of mortar droppings.

When placing concrete, fill all interstices of the masonry, and spade and work the concrete until it has tight contact with every part of the back of the masonry.

Place horizontal construction joints in the concrete backing at grades that will break joints of the stone facing. Provide concrete courses that are approximately 4 ft in depth.

f. Dowels and Cramps. Where required, secure the coping stone, stone in the wings of abutments, and stone in piers with wrought iron, galvanized steel, or stainless steel cramps or dowels.

Drill dowel holes that will be covered by stone masonry through each stone before the stone is placed and, after it is in place, extend the dowel holes by drilling into the underlying course not less than 6 in. On stones where it is desirable to avoid drill holes through the top surfaces, conceal by setting and grouting the stones over dowels set in the preceding course or by a similar method.

Inset cramps or dowels in the stone to clear the bed of the succeeding course. Locate the cramps or dowels to securely bond the stone courses together and the stone facing to the concrete backing.

Set cramps and dowels in lead to completely fill the surrounding spaces with the molten metal. Otherwise, rigidly anchor the cramps or dowels by other means approved by the Engineer.

g. Copings. Use the required and dimensioned stones for copings of wall, pier, and abutment bridge seats. On piers, do not use more than two stones to provide the entire width of coping. Use copings at abutment bridge seats that have sufficient width to extend at least 4 in. under the backwall. Form each step of the coping of a wingwall with a single stone that overlaps the stone forming the step immediately below at least 12 in.

For tops of copings, provide a bevel cut at least 2 in. wide, and fine finish the beds, bevel cuts, and tops. Smooth finish the vertical joints, and lay the copings with joints not more than ¼ in. thick. Provide a drip bead to the underside of projecting copings.

Locate joints in copings to provide not less than a 12-in. bond with the stones of the under course and to ensure that no joint will come directly under the superstructure masonry plates.

h. Bracing. The Engineer will determine if bracing is necessary to hold the stone in place.

i. Cleaning Exposed Surfaces. Clean from all face stones any mortar stains immediately after placement and while the mortar is fresh. Ensure that the stones remain clean until the work is completed. After the pointing is completed and the mortar set, clean the wall.

807.03.4 Brick or Block Masonry.

a. Laying Brick and Block. Lay the blocks or bricks to bond them into the mortar by using the "shove-joint" method; do not use "buttered" or plastered joints. Saturate surface dry with water all clay or shale brick before placement. Do not dampen concrete masonry units before or during construction, unless approved by the Engineer. Arrange the headers and stretchers to bond the mass, and proceed with alternate headers and stretchers with consecutive courses breaking joints.

   Fill all joints with mortar. Provide joints that are not less than ¼ in. and not more than ⅝ in. in thickness. Ensure that the thickness is uniform throughout. Finish all joints as the work progresses and, on exposed faces, neatly strike the joints using the weather joint.

   Do not use any spalls or bats except for shaping around irregular openings or when unavoidable to finish out a course. When used, place full bricks at the corners, placing the bats in the interior of the course.

   Adjust each masonry unit to its final position while the mortar is still soft and plastic. Remove units that are disturbed after the mortar has stiffened and relay in fresh mortar.

   Align vertical cells to be filled with grout to provide a continuous unobstructed opening.

   Piers and walls may be built of solid brick work or may include a brick or block shell backed with concrete.

b. Placement of Reinforcement. Before and during grouting, secure the reinforcing steel in position at the top and bottom and at intermediate points not exceeding 200 bar diameters or 10 ft apart. Ensure that bars are clear of the cell walls and within ±½ in. of their planned position transverse to the wall and within ±2 in. of their planned position longitudinal to the wall.

c. Grouted Brick or Block Construction. Construct grouted masonry so that all elements of the masonry act together as a structural element.

   Before grouting, clean the grout space so that all spaces to be filled with grout do not contain mortar projections greater than ½ in., mortar droppings, or other foreign material. Place grout so that all spaces to be grouted do not contain voids.

   Control grout materials and water content to provide adequate fluidity for placement without segregation.

   Ensure that size and height limitations of the grout space or cell on average are not less than the values in the Table below. The Engineer may approve the use of higher grout pours or smaller cavity widths or cell sizes than shown in the Table below, if it is demonstrated that grout spaces are properly filled.

   When required by the Table, provide cleanouts in the bottom course at every vertical bar but not be spaced more than 32 in. on center for solidly grouted masonry. Ensure that cleanouts have sufficient size to allow removal of debris.

Grouting Limitations

Grout Type	Grout Pour Maximum Height (ft)	Width of Grout Space (in.)[2]	Cell Dimensions (in. × in.)	Cleanout Required[3]
Fine	1	¾	1½ × 2	No
Fine	5	1½	1½ × 2	No
Fine	8	1½	1½ × 3	Yes
Fine	12	1½	1¾ × 3	Yes
Fine	24	2	3 × 3	Yes
Coarse	1	1½	1½ × 3	No
Coarse	5	2	2½ × 3	No
Coarse	8	2	3 × 3	Yes
Coarse	12	2½	3 × 3	Yes
Coarse	24	3	3 × 4	Yes

Notes:

1 *The clear dimension is the cell or group space width less mortar projections.*

2 *Increase grout space width by the horizontal projection of the diameters of the horizontal bars within the cross section of the grout space.*

3 *Cleanouts may be omitted if approved provisions are made to keep the grout space clean before grouting.*

Units may be laid to the full height of the grout pour. Place grout in a continuous pour in grout lifts not exceeding 6 ft. If construction joints are used in columns of grout, locate the joints at least 1½ in. below the level of a mortar bed joint.

Avoid segregation of the grout materials and damage to the masonry during the grouting process.

Consolidate the grout before loss of plasticity to fill the grout space. Mechanically reconsolidate grout pours greater than 12 in. in height to minimize voids due to water loss. Puddle any grout not mechanically vibrated.

In nonstructural elements, mortar that is of pouring consistency may be substituted for grout when the masonry is constructed and grouted in pours of 12 in. or less.

Vertical barriers of masonry may be built across the grout space. Complete the grouting of any section of wall between barriers in one day with no interruption longer than one hour.

807.04 METHOD OF MEASUREMENT.

807.04.1 Stone Masonry.

Stone masonry will be measured by the number of square feet of exposed wall surface placed.

807.04.2 Pointing and Grouting.

When listed as a separate item in the Contract, Pointing and Grouting will be measured by the number of linear feet of wall installed. When not listed in the Contract, Pointing and Grouting is incidental and not measured for payment.

807.04.3 Concrete Block and Brick Masonry.

Concrete Block Masonry and/or Brick Masonry will be measured by the number of square feet placed in the structure.

807.04.4 Concrete Backing.

Concrete Backing of stone fascia walls will be measured by the number of cubic yards placed.

807.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Stone Masonry	SF
Pointing and Grouting	LF
Concrete Block Masonry and/or Brick Masonry	SF
Concrete Backing	CY

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Stone masonry sample wall sections, when required, are incidental and not paid separately.

SECTION 808 — CAST-IN-PLACE STRUCTURE CONCRETE MASONRY

808.01 DESCRIPTION.

This work includes providing cast-in-place concrete in bridges, walls, culverts, and other miscellaneous structures at the required locations. The work includes structures constructed by cast-in-place methods using either plain or reinforced concrete or a combination.

808.02 MATERIALS.

808.02.1 Concrete.

Use materials that conform to **SECTION 601**.

808.02.2 Joint Fillers and Sealants.

Use materials that conform to:

- **Subsection M02.10.1**
- **Subsection M02.10.2**
- **Subsection M02.10.3**
- **Subsection M02.10.4**
- **Subsection M02.10.5**

808.03 CONSTRUCTION METHODS.

808.03.1 General.

Comply with **SECTION 601** for classification, proportioning, batching, mixing, transportation, placing, curing, and testing of concrete**.**

808.03.2 Footings.

Prepare foundations that conform to **SECTION 203**. Do not place concrete until the Engineer has approved the depth and dimensions of the excavation, the character of the material, and the condition of the foundation. Do not support a footing partially on rock and partially on soil. Excavate the rock to allow the placement of 12 in. of gravel according to **Subsection 203.03.1**. The Engineer may direct, in writing, changes in dimensions or elevations of footings as may be necessary to obtain satisfactory foundations. The Plans will be revised accordingly.

For foundations under water, the Contractor is responsible for quality control, which may require a diver to inspect and monitor the construction of the foundation.

808.03.3 Falsework and Centering.

Ensure that all falsework or centering is adequate for the type of construction involved and conforms to Section 3-2, Falsework and Forms, of the currently adopted edition of the AASHTO *LRFD Bridge Construction Specifications*. Submit all Shop Drawings for falsework and centering, including design computations signed and sealed by the Contractor's Rhode Island Registered Professional Engineer, according to **Subsection 105.02**.

The Contractor's Professional Engineer shall certify in writing that the falsework system has been assembled and constructed according to the approved falsework drawings. Do not place loads on the falsework before submittal of the certification.

When structures will be constructed over railroad tracks, ensure that the centering conforms to the requirements of the railroad company for temporary operating clearances, safety, and design.

808.03.4 Forms.

a. General. Prepare detailed plans for all required forms, including design computations signed and sealed by the Contractor's Rhode Island Registered Professional Engineer, according to **Subsection 105.02**. The Engineer will approve the plans in writing before any work is initiated on construction of the forms. Do not use snap ties, and ensure that removable cones meet the minimum diameter requirement. Where forms will be suspended from the structural steel girders, do not use snap tie hangers, wires, or other devices that cannot be adjusted to provide mortar tight joints. Do not allow slab forms to bear on interior diaphragms.

   Do not install forms over steel supporting members until after the steel erection and touchup painting is completed.

   Include a provision in the form for a standard ¾-in. symmetrical chamfer at all square entrant concrete corners.

b. Wood Forms. Construct all face forms of lumber ¾ in. or more in thickness lined with plywood not less than 1¼ in. in thickness. Sheet metal (preferably noncorrosive) of approved gauge may be substituted.

   As an alternative method of construction, face forms may consist of plywood, ⅝ in. or more in thickness, without backing boards if properly designed and supported. Ensure that the alternative construction provides a rigid form that prevents unacceptable deformations in the finished concrete surface.

   Provide plywood forms that are tempered or waterproofed at the time of manufacture to prevent the absorption of moisture.

   When lining is used, use wood forms that require the usual construction with the boards closely spaced. Provide the lining in sheets of maximum useable size, and apply the smooth side to the concrete. Tape or fill joints between panels to provide a smooth, tight form surface.

   Construct metal ties or anchorages that are required within the forms to hold them to correct alignment and location so that the metal work can be removed to a depth of at least 2 in. from the exposed surface of the concrete without causing injury to the surface by spalling or otherwise. When permitted for secondary forms, cut back all wires, upon removal of the forms, at least ½ in. from the face of the concrete with sharp chisels or nippers.

   Use all fittings for metal ties of a design that, upon their removal, the cavities that remain are of the smallest size. Fill the cavities with cement mortar of fine aggregate and cement

in the proportion that has been employed for the class of concrete treated. Ensure that the surface is smooth, even, and uniform in color.

Ensure that formwork lines are straight and true and that forms are mortar tight, well tied, and braced to prevent bulging. Ensure that block shims or wedges are secured before placing concrete. Treat formwork with a form release agent approved by the Engineer just before placing concrete.

Use a form release agent that will not discolor or otherwise injuriously affect the concrete surface or subsequent finish. Apply release agents to the forms before the reinforcement is placed. Remove all excess release agent from the face surfaces, and clean the ties and reinforcement with an approved solvent where necessary.

c. Metal Forms. Use the applicable requirements for wood forms that apply to metal forms. Use a metal for forms that is of such thickness that the forms will remain true to shape. Ensure that all bolt and rivet heads are countersunk. Use clamps, pins, or other connecting devices that are designed to hold the forms rigidly together and to allow removal without injury to the concrete. Do not use metal forms that do not present a smooth surface or line up properly. Keep metal forms free from rust, grease, or other foreign matter that will discolor the concrete.

808.03.5 Placing Concrete (Conventional Method).

a. General. In preparation for the placing of concrete, remove all sawdust, chips, standing water, and other construction debris and extraneous matter from the interior of forms. Remove struts, stays, and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, when the concrete placing has reached an elevation rendering their service unnecessary. Remove these temporary members from the forms. Cut back any hardware allowed to remain in the formwork to the design cover for reinforcement. Fill the resulting recess in the concrete surface with a patching mortar that matches the concrete color approved by the Engineer.

Notify the Engineer 48 hours in advance of placing concrete to provide ample time for the inspection of forms, steel reinforcement, materials, and equipment. Submit a plan for concrete washout to ensure that there is a sufficient volume and an appropriate location before starting concrete placement operations.

Place and consolidate concrete to not cause segregation of materials or displacement of reinforcement and to provide a dense homogeneous concrete that is free of voids and rock pockets. If the quality of the concrete is inadequate, stop work immediately until the quality issue has been resolved to the satisfaction of the Engineer.

Use metal or metal-lined open chutes. Where steep slopes are required, ensure that the chutes are equipped with baffles erected in short lengths to slow the movement of concrete.

Ensure that each part of the form is filled by depositing the concrete as near to its final position as practical.

Do not drop concrete more than 5 ft. Use a tube with a hopper head or other approved device to prevent segregation of the mix and splattering of mortar.

Ensure that all chutes and pipes remain clean and free from coatings of hardened concrete by flushing with water after each run. For washout of chutes and pipes only, direct the concrete into an appropriate concrete washout area. Otherwise, properly dispose of any leftover concrete.

Consolidate concrete by mechanical, high frequency internal or external vibrators, or both, as acceptable to the Engineer. Equip handheld vibrators with rubber tipped heads when used to consolidate around the reinforcement. Ensure that the vibration at any point has sufficient duration to accomplish thorough consolidation but not be prolonged to cause segregation or bleeding.

Do not use vibration directly to or through the reinforcement to sections or layers of concrete that have hardened so that the concrete ceases to be plastic under vibration. Do not use vibrators to transport concrete within the forms.

Continuously place concrete in horizontal layers to prevent separation planes. When less than a 12-in. layer is placed in one operation, terminate the layer in a vertical bulkhead. Place and consolidate each layer before the preceding course has taken initial set to avoid the formation of a cold joint.

If the placing of concrete is temporarily delayed, cover the concrete immediately and keep moist to retard initial set until placement can resume. If placing of concrete is temporarily discontinued, form a construction joint immediately. Do not allow any cold joints. Clean laitance and other objectionable material from the new construction joint when placement is scheduled to resume.

To avoid visible joints as practical upon exposed faces, smooth the top surface of the concrete adjacent to the forms with a trowel. Where a feather edge might be produced at a construction joint, as in the sloped surface of a wingwall, use an inset form to produce a blocked out portion in the preceding layer that produces an edge thickness of not less than 6 in. in the succeeding layer. Do not discontinue work within 18 in. of the top of any face, unless provision has been made for a coping less than 18 in. thick. In this case, and if permitted by the Engineer, the construction joint may be made at the underside of the coping.

Immediately following the discontinuance of placing concrete, remove all accumulations of mortar splashed upon the reinforcing steel and the surface of forms. Do not puddle dried mortar chips and dust into the unset concrete. If the accumulations are not removed before the concrete becomes set, do not damage or break the concrete steel bond at and near the surface of the concrete while cleaning the reinforcing steel.

b. Vertical Members. Place and allow to set and settle the concrete for columns, substructure, culvert walls, and other similar vertical members for a sufficient amount of time before the concrete for integral horizontal members, such as caps, slabs, or footings, is placed. Ensure that the time is adequate to allow completion of settlement due to loss of bleed water. This is not less than 12 hours for vertical members over 15 ft in height and not less than 30 minutes for members over 5 ft but not over 15 ft in height. When friction

collars or falsework brackets are mounted on the vertical members, ensure that the vertical member is in place at least seven days and has attained its specified design strength before loads from horizontal members are applied.

c. Slabs. Before any slab concrete is placed, have access to an approved finishing tool for striking off the surface of the slab to the required crown.

For bridge deck slabs, refer to **SECTION 814**.

d. Superstructure. Do not place any concrete in the superstructure until the substructure has reached its specified design strength and the substructure forms have been stripped sufficiently to determine the character of the supporting substructure concrete.

Concrete for T-beam or deck girder spans with depths less than 4 ft may be placed in one continuous operation or may be placed in two separate operations — first, to the top of the girder stems and, second, to completion. For T-beam or deck girder spans with depths 4 ft or more and, unless the falsework is non-yielding, place the concrete in two operations. Ensure that at least five days have elapsed after placement of stems before the top deck slab is placed.

e. Arch Rings. Place the concrete in arch rings to load the centering uniformly. Cast arch rings and ribs preferably in a single continuous operation. However, with the approval of the Engineer, the arch rings and ribs may be divided by radial bulkheads into transverse sections of a size that each section can be cast in a continuous operation. The arrangement of the sections and the sequence of placing will be approved by the Engineer. Ensure that the arrangement does not distort the centering and consequent creation of initial stress in the newly placed concrete or its reinforcement. Bond the sections together by suitable keys. Where special key sections are required, mix the concrete as dry as practical and consolidate by vibration. Do not cast the spandrel walls or columns and the beams until after the centering is struck. Do not cast any part of the coping, railing, or floor until the spandrel walls or columns are complete. Where casting spandrel wall elements on newly constructed arch rings, ensure that the concrete has reached its required compressive strength before casting.

f. Placing Concrete Under Water. Do not place concrete under water except with the approval of the Engineer and under his/her supervision. In this case, the method of placing will be as specified.

Ensure that concrete placed under water conforms to **Subsection 601.02.1**. Use a tremie to place concrete in water and do not disturb after placement. Maintain still water at the point of placement and ensure that the forms under water are watertight.

For parts of structures under water, when practical, place concrete seals continuously from start to finish. Always keep the surface of the concrete as nearly horizontal as practical. To ensure thorough bonding, place each succeeding layer of a seal before the preceding layer has taken initial set.

Provide a tremie that includes a tube having a diameter of not less than 10 in., constructed in sections having flanged couplings fitted with gaskets. Support the tremies to permit free movement of the discharge over the entire top surface of the work to permit rapid lowering

when necessary to retard or stop the flow of concrete. Close the discharge end with a foot valve when work is initiated to prevent water from entering the tube. Seal all joints so that the concrete may be discharged into the empty tube. Ensure that the tremie tube remains full to the bottom of the hopper. When a batch is dumped into the hopper, induce the flow of concrete by slightly raising the discharge end but always keeping the flow in the mass of placed concrete. Ensure that the flow is continuous until the work is completed.

Do not proceed with dewatering until seven days after completion of the pour. Perform the dewatering to comply with **SECTION 208**. Remove all laitance or other unsatisfactory material from the exposed surface by scraping, chipping, or other means so that the surface of the concrete will not be damaged.

g. Concrete Exposed to Sea Water. Do not place any construction joints where they are exposed to sea water.

h. Cold Weather Concrete. Ensure that concrete operations during cold weather conform to **Subsection 601.03.5**.

i. Hot Weather Concrete. Ensure that concrete operations during hot weather conform to **Subsection 601.03.6**.

808.03.6 Placing Concrete by Pumping (Optional Method).

a. Pumping. Placement of concrete by pumping will be permitted as approved by the Engineer. Arrange the equipment so that no vibrations result that might damage freshly placed concrete. Ensure a pump operation that provides a continuous stream of concrete without air pockets. When pumping is completed, eject the concrete remaining in the pipeline, if such will be used, so that there will be no contamination of the concrete or separation of the ingredients.

b. Handling and Placing Concrete. Place concrete to avoid segregation of materials and displacement of reinforcement. Before the placement of concrete, the Engineer may require the Contractor to demonstrate the capability of the equipment to both convey the concrete mixture and maintain the specified quality. No further verification of the equipment's capability will be required unless evidence of nonuniform concrete is observed by the Engineer during placement.

Do not allow concrete to contact aluminum during conveying and placing operations. When concrete pumps are used, ensure that the lines have a minimum diameter of 5 in.

Keep all chutes, troughs, and pipes clean and free from coatings of hardened concrete by flushing with water after each run; properly dispose of water used for flushing clear of the concrete already in place. Use a concrete washout to flush chutes, troughs, and pipes only. Properly dispose of all other leftover concrete.

Do not drop concrete more than 5 ft or deposit a large quantity at any specific point and then run or work it along the forms.

Fill each part of the form by depositing concrete directly in the form as close to its final position as practical; to work the coarser aggregates back from the face of the concrete; and to force the concrete under and around the reinforcement. After the concrete has taken its initial set, avoid jarring the forms or placing any strain on the ends of projecting reinforcement.

c. Design Mix. As an option, submit for approval by the Engineer a pump mix design formula of the concrete mixture for use with the specific pumping equipment. Ensure that the concrete mixture complies with **Subsection 601.03.1**.

d. Placing Concrete Under Water. Place concrete under water continuously from start to finish. Keep the surface of the concrete as horizontal as practical. To ensure bonding, place each succeeding layer of seal before the preceding layer has taken initial set. For large pours, use more than one tremie or pump to ensure compliance with this requirement.

808.03.7 Expansion, Contraction, and Construction Joints.

The following applies to concrete joints:

- General. Joints may be filled or open. Filled joints may be the poured type or filled with a premolded filler. **Subsection M02.10** specifies materials for joint fillers and sealants.
- Flashing and Water Stops. Splice, weld, or solder metal flashing or flexible water stops to form continuous watertight joints that conform to **SECTION 812**.
- Construction Joints. To reduce the size of pours or for other construction reasons, additional joints may be provided at locations approved by the Engineer.

  Ensure that all bonded construction joints obtain a bond between subsequent placements. Chip and clean all laitance and debris from the surface of the hardened concrete. Clean the contact areas, moisten with water, and cover with a coating of mortar or neat cement grout. Place the new concrete before the grout has attained its initial set and carefully spade into position.

  Use shear keys, steel dowels, or inclined reinforcement approved by the Engineer where necessary to transmit shear or to bond the two sections together.
- Contraction Joints. Use a bond breaker material approved by the Engineer with contraction joints.
- Expansion Joints. Clean joints to be sealed of all foreign matter. Apply joint fillers according to **Subsection 808.03.8**.

808.03.8 Joint Fillers and Sealants.

For all the following, use a joint filler or sealant that is on the RIDOT Approved Materials List.

a. Preformed Polyethylene Foam Joint Filler.

- Preparation. Ensure that joints are dry and cleaned of all deleterious material before placing the joint fillers and sealants.

- Installation. Install the preformed joint filler according to the manufacturer's recommendations.

b. Polyurethane Joint Sealant.

- Preparation. Clean all joints of contaminants and impurities to the depth at which the sealant (and backer rod if detailed) will be installed. Ensure that the operation provides a sound, clean, and frost-free surface for sealant application. Blow out all dust, loose particles, and other debris with oil free compressed air.

  Install an expanded closed cell polyethylene foam rod backup material in joints, or install an approved bond breaker tape if on the Plans.

- Application. Apply a primer to the concrete surfaces of the joints. Use a primer according to the recommendation of the sealant manufacturer and do not apply the primer to the backup rod or the bond breaker tape.

  Apply the polyurethane joint sealant in conformance with the manufacturer's recommendations and, in no case, thicker than ½ in. Ensure that the approximate width to depth ratio of 2:1 for working joints.

  Tool the joint so that it is slightly concave. A soap solution may be used as a tooling aid.

c. Polyurethane Elastomeric Joint Sealant.

- Preparation. The preparation requirements for this sealant are identical to those specified above in Para. b.1 of this Subsection for Polyurethane Joint Sealant.

- Application. Apply a primer to the concrete surfaces of the joints. Ensure that the primer is according to the recommendation of the sealant manufacturer and is not applied to the backup rod or the bond breaker tape.

  Apply the polyurethane elastomeric joint sealant according to the manufacturer's recommendations.

  Do not apply the sealant to joints less than ¼ in. in width. Provide an approximate width to depth ratio of 2:1 for working joints. The application temperature range is 40°F to 100°F.

  Tool the joint so that it is slightly concave. A soap solution may be used as a tooling aid.

  Clean up any spillage immediately according to local regulations and the directions of the Engineer.

d. Silicone Joint Sealant.

Use silicone joint sealants, either on the AML or with the Engineer's approval, according to the manufacturer's recommendations.

808.03.9 Curing Concrete.

Ensure that Portland cement concrete is cured according to **Subsection 601.03.**, except ensure that all placements designated as mass concrete meet the requirements of **SECTION 607**.

808.03.10 Removal of Forms, Falsework, and Centering.

In general, do not remove forms for slabs, beams, pier caps, and other support members until the concrete has reached the specified 28-day strength as indicated by the compression tests of field-cured cylinders fabricated and tested by the Contractor.

To facilitate finishing, side forms carrying no load may be removed after 24 hours if approved by the Engineer. Continue the wet curing process for the remainder of the 14-day wet curing period at no additional cost to the Department.

The following Table presents the minimum strength requirements for the removal of formwork, placement of loads, and placement of backfill.

Structural Element	Removal of Formwork	Placing Superimposed Vertical Dead Loads*	Placement of Backfill
	Strength ($\%f'_c$)	Strength ($\%f'_c$)	Strength ($\%f'_c$)
Subfoundation Concrete	20	30	20
Cast-in-Place Concrete Piles	N/A	50	N/A
Footing	30	40	30
Abutment Wall, Rigid Frame Wall, and Box Culvert Wall	30	50	95
Piers/Columns	30	50	N/A
Drilled Shaft Above Grade	55	60	N/A
Pile Cap and Pier Cap	50	60	50
Arch (Span ≤ 65 ft) (BF)	40	95	95
Arch (Span ≤ 65 ft) (SF)	30		
Concrete Beam (BF)	60	80	N/A
Concrete Beam (SF)	30		
Slab (Span ≤ 10 ft) and Diaphragms**	30	85	95
Slab (Span > 10 ft)**	50		
Bridge Decks	***	85	N/A
Retaining Wall, Headwall, and Wingwall	30	30	95
Parapet Wall, Curb, and Backwall	20	20	50

BF – bottom form SF – side form

* *Examples are placement of parapets on slabs, placement of walls on footings, and placement of beams on pier caps.*

** *Slab includes slab type bridges, box culvert top slabs, rigid frame top slabs, approach slabs, moment slabs, and sleeper slabs.*

*** *Leave all forms in place without loosening for seven uninterrupted calendar days.*

Cure the Quality Control cylinders that are cast for the specific use as cylinder strength testing for form removal in the field under the same conditions as the placed structure concrete according to AASHTO T23/R100.

Test the cylinders to determine concrete strength before removing forms or placing loads on the concrete.

Do not strike falsework and centering for filled arches until fills behind the abutments have been placed up to the spring line. Do not remove falsework supporting the deck of rigid frame structures until fills have been placed behind the vertical legs according to **Subsection 203.03.5.**

Gradually and uniformly lower centers to avoid excessive stresses in any part of the structure. In arch structures of two or more spans, the sequence of striking centers will be specified by the Engineer.

Strike arch centering and ensure that the arch is self-supporting before the railing or coping is placed.

808.03.11 Concrete Finishes.

a. General. Ensure that finishes for concrete bridge decks placed by self-propelled machines conform to **SECTION 814**. Otherwise, apply finishes to different types of surfaces as follows:

- Float Finish. Tops of walls, piers, abutments, parapets, safety walks, sidewalks, and medians.
- Rubbed Finish. All exposed surfaces visible in elevation to 1 ft below final ground line and the underside of concrete slabs outside of the fascia beam.
- Bush-Hammered or Sand Blasted. As shown on the Plans.

b. Float Finish. Achieve float finish for horizontal surfaces by placing excess concrete in the forms and striking it off with a template or screed, forcing the coarse aggregate below the surface. Finish the surface with a wooden float to a smooth true plane. Finish the area under bearing plates as practical to ⅛ in. above the final elevation and then dressed to a uniform level bearing with a carborundum brick or power grinder after the concrete has sufficiently set.

c. Rubbed Finish. After the concrete has hardened, saturate the surface with water and rub using a medium-coarse carborundum stone with a small quantity of mortar on its face. Approved bonding agents may be used.

Use mortar consisting of cement and fine sand in the same proportions used in the concrete being rubbed. Continue rubbing until all form marks, projections, and irregularities are removed, all voids filled, and a uniform surface is obtained. Keep the paste produced by rubbing moist and allow it to set for at least five days. Smooth the surface by rubbing with a fine carborundum stone and water. Rub to produce a smooth texture and uniform color over the entire surface. After the final rubbing is complete and the surface has dried, rub the entire surface with burlap to remove loose mortar. Ensure

that the finished surface does not have unsound patches, paste, powder, or objectionable marks.

d. Bushhammered or Sandblasted Finish. Before finishing any concrete, cast a test panel approximately 4 ft × 4 ft in a vertical position with a joint in the form work near approximately the middle of the panel and demonstrate the proposed method. This method will be approved by the Engineer before use. If the first trial panel does not produce satisfactory results, cast one or more trial panels until a satisfactory finish is obtained.

Cure the surfaces to be finished. After the forms have been removed, patch all holes with an approved mortar that complies with **Subsection M04.03.5**, and remove any fins or other protuberances to present a roughly even surface. Do not initiate any finishing until the concrete has attained its specified 28-day strength.

When finishing bevels or corners, do not damage the lines. After the surfaces are finished, remove all dust and loose particles by brushing with stiff wire brushes or air blasting.

e. Concrete Architectural Treatment Form Liner Finish. The architectural treatment is achieved using form liners. Use form liners that are attached to the concrete formwork and are of the single-use type from the same manufacturer.

Provide evidence to the satisfaction of the Engineer that the products and their installation have been successfully used in similar applications.

Before construction, present a sample panel to the Engineer that includes a butt joint to ensure that the form liner panels produce a consistent surface pattern and appearance without visible seams. Provide a sample panel that has a minimum size of 5 sq ft.

Submit Shop Drawings for the concrete architectural treatment system according to **Subsection 105.02**. The Engineer will review the Shop Drawings and samples for compliance with the specifications.

Apply the concrete architectural treatment to the exterior face of concrete surfaces within the required limits to a minimum of 1 ft below the finished grade. Apply form liners per the manufacturer's recommendations and according to the following provisions:

- Mate form liners with the adjacent panels to produce a consistent pattern, and place adjacent liners to each other with a ⅛-in. seam or less. Attach the form liners to the forms per the manufacturer's recommendations. Coordinate wall ties with the form liner system.

- Ensure that form liners are rigid and capable of withstanding the anticipated concrete placement pressures without leakage, which could cause physical or visual defects, and are able to be removed without causing concrete surface deterioration or weakness in the substrate. Ensure that form release agents, form stripping methods, patching materials, and related construction materials are compatible with all other elements of concrete architectural treatment.

- Blend form liner butt joints into the approved pattern. Ensure that no visible vertical or horizontal seams or conspicuous form marks are created by butt-joined form liners. Ensure that the finished concrete surface has the required finished texture and continuous pattern.

- The Engineer must approve the use of wall ties that result in a portion of the tie being permanently embedded in the concrete before initiating work. Provide wall ties with break setbacks of 1 in. minimum from the finished concrete surface. Place the wall tie holes in the high point of the rustication or mortar joint. Fill any voids left from snapped off wall ties with an approved color matching mortar patch.

- Place concrete according to **Subsection 808.03.5** with an emphasis on the proper vibration of the concrete next to the form liner to ensure that no honeycombs or other deficiencies occur in the face of the concrete.

- After stripping the forms and form liners, clean the concrete surface to ensure that it is free of all laitance, dirt, dust, grease, release agents, efflorescence, and any other foreign or deleterious materials.

- Do not use sandblasting to clean concrete surfaces; use pressure washing with water for removing laitance. When pressure washing will be used, perform the work according to **SECTION 815**. Ensure that the completed surface is free of blemishes, discolorations, surface voids greater than ⅜ in. in diameter, and conspicuous form marks. Ensure that the cleaning process does not diminish the rustic appearance created by the form liner. Ensure that inlet protection is in place and properly maintained.

  Provide materials that are prepared, applied, cured, and stored according to the product manufacturers' directions.

  When directed by the Engineer, provide the manufacturer's technical representatives to answer questions and/or make recommendations before and during the work operations.

808.04 METHOD OF MEASUREMENT.

Structure Concrete Masonry will be measured by the number of cubic yards of concrete provided.

808.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Structure Concrete Masonry	CY

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Unless otherwise included for payment under a specific item, Joint Fillers, Joint Sealants, and Concrete Finishes are incidental to Structure Concrete Masonry and are not paid separately.

The use of a diver for required Contractor Quality Control is incidental to the work being performed and is not paid separately.

Concrete finishes are incidental to the work being performed and are not paid separately.

SECTION 809 — PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY

809.01 DESCRIPTION.

This work includes providing precast, prestressed concrete elements, both pre-tensioned and post-tensioned, and precast concrete elements at the required locations.

809.01.1 General.

Ensure that prestressed concrete structural elements are manufactured according to the Prestressed Concrete Institute *Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products*, MNL 116, currently adopted edition. Ensure that precast and prestressed concrete elements are manufactured in a facility that is certified by the Precast/Prestressed Concrete Institute (PCI) or the National Precast Concrete Association (NPCA).

809.01.2 Out-of-State Inspection Services.

The Department will conduct inspections of the plant and laboratory and will witness the trial batches, full-time acceptance testing, and part-time Independent Assurance sampling and testing (as defined in the Department's Materials Master Schedule of Testing) for all phases of production, repair of products, loading, shipping, and other related operations, including travel days as deemed necessary by the Engineer. Inspection service days or part thereof will also include weekends, holidays, and shutdowns due to the Contractor's inability to produce.

809.02 MATERIALS.

809.02.1 Concrete.

Provide a concrete design mix to produce the strength and other characteristics according to **SECTION 601.**

809.02.2 Steel.

Except as noted herein, ensure that reinforcing steel conforms to **SECTION 810**.

a. Other Requirements. Ensure that steel components conform to the following additional requirements:

- Provide galvanized or plastic chairs or other devices capable of supporting the loads without deformations to ensure the proper placement of steel items all as approved by the Engineer.
- Provide prestressing steel according to **Subsection M05.04**.
- Provide bearing plates, if required, according to **SECTION M05**.
- For coated steel, repair all breaks with a coating according to the manufacturer's recommendations before placement in the form. Use coated tie wires with coated rebars.

- The Engineer will approve in writing any additional prestressing steel strands, reinforcing steel, wire mesh, and any other necessary materials.

809.03 CONSTRUCTION METHODS.

809.03.1 Equipment Checks and Calibration.

Provide a calibration certificate indicating the load calibration of each gauge and hydraulic jack combination used for tensioning. Ensure that the gauge has marked divisions of 2 percent of the final tensioning force that are easily readable at the initial and final tensioning force. Calibrate each combination gauge and hydraulic jack every six months. Recalibrate any rams after repair, such as replacing the seals or changing the length of the hydraulic lines with a load cell.

Provide a compressive strength testing machine conforming to AASHTO T22 Specifications. Produce, store, and cap the specimens according to AASHTO Specifications. Calibrate the compressive strength testing machine at least once every six months and provide the calibration certificate to the Engineer. Provide the Engineer with full access to the compressive testing machine.

809.03.2 Inspection of the Plant and Facilities.

The Engineer will inspect the fabrication of all units. Provide a plant laboratory conforming to **SECTION 930**. The Contractor may perform work in the absence of the Engineer with the Engineer's prior written approval. Inform the Engineer of the day-to-day scheduling of operations. Provide the Engineer free access throughout the fabrication plant to observe that the work being performed conforms to the Contract Documents.

Notify the Engineer before:

- Commencement of production: 30 days
- Recommencement of work after a suspension of 48 hours or more:
  - A minimum of two days when the Engineer is on site
  - A minimum of two weeks when the Engineer is not on site
- Unit shipping:
  - A minimum of two days when the Engineer is on site
  - A minimum of two weeks when the Engineer is not on site

809.03.3 Shop Drawings and Concrete Forms.

a. Drawings.

- Contract Plans. Plans that accompany the Contract documents are designated as Contract Plans. These are not considered Shop Drawings.

- Shop Drawings. Submit Shop Drawings to the Engineer for approval according to **Subsection 105.02**. Modify the dimensions of prestressed units to compensate for elastic shortening, shrinkage, grade corrections, and other factors that make in-process fabricating dimensions different from those shown on the Contract Plans. Do

not perform any fabrication until the Shop Drawings have been approved by the Engineer and copies of the approved Shop Drawings have been submitted to the Engineer.

- Information Required on Shop Drawings. Provide Shop Drawings that include the following information:
  - Plan layout of structure indicating the element identification assigned to each precast/prestressed unit
  - A tensioning and detensioning schedule for all prestressed products to be fabricated
  - Complete details, including:
    - anticipated initial and shipping cambers
    - tensioning force (initial and final)
    - concrete compressive strength for stripping of forms (for precast elements
    - load transfer strength for prestressed elements
    - 28-day strength for shipping), class of concrete, and type and location of lifting devices
  - All deviations from the precast/prestressed unit details shown on the Plans
  - For drawings and other relevant documentation for prestressed concrete elements, refer to “Prestressed Concrete Notes” indicated on the Plans
- Information Required with Shop Drawings. Provide the following information with the Shop Drawings:
  - Calculations of prestressing steel strand elongation for each unique casting length (grip to grip)
  - The location of all dunnage and pick up points

- Approval. Submission for the Engineer’s approval in writing of a detailed plan for curing the precast/prestressed elements. Provide a detailed plan that includes the following:
  - Curing method
  - Provision for enclosures, indicating method of holding down enclosure safely in place
  - Heating devices, types, and location around the structure

- Method of monitoring time/temperature of hardened concrete
- Backup systems as required

b. General. Ensure that forms are constructed according to PCI MNL 116 Division 2.4. The Engineer will approve in writing all forms before placing concrete.

c. Critical Dimensions. Before placing concrete, verify that all critical dimensions conform to the tolerances in the current edition of PCI MNL 116 and the approved Shop Drawings, including:

- Lengths and widths
- Cable locations
- Position of weld plates and bearing plates
- Bulkhead locations and dimensions
- Blockout locations
- Post tensioning duct locations
- Keyway dimensions
- Dimensions on skewed or battered ends
- Expansion duct locations
- Insert locations
- Fixed and expansion sleeve locations
- Locations of voids
- Location of drip grooves
- Sizes of voids

d. Void-Producing Forms. Construct void-producing forms with a waterproof material and with a 1-in. diameter vent located at each end of the void. Vent all voids after removing the concrete element from the form.

809.03.4 Prestressing Steel.

Before installation in the units, ensure that the prestressing steel is free of rust, frost, dirt, oil, paint, corrosion, or any foreign material that may prevent bonding between the steel and the concrete. The Engineer will reject any prestressing steel that has sustained physical damage. The development of pitting or corrosion impacts (other than rust stain) will be cause for rejection as determined by the Engineer. Examine prestressing steel that is exhibiting rust stains before its placement in the forms to determine if pitting exists. Replace any coil that contains broken prestressing or post tensioning steel strands.

Do not splice prestressing steel strands inside the casting form. Splicing of strands outside the casting form may be allowed only with prior written approval of the Engineer. Do not tack weld the bar reinforcement.

Place and fasten all steel reinforcement according to **Subsection 810.03.5**.

Furnish a manufacturer's Certificate of Compliance and a mill test report per size, heat number, source, and load for all prestressing steel strands. The Engineer may obtain strand steel samples for verification testing.

See **SECTION 810** for reinforcing steel.

809.03.5 Tensioning of Prestressing Strands.

Tension the prestressing elements to provide the required prestress to conform to the current edition of PCI MNL 116.

Ensure that all strands of a prestressed member are free from kinks or twists before initiating tensioning operations. Do not allow any unwinding of the strand in excess of one turn after tensioning operations are begun. Ensure that all strands are tensioned to 20 percent of the final jacking force before elongation readings are started. Ensure that the equipment for producing the initial tensioning load provides a means for accurately measuring the force. When the initial tensioning load is applied by pressure jacks, equip the jack with a proper gauging system for the initial force.

Apply the pre-designated initial force to each strand. Use this load as the starting point for measuring additional tensioning for tension determination by the elongation method.

When comparing theoretical gauge and actual gauge readings, and theoretical elongations and actual elongations, comply with the requirements of the currently adopted edition of PCI MNL 116.

In the elongation computation, account for strand anchorage slippage, horizontal movement of abutments, bed shortening, and any change in temperature of the prestressing steel between tensioning and the time when concrete takes its initial set, if the change is expected to exceed 30°F. Do not perform the final pretensioning at temperatures below 20°F.

Stress the draped strands no higher than the required design stress minus the stress increase in the strand from forcing it into a draped profile.

If the strands are tensioned in their draped position, support the strands by rollers at each point of change in direction. Ensure that the holdup rollers between members and at the ends of the members have either bronze bushings or roller bearings that are free running and kept well lubricated. Ensure that rollers at the hold-down points are free running and of a type that produces a minimum amount of friction. If the load for a draped strand, as determined by elongation measurements, exceeds 5 percent less than that indicated by the jack gauges, tension the strand from both ends of the bed. Ensure that the load as computed from the sum of elongation at both ends agrees within 5 percent of that indicated by jack gauges.

There may be a discrepancy in the indicated stress between jack gauge pressure and elongation. If yes, ensure that the load used produces a slight overstress rather than understress. When a discrepancy between gauge and elongation measurements of more than 5 percent occurs, check the entire operation and determine and correct the source of error before proceeding further. The Engineer may require the use of a load cell to check the applied load. Calibrate the load cell at least once every six months or more frequently when deemed necessary by the Engineer.

Check prestressing steel strands in pretensioned members, if tensioned individually or in groups, for loss of prestress not more than three hours before placing concrete. The Engineer will approve the method and equipment for checking the loss of prestress. Retension all strands that show a relaxation loss of prestress in excess of 3 percent to the designed final jacking force.

When stressing grouped strands simultaneously, first bring each tendon to initial tensioning load. Apply the final tensioning load to the group using a procedure approved by the Engineer.

During tensioning of any strand, conduct the process so that the applied load and the elongation of the strand may be measured at all times.

Check any prestressed strand that has been tensioned for over 48 hours without the placement of concrete for elongation or loss of stress before placing concrete. If losses occur, detension the strands and then retension according to the design loading requirements.

809.03.6 Handling and Placing Concrete.

Do not place concrete without the Engineer's written approval. Handle and place concrete according to **SECTIONS 601** and **808**.

Convey and place concrete without segregation. Do not drop the concrete mixture from a height greater than one foot above the top of the forms. Deposit the concrete in its final position in each part of the form.

Consolidate the fresh concrete in place according to PCI MNL 116 Division 4.17.

809.03.7 Finishing.

After all concrete has been placed and compacted as required under Subsection 809.03.6, magnesium float finish the tops of units. To ensure production of well-formed concrete elements with an overall pleasing appearance, ensure that all concrete surfaces are true and even and free from rough, open, or honeycombed areas, depressions, air pockets, or projections. Finish all exposed surfaces by bagging or as otherwise indicated.

809.03.8 Curing.

Ensure that curing conforms to PCI MNL 116, Divisions 4.18, 4.19, and 4.20.

Cure precast concrete members for not less than seven days in conformance with the water method, steam curing, or radiant heat at the option of the Contractor. Ensure that steam curing for precast members conforms to the following provisions:

- After placement of the concrete, hold members for a minimum four-hour presteaming period. If the ambient air temperature is below 50°F, apply steam during the presteaming period to hold the air surrounding the member at a temperature between 50°F and 90°F.
- To prevent moisture loss on exposed surfaces during the presteaming period, cover the members as soon as possible after casting, or keep the exposed surfaces wet by fog spray or wet blankets.
- Allow enclosures for steam curing free circulation of steam about the member, and construct the enclosure to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, if the covers remain in good repair and are secured to prevent the loss of steam and moisture.

- Ensure that steam at the jets is low pressure and in a saturated condition. Do not permit steam jets to impinge directly on the concrete, test cylinders, or forms. During application of the steam, ensure that the temperature rise within the enclosure does not exceed 40°F per hour. Ensure that the curing temperature throughout the enclosure does not exceed 150°F and is maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Cover control cylinders to prevent moisture loss, and place the cylinders where temperature is representative of the average temperature of the enclosure.
- Provide calibrated temperature recording devices that will provide an accurate continuous permanent record of the curing temperature. Use a minimum of one temperature recording device per 100 ft of continuous bed length for checking the temperature.
- Once the minimum transfer compressive strength is achieved, detension members in tension immediately after the termination of steam curing while the concrete and forms are still warm, and ensure that the temperature under the enclosure maintains above 60^{O}F until the stress is transferred to the concrete.
- The initial curing of precast concrete will be considered complete once the specified transfer strength is verified by compressive strength test results.
- Radiant heat may be applied by pipes circulating steam, hot oil or hot water, or electric heating elements. Perform radiant heat curing under a suitable enclosure to contain the heat and moisture loss, and minimize heat loss by covering all exposed concrete surfaces with plastic sheeting.

If the Contractor proposes to cure by any other method, the Engineer must approve the method and its details.

809.03.9 Testing.

a. General. Ensure that Acceptance, Contractor Quality Control, and Independent Assurance sampling and testing conforms to **SECTION 601**, as modified herein.

b. Quality Control Testing. Perform mandatory Quality Control Testing of concrete according to **SECTION 601** and according to the following provisions:

- Field cure the Quality Control cylinders under the same curing conditions as the precast/prestressed element. Furnish the cylinder molds for all compressive test specimens.
- Cast Quality Control cylinders and test in the presence of the Engineer.
- Place all cylinders within 15 ft of each end of the casting bed or as determined by the Engineer.
- Test one cylinder from each location in immediate succession to verify form stripping (precast), stress transfer (prestressed), and 28-day strengths (shipping).

- Do not ship any structure from the plant to the Project site unless it has obtained the minimum 28-day compressive strength. Do not ship without the RIDOT Materials inspection stamp or other documented approval by the Engineer.

c. Acceptance Testing. Only the Engineer performs Acceptance testing.

809.03.10 Transfer of Prestress.

Accomplish the transfer of prestress in the presence of the Engineer and according to the approved detensioning schedule and as soon as the transfer strength is achieved and verified. Provide a detensioning schedule that includes the following:

- The order of detensioning
- A provision that each strand is detensioned at each end and/or between each element

At the end of each prestressed element, chip back the concrete surrounding the individual strands to sound material to a depth of between ¾ in. to 1 in. Cut back the strands to the same depth. Square off the edges to avoid producing a feathered edge. Remove all dirt and residue that is not firmly bonded to the metal or concrete surfaces. Fill the ensuing void, including the end of the strand, with an approved non-shrink grout. Finish the surface to be flush with that of the plane surface of the product.

809.03.11 Handling.

Remove all products from the forms in the presence of the Engineer. Provide adequate notice to the Engineer to allow witnessing of the removal operation. Ensure that precast/prestressed members are not damaged during handling and moving. Transport precast girders and slabs in an upright position. Ensure that the points of support and direction of the reactions with respect to the member are approximately the same during transportation and storage as when the member is in its final position.

Ensure that the storage, hoisting, and handling of the precast units prevents cracking or damage. Repairs must be approved by the Engineer at no additional cost to the Department.

809.03.12 Rejection of Units.

The Engineer will make a preliminary determination on whether spalled, cracked, honeycombed, or otherwise defective concrete must be repaired or be subject to rejection. If the unit will be repaired, submit a detailed non-conformance report and a detailed repair procedure to the Engineer for approval in writing before commencement of the repair work.

Perform all repair work at no additional cost to the Department and in the presence of the Engineer. The Engineer will not accept any repair work not performed in his/her presence. The Engineer will reinspect the repaired unit.

809.04 METHOD OF MEASUREMENT.

Precast, Prestressed Concrete Elements will be measured for the specific item or items of work as specified.

All labor, equipment, tools and materials, including but not limited to backer rods, grouting between units, prestressing, patching of duct pockets, and all incidental items required to complete the work as specified and accepted by the Engineer will not be measured separately for payment but will be incidental to the other items of work covered in this Section.

809.05 BASIS OF PAYMENT.

809.05.1 General.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Precast, Prestressed Concrete Elements	SF or LF

The price constitutes full and complete compensation for all labor, equipment, tools, and materials, including backer rods, grouting between units, prestressing, patching of duct pockets, and all incidentals necessary to finish the work, complete and accepted.

809.05.2 Payment for Compensation for Out-of-State Inspection Services.

If a Contractor selects a Subcontractor that is beyond a 50-mile radius of the Department's base of operation, deemed to be the State Office Building (2 Capitol Hill, Providence, RI, 02903), the Contractor shall compensate the Department for the costs of travel and inspection services for the required days of inspection services. The Contractor shall pay for the out-of-State inspection services by the day (per diem) for each Department Engineer and/or Technician assigned to the plant for inspection of the Project. The rates, which will be established based on the radius in miles from the base of operations, shall be as follows:

Distance in Radial Miles	Rates per Inspector/Day
51 to 100 miles	$150.00
Greater than 100 miles	$500.00

There shall be a maximum charge of one inspector for precast operations and two inspectors for prestress operations. The Contractor shall be credited 50 percent of the rates in the Table above when a plant is performing operations for two or more Department Contracts.

The Contractor will not be charged for an initial inspection of a company or a single follow-up inspection for plant approval before initial production.

The compensation payment for out-of-State inspection services will be paid as a progress payment deduction.

SECTION 810 — REINFORCING STEEL

810.01 DESCRIPTION.

This work includes furnishing, protecting, and placing reinforcing steel, both plain and deformed, uncoated and galvanized; spiral wire; welded wire fabric; and the drilling and grouting of reinforcing dowels.

810.02 MATERIALS.

Furnish materials that conform to the following:

- **Subsection M05.02**, bar reinforcement
- **Subsection M05.03.1**, wire fabric
- **Subsection M05.03.2**, spiral wire
- **Subsection M05.06**, galvanized reinforcement

810.03 CONSTRUCTION METHODS.

810.03.1 Bar Schedules and Bending Diagrams.

Submit complete bar schedules and bending diagrams, including material weights, for all reinforcing steel on the Project. Do not initiate fabrication of the reinforcing steel until written approval of the submittals has been received.

810.03.2 Test Bars.

Follow the Master Schedule of Testing requirements for reinforcing steel.

810.03.3 Fabrication and Delivery.

a. Bending. Cut and cold bend to the shapes shown on the Plans. Provide fabrication tolerances according to ACI 315-92, “Detailing Manual.” Do not field bend bars partially embedded in concrete.

b. Hooks and Bend Dimensions. Ensure that the dimensions of hooks and the diameters of bends comply with the latest edition of the AASHTO *LRFD Bridge Design Specifications* or ACI 318, “Building Code Requirements for Reinforced Concrete.”

c. Identification. Furnish bar reinforcement shipped in standard bundles, tagged and marked according to the *Manual of Standard Practice of the Concrete Reinforcing Steel Institute* (CRSI).

810.03.4 Handling, Storage, and Surface Condition of Reinforcement.

a. Uncoated Bars. Store all reinforcement bar, wire, or fabric above the ground on sills, blocking, or other supports immediately when unloaded, and protect from mechanical injury or corrosion causing conditions.

Ensure that all reinforcement is free from dirt, loose rust or scale, mortar, paint, grease, oil, and other materials that could reduce bond, immediately before placement of concrete. Thoroughly hand-wire brush all rusted areas just before installation. After hand-wire brushing, the remaining rusted areas are acceptable if the minimum dimensions, cross sectional area, and tensile properties meet the physical requirements for the size and grade of steel specified.

b. Galvanized Bars. In addition to the above requirements for uncoated bars, the following apply to galvanized bars:

- Use acceptable methods for handling galvanized bars that have padded contact areas for the bars.

- Use padded bundling bands and lift bundles with a strongback, multiple supports, or a platform bridge to prevent bar-to-bar abrasion from sags in the bar bundle. Do not drop or drag bars or bundles.

Provide galvanized bars without visible white oxide or other surface contaminants of the zinc at the time of concrete placement. Bar that has white oxide or other surface contaminants may be cleaned by methods selected by the Contractor, if the methods do not compromise the zinc coating protection, including causing any reduction of the film thickness below the minimum specification limit.

810.03.5 Placing and Fastening.

a. Uncoated Bars. Carefully check all bar lists and assume full responsibility for their accuracy before ordering bar reinforcement. Ensure that the steel reinforcement is held in place during the placing and setting of concrete. Ensure that reinforcement is free from dirt, rust, loose mill scale, paint, oil, and other foreign deleterious materials when placed in the work. The following apply:

- Spacing and Cover. Ensure that the required spacing and cover of reinforcement is met.

- Support Systems. Maintain bars at the correct distance from the forms by using blocks, hangers, chairs, or other approved devices. Do not use pieces of stone, brick, wood, or metal pipe. If required, precast concrete blocks placed with the small face down may be used. Furnish metallic support systems with a protective coating for corrosion protection. Install plastic tips on metallic support hardware resting against formwork.

- Fastening. Before the concrete is placed, securely fasten together all reinforcement and support with approved chairs or other approved devices. Ensure that chairs are properly sized and spaced to provide the specified minimum concrete clear cover. Securely tie bars with wire at all intersections around the perimeter of each mat and within the interior at not less than 2-ft centers or at every intersection, whichever is greater. Tie bundled bars together at not more than 6-ft centers. Tie a sufficient number of intersections to prevent any movement of the mat or loose bars.

Use plastic coated metallic wire ties and miscellaneous metallic hardware. Use plastic tips on metallic hardware resting against formwork.

Ensure that all reinforcement has been placed and tied, inspected, and approved by the Engineer in writing before placement of concrete.

- Splicing Reinforcing Steel. Furnish full length reinforcement bars. Splicing of bars and wire fabric reinforcing is not permitted without the written approval of the Engineer. When allowed, stagger splices as far as possible. Ensure that splices do not reduce the concrete clear cover. The following also apply:

    - Lap Splices. Use only mechanical splices for splices of bars greater than No. 11. The length of each lap splice must conform to the Plans for tension or compression splices. Place the bars in contact and wire them together for the full lap length of the splice.

    - Mechanical Splices. Mechanical splices will be approved in writing by the Engineer. Ensure that the splices develop at least 125 percent of the specified yield strength of the bar being spliced, in tension or compression. Install according to the manufacturer's recommendations.

    - Welds. Do not weld unless authorized in writing by the Engineer. Where welding is indicated, ensure that it conforms to the applicable requirements of ANSI/AWS D1.4, *Structural Welding Code - Reinforcing Steel*.

    - Wire Fabric. Overlap sheets of welded wire fabric sufficiently to maintain a uniform strength and securely fasten the sheets at the ends and edges. Overlap the edge at least one mesh in width plus 2 in.

b. Galvanized Bars. In addition to the applicable provisions of **Subsection 810.03.5(a)**, the following apply to galvanized bars:

- Field Bending. Ensure that field bending complies with ASTM A1094. Where field bending of galvanized reinforcing bars exceeding the ASTM A1094 limits is allowed by the Engineer, touch-up after field bending with a zinc rich primer according to **Subsection 810.03.5(b)**.

- Splices. The following apply:

    - Lap Splices. Splices for bar sizes No. 11 or smaller may be either a lap splice or a mechanical splice.

    - Mechanical Splices. Use mechanical splices for bars larger than No. 11. Ensure that these splices are galvanized.

    - Welds. Before welding reinforcing fabric, remove the galvanized coating for the length of the bar to be welded plus 6 in. on each side of the weld. After welding, remove all slag, weld spatter, and other foreign material; clean the spliced area and re-galvanize according to the field repair procedure in **Subsection 810.03.5(b)**.

- Placement. Before placement, remove all grease, dirt, mortar, and any other foreign substance from the bars. Place galvanized reinforcement in the position and within ACI tolerances.

- Hazardous Materials. Conform to all OSHA regulations that apply to working with zinc-based materials.

- Field Repair. Repair damage to the galvanized coating from shipping and handling and replace bars that are not field repairable. Repairable damage is defined as any bare or loose spots or breaks in the coating that affect an area smaller than 1 sq in.

  Field repair is allowed only when the total number of repairable damaged areas in a 10-ft length of bar is less than six. Do not use material with a total number of damaged areas greater than six or material with a damaged area greater than 1 sq in. Immediately remove the rejected bars from the work site and replace at no cost to the Department.

  Repair the galvanized coating with an approved zinc-rich paint using the following method:

  - Clean the damaged area by power disk, wire brushing, sand, or grit blasting to a near-white metal condition according to SSPC-SP10 (1-mil to 2-mil anchor pattern) as a minimum. Ensure that the surface is clean, dry, and free of oil, grease, flux residue, corrosion products, or other foreign substances.

  - Apply a minimum of two coats following the manufacturer's recommendations. Apply to achieve the applicable ASTM adherence and quality requirements of the original coating, with a minimum dry film thickness of 4 mils. Apply immediately after surface preparation is complete.

  - Grind smooth and chamfer the ends of field cut bars before application to ensure a uniform thickness of paint.

  - These repair procedures are only allowed for field repairs not shop repairs. Complete all repairs at no cost to the Department.

810.03.6 Drill and Grout Reinforcing Dowels.

See **SECTION 819** for the provisions for drilling and grouting dowels and the applicable Sections above.

810.04 METHOD OF MEASUREMENT.

810.04.1 Bar Reinforcement and Spiral Wire.

Bar Reinforcement and Spiral Wire, either plain or deformed, galvanized or uncoated, is measured by the total number of pounds of each type placed. The weight of plain or deformed bars is computed using the unit weights in the AASHTO *LRFD Bridge Design Specifications*. No allowance is made for the weight of the galvanizing in computing the weight of galvanized bar reinforcement.

810.04.2 Wire Fabric Reinforcement.

Welded Wire Fabric Reinforcement, galvanized and uncoated, is measured by the number of square feet placed. Galvanized coating of fabric reinforcement is not measured separately for payment.

810.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Bar Reinforcement and Spiral Wire	LB
Wire Fabric Reinforcement	SF

The weight of clips, ties, separators, chairs, mechanical splices, or other material used for fastening the reinforcing in place is not included for payment.

The prices constitute full compensation for all labor, materials, equipment, and incidentals required to finish the work by the Engineer.

SECTION 811 — WEEP HOLES, PAVEMENT SUBDRAINS, AND WALL DRAINS

811.01 DESCRIPTION.

This work includes the provision of weep holes through abutments and walls; pavement subdrains through bridge decks; and wall drains behind abutments and walls at the required locations.

811.02 MATERIALS.

811.02.1 Weep Holes.

Provide weep holes that are 4 in. in diameter, Schedule 40 polyvinylchloride (PVC) pipe.

811.02.2 Pavement Subdrains.

Provide pavement subdrains that are 2-in. diameter PVC pipe.

811.02.3 Wall Drains.

Provide wall drains that are perforated PVC pipe conforming to **Subsection M04.01.6.**

811.02.4 Filter Stone.

Provide filter stone that conforms to **Subsection M01.07.**

811.02.5 Filter Fabric.

Provide filter fabric that is included in the Department's Approved Materials List.

811.03 CONSTRUCTION METHODS.

811.03.1 Weep Holes.

To drain backfill material, place weep holes through abutments and retaining walls at the required locations.

811.03.2 Pavement Subdrains.

Install pavement subdrains after the waterproofing membrane has been placed and before the asphalt course is laid down. Cut the waterproofing membrane with a sharp blade so that tabs can be folded into the drain hole. Install the drain cap in the drain hole. Prevent displacement of the drain cap as the asphalt courses are placed.

811.03.3 Wall Drains.

Place pipe on compacted backfill materials. Place the perforated side of the pipe down.

Place filter material around the pipe to form a cover of not less than 6 in. Tamp the filter material around the pipe.

811.04 METHOD OF MEASUREMENT.

811.04.1 Weep Holes and Pavement Subdrains.

Weep holes and pavement subdrains will not be measured separately for payment.

811.04.2 Wall Drains.

Wall Drains will not be measured separately for payment.

811.05 BASIS OF PAYMENT.

Unless covered by a specific Proposal Item, materials for the installation of Weep Holes and Pavement Subdrains, and Wall Drains will not be paid for separately but will be included as incidental items in the Contract unit prices per cubic yard for the applicable classes of Portland cement concrete.

SECTION 812 — WATER STOPS

812.01 DESCRIPTION.

This work includes furnishing and installing water stops in various types of concrete joints at the required locations.

812.02 MATERIALS.

Provide polyvinyl chloride (PVC) water stops that are manufactured by the extrusion process from an elastomeric plastic compound, the basic resin of which is PVC. Ensure that the compound contains any additional resins, plasticizers, stabilizers, or other materials needed to ensure that, when the material is compounded, it will meet the performance requirements in the Table below when tested under the indicated ASTM test method. Do not use any reclaimed PVC or other material.

Specifications for PVC Compound

Specific Gravity	ASTM D792	Max 1.35
Durometer Hardness	ASTM D2240	75 ± 5
Tensile Strength	ASTM D412	Min 1.8 ksi
Elongation	ASTM D412	Min 350%
Cold Brittleness	ASTM D746	-35°F
Stiffness in Flexure	ASTM D747	Min 0.350 ksi

812.03 CONSTRUCTION METHODS.

Where movement at the joint is provided for, ensure that the water stop can accommodate the movement without damage. Splice water stops, welded or soldered, to form durable continuous watertight joints.

Ensure that the water stops are neither displaced nor damaged by construction operations or other means. Repair damaged components. Ensure that all surfaces of the water remain free from oil, grease, dried mortar, or any other foreign matter while the water stop is being embedded in concrete. Ensure that all portions of the water stop designed for embedment are tightly enclosed by dense concrete per the manufacturer's recommendations.

Provide a Certificate of Analysis from an approved independent testing laboratory to the Engineer. Ensure that the certificate states that the material furnished conforms to all requirements specified herein and includes all qualitative and quantitative test results. For the installation of water stops, demonstrate proven ability and competence in the installation of these products, in conformance with the manufacturer's instructions:

- Preparatory Work. Protect all water stops from oil, dirt, concrete spatter, and damage, and clean the water stops to receive concrete forms. During the installation of water stops,

eliminate all deficiencies that may cause leakage. Position water stops to not create interference with reinforcing bars and slip during installation.

- Methods. Different methods may be used to fasten the water stop in position. Hold all water stops rigidly in place by extending through slots in keyways; held by split bulkheads; tied to reinforcing bars; or other adequate methods as necessary to ensure proper support and embedment during the concreting process. Ensure that the method used does not cause damage to the water stops nor compromises the integrity of the watertight seal.
- Splicing. PVC water stops may be butt-spliced on the job according to the manufacturer's recommendations. Demonstrate to the Engineer that all individuals who are responsible for performing splices can create the proper joint. Upon request, the manufacturer shall demonstrate the splicing method for producing a strong, water-tight butt weld.

812.04 METHOD OF MEASUREMENT.

Water stops will not be measured separately for payment.

812.05 BASIS OF PAYMENT.

Water stops will not be paid for separately and are incidental to the pay item for the concrete listed in the Proposal.

SECTION 813 — WATERPROOFING AND DAMPPROOFING

813.01 DESCRIPTION.

This work includes providing waterproofing and dampproofing systems on concrete bridge decks and other surfaces at the required locations.

813.01.1 Systems.

a. Dampproofing includes a system formulated to apply to surfaces to minimize the intrusion of moisture in areas that will not bear traffic.

b. Waterproofing includes the application of heat-applied, prefabricated membrane or a cold spray-applied liquid membrane.

Use only systems on the Approved Material List.

813.01.2 Asphalt Dampproofing.

Dampproofing includes the application of a dampproofing system to concrete surfaces that complies with the manufacturer's recommendations.

813.01.3 Heat-Applied Prefabricated Membrane.

This type of waterproofing consists of applying a heat-applied asphalt polymer-modified reinforced membrane to concrete surfaces that complies with the manufacturer's recommendations.

813.01.4 Cold Spray-Applied Liquid Membrane.

This type of waterproofing system consists of applying a spray-applied plural component resin-based elastomeric membrane to concrete surfaces that complies with the manufacturer's recommendations.

813.02 MATERIALS.

813.02.1 General.

Deliver materials for waterproofing and dampproofing systems in original, tightly sealed containers and unopened packages, as appropriate for the type of material, clearly labeled with the manufacturer's name, brand name and number, and batch number of the material where appropriate. Before delivery, submit to the Engineer a notarized Certificate of Compliance provided by the manufacturer attesting that the material conforms to the product requirements as approved by the Department. Use a primer recommended by the system manufacturer.

813.02.2 Dampproofing.

Provide a dampproofing system that conforms to **Subsection M12.02**.

813.02.3 Heat-Applied Prefabricated Membrane.

Provide primer and membrane materials of this system conform to **Subsection M12.01.1**.

813.02.4 Cold Spray-Applied Liquid Membrane.

Provide primer and membrane materials of this system that conforms **Subsection M12.01.2**.

813.03 CONSTRUCTION METHODS.

813.03.1 Surface Preparation for All Types.

Before applying the product, ensure that new concrete or repair materials have been cured according to the Standard Specifications or the manufacturer's recommendations, whichever is more stringent. If required, perform degreasing with detergent washing according to ASTM D4258 (Standard Practice for Surface Cleaning Concrete for Coating). Clean concrete surfaces abrasively according to ASTM D4259 (Standard Practice for Abrading Concrete), and repair all spalls and depressions with concrete patch materials per the manufacturer's recommendations. Repair voids and blowholes on vertical in the same manner. Prepare all steel surfaces to a near white metal finish per SSPC-10, and overcoat with the manufacturer's specified primer within four hours, per the manufacturer's recommendations. Ensure that all surfaces to receive the material are free of any substance that could adversely affect adhesion.

Do not allow any overspray on equipment and adjacent areas.

813.03.2 Dampproofing.

a. Application. Apply the dampproofing according to the manufacturer's recommendations. Ensure that the asphalt material covers the surface with a continuous film to the recommended thickness to provide a uniform impervious coating.

b. Acceptance. If the Engineer determines that the work is not being performed satisfactorily or that deficient work is not being properly corrected based on the specifications, furnish the services of a competent technical field representative of the approved manufacturer at no additional cost to the Department. The representative shall instruct the Contractor on installation and inspection procedures in the presence of the Engineer. The representative shall inspect the condition of the prepared and treated surfaces and verify that all surfaces meet the requirements for application of the material. Do not proceed with the application until the representative has confirmed that the surface is ready to receive the material.

813.03.3 Heat-Applied Prefabricated Membrane.

Perform all work according to the manufacturer's recommendations. Ensure that the height onto the vertical curb is at least 2 in. but no more than 3 in.

813.03.4 Cold Spray-Applied Liquid Membrane.

Perform all work according to the manufacturer's recommendations. Ensure that the cold spray laps up at the curb line as with the prefabricated sheet membrane above.

813.04 METHOD OF MEASUREMENT.

Dampproofing, Heat-Applied Prefabricated Membrane, and Cold Spray-Applied Liquid Membrane will be measured by the number of square yards of the neat area of the system placed.

813.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Dampproofing	SY
Heat-Applied Prefabricated Membrane	SY
Cold Spray-Applied Liquid Membrane	SY

The prices constitute full compensation for all labor, materials, equipment, and all incidentals required to finish the work, complete and accepted.

SECTION 814 — PLACEMENT OF CONCRETE BRIDGE DECKS

814.01 DESCRIPTION.

This work includes the placement of concrete bridge decks by using self-propelled finishing machines.

814.02 MATERIALS.

Provide materials for all Portland cement concrete mixes that conform to **SECTION 601**.

814.03 CONSTRUCTION METHODS.

814.03.1 General.

Provide all equipment, tools, and requirements pertaining to the classification, proportioning, and testing for the specified class of concrete, including batching, mixing, handling, placing, curing and finishing, that conform to **SECTIONS 601**, **808**, and **816**, as modified in this Section.

814.03.2 Contractor's Plan.

Before the start of placing the concrete bridge deck, submit a Shop Drawing to the Engineer for approval for a Placement and Curing Plan specifying the:

- Method of concrete conveyance, placement, type, and number of finishing machines
- Rate of pour
- Estimated time of completion
- Screed and rail erection plan*
- Sequence of concrete pours
- Concrete curing procedure

* *Ensure that the screed and rail placement are compatible with the deck being finished full width by the finishing machine. Design the support brackets to support the deck finishing machine and screed rails.*

The Placement and Curing Plan shall be prepared and stamped by a Rhode Island licensed Professional Engineer.

Ensure that the Placement and Curing Plan considers weather conditions and that the Plan includes the details and a complete description of equipment to be used in the handling, placement, finishing, and curing the concrete, including the number and type of personnel who will be engaged in the operation. Approval of this Plan does not relieve the Contractor of the responsibility for the satisfactory performance of the methods and equipment.

Base the elevations for setting forms and screed supports on a set of computations but located no more than 10 ft apart. Before placing the concrete, make all necessary arrangements and have all materials on hand for curing and protecting the concrete deck. Do not proceed with concrete placement until the Engineer is satisfied that all necessary steps have been taken to

ensure compliance with the Contract and that completion of the operation can be accomplished within the required scheduled time. Allow sufficient time to permit inspection by the Engineer.

814.03.3 Limitation of Mixing.

a. Temperature and Weather Conditions. Ensure that all weather and concrete temperature requirements meet **Subsection 601.03.4** except as modified herein.

   Do not place the bridge deck concrete when the relative humidity is below 35 percent. When placing concrete, provide suitable equipment and take appropriate actions as approved by the Engineer to limit the evaporation rate of the exposed concrete surface to less than 0.15 lb/sq-ft/hr. Determine the evaporation rate according to Figure 1 below. To maintain the evaporation rate below the specified limit, mist the surface of the concrete with a triple head nozzle immediately behind the finishing machine and until the curing cover is applied. Rate the nozzle at one gallon per minute or less, and ensure that this produces a fine, fog mist that will maintain a sheen of moisture on the concrete surface without ponding.

b. Hot Weather Concrete. During hot weather conditions, ensure that the concrete temperature at time of placement conforms to **Subsection 601.03.6**.

c. Cold Weather Concrete. During cold weather conditions, ensure that the concrete temperature at the time of placement conforms to **Subsection 601.03.5**.

d. Inclement Weather. When rain or snow is imminent, protect all new concrete to prevent damage that may result in surface imperfections of the deck. Ensure that sufficient polyethylene coverings conforming to **Subsection M02.04.2** are available at the site of the work for possible immediate use.

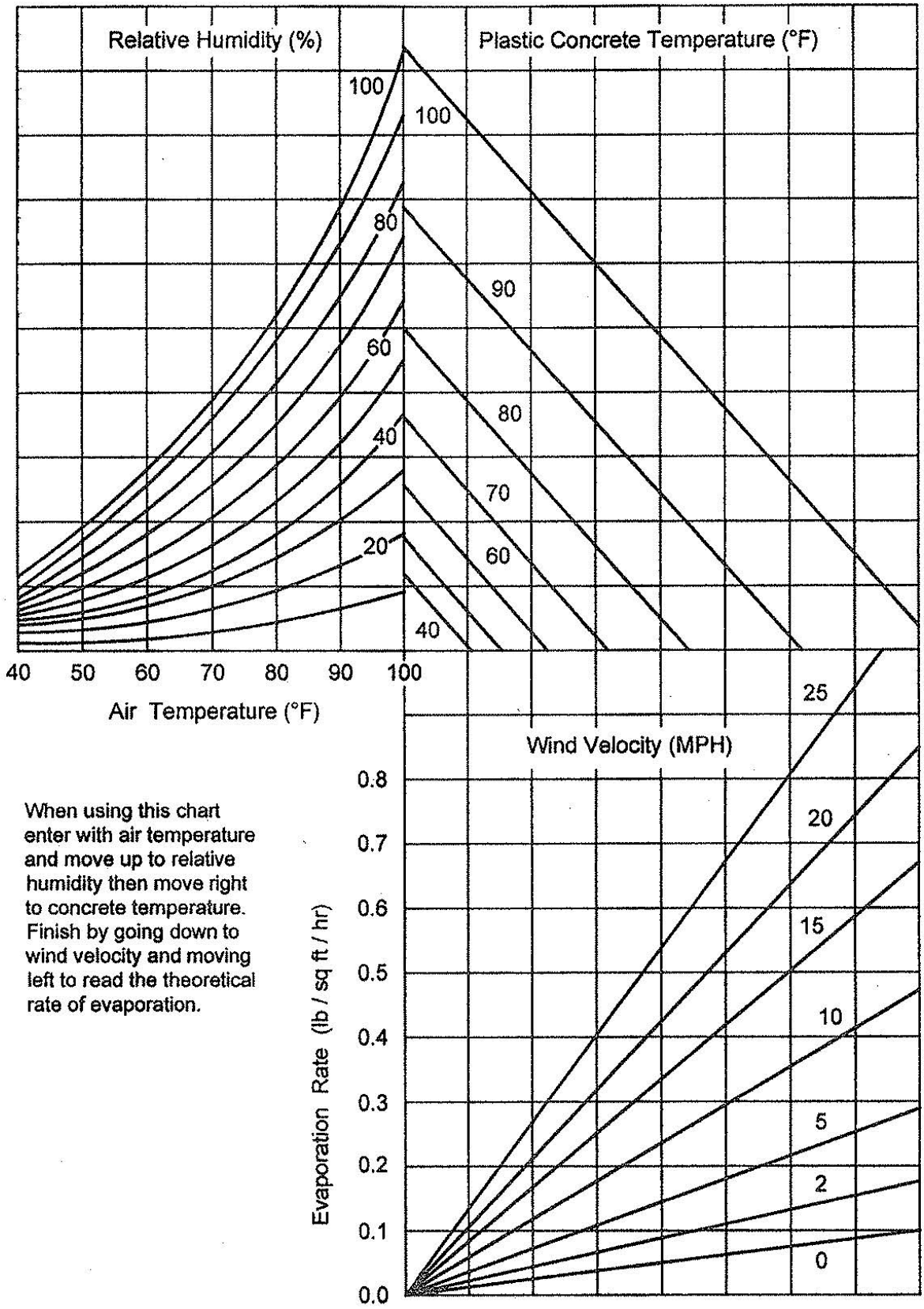
814.03.4 Handling.

Before concrete placement, ensure that all forms are clean and free of rust, excessive oils, and any foreign debris. The Engineer will inspect all concrete forms and materials such as shear connectors, dams, ductwork, spacers, rebars, and any other required materials before concreting operations commence.

Do not weld the forming attachments nor other construction aids to tension flanges.

Place concrete continuously without interruption between planned construction or expansion joints.

Figure 1


Relative Humidity (%)
Plastic Concrete Temperature (°F)
100
100
80
90
60
80
40
70
20
60
40
40 50 60 70 80 90 100
Air Temperature (°F)
Wind Velocity (MPH)
25
20
15
10
5
2
0
Evaporation Rate (lb / sq ft / hr)
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
When using this chart enter with air temperature and move up to relative humidity then move right to concrete temperature. Finish by going down to wind velocity and moving left to read the theoretical rate of evaporation.

814.03.5 Concrete Placement Sequence.

a. Simple Spans. Ensure that concrete bridge deck placement progresses continuously over the entire width and for the full length of the bridge. Begin deck placement at the expansion end of the span and terminate at the fixed end. Transverse construction joints are not permitted.

b. Continuous Spans. Ensure that concrete placement complies with the concrete deck placement sequence specified in the Contract Plans. The Engineer must approve any deviations. Place all concrete between consecutive joints in a continuous operation. The first pour includes the positive moment area in all spans. The second pour includes the negative moment area and is not placed until a minimum of 72 hours have elapsed from initiation of the first pour.

814.03.6 Placement.

Except as modified herein, ensure that concrete placement conforms to **Subsections 808.03.5** and **808.03.6**. Attain a rate of placement so that the concrete is finished before the beginning of initial set. Maintain a minimum rate of placement of 35 cu yd/hr at each finishing machine.

Before concrete placement operations begin, shape substantial bulkheads or headers to the required deck surface cross section. If unforeseen circumstances force the concrete placement to cease, install sufficient bulkheads at locations determined by the Engineer and discontinue concrete placement. Remove all concrete beyond the bulkhead. Concrete placement will recommence only with the approval of the Engineer. Place the concrete as a monolithic unit in a continuous operation between joints.

Consolidate the concrete by a high frequency internal vibrator that is applied to secure maximum consolidation of the concrete. Ensure that consolidation yields concrete free from voids and ensures a dense surface texture, but is not continued so long to cause segregation or bleeding. Maintain a small uniform quantity of concrete ahead of the screed on each pass. Do not allow the quantity of concrete carried ahead of the screed to be so great to cause slipping or lifting.

Where the vibratory action of the finishing machine does not provide consolidation according to the rate of placement, have in reserve sufficient vibration equipment to guard against shutdown of the work. Ensure that the reinforcement is not susceptible to damage by the vibrators.

814.03.7 Finishing.

Use methods, procedures, and equipment that will ensure a uniform riding surface without over-vibration or segregation of the concrete components. Maintain the leading edge of freshly placed concrete approximately parallel to the finishing machine.

a. Finishing Machine. Use an approved self-propelled finishing machine(s) for consolidating, striking off, and finishing the concrete deck surface. Provide a finishing machine(s) that has sufficient width to finish the full width of the deck. Ensure that the weight of the finishing machine(s) does not cause unaccounted for deflection of the bridge members or falsework. Ensure that the machine travels on steel rails, pipe, or other approved grade control, which will be supported by vertical supports securely fastened in place at a maximum spacing of 2 ft to prevent any appreciable deflection between rail supports.

Before placing the concrete, ensure that all screed rails are in place and accurately set to ensure finishing of the concrete deck surface to the required elevations. Provide supports for rails, if embedded in the deck concrete, that can be removed without disturbing the concrete. Do not treat screed rails with form-release compound to facilitate their removal. Extend rails for finishing machines beyond both ends of the scheduled length for concrete placement. Ensure that the extended length is a sufficient distance to allow the finishing machine(s) to clear the concrete to be placed.

Provide a finishing machine that can propel itself both forward and backward to enable repeated passes to correct surface irregularities and to produce a surface that conforms to the required profile grade, cross section, and surface smoothness. A maximum of two passes of the machine will be allowed over any given deck area.

Operate the finishing machine(s) over the full length of the bridge segment to be finished before beginning concrete operations. Conduct a test run with the screed adjusted to its finishing position. During the test run, check the deflection due to the finishing machine, adjustment of guide rails, and required cover for slab reinforcement. Check the required concrete cover over the top bars by riding the screed over the bars and measuring the cover over the slab reinforcement. Rectify discrepancies that are in excess of the allowed tolerances to secure the required concrete cover. Make all necessary corrections before concreting is begun.

Coordinate concrete placement and initial strike-off so that the initial strike-off is never more than 10 ft behind the concrete placement. Make sufficient depth checks behind the machine(s) and along the full length of the span to ensure that the required section and reinforcement cover are provided.

On skewed bridge decks, ensure that the placement of the concrete and the operation of the finishing machine is parallel to the skew angle.

Correct improper adjustment or operation of the finishing machine that results in inadequate reinforcement cover or smoothness. Unsatisfactory performance, particularly with respect to the surface smoothness attained, may be cause for rejection of the equipment.

b. Work Bridge. Provide an adequate number of work bridges to permit access to the deck surface to allow finishing, straight-edging, making corrections, and setting curing materials. Do not permit workmen to walk in the fresh concrete after it has been screeded. Perform all finishing work, including application of the fog spray and placement of curing mats, from work that bridges support above the deck surface.

c. Tolerances. Verify that the completed surface of the deck meets the required grades and cross slope both during placement and after the deck has been cured. When the concrete is still plastic, use a 10-ft straightedge to test the deck surface and correct any variance in excess of ⅛-in. in 10 ft. If this tolerance is not met when tested after the concrete has hardened, correct any variance in excess of ⅛-in. in 10 ft at no additional cost to the Department.

814.03.8 Curing.

In the Placement and Curing Plan, include the following details for curing the concrete.

a. Detailed Plan. Provide a Plan that includes the following:

- Curing method
- Provisions for enclosures, indicating method of holding down enclosure safely in place
- Heat devices, types, and locations around structure
- Method of monitoring temperature of hardened concrete
- Backup systems as required

b. Curing Operations. Immediately following the finishing operation, initiate the application of a water fog spray and apply continuously until the moist covers are placed on the concrete surface. Continue fog spraying to provide a continuous supply of moisture to maintain a thoroughly moist concrete surface. As soon as concrete finishing operations are completed, promptly cover the newly placed concrete surface with a single layer of clean, heavy duty, water-saturated burlap conforming to **Subsection M02.04.1**. Ensure that the burlap is free from cuts, tears, uneven weaving, and contaminants. Place the burlap so that the edges are lapped a minimum of 6 in. Place a 4-mil clear or white polyethylene sheet conforming to **Subsection M02.04.2** over the saturated burlap cover.

White plastic-coated fiber blankets conforming to **Subsection M02.04.2** may be used. Comply with the placement requirements for the burlap edge lapping specification.

Do not apply curing compounds in lieu of fog spray and the moist cure process.

Ensure that all concrete remains continuously moist and protected against any drying for a minimum period of 14 consecutive days after placement of concrete. Ensure that the burlap covers remain moist for the entire 14-day curing period. Do not allow the concrete to be exposed to an alternating wet and dry condition.

If at any time during the curing period the surface of the concrete deck is judged to be losing excessive moisture that adversely affects the curing process, the Engineer may require that the polyethylene sheets be removed and the coverings be saturated. Then recover the saturated coverings with polyethylene sheets.

If forms or sections of forms have been loosened and/or removed in advance of the curing period, immediately cover the exposed concrete surface with saturated curing covers and keep the concrete saturated for the remainder of the curing period.

c. Falling Temperatures. Provide suitable measures to maintain the concrete surface temperature at a minimum of 50°F, and monitor the temperature by a continuously recording thermometer. Continuously maintain the minimum 50°F temperature around the forms and deposited concrete for seven days after concrete placement and above 40°F for the remaining seven days of the curing period.

If, during the curing period, the concrete surface temperatures fall below the temperatures outlined in the paragraph above, enclose the structure and provide external heat. Always have the required heating measures ready on short notice during the curing period. If external heat is required, the following applies:

- Do not count the time required for tenting as curing time.

- Maintain external heat on the structure for the first seven days of the curing period. For the next seven days, gradually reduce the external heat so that the uniform change in temperature does not exceed 5°F in one hour nor exceed 50°F (while still maintaining the minimum temperatures stated above) in any 24-hour period.

Remove forms as specified in **Subsection 808.03.10**.

If during the curing period the concrete surface temperature falls below 35°F, concrete may be rejected if the surface temperature falls below 35°F during the curing period.

Take precautions to protect the concrete deck from damage resulting from severe weather conditions during the curing process.

d. Quality Control Test Cylinders. Fabricate Quality Control test cylinders on all bridge deck placements. Field cure all Quality Control test cylinders with the concrete deck under identical curing conditions according to AASHTO T23 / R100.

814.03.9 Final Finish.

Comply with the following for the final finish:

a. Bridge Decks with Exposed Concrete Surfaces. For the final concrete surface finish, perform the saw cut grooving before the installation of expansion joint systems.

- Equipment. Ensure that the equipment has a positive means of removing the saw cut grooving residue from the deck surface leaving the surface in a clean, near dry condition.

- Surface Preparation – Disposal of Construction Debris. Before initiation of work, submit a debris handling and management plan indicating quantities of residue that are expected to be generated, locations for temporary storage for drying or settling of fines and, if necessary, the location acquired or designated for disposal of residue.

- Disposal. Manage and legally dispose of all debris from the saw cutting operation consistent with applicable health and safety regulations.

- Construction Methods. Ensure that the entire bridge deck area receives saw cut grooving. Perform saw cut grooving to the deck surface while providing positive lateral drainage by maintaining a constant cross slope between saw cutting extremities in each lane.

  Apply a saw cut grooved finish to concrete wearing surfaces. Perform this work using a multi-bladed diamond wet saw with circular saw blades. The Engineer may allow the use of a single blade, circular saw tool, where it is determined that this equipment is necessary to complete the work. The Engineer will approve the proposed equipment before the work is initiated.

Saw cutting may begin only after the specified curing period has elapsed. Cut all grooves in a rectangular shape conforming to the following dimensions:

- Width: ⅛ in. ±1/32 in.
- Depth: ¼ in. ±1/16 in.

Terminate grooves 4 in. to 12 in. away from curbs, parapets, drainage structures, bridge joints, medians, and exposed edges of the structural concrete slab.

During the grooving operations, the Engineer will verify, at random, that the minimum grooved depth is being achieved. If not, then stop grooving operations and make all necessary adjustments, and any repairs, as required by the Engineer. At each location, a minimum of five depth measurements will be taken and the average depth determined. If the average depth is outside the specified depth limits, two additional measurements will be conducted in the vicinity to ascertain non-compliance (i.e., consistently too shallow or too deep). Areas that do not meet the specified minimum groove depth will be subject to corrective action by the Contractor. Areas that exceed the specified maximum groove depth will be subject to a price adjustment of a 1-percent reduction of the concrete cost for that area of diamond grooving performed that day.

Supply the Engineer with two accurate, easily readable, gauges with which to verify groove depth. Deliver the gauges and the applicable manufacturer's instructions for use no later than seven days before the anticipated start of grooving operations.

Do not allow slurry or debris from the grooving operation to accumulate or harden, and prevent the slurry from flowing into drains, onto the roadway slopes, or into water bodies below or adjacent to the bridge. Remove residue continuously and dispose of the slurry or debris properly.

Only use rubber-tired vehicles on the bridge deck after saw cut grooving.

Saw cut grooves may be either transverse or longitudinal as follows as specified on the Plans:

- Transverse Saw Cut Grooves. Cut transverse grooves perpendicular to the centerline of the roadway using a single pass. Ensure that the grooves are randomly spaced, ranging from 1¼ in. to 2 in., with 50 percent of the spacings being less than or equal to 1½ in. Submit a spacing pattern to the Engineer for approval.

  An example of an acceptable random pattern is 1¼, 1½, 1⅜, 1¼, 1¾, 1½, 2, 2, 1½, 1¼, 1⅜, 2, 1⅝, 1¼, 1½, 1½, 1¾, 2, and 1⅝, with all spaces measured in inches. Do not base spacings solely on multiples of ¼ in., because the result will not be truly random (e.g., do not use a pattern such as 1¼, 1¼, 1¾, 2, 1½, 2, 2, etc.).

- Longitudinal Saw Cut Grooves. Cut longitudinal grooves parallel to the bridge centerline, or working line, using continuous passes. On curved alignments,

ensure that longitudinal grooves are parallel to the centerline of construction or working line.

Ensure that the spacing of longitudinal grooves is 1½ in. Spacing does not need to be variable.

Immediately after saw cut grooving, leave the pavement in a washed and clean condition, free of all residue and slurry. Do not permit residue to flow across lanes used by the traveling public or into gutters or drainage facilities.

814.04 METHOD OF MEASUREMENT.

This work will not be measured separately for payment.

814.05 BASIS OF PAYMENT.

No separate payment will be made for this work. Payment will be included with the payment, and at the Contract unit price per cubic yard for Concrete Superstructure Class HP Bridge Deck. This includes all labor, materials, equipment, and all incidentals required to complete the work, including the mixing, handling, placement, finishing, and curing of the bridge deck concrete.

In addition, all costs associated with the management and legal disposal of tipping fees, disposal permits, or applications for permits will be incidental to the concrete work and will not be paid for separately.

SECTION 815 — HIGH-PRESSURE WATER CLEANING

815.01 DESCRIPTION.

815.01.1 Concrete Surfaces.

This work includes the removal of dirt, organic growth such as moss or lichens, efflorescence, and all other accumulated foreign matter from concrete surfaces through the application of a high-pressure water spray to the affected surfaces. The intent of this work is to produce a sufficiently clean surface for color matching of replacement and repair work, the application of concrete sealers, or other required structural repair or rehabilitation work.

815.01.2 Bridge Structures.

This work includes the removal of all dirt, organic growth, efflorescence and all other foreign particles, including sand, salt, guano, and other debris from steel or concrete bridge girders, cross frames, trusses, pier tops, utility supports, utility pipes and conduits, bearing devices, beam seats, scuppers, and other bridge components through the application of a high-pressure water spray to the affected surfaces.

Do not remove or attempt to remove paint, sealant, or any other weatherproof material or waterproof coating.

Existing paint systems on Department bridges may contain toxic substances such as lead, chromium, or cadmium, and these substances are considered hazardous to personnel, the environment, and the public proximate to the Project. Plan and take appropriate precautions during the cleaning operation for waste (including water runoff), containments, and disposal to meet the State and Federal requirements for the protection of workers, the public, and the environment.

815.02 EQUIPMENT.

815.02.1 General.

Ensure that the high-pressure water cleaning equipment has sufficient controls to vary the water pressure so that it can be adjusted to clean the concrete surfaces without damaging the surface being cleaned. Ensure that the equipment produces a maximum pressure of up to 3000 psi and has a functional pressure gauge and control incremented so that the pressure can be adjusted and maintained consistently. Ensure the availability of a sufficient variety of nozzle tips and accessories so that the spray can be applied uniformly to all applicable parts of the structure. Do not allow the tip to concentrate the spray at less than 25 degrees to the surface.

Provide potable water to be used for cleaning.

Do not use detergents to wash the bridge or concrete structure.

815.02.2 Bridge Structures.

Ensure that the cleaning equipment includes the necessary high-pressure water cleaning equipment and all ancillary equipment necessary to flush, clean, and remove all foreign material

from the bridge structure, including hand tools, compressors, water tanks, water pumps, personal protective equipment, and storage containers for proper disposal. Determine the method and equipment, subject to the Engineer's approval, that is best suited to successfully complete the cleaning operation.

815.03 CONSTRUCTION.

815.03.1 Protection of Wildlife.

All nests of protected migratory birds on bridges are presumed to be active and occupied between April 15 and December 15. Do not clean or wash the areas within 3 ft laterally of the nest; begin washing at the 3-ft line and progress away from the nest.

Before April 15 and after December 15, nests of protected migratory birds on bridges will most likely be inactive and unoccupied. Through coordination with the Engineer, confirm that the nests are unoccupied. If unoccupied, remove the nests as part of the cleaning operation based on a USFW Migratory Bird Permit Program.

Do not clean or wash the areas within 3 ft laterally of a bat nest; begin washing at the 3-ft line and progress away from the nest. Remove the nests of unprotected species as part of the cleaning operations.

Treat pigeons as humanely as possible.

815.03.2 Concrete Surfaces.

In the presence of the engineer, perform a test cleaning in an inconspicuous area of the structure to establish the appropriate pressure to produce a sufficiently clean and undamaged surface. Start the initial pressure for the test area at approximately 500 psi, and gradually increase as necessary until the surface has been adequately cleaned to the satisfaction of the engineer. When the test area has been sufficiently cleaned, the Engineer will record the pressure, nozzle used, angle of impingement of the water stream, approximate cleaning rate per square foot, and other pertinent information for reference and inspection during the cleaning operations. Provide a supply of clean potable water for the operation. Do not combine any additives, such as de-greasers, chemical cleaners, detergents, or abrasives, with the water used for cleaning. Perform the Cleaning of concrete surfaces by moving the wand in a smooth stroke to achieve a uniform and thorough cleaning over the entire surface without pitting or marring.

Collect and dispose of the solid material removed from the bridge structure by the cleaning operation at approved waste sites. Do not allow any wastewater or debris from the cleaning operation to enter adjacent water bodies. Protect all stormwater inlets (i.e., scuppers, catch basins, curb inlets) adjacent to the work area before initiating any cleaning operations and for the proper removal of all debris and the protection devices.

Prevent property damage and protect the general public from exposure to spray, debris, and any other potentially hazardous conditions.

815.03.3 Bridge Structures.

In the presence of the Engineer, conduct a test cleaning in an inconspicuous area of the structure to establish the appropriate pressure to produce a sufficiently clean and undamaged surface. Start the initial pressure for the test area at approximately 500 psi, and gradually increase as necessary until the surface has been adequately cleaned to the satisfaction of the Engineer. Ensure that the water pressure is sufficient to remove the accumulated material without damaging the paint coverage of structural steel. When the test area has been sufficiently cleaned, the Engineer will record the pressure, nozzle used, angle of impingement of the water stream, approximate cleaning rate per square foot, and other pertinent information for reference and inspection during the cleaning operations.

Proceed with the cleaning in an orderly manner, subject to the limitations of traffic control. Ensure that no residue from the cleaning operation remains on the surfaces to be cleaned at the completion of the operation. Provide a supply of clean potable water for the operation. Do not combine any additives, such as degreasers, chemical cleaners, detergents, or abrasives, with the water used for cleaning. Perform the cleaning of concrete surfaces by moving the wand in a smooth stroke to achieve a uniform and thorough cleaning over the entire surface without pitting or marring.

Collect and dispose of the solid material removed from the bridge structure by the cleaning operation at approved waste sites. Do not allow any wastewater or debris from the cleaning operation to enter adjacent water bodies. Protect all stormwater inlets (i.e., scuppers, catch basins, curb inlets) adjacent to the work area before initiating any cleaning operations and for the proper removal of all debris and the protection devices.

Prevent property damage and protect the general public from exposure to spray, debris, and any other potentially hazardous conditions.

815.04 METHOD OF MEASUREMENT.

815.04.1 Concrete Surfaces.

High Pressure Water Cleaning of Concrete Surfaces will be measured by the number of square feet of surface cleaned.

815.04.2 Bridge Structures.

High-Pressure Water Cleaning of Bridge Structures will be measured by the number of bridge(s) cleaned.

815.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
High-Pressure Water Cleaning of Concrete Surfaces	SF
High-Pressure Water Cleaning of Bridge Structures	EA BRIDGE

The prices constitute full compensation for all materials, tools, equipment, labor, and all incidentals, including the installation and removal of temporary protective measures, necessary to finish the work, complete and accepted.

SECTION 816 — CONCRETE BRIDGE DECK OVERLAYS

816.01 DESCRIPTION.

This work includes placing a Portland cement concrete overlay on a prepared surface of bridge decks, precast concrete butted box beams, deck slabs, deck planks, or other specified concrete substrate at the required locations.

816.02 MATERIALS.

Use Portland cement concrete that is Class HP and conforms to **SECTION 601**, except as modified herein.

816.03 CONSTRUCTION METHODS.

816.03.1 Existing Bridge Decks.

a. Surface Scarification. Scarify existing bridge decks in an approved manner.

b. Surface Preparation. Perform the blast-cleaning of an area of the deck before the 24-hour water soak period preceding placement of the overlay on the area. Perform the blast-cleaning by a method approved by the Engineer in writing. Clean all debris, including dirty water, resulting from the blast-cleaning operations from the blast-cleaned surfaces and from other areas where debris may have accumulated. Remove all dust and other debris. Protect the blast-cleaned areas, as necessary, against contamination before the 24-hour presoaking. Blast-clean contaminated areas and areas exposed more than 36 hours after cleaning again, as directed by the Engineer and at no additional expense to the Department.

   Soak the prepared surface with clean water for not less than 24 hours before the placement of the Class HP concrete overlay. Maintain the surface in a clean, saturated condition by using polyethylene film or other suitable water-impermeable clear covers, until ready to receive the overlay. Before the overlay is applied, blow off all standing water with oil-free compressed air.

816.03.2 Precast Concrete Butted Box Beams, Deck Slabs, or Deck Beams.

Finish the surfaces of Precast Concrete Butted Box Beams, Deck Slabs, or Deck Planks upon which an overlay will be applied with a roughened surface with amplitude of ¼ in. minimum. Ensure that the method of roughening does not cause cracking.

After the placement and curing of the shear key grout and successful post-tensioning of the structural elements is complete, and before placing the overlay, blast-clean the entire area of the deck according to **Subsection 816.03.1(b)**. Ensure that the profile is maintained after blast cleaning. Protect galvanized reinforcing steel and any other appurtenances cast into the surface of the precast elements from the effect of the blast medium so that damage to the galvanization does not occur.

816.03.3 Bonding Grout.

Apply bonding grout as follows. After the surface has been cleaned and wetted, and immediately before placing concrete, thoroughly broom, brush, or spray a thin (approximately ⅛-in.) coating of bonding grout onto the saturated bridge deck.

Use bonding grout that consists of equal parts, by volume, of Portland cement, microsilica (solids part) and mortar sand with sufficient water to form a slurry. Do not exceed water-to-cementitious ratio by weight of 0.40. Ensure that the consistency of the slurry facilitates the application in a thin, even coating that will not run or puddle.

Do not retemper bonding grout.

Broom bonding grout with straight push brooms at all joints and concrete surfaces around or below reinforcing steel. Ensure that all prepared surface areas receive a thorough, even coating, and that no excess bonding grout is permitted to collect in pockets. Coat all surfaces to be in contact with new concrete with the bonding grout.

Limit the rate of bonding grout application to that surface area that can be covered with new concrete before the bonding grout begins to dry out. Ensure that the application of the bonding grout is not more than 5 ft from the leading edge of the overlay. If drying does occur, as evidenced by a light gray color, remove the bonding grout by sandblasting. Do not wet or spray the wet or dry bonding grout.

816.03.4 Limitations of Mixing.

a. Temperature and Weather Conditions. Ensure that all weather and concrete temperature requirements meet **Subsection 814.03.3** except as modified below.

b. Cold Weather Concrete. Do not place Class HP concrete mixtures when ambient temperatures are below 45°F. However, the Class HP concrete may be placed at 45°F when rising temperatures are forecast and if the forecast indicates temperatures over 45°F for a minimum period of eight hours after the placement has been completed.

   If the minimum air temperatures will not be met, the Contractor may place concrete if the structure is enclosed and external heat is provided to meet specified ambient temperature requirement for placement.

   At temperatures above 85°F, the Engineer may require placements to be made at night or in the early morning hours if a satisfactory surface finish is not being achieved. If any deviation from the approved Traffic Management Plan is necessary, a resubmittal is required.

c. Inclement Weather. For structures that are not enclosed, cease all placing operations when it starts to rain or snow.

816.03.5 Placing and Finishing.

Ensure that Class HP concrete overlay conforms to the placement requirements of **Subsection 814.03.6** except as modified herein. Notify the Engineer before placement, and do not proceed

with concrete placement until receiving the Engineer's approval. Complete the operation within the required scheduled time.

a. Finishing Machine. Ensure that the finishing machine conforms to **Subsection 814.03.7**.

b. Placement and Consolidation. Coordinate the concrete placement and initial strike-off so that initial strike-off is never more than 5 ft behind the concrete placement.

   Ensure that the concrete is consolidated with an approved high frequency (3000 to 7000 vpm) vibratory pan that is applied to secure maximum consolidation of the concrete.

   Use spud vibration in deep pockets, edges, and adjacent to joint bulkheads and overlays greater than 3 in. thick.

   Install a construction dam or bulkhead if a delay in the placement operations occurs exceeding 30 minutes duration. During delays of 30 minutes or less, protect the placement with presoaked wet burlap. If the concrete placement is stopped or delayed for 90 minutes or more, discontinue further placement.

   Separate screed rails and/or construction bulkheads from the newly placed material by passing a pointed trowel along their inside face. Do not separate metal expansion dams from the overlayment. Ensure that the trowel cut is made for the entire depth and length of rails after the mixture has sufficiently stiffened.

c. Finishing. Ensure that the finished surface, before texturing, is uniformly smooth, dense, and even. Variations in pavement surface in excess of ⅛ in. above or below the proper finished elevation or surface irregularities of more than ⅛ in. in 10 ft will not be accepted. Check the concrete surface according to **Subsection 814.03.7(c)**.

   Hand finishing with a float may be required along the edge of the pour or on small areas or repair. Use edge tooling at joints, except next to metal expansion dams, curbs, and previously placed lanes.

816.03.6 Testing.

Field cure all compressive strength cylinders used for QC at the job site and under the same conditions as the Class HP concrete overlay.

816.03.7 Curing Concrete.

Ensure that the curing of Class HP concrete overlay conforms to **Subsections 814.03.2** and **814.03.8**, except as modified below.

Do not allow any vehicular traffic on the Class HP concrete surface for a minimum period of 14 days and after the minimum specified 28-day design compressive strength is achieved.

816.03.8 Grooving.

Texture the final Class HP concrete deck overlay by transverse grooving that conforms to **Subsection 814.03.9**.

816.03.9 Defective or Damaged Class HP Concrete.

Repair or replace all defective or damaged HP concrete identified before the final acceptance of the work. Defects include:

- Insufficient thickness
- Cracking
- Tearing
- Honeycombing
- Damage or other imperfections caused by the Contractor's operations
- Propose repair methods for approval by the Engineer

816.04 METHOD OF MEASUREMENT.

Concrete Bridge Deck Overlay will be measured by the number of cubic yards of concrete placed.

816.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Concrete Bridge Deck Overlay	CY

The price constitutes full compensation for all labor, materials, equipment, surface preparation, bonding grout, grooving, and all incidentals required to finish the work and accepted by the Engineer.

SECTION 817 — REPAIRS TO STRUCTURE CONCRETE MASONRY

817.01 DESCRIPTION.

This work includes making repairs to structure concrete masonry by removing and disposing deteriorated concrete; furnishing and installing steel reinforcement; preparing bonding surfaces of concrete; replacing the deteriorated concrete with a specified repair material; and finishing and curing to the lines and grades specified at the required locations.

817.02 MATERIALS.

Ensure that all proposed repair materials conform this Subsection and/or are listed on the Department's Approved Materials List.

817.02.1 Pneumatically Applied Mortar (Shotcrete).

Use materials for shotcrete that conform to **SECTION 601** and **SECTION M02**, except as modified herein.

Produce shotcrete by either the wet mix process or the dry mix process and conform to the following requirements:

Material or Property	Value
Compressive Strength at 28 days, f'_c (psi)	As indicated on Plans
Maximum Water/Cementitious Ratio	0.45
Minimum Cement Factor (lb/cu yd)	500
Air Content (percent)	5 - 9
Slump (inches)	1 to 3

Determine, recommend, and submit a mix proportion for approval, 28-day compressive strength results, water-cement ratio, and source of materials. Select mix proportions on the basis of compressive strength tests of specimens continuously moist cured until tested at 28 days or different test age if specified according to ASTM C1604. Sample shotcrete core specimens from shotcreted test panels not earlier than three days after shotcreting. Perform sampling and testing of shotcrete cores in accordance with ASTM C1604. Ensure that the combined aggregate gradation (fine and coarse) meets either gradation #1 or #2 of Table 1.1 of ACI 506R, Section 1.5.

Premixed and prepackaged concrete products specifically manufactured as a shotcrete product may be provided for the dry mix shotcrete process. Ensure that the packages contain cement and aggregates conforming to the materials requirement of this Specification, and the product must be listed on the Department's Approved Materials List. Materials not previously approved must be submitted to the Engineer. Do not use without written approval.

817.02.2 Patching Mortar.

Ensure that patching mortar, formulated as for vertical or overhead repairs, as appropriate, conforms to ASTM C928, Rapid Hardening or Very Rapid Hardening Mortar and that it is listed

on the Department's Approved Materials List. Use mortar that is a non-shrink type and chloride free. For repair mortars not previously approved, submit to and the Engineer for written approval before use. Use all materials according to the manufacturer's recommendations.

817.02.3 Reinforcement.

Ensure that all reinforcement is galvanized and conforms to **SECTION M05**. Use welded wire reinforcement that is welded fabric No. 12 gauge wire (minimum size) spaced 2 in. in each direction.

817.02.4 Bonding Agent.

Use a bonding agent when mortar repairs are specified as listed on the Department's Approved Materials List.

817.02.5 Form and Cast-in-Place Concrete.

Use concrete that conforms to **SECTION 601**.

817.02.6 Aggregate.

The fine and coarse aggregates must be approved by the Engineer regarding color and texture.

817.02.7 Integrally Colored Concrete.

Ensure that integrally colored Portland cement concrete conforms to **SECTION 601**.

817.02.8 Integrally Colored Patching Mortar.

Use patching mortar that conforms to **Subsection 817.02.2**. Ensure that the maximum water cement ratio does not exceed 0.40 by weight.

817.02.9 Coloring Pigment.

Use coloring pigments for integrally colored concrete or patching mortar that meets ASTM C979 and is approved by the Engineer. Use coloring pigments according to the manufacturer's recommendations.

817.02.10 Portland Cement Bonding Grout Slurry.

Use bonding grout slurry that has the cement and mortar sand proportioned 1:1 by volume. Add water in sufficient quantity to form a slurry.

817.02.11 Concrete Anchors.

Use mechanical concrete anchors that are the hooked type expansion bolts galvanized according to **Subsection M05.05.4(c)** and has been approved by the Engineer.

817.02.12 Prototype (Samples).

Submit to the Engineer a prototype (1 ft × 1 ft × 3 in. min.) showing color and texture of the concrete and/or mortar required specifically for Repairs to Structural Concrete Masonry with Integrally Colored Concrete or Patching Mortar. Provide, in writing, the mix design and methods for obtaining any required surface finish (e.g., exposed aggregate) for each material. Submit the prototype(s) sufficiently in advance to allow for review and approval of the repair material. The Engineer must approve the prototypes in writing and, if necessary, gain approval from the Department's Historic Preservation Specialist before use in production.

817.03 CONSTRUCTION METHODS.

817.03.1 Surface Preparation (All Repair Methods).

Remove all deteriorated, soft or honeycombed concrete from the areas to be repaired, using suitable power and hand tools, to a uniform depth, sufficient to expose a bonding surface of sound material. Do not use power tools that cause or may cause over-breakage of concrete. Ensure that pneumatic/chipping hammers are not heavier than the nominal 30-lb class. To remove concrete within 2 in. beneath or around reinforcing steel designated to remain, use pneumatic/chipping hammers or mechanical chipping tools that are not heavier than the nominal 15-lb class. Do not allow tools to contact reinforcing steel to remain. At the direction of the Engineer, saw cut the perimeter of the area to be repaired parallel to the horizontal and/or vertical axis of the element being repaired to a depth of at least ¾-in. Do not allow any thin or feathered edges. Ensure that areas to be repaired are roughly circular or rectangular in outline. Avoid re-entrant corners and shapes that include acute angles.

Saw cut the boundaries of areas to be removed square to a minimum depth of 1 in. Do not allow thin, tapered, or feathered edges.

Where reinforcing steel is surrounded by deteriorated concrete or where at least one-half of the rebar surface area is exposed, ensure that the depth of concrete removal includes all deteriorated concrete but not less than that depth necessary to allow for a 1 in. minimum annular clearance around the reinforcing bars. Extend concrete removal along the reinforcement to where it is well bonded to sound concrete. Clean all corroded reinforcing bars to remain within the concrete removal boundaries by sandblasting or by other suitable methods approved by the Engineer to remove all rust. For bars that have lost ¼ or more of their original diameter, supplement these with new bars spliced in place. Lap new bars (30 diameters on both sides of the affected area) to develop the required full strength of the bar. Additional concrete removal may be necessary to provide this lap. Dual bars of equivalent or greater cross-sectional area may be used. Maintain required concrete cover.

Ensure that all newly exposed concrete repair surfaces are free of loose particles and other foreign material. Clean the repair areas and roughen the areas by the use of sandblasting, compressed air, air and water blasting, steam, wire brushing, or other methods approved by the Engineer in writing. The Contractor may use one or any combination of the various options for cleaning the repair areas as directed by the Engineer.

Once all deteriorated concrete has been removed, maintain the existing sound concrete in a clean, rough, and surface saturated moist condition until the concrete repair has been completed.

When an epoxy-resin agent is specified, ensure that the prepared sound concrete surface is thoroughly dried before applying the epoxy-resin.

During the removal of the designated portions of the structure, avoid damaging the portions that will remain in place. If the removal operation causes excessive damage to portions of the concrete that will remain, cease operations and submit a proposed alternative removal method for approval.

Ensure that no debris or any other material falls onto the roadway or waterway below the bridge. Should debris or material fall onto the roadway or waterway, remove the material immediately and cease all work until a revised procedure of operation has been submitted and approved by the Engineer in writing. The Contractor shall be responsible for all damages or injuries as a result of debris or material falling. Do not store or bury material or debris on site.

Keep the surface against which mortar will be placed wet for at least one hour and allow the surface to dry to a saturated surface dry (SSD) condition just before application of the repair material.

Where bonding agents are specified for use, apply the agents according to the manufacturer's recommendations. If practical, ensure that the contact time is not exceeded. If the Contact time is exceeded, reapply the bonding agent. Reapplication, including form removal and re-installation, will be at no additional cost to the Department.

Use forms for Portland cement concrete repairs when necessary to confine the concrete and shape it to the required lines. The forms may partially require progressive installation as the concrete is placed as a result of confinements for placing concrete due to the location of the particular repair or restoration required. Ensure that the forms have sufficient strength to withstand the pressure resulting from placing operations, is maintained rigidly in position, and is sufficiently tight to prevent loss of mortar from the concrete. Do not use form oils. Use an alternative method or material for facilitating form release that will not cause discoloration or staining of the concrete. All methods or materials are subject to the approval of the Engineer.

With respect to temperature and weather conditions, use concrete repair materials according to **Subsections 601.03.4**, **601.03.5**, and **601.03.6**.

817.03.2 Placement of Reinforcing.

Repairs less than 1½-in. depth do not require wire mesh reinforcement unless otherwise directed by the Engineer. Where the thickness of the repair mortar exceeds 1½-in. depth and existing bar reinforcement is available, attach galvanized wire mesh reinforcement to the bars with tie wire. If existing rebar is not available, install wire mesh reinforcement using mechanical concrete anchors according to the requirements of the Table below. Where the repair exceeds a 4-in. depth, use a single layer of wire mesh to reinforce each 1-in. thickness of patch material.

Size and Spacing of Anchors

Thickness of Placement (in.)	Overhead Surfaces Diameter (in.) Spacing (in.)	Vertical Surfaces Diameter (in.) Spacing (in.)	Top Horizontal Surface Dia. (in.) Spacing (in.)
1½ to 4	¼ at 24	¼ at 24	¼ at 36
4 to 5	¼ at 20	¼ at 24	¼ at 36
5 to 6	⅜ at 17	⅜ at 21	⅜ at 36
over 6	⅜ at 16	⅜ at 20	⅜ at 36

Use mechanical concrete anchors that are galvanized and hooked-type expansion bolts in drilled holes. Use bolts with sufficient engagement in sound masonry to resist a pull out force of 150 lb. Ensure that the exposed end of each anchor has at a minimum a right-angle bend for engaging reinforcement. Use at least three anchors in each individual patch area.

817.03.3 Application of Pneumatically Applied Mortar (Shotcrete).

a. Submittals. Provide Shop Drawings, details, material Certificates of Compliance (including mill test reports), mix designs, Quality Control (QC) Plan to include construction procedures, detailed construction sequencing plans, and details of temporary debris shields. Submit submittals for review and approval by the Engineer a minimum of 45 days before the commencement of work.

Ensure that the QC Plan includes the following:

- Number and qualifications of personnel involved in shotcrete placement
- Surface preparation method
- Equipment and materials for placement, finishing, and curing
- Placement method including application rates, plans for multiple layers where applicable, and methods for achieving required thickness and finish
- Curing method
- QC testing and inspection personnel
- QC testing and inspection methods and frequencies including determinations of thickness and strength of placed shotcrete and checking for hollow areas and surface defects
- Methods for correcting deficiencies in shotcrete thickness, strength, hollow areas, and surface defects
- Documentation of nozzle operator’s experience

Before new personnel can start work, ensure that shotcreting nozzle operators have at least one year of experience in the application of shotcrete and have completed at least

three projects of comparable nature or work under the immediate supervision of a foreman or instructor with at least two years of such experience.

Do not begin work until the QC Plan has been approved by the Engineer.

b. Batching and Mixing. Aggregate and cement may be batched by weight or by volume. Ensure that the mixing equipment can thoroughly mix the materials in sufficient quantity to maintain placing continuity. Ensure that ready mix shotcrete complies with **SECTION 601.**

c. Application Equipment. Apply the shotcrete by pneumatic equipment that sprays the mix onto the prepared surface at the velocity needed to produce a compacted, dense, homogeneous mass. Ensure that the velocity of the material as it leaves the nozzle maintains a uniform rate determined for the given job conditions to minimize rebound.

- Dry Mix Process. Ensure that the delivery equipment delivers a continuous, smooth, uniformly mixed material to the nozzle. Equip the nozzle with a water ring and valve to permit adjustment of the water. Ensure that the nozzle can deliver a conical discharge stream.

- Wet Mix Process. Only use pneumatic-feed type delivery equipment.

d. Preconstruction Testing. Make test panels for each application crew using the equipment, materials, mixture proportions, and procedures proposed for the job before the commencement of the work. Make a test panel at least 30 in. × 30 in. for each mixture being considered and for each shooting position to be encountered in the job. Fabricate the test panels to the same thickness as in the structure but not less than 4 in. Take at least five, 3-in. minimum diameter cores from each panel for testing according to ASTM C1604. Obtain samples for testing in the presence of the Engineer, which will be tested by the Engineer.

e. Placement of Shotcrete. Apply shotcrete with the same equipment and the same technique as used to construct the approved test panels. Ensure that the nozzle operator constructing the test panels is the same operator used in placing shotcrete in the work. Apply the shotcrete as dry as practical to prevent shrinkage cracking, sagging, and sloughing off.

Use shooting guide strips or wires to ensure square corners, straight lines, and a plane surface of mortar. Place the strips or wires to minimize trapping of rebound. Do not re-use rebounded materials. Install thickness measuring pins on 5-ft centers in all direction. Ensure that the pins are non-corrosive. The Engineer may approve other methods to establish if the required minimum thickness of shotcrete is being applied if the Contractor can satisfactorily demonstrate the reliability of the other methods.

Apply a sufficient number of mortar coats to obtain the required thickness. On vertical and overhead surfaces, ensure that the thickness of each coat is not greater than 1 in., and is placed so that it will neither sag nor decrease the bond of the preceding coat. Ensure that the time interval between successive layers in sloping, vertical or overhanging work, is sufficient to allow initial set but not final set to develop. At the time initial set is developing, clean the surface to remove the thin film of laitance to provide a bond with succeeding

applications. Remove and dispose of all rebound or accumulated loose sand from the surface by brooming or scraping. Cover the surface before placing the original or succeeding layers of mortar and ensure that the mortar is not embedded in the work. Remove all laitance that has been allowed to take final set by sandblasting and thoroughly clean the surfaces without damaging the concrete.

Ensure an SSD condition exists before shooting new material.

Position and secure the wire fabric reinforcement to minimize vibration while the shotcrete is being applied. Lap mesh one and a half squares in both directions. Bend tie wires flat in the plane of the mesh and ensure there are no large knots. Place reinforcement to ensure that proper cover is maintained.

Apply the shotcrete to prevent accumulation of rebound on the surface still to be covered.

Fill first the horizontal and vertical corners and any area where rebound cannot escape or be blown free. Hold the nozzle at a distance and angle to place material behind the reinforcement before material is allowed to accumulate on its face. Do not place shotcrete through more than one layer of reinforcing steel in one application. Unless suitable means to screen the nozzle is provided, discontinue shotcreting if wind or air currents will cause separation of the stream during placement.

Conduct hammer sounding in the presence of the Engineer after sufficient strength is obtained to prevent damage. Hollow areas and areas containing any other non-conforming work or defects are considered deficient areas. Use an approved repair method, including proposed mitigation measures, to correct deficient areas. Submit the repair method for review and approval by the Engineer in writing before commencement of any repair work. At the discretion of the Engineer, repair deficient areas after initial placement of the shotcrete is completed. Remove and replace with fresh shotcrete all shotcrete defects, including lack of uniformity, segregation, honeycombing, lamination, or the presence of any dry patches, slugs, voids, or sand pockets, all at no additional cost to the Department.

f. Acceptance Testing. Prepare a minimum of one test panel for each day of production up to 50 cu yd and one test panel for each additional increment up to 50 cu yd of shotcrete placed. Ensure that test panels have minimum dimensions of 24″ × 24″ × 4″ gunned in the same position as the work represented. Ensure that the panels are gunned during the course of the work by the previously qualified nozzle operator. Cure the panels and obtain a minimum of three cores as described under Preconstruction Testing in Para. d above. Cores will be tested by the Engineer according to the requirements under Preconstruction Testing.

g. Limitation of Mixing. Place shotcrete according to the temperature and weather conditions in **SECTION 601**.

h. Finish. Finish all exposed surfaces straight and true, approximating the original contour as close as practical as indicated on the Plans.

i. Curing. Ensure that shotcrete is cured according to **SECTION 601**.

Do not use curing compounds on any surfaces against which additional shotcrete or other cementitious finishing materials will be bonded.

817.03.4 Application of Form and Cast-in-Place Concrete.

a. General. Perform repairs accomplished by the form and cast-in-place method according to **SECTION 808**.

b. Use of Self Consolidating Concrete (SCC) in Form and Cast-in-Place Concrete. Refer to **SECTION 601**.

c. Final Finish. Finish all exposed surfaces straight and true, approximating the original contour as close as practical as indicated on the Plans.

817.03.5 Application of Integrally Colored Concrete or Patching Mortar.

Mix, apply, and cure concrete patching mortar according to the manufacturer's recommendations.

a. Prime Coat. Before placing the concrete or mortar on a previously prepared and approved concrete surface, apply a prime coat to the entire area to be patched using a Portland cement bonding grout slurry.

Ensure that the consistency of the Portland cement bonding grout slurry can be applied with a brush on a prepared moist concrete surface in a thin (approximately ⅛-in.) even coating that will not run or puddle. Do not allow any excess bonding grout to collect in pockets. Apply Portland cement bonding grout to the concrete and the surfaces of the reinforcing bars and into the spaces between the reinforcing bars and the prepared concrete surfaces. Ensure that all surfaces receive a thorough, even coating.

Limit the rate of bonding grout application to that surface area that can be covered with new concrete or mortar before the bonding grout begins to dry out. Do not incorporate into the work any grout that has dried or become unworkable, as determined by the Engineer. If drying does occur, remove the bonding grout and place new bonding grout. The Engineer must approve the removal of the bonding grout method.

b. Placing and Consolidation. Place, consolidate, and finish the integrally colored Portland cement concrete on a previously prepared surface for which a Portland cement bonding grout slurry has been applied.

Place integrally colored patching mortar in ½-in. to 1-in. lift layers within 5 to 10 minutes after water is added to avoid the rapid setup of the material after the application of the bonding grout slurry.

If more than one lift layer is required to perform the repair, do not allow the previously placed lift layer to dry, and roughen its surface before placing the next layer.

Do not apply patching mortar when the ambient temperature is below 45°F or is not according to the manufacturer's recommendations.

c. Finish. Use an experienced mason to finish all exposed surfaces straight and true, approximating the original contour as close as practical. Ensure that the final finished surfaces match the texture, color, and aggregate exposure of the existing concrete surfaces adjoining or proximate to the area where new concrete has been placed.

   Capture all waste and water from the finishing operations, and dispose these materials.

d. Curing. Use curing procedures and methods that comply with the color additive from the manufacturer's recommendations and as set forth in **Subsection 601.03.7**. Do not use curing compounds unless specifically required by the manufacturer of the color additive.

817.04 METHOD OF MEASUREMENT.

Repairs to Structure Concrete Masonry – Pneumatically Applied Mortar, Repairs to Structure Concrete Masonry – Patching Mortar, Repairs to Structure Concrete Masonry – Form and Cast-in-Place Concrete, and Repairs to Structural Concrete Masonry with Integrally Colored Concrete or Patching Mortar will be measured by the number of cubic feet of new concrete placed.

817.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Repairs to Structure Concrete Masonry - Pneumatically Applied Mortar	CF
Repairs to Structure Concrete Masonry - Patching Mortar	CF
Repairs to Structure Concrete Masonry - Form and Cast-in-Place Concrete	CF
Repairs to Structural Concrete Masonry with Integrally Colored Concrete or Patching Mortar	CF

The prices constitute full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Unless called out otherwise in the Plans, steel reinforcing bars and wire mesh reinforcement will be paid for separately by Force Account according to **Subsection 109.04** or, when applicable, will be paid under the respective pay item for Reinforcing Steel in **SECTION 810**.

All materials and/or labor costs resulting from the surface finishing operations, including sedimentation and dewatering controls, will be included in this item of work.

SECTION 818 — PORTLAND CEMENT CONCRETE BRIDGE DECK REPAIR

818.01 DESCRIPTION.

This work includes removing deteriorated concrete from bridge deck surfaces, erecting formwork, and placing new Portland cement concrete.

a. Partial Depth Removal. The limits of partial depth concrete removal are those areas for which deteriorated concrete extends less than 50 percent of the depth of the original deck.

b. Full Depth Removal. The limits of full depth concrete removal are those areas for which deteriorated concrete extends more than 50 percent of the depth of the original deck.

818.02 MATERIALS.

Use materials that conform to the following requirements.

818.02.1 Concrete.

Use concrete that conforms to the requirements for Class HP material as stated in **Subsections 601.02.1** and **601.03.1**, with the exception to use coarse aggregate gradation that meets **Subsection M02.03** for aggregate size ½ in. or ⅜ in. The size used is at the discretion of the Contractor.

818.02.2 Bonding Agent.

Use bonding agent that is an all-purpose, high-strength, moisture-insensitive, rigid bonding agent that is listed on the Department's Approved Materials List. Ensure that the material used is compatible with the surfaces to be bonded.

818.02.3 Reinforcement.

Use reinforcement that conforms to ASTM 615 Grade 60 Reinforcing Steel as presented in **SECTION 810**.

818.03 CONSTRUCTION METHODS.

818.03.1 Removal of Deteriorated Concrete.

Remove all loose, deteriorated, or unsound concrete. Make a saw cut to an approximate depth of ¾ in. along all boundaries of the repair patches before removal, except those patches bounded by the bridge curbing. Do not cut into the top mat of bridge deck reinforcing steel.

Perform concrete removal so as to not damage reinforcing steel or saw cut areas at the repair boundaries.

Remove the concrete to a minimum depth of 1 in. Do not use jackhammers heavier than a nominal 30 lb. Do not use chipping hammers heavier than a nominal 15-lb class to remove concrete from areas beneath reinforcing bars. Provide hand tools such as hammers and chisels

for removal of particles of unsound concrete or to achieve the required depth throughout the repair areas, including the saw cut edges. Do not place pneumatic tools in direct contact with reinforcing steel or the surrounding concrete to remain. The Engineer can require other methods if the Engineer determines that the Contractor's method is damaging the concrete.

Where reinforcing steel is surrounded by deteriorated concrete or where at least one-half of its surface area is exposed, ensure that the depth of concrete removal includes all deteriorated concrete but not less than that depth necessary to allow for ¾-in. clearance below the primary reinforcing bars in the top mat of reinforcing steel. If removal extends deeper than 50 percent of the original deck thickness solely for obtaining the ¾-in. clearance, the repair is still considered a partial-depth repair. It is not necessary to remove concrete underneath any temperature and distribution reinforcement that has no more than one half of its surface area exposed. For reinforcing bars that have lost 25 percent or more of their original diameter, supplement the bars with new bars spliced in place while maintain the required cover, especially for dual bars. In splicing new bars, lap sufficiently (30 diameters on both sides of the affected areas) to develop the full strength of the bar and, if necessary, provide additional concrete removal for the lap. Dual bars of equivalent or greater section may be used.

Perform deck removal by hydrodemolition according to **SECTION 840**. Use alternative methods only with written approval from the Engineer.

818.03.2 Preparation of Sound Concrete and Reinforcing.

Clean all exposed reinforcing bars and newly exposed concrete by sandblasting or other mechanical abrasion methods.

Ensure that the exposed concrete and reinforcing steel surfaces are free of rust, oil, solvent, grease, dirt, dust, bitumen, loose particles, and other foreign matter before the application of the bonding agent. Use a large sized vacuum cleaner and/or an air jet to remove dust and other particles before placing the bonding agent. Repair all damage to steel reinforcement coatings.

818.03.3 Forms for Full Depth Removal.

Ensure that forms used for patching can support the quantity of fresh concrete needed to install the patch.

818.03.4 Bonding Agent.

Apply bonding agent to the substrate to a thickness of according to the recommendations of the manufacturer.

Follow the manufacturer's recommendations for curing the bonding agent before placing the concrete.

818.03.5 Placing and Finishing Concrete.

Hand manipulate the new concrete and strike-off the concrete slightly above the final grade. Then, mechanically consolidate and screed to a final grade.

Provide a mechanical or hand trowel finish to produce a tight and uniform surface.

As soon as the finishing has been completed, seal all vertical joints with adjacent concrete by painting with thinned grout.

Apply white pigmented liquid curing compound immediately after the joint application is completed. Use a rate of application 15 sq yd/gal, applied evenly and uniformly over the surface area. If the curing compound is not applied within 10 minutes after the final screeding, cover the finished concrete surfaces with wet burlap until the application of curing compound can be made. Remove the repaired concrete in the rejected areas, and re-repair the areas.

Do not allow traffic or external loads from heavy equipment such as pavers on the repaired deck surfaces until the concrete has reached a minimum of 95 percent of its 28-day compressive design strength.

818.04 METHOD OF MEASUREMENT.

Portland Cement Concrete Deck Repairs (Partial Depth Removal) and Portland Cement Concrete Deck Repairs (Full Depth Removal) will be measured by the number of square feet of the repairs made.

818.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Portland Cement Deck Repairs (Partial Depth Removal)	SF
Portland Cement Concrete Deck Repairs (Full Depth Removal)	SF

The prices constitute full compensation for all labor, tools, materials, equipment, and incidentals required to finish the work, complete and accepted. Supplemental reinforcing bars will be paid for separately by Force Account according to **Subsection 109.04**.

Existing reinforcing steel clearances indicated on the Contract Drawings are nominal and may vary due to the as-built conditions. An adjustment in the bid price for partial depth removal based on the percentage increase in depth of removal will be made if the concrete needs to be removed beyond the depth indicated by the Drawings.

SECTION 819 — DRILL AND GROUT REINFORCING DOWELS

819.01 DESCRIPTION.

This work includes setting reinforcing bar dowels in existing concrete or granite at the required locations.

819.02 MATERIALS.

819.02.1 Reinforcing Dowels.

Use reinforcing dowels that conform to **Subsection M05.02** and are of the same type (black, galvanized or stainless) as the bar reinforcement called for on the Plans.

819.02.2 High Strength Non-Shrink Grout.

Only use grout materials that are on the Department's Approved Materials List or as approved by the Engineer.

819.03 CONSTRUCTION METHODS.

Drill the holes for the dowels at the designated locations that are perpendicular to the joint face and provide at least the minimum specified cover. Ensure that the minimum hole diameter and embedment lengths comply with the manufacturer's recommendations. If not specified by the manufacturer, ensure that the diameter of the holes and the embedment lengths are as indicated in the following table:

Size of Bar	Min. Hole Diameter. (in.)	Min. Embedment Length (in.)
#4	1¼	8
#5	1⅜	10
#6	1½	12

819.04 METHOD OF MEASUREMENT.

Drill and Grout Dowels will be measured by the number of dowels installed.

819.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Drill and Grout Dowels	EA

The price constitutes full compensation for all labor, materials, equipment, tools, and incidentals required to finish the work, complete and accepted.

SECTION 820 — CONCRETE SURFACE TREATMENT PROTECTIVE SEALER

820.01 DESCRIPTION.

This work includes providing two or more applications of a uniform coating to those concrete surfaces where indicated in the Contract Documents.

820.02 MATERIALS.

Use concrete protective sealers that conform to **Subsection M12.03**.

820.02.1 Film Forming Sealers.

Ensure that the concrete surface protective sealers applied to concrete median barriers are of the film forming sealer type and conform to **Subsection M12.03.1.** Other surfaces will also require film forming sealers as stipulated in the Contract Documents.

820.02.2 Penetrant Sealers.

Apply penetrant sealers at the required locations, and ensure that the sealers conform to **Subsection M12.03.2**.

820.03 CONSTRUCTION METHODS.

Ensure that all work conforms to the manufacturer's written recommendations for the selected product.

a. Surface Preparation.

- Clean concrete to be coated and ensure that the concrete is free of any efflorescence, laitance, frost, grease, curing compounds, form release oil, etc., or foreign substances that may impair the bond of the sealer. Complete the cleaning no more than 24 hours before coating the concrete unless otherwise indicated by the manufacturer's recommendations. Clean surfaces that become contaminated before application of the coating to these requirements.

- Ensure that the curing time of concrete surfaces to receive the sealer is the lesser of the manufacturer's recommendations or seven days after the concrete has been placed and finished.

- Mask all adjacent surfaces not specified to be coated to protect from potential over-spray or spillage, on for example, pedestrians and traffic.

- Clean the areas adjacent to the surface to be coated by high pressure water washing before commencing work. See **SECTION 815** for additional information.

b. Application.

- Apply the protective coating evenly in a continuous operation over all surfaces to be treated to obtain a uniform coat. Schedule the work so that the stopping point each day occurs at an opening, joint, column, corner, other natural termination point.

- Apply protective concrete sealers to concrete surfaces in alternating coats of light gray and white, with the topcoat being white.

- Apply protective concrete sealer within the environmental conditions specified by the manufacturer. Do not apply the coating in the rain, at the imminent approach of rain, or when it is windy such that it adversely affects the application procedure.

- Apply the protective concrete sealer using methods and equipment types per the manufacturer's recommendations or as approved by the Engineer in writing. Use methods that provide an aesthetically pleasing, uniform, consistent protective coat, without splatter, holidays, or other defects.

- The Contractor may be required to apply the coating to a sample section of not less than 25 sq ft before the start of work to demonstrate that the applicator can perform the work to the satisfaction of the Engineer. Ensure that the surface for the sample is representative of the concrete to be coated for the Project and provides a reference for the minimum quality level for Project application. Do not perform any concrete sealer work until the sample section, if required, has been approved by the Engineer.

- When spray equipment is used to apply a coating consisting of two or more parts, ensure that the spray equipment can automatically shut down if the mixing ratio cannot be maintained within the tolerance specified.

- The operation may commence or proceed only with the approval of the Engineer in writing.

820.04 METHOD OF MEASUREMENT.

Concrete Surface Treatment Protective Sealer will be measured by the quantity of square feet of concrete surface coated.

820.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Concrete Surface Treatment Protective Sealer	SF

The price constitutes full compensation for all labor, materials, equipment, and incidentals required to complete the work, complete and accepted by the Engineer.

SECTION 821 — SAWING AND SEALING JOINTS IN ASPHALT CONCRETE PAVEMENTS

821.01 DESCRIPTION.

This work includes making two saw cuts, one within the other, in the finished asphalt concrete pavement directly over the transverse joints and edge of deck, and filling the cuts with a hot poured asphalt rubber compound at the required locations.

821.02 MATERIALS.

Use poured joint seal material that is an asphalt rubber compound of the hot poured type conforming to AASHTO D6690.

821.03 CONSTRUCTION METHODS.

Make the cuts centered over the transverse joints at the piers and the edge of deck at the abutments. After the cuts have been satisfactorily completed, seal the cuts with the hot asphalt rubber joint sealer.

821.03.1 Sawing Joints.

Ensure that the asphalt concrete has hardened sufficiently to allow clean cuts to be made and to withstand the eroding effects of the saw or other cutting device.

Ensure that the initial saw cut is ⅜-in. wide by ½-in. deep. Make the second saw cut, ⅛-in. wide and 1 in. deep, within the initial saw cut and, as practical, centered on the initial saw cut. Make the saw cuts with an abrasive blade and sawn dry.

Extend the completed cuts in a straight line across the pavement from curb to curb.

Reference each joint to be sawed. Ensure that the saw cuts are constructed directly over the deck joints at the piers and the edge of deck at the abutments.

821.03.2 Sealing Joints.

Seal the sawed joints immediately after the second saw cut has been made. Do not allow traffic until the seal is fully cured according to the manufacturer's recommendations. Clean and dry each joint before placement of the sealing compound. Perform the cleaning by blowing out all dirt, dust, or deleterious matter that may have accumulated in the sawed joints.

Use a combined melter and pressure application. Equip the melter with a thermostat to maintain the sealing compound within the range of temperatures specified by the manufacturer and with a suitably mounted thermometer to indicate the temperature of the sealing compound in the melter.

Apply the joint seal to ensure that all cracks are filled to refusal to eliminate all voids or entrapped air and not leave unnecessary surplus crack sealer on the pavement surface. Ensure that the hot seal completely fills the joint so that, after cooling, the level of the sealer will not be greater than ⅛-in. below the pavement surface. Ensure that any depression in the seal greater than 3/16 in.

is elevated to the specified limit by the further addition of hot seal. Ensure that, when sealing the joints, the final appearance presents a neat, fine line. Do not overfill the joints, and avoid spillage of the sealer. Remove all excess or spilled sealer from the pavement and discard. The melting temperature of the sealer will be furnished by the manufacturer. Ensure that the actual temperature of the material in the melter does not exceed the melting temperature by more than 15°F.

821.04 METHOD OF MEASUREMENT.

Sawing and Sealing Joints in Asphalt Concrete Pavement will be measured by the number of linear feet sawed and sealed. The measurement of linear feet is inclusive of both saw cuts, which will not be measured separately.

821.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Sawing and Sealing Joints in Asphalt Concrete Pavement	LF

The price constitutes full compensation for all labor, tools, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 822 — SILICONE HIGHWAY JOINT SEAL

822.01 DESCRIPTION.

This work includes providing silicone joint sealant in highway and bridge expansion and contraction joints at the required locations.

822.02 MATERIALS.

Ensure that the silicone joint sealant is on the Approved Materials List and that the sealant is one part silicone material that readily extrudes over a wide temperature range and cures to produce a durable, flexible, low modulus, silicone rubber seal. Ensure that the material has a minimum extension recovery of 100 percent and a minimum compression recovery of 50 percent of the original joint width.

Use a silicone sealant that conforms to Federal Specifications TT-S-01543 A Class A (one-part silicone sealants) and TT-S-00230 C Class A (one component sealants).

822.03 CONSTRUCTION METHODS.

Clean all joints of contaminants and impurities to the depth at which the sealant (and backer rod if detailed) will be installed. This will provide a sound, clean, and frost-free surface for sealant application.

Blow out all dust, loose particles, and other debris with oil-free compressed air.

Install an expanded closed cell polyethylene foam rod back-up material in joints or an approved bond breaker tape if detailed on the Plans.

Apply to the surfaces of steel expansion joints if recommended by the manufacturer. Use a primer as recommended by the sealant manufacturer.

Apply silicone highway joint sealant in a continuous operation to properly fill and seal the joint width. Ensure that the sealant application is not thicker than ½ in. and no thinner than ¼ in. with an approximate width to depth ratio of 2:1 or as recommended by the manufacturer.

Apply the sealant at a temperature as recommended by manufacturer. Pump the sealant directly from the original container into the joint by use of an air powered pump, pushing the sealant ahead to form a uniform bead. Ensure that the sealant fills the joint from the bottom to slightly below the pavement surface.

Tool the joint using a blunt instrument so that it is slightly concave and approximately ¼-in. below the adjacent surface. Perform the tooling within 10 minutes of application before a “skin” forms. Do not use soap or oil as a tooling aid.

Do not allow traffic on the sealed joint for at least 30 minutes after sealant application.

822.03.1 Limitations.

Silicone sealant is not intended for continuous water immersion, and it should not be applied in totally confined spaces where the sealant is not exposed to atmospheric moisture. Do not apply the sealant to wet or damp surfaces. Do not install the sealant during inclement weather.

822.04 METHOD OF MEASUREMENT.

Silicone Highway Joint Sealant will be measured by the number of linear feet of each type of joint installed.

822.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Silicone Highway Joint Sealant	LF

The price constitutes full compensation for all silicone sealant, backer rods, bond breaker tape, primer, surface preparation, other materials, labor, tools, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 823 — BRIDGE JOINTS

823.01 DESCRIPTION.

This work includes specifications for furnishing and installing various types of roadway joints, both expansion and fixed, between bridge decks and abutments or between sections of bridge decks at intermediate piers.

823.02 MATERIALS.

823.02.1 Compression Type Neoprene Deck Joints.

a. Structural Steel. Use structural steel bars and plates that conform to AASHTO M270, Grade 36, hot-dipped galvanized. Use stud anchors that conform to ASTM A108.

b. Sealer and Adhesive. Use a neoprene sealer that is a preformed extruded type. Ensure that the sealer and adhesive that conforms to **Subsection M02.10.3**.

c. Aluminum Sheet Metal. Use aluminum sheet metal that conforms to AASHTO M274. Do not allow aluminum to directly contact concrete or steel.

d. Metal Material. Use metal materials that are hot-dipped galvanized or metalized.

823.02.2 Strip Seal Expansion Joints.

The materials for the strip seal joint are the same as those in **Subsection 823.02.1**.

823.02.3 Asphaltic Expansion Joint System.

a. Backer Rod. Use a backer rod material that is an expanded closed cell polyethylene foam capable of withstanding the temperature of the hot binder material and with a diameter 150 percent of the width of the joint opening and with the following properties:

- Density: 2.0 lb/cu ft minimum, ASTM D1622
- Tensile Strength: 25 psi minimum, ASTM D1623
- Water Absorption: 1 percent of weight maximum, ASTM C509

b. Binder Material. Use a binder material that is a hot applied polymer modified asphalt material conforming to ASTM D6690 and conforming to the following:

- Softening Point, (ASTM D36) – 180°F minimum

c. Aggregate. Use an aggregate that is of the Basalt, Gabbro, or Granite groups, meeting the manufacturer's size and gradation requirements. Ensure that all stones are double washed, dried, and delivered to the site pre-weighed in labeled packs. When tested according to AASHTO T11, ensure that the material passing the #200 sieve is no more than 0.3 percent by weight of the stone. Use basalt for the broadcast stone for the surface of the joint system and is sized to pass the #8 sieve and be retained on the #16 sieve.

d. Steel Backing Plate. Use a backing plate that conforms to AASHTO M270, Grade 36 steel, minimum ¼-in. thick and is galvanized according to AASHTO M111. Ensure that holes for locating pins are approximately 1 ft center-to-center along the centerline of the plate.

e. Locating Pins. Use locating pins that are 16d common nails or larger and are hot-dipped galvanized according to AASHTO M232.

f. Asphaltic Joint System. Provide the materials for the joint system, both aggregate and binder, by one of the manufacturers included in the Department's Approved Materials List.

823.03 CONSTRUCTION METHODS.

For all types of deck joints, ensure that the joints are installed within the applicable temperature ranges for installation of the joint types.

823.03.1 Compression Type Neoprene Deck Joints.

a. Installation. Assemble, erect and set the entire structural steel frame to grade before placing deck (or abutment) concrete. Make allowance for temperature conditions at the time of final setting to allow for full movement of the joint over the temperature range. Clean the joint assembly to be free of foreign material immediately before installation of the seal.

Install the neoprene sealer in the field and secure the sealer in place with the approved material that will lubricate the sealer and become an adhesive upon curing (lubricant-adhesive). Ensure that the adhesive cover both sides of the sealer over the full contact area with the sides of the metal joint. The adhesive may be applied to the metal or the sealer or both. Install the sealer in a compressed condition in the position shown on the Plans within seconds after the application of the adhesive. Ensure that the sealer is in one piece for the full width of transverse joints without splicing. Seal any joints in the sealer material sealed with additional adhesive.

b. Frames. Where the seal will be installed after the frame for a transverse joint, do not field splice the seal. Install as one continuous piece.

c. Compliance. Identify each shipment with the manufacturer's name, address, and trademark and ensure that the shipment includes four copies of the manufacturer's standard test results and an affidavit attesting to full compliance with these Specifications. Ensure that all sealer and adhesive to be employed in the work conforms with the material that has been approved on the basis of test results.

823.03.2 Strip Seal Expansion Joint.

a. Installation. Assemble, erect, and set the entire strip seal frame to grade before placing the deck (or abutment) concrete. Make an allowance for temperature conditions at the time of final setting to allow for full movement of the joint over the temperature range. Clean the joint assembly to be free of foreign material immediately before the installation of the seal.

Install the neoprene strip seal in the field by suitable hand or machine tools. Secure the seal in place with the approved adhesive according to the manufacturer's recommendations. Ensure that the strip seal is in one piece for the full width of the transverse joints without splicing.

b. Compliance. Compliance requirements for strip seal joints are the same as those in **Subsection 823.03.1(c)**.

823.03.3 Asphaltic Expansion Joint System.

823.03.3.1 Installation.

Prepare the joint and install the asphaltic expansion joint system according to the manufacturer's specifications. Emphasize the following requirements:

- Tanking. Immediately after cleaning/caulking, coat the bottom of the blockout area with a layer of hot binder according to the manufacturer's recommendations. If any delay greater than one hour occurs between cleaning and tanking, reclean the joint using a hot compressed air lance as described above.
- Aggregate. Ensure that the aggregate is dry, clean, and heated according to the Manufacturer's recommendations. Remove all tangible signs of dust before mixing binder with the aggregate.
- Bond Breaker. Use a bond breaker at the blockout location at the time of overlay paving to facilitate clean removal.

823.03.3.2 Asphaltic Expansion Joint System and Materials and Workmanship Warranty.

Correct defects in the asphaltic expansion joint system caused by elements within the Contractor's control (i.e., the materials supplied and the workmanship) during the warranty period. Provide a bond issued by a surety that guarantees the warranty requirements will be met. The following summarizes the warranty requirements:

- Limits of Warranted Work. The warranted work includes all asphaltic expansion joint systems within the Project limits, unless otherwise indicated in the Contract.
- Warranty Period. The length of the warranty will be five years from the date of Final Acceptance.
- Amount of Warranty Bond. Supply a warranty bond equal to 100 percent of the warranted work for asphaltic expansion joint systems, as described in the above bullet "Limits of Warranted Work."
- Warranty Parameters. Condition parameters are used to measure the performance of the asphaltic expansion joint system during the warranty period. Each condition parameter has a threshold limit that defines when corrective action (warranty work) is required.
- Definitions.
    - Debonding. Physical separation of the asphaltic expansion joint from the adjacent vertical face of the pavement or the bridge deck.

- Transverse Crack. Any open crack that extends more in the transverse (perpendicular to traffic flow) than in the longitudinal direction.
- Longitudinal Crack. Any open crack that extends more in the longitudinal (parallel to traffic flow) than in the transverse direction.
- Perviousness. Absence of watertightness.
- Rutting. Depression, displacement, or dislodgment of the asphaltic expansion joint surface.

- Warranty Requirements. The Table lists the allowable threshold limit for each condition parameter for each asphaltic expansion joint. If any of the warranty requirements are not met as a result of a defect in materials and/or workmanship, corrective action (warranty work) is required.

Condition Parameter	Threshold Limit for Each Asphaltic Expansion Joint
Debonding (either edge)	5% total for the joint, with no debond greater than 2 ft
Transverse cracking	5% total for the joint, with no crack greater than 2 ft
Longitudinal cracking	3 times joint longitudinal dimension
Perviousness	Visible seepage of water
Rutting	Maximum depth ½ in.

- Corrective Actions. The following corrective actions are required to implement acceptable treatments for the various condition parameters. The Department will accept the listed corrective action if the action addresses the cause of the condition parameter. The Contractor may use an alternative action, subject to Department approval.

Condition Parameter	Required Action
Debonding (either edge)	Sawcut and remove the affected area; replace with a new asphaltic expansion joint system as shown on the Plans and described in this Specification.
Transverse cracking	Sawcut and remove the affected area; replace with a new asphaltic expansion joint system as shown on the Plans and described in this Specification.
Longitudinal cracking	Seal
Perviousness	Seal
Rutting	Sawcut and remove the affected area; replace with a new asphaltic expansion joint system as shown on the Plans and described in this Specification.

823.03.4 Rideability.

Ensure that the rideability across the deck joints complies with **SECTION 413**.

823.04 METHOD OF MEASUREMENT.

Bridge Joints will be measured by the linear feet installed and accepted. The length will include the vertical rise at curbs.

823.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Bridge Joints	LF

The price constitutes full compensation for all labor, materials, equipment, warranties, warrantee work, and incidentals required to finish the work, complete and accepted. Warrantee work includes all engineering, maintenance and protection of traffic, and uniformed traffic control personnel.

823.05.1 Materials and Workmanship Warranty.

The materials and workmanship pavement warranty shall consist of the warranty bond and the terms of this provision in its entirety. This provision establishes the common terms and definitions that apply to all Projects requiring a warranty (the warranted work). The Materials and Workmanship Warranty warrants the Department against defects in materials and workmanship.

823.05.1.1 Definitions.

1. Materials & Workmanship Warranty. The Contractor is responsible for correcting defects in the asphaltic expansion joint system caused by elements within the Contractor's control (i.e., the materials supplied and the workmanship) during the warranty period. Since the Department is responsible for the bridge design, the Contractor assumes no responsibility for defects that are design related. If a defect is attributable to both the materials and/or workmanship and the design, the responsibility for correcting the defect shall be shared by the Department and the Contractor; the Contractor is responsible for the percentage of fault attributable to the workmanship and/or materials, and the Department is responsible for the percentage of fault attributable to the design.

2. Acceptance Date of Construction. The date when the warranted work is complete and confirmed, in writing, on the initial acceptance document by the Department that the warrant complies with the Contract specifications and is open to traffic. This is the date of initial acceptance and constitutes the start date for the warranty period. There may be more than one acceptance date of construction for a Project.

3. Warranty Bond. A bond issued by a surety that guarantees that the warranty requirements will be met.

4. Warranty Work. Corrective action taken to bring the warranted work into Contract compliance.

823.05.1.2 Initial Acceptance.

The Department and the Contractor shall jointly review all completed warranted work, or a portion thereof, as determined by the Department. If the work does not meet Contract requirements, the Contractor shall make all necessary corrections, at its expense, before initial acceptance. Initial acceptance will occur as soon as the Department confirms, in writing, on the initial acceptance form that the Contract requirements have been met for the warranted work. The date on which initial acceptance occurs is termed the Acceptance Date of Construction.

Initial acceptance will be documented and executed jointly by the Department and the Contractor on a form furnished by the Department. A copy of the form will be sent to the Contractor's warranty bond surety agent by the Department. Neither the initial acceptance nor any prior inspection, acceptance, or approval by the Department diminishes the Contractor's responsibility under this warranty.

The Department may accept the work and begin the warranty period, excluding any area needing corrective work, to accommodate seasonal limitations or staged construction.

Acceptance of material, in penalty, under the Department's quality assurance program will not relieve the Contractor from meeting the material and workmanship warranty requirements for the accepted material.

823.05.1.3 Warranty Bond.

The Contractor shall furnish a single term warranty bond, in an amount stipulated in the Amount of Warranty Bond, as defined in **Subsection 823.03.3.2**, before Contract award. The effective starting date of the warranty bond shall be the Acceptance Date of Construction. The warranty bond will be released at the end of the warranty period or after all warranty work has been satisfactorily completed, whichever is the latest.

823.05.1.4 Rights and Responsibilities of the Department.

The Department:

- Reserves the right to approve the schedule proposed by the Contractor to perform warranty work.
- Reserves the right to approve all materials and specifications used in warranty work.
- Reserves the right to determine if warranty work performed by the Contractor meets the Contract specifications.
- Reserves the right to perform, or have performed, routine maintenance during the warranty period; any routine maintenance will not diminish the Contractor's responsibility under the warranty.
- Reserves the right, if the Contractor is unable, to make immediate emergency repairs to the asphaltic expansion joint system to prevent an unsafe road condition as determined

by the Department. The Department will attempt to notify the Contractor that action is required to address an unsafe condition. However, if the Contractor is unable to comply with this requirement to the Department's satisfaction and within the time frame required by the Department, the Department will perform or will have performed any emergency repairs deemed necessary. Any emergency repairs undertaken will not relieve the Contractor from meeting the warranty requirements of this Specification. Any costs associated with the emergency repairs will be paid by the Contractor if it is determined that the cause was from defective materials and/or workmanship.

- Is responsible for monitoring the asphaltic expansion joint system throughout the warranty period and will provide the Contractor all written reports of the system's condition related to the warranty requirements. The Contractor shall not be relieved of any responsibility based upon a claim that the Department failed to adequately monitor the asphaltic expansion joint system to report its findings to the Contractor.
- Is responsible for notifying the Contractor, in writing, of any corrective action required to meet the warranty requirements.

823.05.1.5 Rights and Responsibilities of the Contractor.

The Contractor:

- Shall warrant to the Department that the warranted work will be free of defects in materials and workmanship for a period of five years from the Acceptance Date of Construction, as defined in **Subsection 823.05.1.1**. The warranty bond shall be described on a form furnished by the Department. The completed form shall be submitted to the Department before award of Contract.
- Is responsible for performing all warranty work, including but not limited to, all M&PT, all M&PT incidentals, and any uniformed traffic control personnel required to complete the warranty repairs or replacement work and restoring all associated bridge and pavement features, at no additional cost to the Department.
- Is responsible for performing all temporary or emergency repairs resulting from any non-compliance with the warranty requirements using Department approved materials and methods. Upon receipt of a notice of non-compliance with the warranty requirements from the Department, shall submit to the Department within 21 calendar days a written course of action for performing the warranty work with all work items segregated and all materials and methods to be used. All of the warranty work shall be completed within 30 calendar days of the date of the submittal or as agreed to by the Department.
- Shall follow a Department approved maintenance of traffic plan when performing warranty work. All warranty work shall be performed under permit issued by the Department.
- Is required to supply to the Department original documentation that all insurance required by the Contract is in effect during the period(s) that warranty work is being performed, as required by **Subsection 107.14**.
- Shall furnish to the Department, in addition to the regular performance and lien bond for the Contract, supplemental performance and lien bonds covering any warranty work being performed. The supplemental bonds shall be furnished before beginning any warranty work using Department approved forms. The supplemental bonds shall be in the amount required by the Department to cover the costs of warranty work.

- Shall complete all warranty work before conclusion of the warranty period or as otherwise agreed to by the Department.
- Shall be liable during the warranty period in the same manner as Contractors currently are liable for their construction related activities with the Department pursuant to the Contract. This liability shall continue until the warranty work is accepted by the Engineer. The liability is in addition to the Contractor performing and/or paying for any required warranty work, and shall include liability for injuries and/or damages and any expenses resulting that are not attributable to normal wear and tear of traffic and weather, but are due to non-compliant materials, faulty workmanship, and/or Contractor operations.

823.05.1.6 Quality Control.

The Contractor shall provide an affidavit from the joint manufacturer certifying that the aggregate meets all requirements and a certificate of compliance from the binder manufacturer certifying that the binder conforms to these Specifications.

At the direction of the Engineer, the Contractor shall arrange for and have present, at the time the first joint-sealing operation will be performed, a manufacturer's representative knowledgeable in the methods of installation of the joint system. The Contractor shall also arrange to have the representative present at such other times as the Engineer may request.

823.05.1.7 Evaluation Method.

The Department will conduct evaluations of each asphaltic expansion joint system installed under this Contract.

823.05.1.8 Warranty Requirements.

Warranty work will be required when the threshold limit for a condition parameter is exceeded as a result of a defect in material and/or workmanship.

Specific threshold limits and segment limits and other items that the Contractor is responsible for are covered in the previous sections of this Specification.

To determine whether the failure to meet the warranty criteria is a result of defects in materials and/or workmanship, a joint field investigation by the Department and the Contractor will be conducted. The Department and Contractor may elect to have a forensic investigation conducted. The decision to undertake a forensic investigation, the scope of the investigation, and the selection of the party to conduct the investigation will be agreed to by the Department and the Contractor. All costs related to the forensic investigation will be shared proportionately between the Contractor and the Department based on the determined cause of the condition.

During the warranty period, the Contractor will not be held responsible for distresses that are caused by factors unrelated to materials and workmanship. These include, but are not limited to, chemical and fuel spills, vehicle fires, snow plowing, and quality assurance testing such as coring. Other factors considered to be beyond the control of the Contractor that may contribute to distress will be considered by the Engineer on a case-by-case basis upon receipt of a written request from the Contractor.

823.05.1.9 Emergency Repairs.

If the Department determines that emergency repairs are necessary for public safety, the Department or its agent may take repair action.

Before emergency repairs, the Department will document the basis for the emergency action. In addition, the Department will preserve evidence of the defective condition.

823.05.1.10 Non-Extension of Contract.

This Provision shall not be construed as extending or otherwise affecting the claim process and statute of limitations applicable to this Contract.

SECTION 824 — STRUCTURAL STEEL CONSTRUCTION

824.01 DESCRIPTION.

This work includes furnishing, fabricating, and erecting all structural steel at the required locations. Structural steel includes carbon, special alloy steels, steel forgings, steel and iron castings, and weldments.

In addition to this Specification, ensure that all structural steel work conforms to the applicable requirements in the current editions of the AASHTO *LRFD Bridge Design Specifications* and the AWS D1.5 *Bridge Welding Code*.

824.02 MATERIALS.

824.02.1 General.

Use materials that conform to the following.

Material	Standard Specification Reference
Structural Steels	**Subsection M05.05.1**
Steel Bars and Forgings	**Subsection M05.05.2**
Structural Tubing	**Subsection M05.05.3**
Bolts, Nuts, Washers	**Subsection M05.05.4**
Weld Metal	**Subsection M05.05.5**
Shear Connectors	**Subsection M05.05.6**
Low Alloy Nickel Copper Steel Pipe	**Subsection M05.05.7**
Steel Forging and Shafting	**Subsection M05.05.8**
Steel and Iron Castings	**Subsection M05.05.9**

824.02.2 Shear Connectors.

This work includes providing stud shear connectors welded to the flanges of steel beams or girders at the required locations. Ensure that the welded stud shear connectors comply with the AASHTO/AWS1.5M/D1.5 *Bridge Welding Code* provisions related to material, manufacturing, physical properties, certification, and welding.

Ensure that shear connector studs have a design suitable for end-welding to steel beams and girders with automatically timed stud welding equipment.

Ensure that finished studs are of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other defects.

Before placing orders for studs, submit to the Engineer for approval the following information on the studs to be purchased:

- The name of the manufacturer
- A detailed description of the stud and arc shield to be furnished
- A certification from the manufacturer that the stud to be furnished is qualified according to the currently adopted edition of the AASHTO *LRFD Bridge Construction Specifications*

At the option of the Engineer, the manufacturer of the studs may be required at any time to submit requalification test data according to the procedure in Section 11 of the AASHTO *LRFD Bridge Construction Specifications*.

824.02.3 Direct Tension Indicators (DTI).

DTIs may be used in conjunction with bolts, nuts, and washers specified in **Subsection M05.05.4**. Ensure that the DTIs conform to ASTM F959, "Specification for Compressible-Washer Type Direct Tension Indicators for Use with Structural Fasteners," except as provided in the following paragraph.

Subject to the approval of the Engineer, alternative design direct tension indicating devices may be used if they satisfy the requirements detailed in the specifications provided by the manufacturer.

824.03 CONSTRUCTION METHODS.

824.03.1 Shop Drawings.

Submit all Shop Drawings, erection diagrams, camber diagrams, and a list of bolts from the Plans furnished by the Department. The Engineer will review the submittals according to **Subsection 105.02**.

824.03.2 Inspection and Testing.

a. Mill Orders. Furnish four copies of mill orders. Do not roll the material or perform work before the Engineer has been notified where the orders have been placed so that he/she may arrange for the inspection.

   The manufacturer shall furnish all facilities for inspecting and testing the weight and quality of all material at the mill where it is manufactured. Furnish suitable testing equipment, properly calibrated. Prepare the pieces for the testing machine at no cost to the Department. The manufacturer shall perform all testing of materials.

   Furnish the Engineer with four copies of the mill report of the chemical and physical tests before starting work. Do not cut off any markings until the inspector has established the heat and designation and determined the method of continued identity. Perform inspection and testing that conforms to **SECTION 106**.

b. Shop. Notify the Engineer 48 hours in advance of the start of work in the shop so that an inspector can be on hand to inspect the material and workmanship.

The fabricator shall furnish all facilities for inspecting and testing the weight and quality of workmanship at the shop where the material is fabricated. Provide suitable testing equipment, properly calibrated, for the Department Inspector.

Provide full and safe access at all times and to all parts of the mills or shops where the material is being manufactured or fabricated.

c. Site. The Engineer may waive shop inspections and instead inspect all fabricated material when delivered at the work site. However, if the Engineer rejects defective material, its repair or replacement will be performed at no additional cost to the Department, including any additional shipping costs.

Furnish a minimum of four copies of shipping statements that include the weights of the individual members.

Furnish a Certificate of Identification as defined in Subsection 11.4.1 of the AASHTO *LRFD Bridge Construction Specifications*.

d. Delegation of Authority. The Department may delegate inspection and testing to an independent, accredited laboratory or testing company. This agency shall have all the prerogatives as previously mentioned for the Engineer except that, in the event of a disagreement of substance, the Contractor may appeal the decision to the Engineer whose decision will be final.

824.03.3 Fabrication.

a. Storage of Materials. Store structural material, either plain or fabricated, at the bridge shop above the ground and on platforms, skids, or other supports. Keep the materials free from dirt, grease, and other foreign matter and protected from any corrosion that will degrade the performance of the element.

b. Holes for High-Strength Bolts and Unfinished Bolts.

- General. Ensure that all holes for bolts are either punched or drilled. Material forming parts of a member composed of not more than five thicknesses of metal may be punched 1/16 in. larger than the nominal diameter of the bolts when the thickness of the material is not greater than ¾ in. for structural steel, ⅝ in. for high-strength steel, or ½ in. for quenched and tempered alloy steel.

  When there are more than five thicknesses or when any of the main material is thicker than ¾ in. for structural steel, ⅝ in. for high-strength steel, or ½ in. for quenched and tempered alloy steel, ensure that all holes are either subdrilled and reamed or drilled full size with sufficient tolerance to ensure that the standard size bolt passes though all parts without interference.

  When required, ensure that all holes are either subpunched or subdrilled (subdrilled if thickness limitation governs) 3/16 in. smaller and, after assembling, reamed 1/16 in. larger or drilled full size to 1/16 in. larger than the nominal diameter of the bolts.

When shown on the Plans, enlarged or slotted holes are allowed with high-strength bolts.

- Punched Holes. Ensure that the diameter of the die does not exceed the diameter of the punch by more than 1/16-in. If any holes must be enlarged to admit the bolts, ream the holes. Ensure that the holes are clean cut without torn or ragged edges.

- Reamed or Drilled Holes. Ensure that reamed or drilled holes are cylindrical, perpendicular to the member, and comply with the requirements of Para. b, first bullet above for size. Where practical, direct reamers by mechanical means. Remove burrs on the outside surfaces and finish the holes with a slight chamfer. Perform reaming and drilling with twist drills, twist reamers, or rotobroach cutters. Assemble connecting parts requiring reamed or drilled holes that securely hold while being reamed or drilled and that are match marked before disassembling.

- Accuracy of Holes. Holes not more than 1/32 in. larger in diameter than the true decimal equivalent of the nominal diameter that may result from a drill or reamer of the nominal diameter are considered acceptable. The slightly conical hole that naturally results from punching operations is considered acceptable. This would have the 1/32-in. tolerance, with the minimum at the small end of the taper being at least a clearance fit. Ensure that the width of slotted holes that are produced by flame cutting or a combination of drilling or punching and flame cutting are not more than 1/32 in. greater than the nominal width. Grind smooth the flame cut surface.

c. Accuracy of Hole Group.

- Accuracy Before Reaming. Ensure that all holes punched full size, subpunched, or subdrilled are accurately punched so that, after assembling (before any reaming is done), a cylindrical pin ⅛ in. smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 3/16 in. smaller in diameter than the nominal size of the punched hole, this will be cause for rejection.

- Accuracy After Reaming. When holes are reamed or drilled, ensure that 85 percent of the holes in any contiguous group, after reaming or drilling, show no offset greater than 1/32 in. between adjacent thicknesses of metal.

  Ensure that all steel templates have hardened steel bushings in holes accurately dimensioned from the centerlines of the connection as inscribed on the template. Use the centerlines to accurately locate the template from the milled or scribed ends of the members.

d. Holes for Ribbed Bolts, Turned Bolts, or other Approved Bearing-Type Bolts. Subpunch or subdrill all holes for ribbed bolts, turned bolts, or other approved bearing-type bolts 3/16-in. smaller than the nominal diameter of the bolt and reamed when assembled, or drilled to a steel template or, after assembling, drilled from the solid at the option of the fabricator. Ensure that the finished holes provide a driving fit as specified.

e. Preparation of Field Connections. Subpunch or subdrill holes in all field connections and field splices of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames and subsequently reamed while assembled or drilled full size to a steel template. Holes for field splices of rolled beam stringers continuous over floor beams or cross frames may be drilled full size unassembled to a steel template. All holes for floor beams or cross frames may be drilled full size unassembled to a steel template. Subpunch and ream all holes for floor beam and stringer field end connections while assembled or drilled full size to a steel template. Perform reaming or drilling full size of field connection holes through a steel template after the template has been located in the correct position and angle and firmly bolted in place, using at least two holes previously drilled for the connection. Ensure that templates used for reaming matching members, or the opposite faces of a single member, are duplicates within 1/32 in. Accurately locate templates used for connections on like parts or members so that the parts or members are duplicates and require no match-marking.

For any connection, in lieu of subpunching and reaming or subdrilling and reaming, the fabricator may, as an option, drill holes full size with all thicknesses or material assembled in the proper position with the hole locations matching the Plans/Shop Drawings.

824.03.4 Bolts and Bolted Connections Using Unfinished, Turned, and Ribbed Bolts.

a. General. Ensure that bolts are unfinished, turned, or an approved form of ribbed bolts as designed. Ensure that bolts have hexagonal heads and nuts and are of a length that they will extend entirely thorough the nut but not more than ¼ in. beyond after completing torquing of the connection.

Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Ensure that bolts have single, self-locking nuts or double nuts.

b. Unfinished Bolts. Ensure that bolts in shear have not more than one thread within the grip. Ensure that the diameter of the unfinished bolt is not more than 1/16 in. smaller than the diameter of the hole.

c. Turned Bolts. Ream holes for turned bolts, and turn the bolts to a light driving fit, with threads entirely outside of holes, and use a washer. Use ¼-in. nut locks on all turned bolts.

d. Ribbed Bolts. Special types of ribbed bolts, with drive fit, may be used if approved by the Engineer. If the bolt twists before drawing tight, remove the bolt, re-ream the hole, and replace with an oversized bolt. Size the reamed hole to meet industry standard practices to hold the bolt in place at the required torque. Re-ream the hole to the minimum proper size to hold the next largest standard size bolt, which shall be used as a replacement.

824.03.5 Connections Using High-Strength Bolts.

a. General. This Subsection addresses the assembly of structural joints using ASTM F3125 Grade A325 and A490 high strength carbon steel bolts or equivalent fasteners, tightened to a high tension. The bolts are used in holes conforming to **Subsection 824.03.3**.

b. Bolted Parts. Ensure that the slope of surfaces of bolted parts in contact with the bolt head and nut do not exceed 1:20 with respect to a plane normal to the bolt axis. Fit bolted parts solidly together when assembled and do not separate the bolts by gaskets or any other interposed compressible material.

When assembled, ensure that all joint surfaces, including those adjacent to the bolt heads, nuts or washers, are free of scale, except tight mill scale, and are also free of dirt, loose scale, burrs, other foreign material and other defects that would prevent solid seating of the parts.

Ensure that contact surfaces within friction-type joints are free of oil, paint, lacquer, rust inhibitor or galvanizing. After connection, ensure that primers and paint provide a moisture-tight joint.

c. Installation. Clean and lubricate the threads. Tighten each fastener to provide, when all fasteners in the joint are tight, at least the minimum bolt tension shown on the Bolt Tension Table in Para. f below.

Tighten threaded bolts with properly calibrated wrenches or by the turn-of-the nut method. If required because of bolt entering and wrench operation clearances, tightening by either procedure may be done by turning the bolt while the nut is prevented from rotating.

d. Washers. Provide all fasteners with a hardened washer under the element (nut or bolt head) turned in tightening.

Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, use a smooth beveled washer to compensate for the lack of parallelism.

On diaphragm connections using oversized holes, use a washer over every oversized hole regardless of the part turned in tightening.

e. Calibrated Wrench Tightening. Calibrated wrench tightening may be used only when installation procedures are calibrated on a daily basis and when a hardened washer is used under the element turned in tightening. Standard torques determined from tables or from formulas that are assumed to relate torque to tension are not acceptable.

When calibrated wrenches are used for installation, set the wrenches to provide a tension not less than 5 percent in excess of the minimum tension specified in the Bolt Tension Table in Para. f below. Calibrate the installation procedures by verification testing at least once each working day for each bolt diameter, length, and grade using fastener assemblies that are being installed in the work. Perform the verification testing in a device capable of indicating the actual bolt tension by tightening three typical bolts of

each diameter, length, and grade from the bolts being installed and with a hardened washer from the washers being used in the work under the element turned in tightening. Recalibrate wrenches when a significant difference is noted in the surface condition of the bolts, threads, nuts, or washers. Perform the verification during the actual installation in the assembled steel work so that the wrench adjustment selected by the calibration does not produce a nut or bolt head rotation from snug tight greater than that permitted in the Nut Rotation Table in Para. f below. If manual torque wrenches are used, turn nuts in the tightening direction when torque is measured.

When calibrated wrenches are used to install and tension bolts in a connection, install the bolts with hardened washers under the element turned in tightening bolts in all holes of the connection and bring to a snug tight condition. Following this initial tightening operation, tighten the connection using the calibrated wrench. Ensure that tightening progresses systematically from the most rigid part of the joint to its free edges. Return the wrench to touch up previously tightened bolts that may have been relaxed as a result of the subsequent tightening of adjacent bolts until all bolts are tightened to the prescribed amount.

f. Turn-of-Nut Tightening. Perform the verification testing using a representative sample of not less than three bolt and nut assemblies of each diameter, length, and grade to be used in the work at the start of work in a device capable of indicating bolt tension. Ensure that this verification test demonstrates that the method for estimating the snug tight condition and controlling the turns from snug tight to be used by the bolting crew develops a tension not less than 5 percent greater than the tension required by the Bolt Tension Table below. Perform periodic retesting when ordered by the Engineer.

Bolt Tension Table Minimum Bolt Tension In Pounds*

Bolt Size, in Inches	A325 Bolts	A490 Bolts
½	12,000	15,000
⅝	19,000	24,000
¾	28,000	35,000
⅞	39,000	49,000
1	51,000	64,000
1⅛	56,000	80,000
1¼	71,000	102,000
1⅜	85,000	121,000
1½	103,000	148,000

* *Equal to 70 percent of specified minimum tensile strength of bolts (as specified in ASTM Specifications for tests of full-size A325 bolts with UNC threads loaded in axial tension) rounded to the nearest kip.*

After snug tightening fasteners and fully compacting the connection, further tighten all bolts in the connection by the applicable amount of rotation specified in the Nut Rotation Table below. During the tightening operation, do not allow any rotation of the part not turned by the wrench. Tighten by progressing systematically from the most rigid part of the joint to its free edges.

Nut Rotation from the Snug Tight Condition [a,b]
Geometry of Outer Faces of Bolted Parts

Bolt length measured from underside of head to end of bolt	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20. Bevel washer not used	Both faces sloped not more than1:20 from normal to bolt axis. Bevel washers not used
Up to and including 4 diameters	⅓ turn	½ turn	⅔ turn
Over 4 diameters but not exceeding 8 diameters	½ turn	⅔ turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters [c]	⅔ turn	5/6 turn	1 turn

Notes:

[a] *Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by ½ turn and less, the tolerance should be plus or minus 30 degrees; for bolts installed by ⅔ turn and more, the tolerance should be plus or minus 45 degrees.*

[b] *Applicable only to connections in which all material within grip of the bolt is steel.*

[c] *No research work has been performed by the Research Council on Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. Therefore, the required rotation must be determined by actual tests in a suitable tension device simulating the actual conditions.*

g. Inspection.

The Engineer will approve the procedure for calibration of wrenches and installation of bolts and will further observe the field installation to determine that these procedures are followed.

Spot checks will be made with a manual torque wrench that has been calibrated as previously specified.

824.03.6 Welding.

a. General. Ensure that all welding, welder qualifications, prequalification of weld details, and inspection of welds conform to ANSI/AASHTO/AWS D1.5 *Bridge Welding Code*.

Do not weld or tack brackets, clips, shipping devices, or other material not required by the Contract to any member unless shown on the Shop Drawings and approved by the Engineer in writing.

b. Qualification of Welders. Ensure that all work is according to the best modern practices using qualified welding operators. Use the same type of equipment as required for the execution of the actual construction work in qualifying welders and welding operators.

If the Contractor prequalifies its metal-arc welding operators according to the standard qualification procedures of the American Welding Society and certifies to the Engineer that an operator working on the structure has been prequalified previously, the Engineer may consider such operator qualified. This certificate shall state that the operator has been performing satisfactory welding of the required type within the three-month period previous to the subject work. Submit a certification for each operator and for each Project, stating the:

- Name of the operator
- Name and title of the person who conducted the examination
- Type of specimens
- Positions of welds
- Results of the test
- Date of the examination
- Identifying steel stamp symbol assigned

The prequalification certification may also be accepted as proof that an operator of field welding is qualified, if the Contractor who submits the certificate is properly staffed and equipped to conduct such an examination or if the examining and testing is performed by a recognized agency that is staffed and equipped for this purpose. The qualification of a welder shall not prohibit his/her subsequent removal from the job for poor workmanship in the execution of welds.

The welder shall place his identification stamp near the welds that he/she has made.

Perform shop welding in areas sheltered from wind and weather with an ambient minimum temperature of 50°F.

c. Qualification of Welding Procedure. Submit a complete welding procedure specification for welding all primary members and other members on which welds are subject to calculated stress before proceeding with fabrication.

d. Procedures for Manual Shielded Metal-Arc Welding. Position the work for flat position welding when practical.

824.03.7 Inspection of Welds.

a. General. All welding, both shop and field, will be subject to inspection by the Engineer according to the ANSI/AASHTO/AWS D1.5 *Bridge Welding Code*, as amended herein. A minimum routine inspection program is outlined in Table 1. However, do not construe the inspection to be limited to the program described.

b. Visual Inspection of Welds and Welding Operations. Allow unlimited, safe access to the site of welding operations to allow the Engineer to observe the procedure and techniques used on all welds.

c. Non-Destructive Testing. Implement a routine program of non-destructive testing on all welds (shop and field) carrying calculated stress as indicated in the Table on the next page.

Non-destructive testing will be performed by the Department. Radiograph and furnish one set of films of shop butt welds and furnish all equipment and an operator at no cost to the Department for making magnetic particle tests of shop fillet welds. Furnish all labor and equipment required to move and position the various members for inspection.

824.03.8 Machining.

Ensure that the steel fabricator machines all steel according to the ASIC Quality Certification Program, the American Society for Nondestructive Testing, and the Steel Structures Technology Center Structural Bolting Handbook.

824.03.9 Marking, Shipping, Delivering, and Handling.

Paint or mark each member with an erection mark for identification that is suitably durable or permanent. Furnish an erection diagram showing these marks.

Furnish as many copies of material orders, shipping statements, and erection diagrams as the Engineer may direct. Record the weights of the individual members on the statements. Ensure that members weighing more than 3 tons have the weights marked thereon. Load structural members on trucks or cars with proper dunnage and support so that they can be transported and unloaded at their destination without being excessively stressed, deformed, or otherwise damaged.

Ship bolts, nuts, and washers (where required) from each rotational-capacity lot in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Ship pins, small parts and packages of bolts, washers, and nuts in boxes, crates, kegs, or barrels, but ensure that the gross weight of any package does not exceed 300 lb. Clearly mark a list and description of the contained materials on the outside of each shipping container.

Conduct the loading and delivery of the structural material so that the metal and its coating will remain clean and free from damage. Keep girders and beams upright and shored. Support long members on skids spaced to prevent damage from deflection.

824.03.10 Erection.

a. General. Provide the falsework and all tools, machinery and appliances, including drift pins and fitting bolts necessary for the expeditious handling of the work. Before starting work, inform the Engineer as to the method of erection, and the amount and character of equipment proposed to be used, which is subject to the approval of the Engineer.

Non-Destructive Testing Program

Type of Weld	Percentage (Number, Quantity) of Weld(s) to be Tested	Inspection	Remarks
Flange to flange butt welds – tension	100%	Radiographic	
Flange to flange butt welds – compression	50% (selected at random by the Engineer)	Radiographic	If any radiographed joint is rejected, radiograph all compression grooved welds of this member 100%.
Web to web butt welds	One-third of depth closest to tension flange of each weld	Radiographic	If quality of the portion radiographed is unsatisfactory, radiograph entire weld.
Flange plate to cover plate fillet weld	10% (each end of each weld and other locations to be selected at random by the Engineer)	Approved magnetic particle	Increase quantity of weld to be inspected if quality of initially inspected weld proves unsatisfactory. (See AWS D.2.0 as amended by Circular Memo).
Flange to web fillet welds	10% (each end of each weld and other locations to be selected at random by the Engineer)	Approved magnetic particle	Increase quantity of weld to be inspected if quality of initially inspected weld proves unsatisfactory. (See AWS D.2.0 as amended by Circular Memo).
Repair of flame out edge with greater than 3/16 in. gage.	100%	Radiographic	Radiographing and laboratory report no expense to the Department.

b. Storage of Materials at Site. Place material to be stored on skids above the ground. Keep the material clean, free of graffiti, and properly drained. Place girders and beams upright and shored. Support long members, such as columns and chords, on skids placed close enough together to prevent injury from deflection. If the Contract is for erection only, check the material against the shipping lists and report promptly in writing any shortage or injury discovered.

c. Falsework. Design the falsework, and construct and maintain the falsework for the applicable loads. Prepare and submit to the Engineer for approval in writing plans for falsework or for changes in an existing structure necessary for maintaining traffic. Approval of the plans does not relieve the Contractor of its primary responsibility for the adequacy of the design.

d. Straightening Bent Material (Field). Perform the straightening of plates, angles, other shapes, and built-up members, when permitted by the Engineer, by methods that will not produce fracture or other injury to the metal. Straighten distorted members by mechanical means or, if approved by the Engineer, by effective procedures and the supervised application of a limited amount of localized heat. As an exception, perform the heat straightening of AASHTO M270 (ASTM A709) Grades 70W, 100, and 100W steel members only under rigidly controlled procedures, with each application subject to the

approval of the Engineer. Do not allow the maximum temperature to exceed the values in the following table.

Grade	Max. Temp
Grade 70W > 6 in. from weld	1050°F
Grade 70W < 6 in. from weld	900°F
Grade 100 or 100W > 6 in. from weld	1100°F
Grade 100 or 100W < 6 in. from weld	950°F

In all other steels, do not allow the temperature of the heated area to exceed 1200°F, as controlled and monitored by temperature indicating crayons, liquids, or bimetal thermometers or by other methods as approved by the Engineer. Heating in excess of the limits shown shall be cause for rejection, unless the Engineer allows testing to verify material integrity.

Ensure that parts to be heat straightened are substantially free of stress and from external forces, except stresses resulting from mechanical means used in conjunction with the application of heat.

Evidence of fracture following straightening of a bend or buckle will be cause for rejection of the damaged piece.

e. Assembling Steel. Handle the materials so that no parts are bent, broken, or otherwise damaged. When hammering material, avoid damage or distortion of the members. Repair all damage to coatings according to **SECTION 825** at no additional cost to the Department. Clean bearing surfaces and surfaces to be in permanent contact before the members are assembled. Ensure that splices and field connections have one-half of the holes filled with bolts and cylindrical pins (half bolts and half pins).

Use fitting-up bolts that are the same nominal diameter, and ensure that cylindrical erection pins are 1/32 in. larger.

f. Bolted Connections. Clean the surfaces of metal in contact before assembling. Assemble the parts of a member and ensure that the parts are well pinned and firmly drawn together before drilling, reaming, or bolting is commenced. Take apart assembled pieces, if necessary, for the removal of burrs and shavings produced by the operation. Ensure that the member is free from twists, bends, and other deformations.

Ensure that the drifting performed during assembly is only that needed to position the parts and does not enlarge the holes or distort the metal.

For high strength bolted connections, see **Subsection 824.03.5**.

g. Field Welding. When field welding is specified, perform the welding by the electric arc process, and ensure that it conforms to the same requirements in **Subsection 824.03.6** with the following modifications.

Unless approved by the Engineer, do not undertake welding when the ambient temperature is lower than 32°F, when surfaces are wet or exposed to rain, snow, or high wind, nor when the welders would be exposed to inclement conditions.

h. Misfits. The correction of minor misfits involving non-harmful amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, report immediately to the Engineer if any error in the shop fabrication or deformation resulting from handling and transportation that prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, and secure his/her approval of the method of correction. Make the correction in his/her presence.

824.03.11 Surface Preparation for Weathering Steel.

a. Cleaning After Fabrication. After completion of fabrication operations, blast clean all steel surfaces according to SSPC-SP 6, "Steel Structures Painting Council Surface Preparation Specification No. 6 - Commercial Blast Cleaning." Emphasize the inspection of all exposed surfaces, including the outside face and bottom side of fascia girders and all exposed fascia welds.

b. Handling. Ensure that all steel remains clean. Ensure that exposed steel remains clean of all foreign material such as grease, oil, concrete spatter, chalk marks, crayon marks, dirt, etc. Natural oxidation of the steel is not considered foreign matter.

c. Final Cleaning. After the deck is in place and all formwork has been removed, inspect the steel surfaces for stains, discoloration, and any other deleterious materials that may affect the weathering of the steel in a uniform manner. Remove stains, discoloration, and any other deleterious materials on exterior surfaces of fascia girders by high pressure (5000 - 10,000 psi) water cleaning. If necessary, add a chemical cleaning agent, with the approval of the Engineer, to the high-pressure cleaning to remove staining. If high pressure water cleaning does not remove the stains, propose an alternative cleaning method, subject to the approval of the Engineer in writing. Ensure that the surrounding area is protected from contamination. Avoid any damage to the adjacent concrete. Once the final cleaning is accomplished, do not use the structural steel for attachment or support.

824.03.12 Shear Connectors.

a. Welding. End-weld stud shear connectors to steel beams or girders (on axes parallel to the transverse reinforcement) with automatically timed stud welding equipment connected to a suitable power source. Ensure compliance with **Subsection 824.03.7**.

If two or more stud welding guns will be operated from the same power source, interlock the gunsso that only one gun can operate at a time and so that the power source has fully recovered from making one weld before another weld is started.

Do not perform welding when the ambient temperature is below 32°F or when the surface is wet or exposed to rain or snow.

While in operation, hold the welding gun in position without movement until the weld metal has solidified.

Ensure that longitudinal and lateral spacings of studs with respect to each other and to edges of beam or girder flanges do not vary more than ½ in. from the dimensions shown on the Plans, except that a diagonal variation of 1 in. will be permitted where required to avoid obstruction with other attachments on the beam or where a new stud is being welded to replace a defective one. Ensure that the minimum distance from the edge of a stud to the edge of a beam is 1 in. but preferably not less than 1½ in.

Bend the first two studs welded on each beam or girder, after being allowed to cool, to 45° by striking the stud with a hammer. If failure occurs in the weld of either stud, correct the procedure and attain two successive studs successfully welded and tested before any more studs are welded to the beam or girder. Promptly inform the Engineer of any changes in the welding procedure at any time during construction.

If the reduction in the height of studs as they are welded becomes less than normal, cease welding immediately and do not resume until the cause has been corrected.

Before welding a new stud where a defective one has been removed, ground smooth and flush the area or, for a pullout of metal, fill the pocket with weld metal using the shielded metal-arc process with low-hydrogen welding electrodes and then ground flush. In compression areas of flanges, a new stud may be welded adjacent to the defective area in lieu of repair and replacement on the existing weld area.

b. Inspection. If visual inspection reveals any stud that does not show a full 360-degree weld, any stud that has been repaired by welding, or any stud in which the reduction in height due to welding is less than normal, strike the stud with a hammer and bend the stud 15 degrees off the vertical. For studs showing less than a 360-degree weld, ensure that the direction of bending is opposite to the lack of weld. Replace studs that crack either in the weld or the shank.

The Engineer may select additional studs to be subjected to the bend test specified above. The studs tested that show no sign of failure may remain in the bent position.

824.04 METHOD OF MEASUREMENT.

Structural Steel is measured by the pounds of each type and configuration provided.

Castings, forgings, wrought iron, special alloy steels, weld metal, and special shapes for expansion joints, shear connectors, drainage fixtures, or railing are considered as structural steel even when made of other materials.

Compute the weight of metal based on the following unit weights expressed in pounds per cubic foot:

Metal	Unit Weights (lb/cu ft)
Aluminum, cast, or rolled	173.0
Bronze or copper alloy	536.0
Copper, sheet	558.0
Iron, cast	445.0
Iron, wrought	487.0
Iron, malleable	470.0
Lead, sheet	707.0
Steel, cast, or rolled, including alloys, copper bearing, and stainless	490.0
Zinc	450.0

For the estimated overrun, compute the weight of steel shapes and plates based on their nominal weights and dimensions as shown on the approved Shop Drawings and after deducting for open holes. An estimated overrun computed as one-half the "Permissible Variation in Thickness and Weight" as tabulated in ASTM A6 will be added to all universal mill and sheared plates and slabs.

For high strength bolts and nuts, compute the weight based on the following weights:

Diameter of Bolt Bolts in Inches	Weight per 100 Bolts in Pounds
½	19.7
⅝	31.7
¾	52.4
⅞	80.4
1	116.7
1⅛	165.1
1¼	212.0
1⅜	280.0
1½	340.0

Compute the weight of weld metal to the net length called for on the Shop Drawings based on the following table:

Size of Fillet in Inches	Weight in Pounds Per Foot of Weld
3/16	0.08
¼	0.14
5/16	0.22
⅜	0.30
½	0.55
⅝	0.80
¾	1.10
⅞	1.50
1	2.00

If the Contract does not include erection by the fabricator, field welds will not be included.

The weight of temporary erection bolts, shop, and field paint, galvanizing, and material used for shipping and erection will not be included.

Compute the weight of castings from the dimensions shown on the approved Shop Drawings, deducting for open holes. Add a 5 percent allowance for fillets and overrun. Scale weights may be substituted for computed weights for castings or for small complex parts for which accurate computation of weights is difficult.

Surface preparation for weathering steel will not be measured separately for payment.

Welded Stud Shear Connectors will be measured by the number of each piece welded to steel flanges.

824.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Structural Steel	LB
Welded Stud Shear Connectors	EA

824.05.1 Structural Steel.

The price constitutes full compensation for all labor, materials, and equipment, including fabricating, delivering, erecting, shop and field painting, and all incidentals required to finish the work, complete and accepted.

No separate payment will be made for surface preparation for weathering steel. This work is included with the payment, and at the Contract unit price, per pound for Structural Steel; Weathering.

No additional compensation will be granted to the Contractor for moving, handling, rehandling or positioning the members to facilitate testing.

824.05.2 Welded Stud Shear Connectors.

The price constitutes full compensation for all labor, materials, and equipment, and all incidentals required to finish the work, complete, and accepted.

SECTION 825 — PAINTING STRUCTURAL STEEL

825.01 DESCRIPTION.

This work includes the thorough cleaning, preparation of surfaces, painting or repainting of new or existing steel, galvanized, and metalized structures, its components or other steel materials at the required locations.

825.01.1 Submittals.

Submit the items listed below to the Department for approval before performing any work. This list does not include required submittals that are a part of other related Specifications:

- Contractor applicator qualifications and material certifications. Refer to **Subsection 825.01.5** and **SECTION M06**
- Topcoat color samples
- Product Data Sheets (PDS) and Safety Data Sheets (SDS) according to **SECTION M06**
- Quality Control Plan according to **Subsection 825.03.8**
- Scaffolding/work platforms
- Removal/repair procedures for unsatisfactory material (if required)

825.01.2 Toxic Substances.

Existing paint systems on the Department's bridges may contain toxic substances such as lead, chromium, or cadmium, and these substances are considered hazardous to personnel, the environment, and the public proximate to the Project. Plan and take appropriate precautions during the painting operations and for waste disposal to meet the State and Federal requirements for the protection of workers, the public, and the environment. See **SECTION 826** for a thorough discussion.

825.01.3 Protection of Personnel, Public, Environment, and Structure.

This provision addresses the requirements for removal and containment of paint and/or corrosion products from any steel bridge or other specified appurtenances during surface preparation and painting operations. Conduct all activities associated with the coating work specified herein according to all applicable Federal, State, and local regulations, **SECTIONS 107** and **826**, the Contract Special Provisions and the SSPC-PA Guide 10, "Guide to Safety and Health Requirements for Industrial Painting Projects."

Protect pedestrians from injury, vehicular, and/or other traffic on or under the bridge or structure, surrounding property, surfaces, buildings, grounds, etc., against damage or disfigurement from surface preparation media, or spatters, splashes, overspray, and smears of paint or material. Furnish adequate containment materials for protection.

Remove paint drips, spills, or overspray from concrete or other surfaces not designated to receive coatings. Remove and dispose of debris from cleaning operations, and empty paint containers and other refuse at no additional cost to the Department.

825.01.4 Pollution Controls.

Prevent environmental pollution of air, soil, and water caused by surface preparation media, paint spills or overspray, paint chips, dust, or other harmful materials. See **SECTION 107**.

825.01.5 Contractor Applicator Qualification.

Ensure that all painters are SSPC certified or AISC certified.

When the Contract requires surface preparation and painting beyond the first 5 ft of a beam end, demonstrate that the Contractor(s) performing coating application must demonstrate has qualifications by obtaining either the Society for Protective Coatings (SSPC) QP 1 “Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)” for field painting or SSPC QP-3 “Certification Standard for Shop Application of Complex Protective Coating Systems” as appropriate, or the American Institute of Steel Construction (AISC) Sophisticated Paint Endorsement (SPE). Demonstrate that the Contractors involved in the removal of paint containing lead or other toxic metals are certified SSPC QP2, “Standard Procedure Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint.” For field work involving abrasive blast cleaning and painting, follow the requirements of the SSPC CAS QP1 Implementations Schedule as defined on the SSPC Web site (www.sspc.org). Maintain the qualification throughout the painting portion of the Project. If the qualification expires or is revoked for any reason, notify the Engineer, who may require that a qualified Contractor complete the coating portion of the Project.

825.02 MATERIALS.

Provide materials that conform to **SECTION M06** and to the manufacturer’s recommendations as applicable. If there is a conflict between the manufacturer’s recommendations and the requirements of this Section, comply with this Section unless the requirements of the manufacturer are more restrictive. In these cases, advise the Engineer of the discrepancies, in writing, and comply with the Engineer’s written resolution.

825.02.1 Paint Supplier.

Provide all paint material products including primer, intermediate coat, topcoat, and thinners from the same paint supplier and ensure compatibility of components. Use the same paint manufacturer throughout all work. Provide paints that are lead and chromium free. Use a coating system that is an approved NEPCOAT Qualified Product from List A or B according to **SECTION M06**.

825.02.2 Topcoat Color.

Provide a semi-gloss topcoat in the color specified. Provide color chips and the Munsel and/or Federal Standard color designation for verification of the color of the topcoat. Ensure that the color of the primer does not affect the color of the topcoat.

825.02.3 VOC Compliance.

Ensure that all paint products conform to all Federal, State, and local requirements at the point of application as determined using EPA Method 24.

825.03 CONSTRUCTION METHODS.

825.03.1 Surface Preparation.

a. General Requirements. Perform the surface preparation according to the manufacturer's recommendations, most recent edition of the "Society of Protective Coatings Specifications" and additional requirements contained in the Contract Documents, whichever is more stringent, as determined by the Engineer.

b. Engineer's Access. Provide access for sampling and testing paint material components. Samples may be subject to chemical and physical testing. Materials that are of unsatisfactory quality will be rejected. Also, see **SECTION 107**.

c. Surface Anomalies.

- Corner Condition – Remove all sharp corners of steel created by flame cutting or shearing using a grinder. For zinc-rich primers, stripe-coat all corners resulting from sawing, burning, or shearing operations.

- Preparation of Thermal Cut Edges – Soften thermal cut edges before blast cleaning as necessary to achieve proper blast profile.

- Base Metal Surface Irregularities – Remove all visually evident surface defects according to ASTM A6 before blast cleaning steel. When material defects exposed by blast cleaning are removed, restore the blast profile by either blast cleaning or by using mechanical tools according to SSPC-SP 11 "Power Tool Cleaning to Bare Metal."

- Weld Irregularities or Spatter – Remove or repair all sharp weld prominences, weld deficiencies (overlap, rollover, excessive concavity, convexity, or roughness), and all heavy, sharp, or loose weld spatter. Occasional individual particles of rounded tight weld spatter may remain if fully covered or encapsulated, but remove widespread, sharp, or clustered particles of tight weld spatter. Remove the weld irregularities and spatter to form a flush surface.

d. Pre-Cleaning. Remove all oil, grease, and other adherent deleterious substances from areas to be painted according to SSPC-SP 1 "Solvent Cleaning" before abrasive blast cleaning.

e. Abrasive Blast Cleaning. Abrasive blast-clean the entire surface according to the cleanliness and profile required by the manufacture's Product Data Sheet. Assess the profile per ASTM D 4417. Clean all new structural steel according to SSPC SP-10, "Near White Blast Cleaning." Ensure that the abrasive blast media meets SSPC-AB1 "Mineral & Slag Abrasives," SSPC-AB 2 "Cleanliness of Recycled Ferrous Metallic Abrasives," or SSPC-AB3 "Ferrous Metallic Abrasives." If the material for the Project is heavily rusted or pitted, measure the non-visible contaminant and remove according to SSPC-Guide 15 "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous

Substrates" to ensure that detectable chloride levels are less than 10 micrograms per square centimeter.

Equip compressed air supply lines with oil traps and moisture separators. Conduct a white blotter test according to ASTM D 4285 to verify the cleanliness of the compressed air. Conduct the test at least once per shift for each compressor system. Sufficient freedom from oil and moisture is confirmed if no soiling or discoloration is visible on the paper.

825.03.2 Paint Application.

a. General Requirements. Apply coatings according to SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and the manufacturer's recommendations. Apply the coating to provide a coating that is:

- A continuous, uniform film of the specified thickness that is well bonded to the substrate or previously applied coating
- Free of laps, streaks, sags, separation, unevenness, discoloration, and other visually evident defects
- Applied within the manufacturer's specified pot life

Repair areas that fail any required test as outlined in Para. j "Removal/Repair of Unsatisfactory Material."

b. Coating Material Storage. Store paint according to SSPC-QP3, SSPC-PA 1, and the manufacturer's recommendations. Record the daily storage temperature range for coating materials and verify conformance with the coating manufacturer's recommendations. Inventory the components to ensure that they are used within the shelf life prescribed by the manufacturer. Record the coating batch numbers from each mixed component, the amount and type of thinner used, and the date of application.

Do not expose paint in storage to temperatures lower than those recommended by the paint manufacturer. Paint exposed to temperatures higher or lower than specified is subject to rejection or retesting.

When paint is rejected, cease painting operations until the rejected paint is removed from the Project site.

c. Conditions for Application. Apply the paint material to clean dry surfaces. Comply with the atmospheric conditions specified below or the written recommendations of the manufacturer, whichever is more stringent. Do not apply materials when:

- The temperature of the air or substrate is below 40°F or greater than 100°F or is forecasted to drop below 40°F before the coating dries according to the dry times specified in the manufacturer's recommendations.
- The surface temperature is less than 5°F above the dew point.
- The relative humidity is above 85 percent.

- There is or will be rain, mist, fog, or snow during application and/or cure.
- The manufacturer's requirements for reaction time after mixing are not satisfied.

d. Methods of Application. Use brushes, rollers, spray equipment, or any combination of equipment recommended by the manufacturer and authorized by the Engineer that provides a finish acceptable to the Department.

e. Stripe Coats. Apply a stripe coat of primer to corners, weld seams, around nuts and bolts, or as otherwise directed in the Contract Documents. Do not apply the full coat of primer any sooner than 15 minutes after the application of the stripe coat or any later than the manufacturer's recommended recoat times. Notify Inspection personnel and provide ample time to verify and approve the stripe coat application. Do not apply the full coat of primer until the Engineer has approved the striping in writing. The coating material used for the stripe coat is typically the intermediate coat but, for painting, metalizing, or galvanizing surfaces, the approved finish coat is striped.

f. Intermediate and Topcoat. Ensure that the intermediate coat color contrasts with both the primer and topcoat. Stripe coats may be tinted as necessary to ensure proper coverage. Ensure that coating materials used to apply piece marks are compatible with the existent and any subsequent coats.

g. Recoat Interval. Comply with the coating manufacturer's minimum and maximum recoat interval for each coating layer. Ensure that each coating layer is sufficiently cured before applying the next scheduled coating layer.

h. Field Applied Coatings-Touchup of Primer and Intermediate Coat(s). Before applying field touch-up coatings, verify that all surfaces, including installed bolts, nuts, and zinc-rich primer around connection plates, are thoroughly cleaned of grease, oil, chalk, bird droppings, lubricants, and other adhesive interference material. Use pressure washing or solvent cleaning, as appropriate, to remove the interference material. Use hand and power tool cleaning for spot repair of localized damage to the coating system. Pressure wash using 1500 psi water pressure all surfaces primed with zinc-rich primer to remove zinc salts. Do not proceed with touchup and painting until the Engineer has accepted the surface cleaning. Repair any damaged areas of coating and reapply all affected coating layers. Perform field touchup in areas around bolts, nuts, connection plates, and other areas that had not previously been painted according to the manufacturer's recommendations. Comply with Paras. c and d for application.

i. Field Applied Coatings Topcoat Application. Apply topcoat in the field after the Engineer has accepted the touch up (primer and intermediate) and after the structure has been erected on the Project site. Verify that the amount of time between the application of the intermediate and the topcoat is within the coating manufacturer's recommended maximum recoat time. Verify that the surface is clean and dry before the application of the topcoat. If grease, oil, or other contaminants become deposited on the intermediate coat, remove it according to SSPC-SP1 before the application of the topcoat. Comply with Paras. c and d for application.

j. Removal/Repair of Unsatisfactory Material. The coating system is unsatisfactory if any of the following defects are observed:

- Abrasion damage
- Peeling
- Blistering
- Wrinkling
- Excessive runs
- Sags
- Evidence of application under unfavorable conditions
- Poor workmanship
- Use of unauthorized coating material
- Other defects as determined by the Engineer

Submit repair procedures for unsatisfactory material to the Department for approval in writing before performing related work. Remove and replace unsatisfactory coating layers at no additional cost to the Department as specified below:

- Bare Steel Exposed Less Than 4 in. × 4 in. Area. When the defective paint or damage extends to the bare steel or if bare steel is exposed in areas less than 4 in. × 4 in. in size, clean the surface by power tool cleaning according to SSPC-SP11. Feather the surrounding paint to expose a minimum of ½ in. of each coat around the entire perimeter of the repair area and to provide a smooth transition into the surrounding intact, adherent material. Select a primer recommended by the manufacturer for the intermediate and topcoat. For new steel, apply a spot coat of zinc-rich primer to the prepared surface. Follow with a spot coat of the intermediate and topcoat.

- Bare Steel Exposed Greater Than 4 in. × 4 in. Area. When the defective paint or damage extends to the bare steel in areas greater than 4 in. × 4 in. in size, blast clean the area according to SSPC SP10, feather the surrounding paint, and repair as described above.

- Primer or Intermediate Coat Exposed. When the damaged or defective paint extends to the primer or intermediate coat, and for primed areas around and on connection plates, clean the surface by hand or power tool cleaning. Clean according to SSPC SP2 or SSPC SP3 to remove oxidation, zinc-salts, and contamination from the surface. Do not burnish or polish the surface. Supplement hand and power tool cleaning with pressure washing (1500 psi minimum) accompanied by scrubbing with stiff bristled brushes or other means as necessary. Feather the surrounding material to expose a minimum of ½ in. of each coat and to provide a smooth transition into the surrounding intact, adherent coating material.

- All Repairs. For all repairs, roughen the paint in overcoat areas with 80 grit sandpaper to ensure good adhesion of the overcoat material to the underlying paint. Also, solvent clean according to SSPC SP1 and repaint the affected areas with the intermediate and topcoat.

k. Scaffolding. Use rubber rollers or other protective devices to prevent damage to the finished coatings. In particular, use sufficient support pads for bracing on fascias. Do not allow temporary supports or attachments for scaffolding or forms to damage the coating system. Repair areas damaged by scaffolding according to Para. j above.

l. Technical Supervision. The Contractor/fabricator is responsible for securing the services of the technical representative, the services of which will be at no additional cost to the Department.

825.03.3 New Steel Structures.

Work under this paragraph only applies to structures being built new or structures whose superstructure is being replaced in its entirety. For new steel used in partial replacement or rehabilitation, see **Subsection 825.03.4**.

a. General. Use a three-coat system approved by the Northeast Protective Coating Committee (NEPCOAT), or as described in **Subsection 825.03.5**, and that conforms to **SECTION M06** and the following:

- Exterior Steel Surfaces. Use a system that consists of a prime coat, intermediate stripe coat, intermediate coat, and topcoat.

- Interior Steel Surfaces. Use a coating system for the interior surfaces, such as open box girders, arch ribs and ties, and tubular wind bracing, that consists of a two-coat NEPCOAT exterior system and contrasts with the primer. This system contains a zinc-rich primer and intermediate coat. Select the same primer and intermediate coat for application to both interior and exterior surfaces of the same steel member. Interior surfaces require no topcoat. Use white for the intermediate coat applied to interior surfaces.

b. Priming Faying Surfaces. Ensure that the coatings applied to contact surfaces of bolted connections between primary members comply with the AASHTO *LRFD Bridge Construction Specifications*. Use a coating system for faying surfaces that has a slip coefficient of Class B. Before shop bolting, verify that the coating on faying surfaces is applied at the recommended dry film thickness and that the temperature adjusted cure time for shop and field slip critical bolted faying surfaces is within the range previously validated through testing by the applicator's QC person or as given by NEPCOAT. Verify the cure according to ASTM D 4752 or the manufacturer's requirements.

Apply the zinc-rich primer to all surfaces. Do not apply intermediate and topcoats to faying surfaces, connection areas, or within 2 in. of a connection area that will be welded. Mask or otherwise protect these surfaces to prevent the application of intermediate and topcoats. Zinc-rich primer is not allowed on flange surfaces that will be embedded in concrete, although overspray is allowed on the flange surfaces.

Apply the topcoat to the same surfaces coated with the intermediate coat, except those surfaces that will be embedded in concrete.

c. Bolts (Fasteners). Prepare bolts installed and final tightened before priming as necessary so that, after the steel is abrasive blast cleaned, exposed bolt surfaces will satisfy the requirements in the Table below. Black bolts, nuts, and washers, including flat faces of nuts and bolt heads facing adjacent material, may require spot blast cleaning or other surface preparation before general blast cleaning to ensure that the proper surface profile to obtain adhesion of the primer has been achieved.

Surface Preparation Requirements for Fasteners and Bolts

Item	Fasteners Installed Before Cleaning & Primer Application		Fasteners Installed After Primer Application	
	Coating System	Surface Preparation	Coating System	Surface Preparation
Black Iron Bolts	OZ or IOZ, I, T	SSPC-SP10	IOZ, OZ, I, T	SSPC-SP 1 & 10
Galvanized (Mechanical or Hot Dip)	OZ or IOZ, I, T	SSPC-SP 1	I, T	SSPC-SP 1 & 2/3

Key:

- OZ = Organic Zinc-Rich Primer
- IOZ = Inorganic Zinc-Rich Primer
- I = Intermediate Coat
- T = Topcoat

If the zinc coating on shop-installed galvanized bolts is damaged during shop abrasive blast cleaning or tightening, the coating may remain as is only if the entire coating system (including the zinc-rich primer) will be applied over the fasteners.

Remove the lubricant from bolts. Obtain from the fabricator the identity of solvents and methods needed to remove the lubricant. Consult with the coating supplier to assess the compatibility of the coating with any lubricant residue.

Supply to the shop and field painters, the Engineer, and other interested parties the information concerning the lubricant removal and the cleanliness necessary for satisfactory adhesion of the subsequent coat as described in the Table above.

Use a white cloth wipe test with no color transfer to confirm that all lubricant and non-absorbed dye has been removed; only residual stain is permitted to remain on the surface.

d. Shipping, Storage, and Erection of Steel. When handling, storing, shipping, and erecting the steel, avoid damage to the coating system. Do not move coated steel in the shop until sufficient cure time has elapsed to ensure that no damage will be done to the fresh coating. Do not ship the steel from the shop to the field until the last coating has fully cured.

Install padding on hooks and slings used to hoist the steel, and use softeners approved by the Engineer to insulate the steel from binding chains. Place small structural pieces in so that no rubbing will occur during shipment.

Store the steel at the job site on pallets or by other means to prevent members from resting directly on the ground or from falling onto each other.

825.03.4 Existing Steel Structures.

Work under this section is only applicable to structures that are not addressed under **Subsection 825.03.3**.

a. Protection of Painted Surfaces. Protect freshly coated surfaces and those surfaces not scheduled for painting from over blast and stray abrasive during blast cleaning operations. Clean any previously coated surfaces damaged by subsequent blast cleaning operations according to SSPC SP10 and recoated according to this specification.

b. Surface Preparation. Obtain the Engineer's approval of the preparation of all surfaces to be painted before applying any paint.

Surface preparation and coating requirements are dependent upon the scope of work and the type and condition of the existing coating system. The Table below provides the required surface preparation methods for four scenarios. Use the specific coating material requirements for each surface preparation method in **SECTION M06**.

Surface Preparation Methods for Spot, Zone and Overcoating[1]

Scope of Work	Surface Preparation	Existing Coating System
Spot Prime and Overcoat	Method 1	Alkyd Coatings
Spot Prime and Overcoat	Method 2	Zinc-rich or Metalizing/Galvanizing with Topcoat
Zone Painting	Method 3	Alkyd Coatings
Zone Painting	Method 3 or Method 4	Zinc-rich or Metalizing/Galvanizing with Topcoat

1. *Ensure that the surface preparation methods are according to the paint manufacturer's recommendations, unless the requirements in this Table exceed the manufacturer's recommendations. In case of conflict, use the more stringent surface preparation methods as determined by the Engineer.*

c. Method 1: Spot Prime and Overcoat an Existing Alkyd Coating System. Spot clean localized areas of corrosion or coating breakdown using vacuum shrouded power tools according to SSPC-SP3, "Power Tool Cleaning." Feather the edges of the power tool cleaned areas. Prepare the intact alkyd coating for overcoating by cleaning according to Low-Pressure Water Cleaning (LP WC) of SSPC-SP12. The minimum acceptable water pressure is 1500 psi. Use low pressure water cleaning to remove chalk, pigeon droppings, dirt, and other deleterious materials from the surface.

d. Method 2: Spot Prime and Overcoat an Existing Coating System. Spot clean localized areas of corrosion or coating breakdown using vacuum shrouded power tools according to SSPC-SP11, "Power Tool Cleaning to Bare Metal," or using vacuum blast cleaning equipment according to SSPC-SP10, "Near White Blast Cleaning." Feather the edges of the repaired area. Prepare the intact topcoats (epoxies or urethanes) for overcoating by hand sanding to roughen the surface.

e. Method 3: Abrasive Blast Clean. To remove all coating material from a well-defined zone (portion of the structure). Blast clean steel according to SSPC SP10, "Near White Blast Cleaning." Ensure that the surface area of the steel to be blast cleaned is no greater than the surface area of steel that can be primed during the same day. Ensure that the maximum time lapse between surface preparation and application of the prime coat is not greater than eight hours, unless atmospheric controls are used to prevent "rust back." If any "rust back" occurs before priming, reclean surfaces to provide the specified degree of cleanliness. Ensure that the abrasive blast profile meets the manufacturer's requirements as stated on the product data sheets.

f. Method 4: Water Wash and Ultrahigh Pressure Water Clean. Use in a well-defined zone (portion of the structure). Pressure wash all surfaces in the zone that will be coated, including areas of limited access such as crevices between back to back angles. Use low pressure washing to remove the loose debris, followed by ultrahigh pressure water cleaning to remove all existing coating and corrosion from the steel surfaces scheduled to be coated. Comply with the requirements of SSPC-SP 12, "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Before Recoating." Ensure that cleaned steel surfaces that will be painted conform to the Visual Surface Preparation Definitions of the surface condition WJ-3 in SSPC SP12. Do not use rust inhibitors. Reclean steel surfaces not primed within 72 hours by water jetting. Collect all water and paint chips dislodged by the water cleaning process. Use potable filtered water for the washing to achieve a surface that is free of paint, corrosion, and other visible contaminates. Measure the non-visible contaminant and remove according to SSPC-Guide 15 to ensure that detectable chloride levels are less than 10 micrograms per square centimeter.

g. Limited Access Areas. The design of the structure may create areas of limited access that cannot be cleaned to the specified degree of surface preparation across every square inch of the surface. In these cases, provide surface preparation as follows.

   Clean all areas that can be viewed without the use of mirrors to the specified degree of cleanliness. Localized areas of limited access due to the configuration of the structure may prevent the specified degree of cleanliness from being achieved. At a minimum, remove all loose coatings in these areas. Inspect the surfaces by touch, using a putty knife and inspection mirrors, optical or digital scopes. Cleaning and painting of these areas may require the use of specialized equipment. If the limited access area is a crevice or gap from which pack rust cannot be removed such as between mating plates, between back-to-back angles, or between structural members, apply sealants/caulks to seal the top and side surfaces to prevent moisture intrusion. Do not caulk the bottom crevice. Use sealants/caulks compatible with the coating system and provide written verification from the coating manufacturer on the compatibility of the sealant/caulk with the coating.

825.03.5 Painting Metalized or Galvanized Surfaces.

Use a coating system that is an approved NEPCOAT system and conforms to **SECTION M06**. The zinc-rich primer is not required for metalized or galvanized surfaces.

Prepare galvanizing according to SSPC SP-16 before painting. Remove white corrosion deposits, such as wet storage stains, before coating. Overcoat with any of the NEPCOAT approved intermediate coats followed by applying the compatible NEPCOAT-approved topcoat.

The natural profile of metalized surface will not require any surface preparation.

For any process that reduces the metalized or galvanized thickness below the specification limit, remove and re-apply the metalize or galvanize, as applicable, to meet the specification.

Apply the intermediate coat to the surface as soon as possible after the Engineer has accepted the metalizing or galvanizing surface preparation and no later than eight hours after the preparation. If more than eight hours elapses, provide written recommendations from the intermediate coat manufacturer that identify the required steps to compensate for any oxidation and make the surface suitable for the intermediate coat application. Do not implement the steps without written approval from the Engineer. Apply a stripe coat of urethane to all edges of bolted connections and other areas followed by a full approved finish coat of urethane.

825.03.6 Stenciling of Topcoat.

After the topcoat has fully cured, provide stencil information on the inside surface of the fascia member at each abutment location. Use suitable black paint or other color as approved by the Engineer to contrast with the topcoat for visibility. Stencil uniform block lettering on the surface, 2 in. to 3 in. in height, with the following information:

- The bridge identification number as shown on the Plans
- The month and year of completion of the coating system (MM/YYYY)
- The SSPC identification of the cleaning method
- Identification of the coating system (for example: IOZ/OZ, E, U) with the name of the manufacturer; use the following designations:
    - IOZ = Inorganic Zinc Rich Primer
    - OZ = Organic Zinc Rich Primer
    - M = Metalized
    - G = Galvanized
    - E = Epoxy
    - U = Urethane

825.03.7 Lighting.

Provide adequate lighting for all surface preparation, paint application, and inspection work. Maintain a minimum of 10 ft-candles for surface preparation and painting, and a minimum of 30 ft-candles of general area lighting for inspection. Increase the lighting if workers or other personnel have difficulty seeing. Use explosion-proof lighting.

825.03.8 Quality Control.

Document and conduct an on-going Quality Control plan for the process and for the inspection of the materials, surface preparation, coating applications storage, and shipping of components as

necessary to ensure that all work is performed in compliance with the Contract Documents and the manufacturer's recommendations. At a minimum, address the following:

- Qualifications, authority, and responsibilities of the QC Manager
- Qualifications, responsibilities, and training for workers (Include the frequency of checks on the quality of work)
- Documentation of the proposed equipment and calibration records
- How the QC documentation and supporting records are maintained
- How the surface preparation of the steel before the application of the paint system, especially the profile, is verified and monitored (e.g., frequency). For galvanized steel, include the method of profiling
- How the environmental conditions (e.g., ambient temperature, dew point, relative humidity) for various stages of the paint process are monitored and maintained throughout the duration of the Project
- How the coating materials and abrasives are verified and monitored for receipt, storage, and control
- How the coating materials are verified and monitored for batch numbers, mixing, pot life, mix reaction time, dry time, curing, recoat time, and cleanliness of each coat before the application of the subsequent coat
- How the coating materials, including galvanize and metalize, are inspected and accepted for appearance, film thickness, adhesion, etc. For galvanized surfaces, include the galvanize thickness after the surface preparation.
- How the coating films are inspected for defects
- How the faying surfaces are treated and protected
- How the coatings of steel components are protected from damage during storage, shipping, and erection

825.03.9 Equipment and Standards.

If requested by the Engineer, furnish the following equipment and standards, which will be returned to the Contractor when the Engineer is finished with the inspection:

- Magnetic contact surface thermometer
- A portable instrument capable of measuring and digitally displaying the temperature, humidity and dew point
- SSPC VIS Standard appropriate for the specified degree of cleaning:
  - SSPC VIS 1, "Visual Standard for Abrasive Blast Cleaned Steel"
  - SSPC VIS 3, "Visual Standard for Power- and Hand-Tool Cleaned Steel"
  - SSPC VIS 4/NACE
  - SSPC VIS 4/NACE VIS 7, "Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting"

- Wet film thickness comb or combs of a suitable scale for the coatings being applied
- A digital display dry film thickness gauge with a scale suitable for the coatings being applied and probes suitable for the surface to be measured
- NIST (NBS) Calibration Standards
- SSPC Surface Preparation Standards appropriate for the surface preparation requirements of the Contract Documents
- A microscope with an illuminated graduated scale suitable for the dry film coating thicknesses to be measured; provide suitable cutters to create scratches of the geometry needed to take measurements with the microscope.

Provide current certificates of calibration for the instruments.

825.03.10 Pre-Painting Meeting.

Arrange a meeting at the site where the surface preparation and painting will be performed at least one month in advance of starting the work to discuss the Project requirements with the Department and the manufacturer's technical representative and for an examination of the surface preparation and paint application equipment. The meeting will address:

- Methods of operation
- Weather-related concerns
- Health and safety
- Proper storage of material and equipment
- Location of recycling, dust collection, and storage equipment
- Treatment of inaccessible areas
- Visual standards to be satisfied

Provide the QCP to the Engineer for review at least two weeks before this meeting. Do not proceed with the work until this meeting has been completed to the satisfaction of the Engineer.

825.04 METHOD OF MEASUREMENT.

825.04.1 Painting Existing Structural Steel.

Painting Existing Structural Steel will be measured by the number of square feet of steel painted. Cleaning, surface preparation, and paint systems on new steel will be considered as incidental to the painting work and, therefore, will not be measured separately.

825.04.2 Surface Preparation for Existing Steel.

Surface Preparation for Existing Steel will be measured by the number of square feet of steel surface prepared. Separate levels of surface preparation necessary to accomplish the final specified surface preparation will not be measured separately for payment but will be considered included in the single square foot measurement.

825.04.3 Lump Sum Alternative.

In some cases, any or all of the above items of work may be paid on a lump sum basis. In these cases, no measurement will be required.

825.04.4 Personnel and Environmental Protection.

Personnel and environmental protection will be measured according to **SECTION 826**.

825.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Painting Existing Structural Steel	SF
Surface Preparation for Existing Steel	SF

825.05.1 Painting Existing Structural Steel.

The price constitutes full compensation for all labor, materials, and equipment including cleaning, surface preparation, selection of paint system, painting, and all incidentals required to finish the work, complete and accepted.

825.05.2 Surface Preparation for Existing Steel.

The price constitutes full compensation for all labor, materials, equipment, and all incidentals required to finish the work, complete and accepted.

SECTION 826 — PERSONNEL AND ENVIRONMENTAL PROTECTION

826.01 DESCRIPTION.

This work includes providing protection for both persons and the environment during the blast cleaning of existing structural steel before repainting the steel.

This Section addresses the requirements for removal and containment of paint and/or corrosion products from any steel bridge or specified appurtenances during blast cleaning operations and the requirements to ensure that both Contractor and Department employees are adequately equipped and protected from the harmful effects of lead, blast media dust, and fumes from the blasting operations.

This provision is associated with and applies to **SECTION 825**.

826.01.1 Toxic Caveat.

Existing paint systems on the State's bridges may contain toxic substances such as lead or chromium, and these substances may be considered hazardous wastes when removed.

826.01.2 Legal Responsibilities.

Take responsible charge of the worksite and comply with all Federal, State, and Municipal laws related to the work. See **SECTION 107**.

The Department is the generator of the waste and is, therefore, directly responsible for complying with the applicable laws and regulations. The Contractor shall be liable for any fines, penalties, or remediation costs incurred by the Department as a result of the Contractor's failure to comply with the applicable laws and regulations.

826.02 MATERIALS.

Not applicable.

826.03 CONSTRUCTION METHODS.

826.03.1 General.

Provide adequate protection for pedestrian, vehicular, and other traffic upon and underneath structures according to **SECTION 107** and any additional provisions of this Section.

Provide a barrier that protects vehicles, vessels, or pedestrians from direct or indirect exposure to the blasting operations, and prevents abrasive materials or debris from falling onto the roadway, into waterways, or any other location where a traffic hazard may be created. Otherwise, the Engineer will suspend work until corrections are made.

Protect all portions of the structure and its appurtenances that could be damaged by the blast cleaning operations by covering or shielding.

826.03.2 Containment.

Ensure that there is total containment of all debris or spent materials during the blast cleaning operations or subsequent air blowing or vacuuming of the work area.

a. Containment, Collection, Storage, and Disposal. Perform the containment, collection, storage, and disposal of debris and spent materials. Additionally, ensure that all containment, collection, storage, and disposal of debris and spent materials resulting from the cleaning operations comply with the latest rules, regulations, requirements, standards, and/or procedures of the following agencies, which include the following:

- The Environmental Protection Agency, 40 CFR Part 745, Lead, Requirements for Lead Based Paint Activities.
- Rhode Island Department of Environmental Management, Division of Air and Hazardous Materials:
  - Air Pollution Control Regulation No. 5, Fugitive Dust
  - Air Pollution Control Regulation No. 24, Removal of Lead Based Paint From Exterior Surfaces
  - Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage, and Disposal
  - Rules and Regulations for Solid Waste Management Facilities

826.03.3 Personnel Protection.

a. Painting and Cleaning Operations. During painting and cleaning operations, ensure that all workers engaged in the removal of lead-based paints and blast cleaning operations are adequately trained, protected, equipped, and monitored against the harmful effects of lead and blast media during all phases of the painting operations. Additionally, ensure that all monitoring respiratory protection, protective clothing, housekeeping and hygiene, medical surveillance, medical protection, training, signs and record keeping comply with the latest rules, regulations, requirements, standards, and/or procedures of the following agencies, which include the following:

- The Occupational Safety and Health Administration, 29 CFR Part 1926 and, more specifically, Part 1926 and Part 1926.62, OSHA Standard for Lead in the Construction Industry with:
  - Appendix A — Substance Data Sheet for Occupational Exposure to Lead
  - Appendix B — Employee Standard Summary
  - Appendix C — Medical Surveillance Guidelines
  - Appendix D — Qualitative and Quantitative Fit Test Protocols
- Rhode Island Department of Health, Environmental Lead Program, Rules and Regulations for Lead Poisoning Prevention as applicable

Ensure that these documents are available as applicable through the local offices of the US Department of Labor, Occupational Safety and Health Administration. The location of the offices is indicated in **Special Provision Code 826.1000** of the Contract.

826.04 METHOD OF MEASUREMENT.

Containment, Collection, Storage, and Disposal of Debris and Spent Materials will not be measured separately for payment. Personnel Protection During Painting and Cleaning Operations will not be measured separately for payment.

826.05 BASIS OF PAYMENT.

Containment, Collection, Storage, and Disposal of Debris and Spent Materials will not be paid and is incidental to the bid item that requires this work, and these costs should be included in the item. This incidental work includes all materials, labor, equipment, collection and containment equipment, storage requirements, engineering, sampling, testing, disposal fees, and all incidentals required to finish the work, including toxic substances as stated under **Subsection 826.01.1**.

Personnel Protection During Painting and Cleaning Operations will not be paid and is incidental to the bid item that requires this work and these costs should be included in that item. This incidental work includes all materials, labor, equipment, monitoring devices, changing and shower facilities, professional hygienist, medical facilities and all incidentals required to finish the work complete and accepted.

SECTION 827 — THERMAL SPRAYED ZINC COATING FOR NEW STRUCTURAL STEEL

827.01 DESCRIPTION.

This work includes cleaning, preparing surfaces, and applying an application of thermal sprayed zinc coating to the surfaces of new structural steel and its components at the required locations indicated.

827.02 MATERIALS.

Use materials that conform to **Subsection M05.07**.

827.03 CONSTRUCTION METHODS.

827.03.1 Surface Preparation.

a. Blast Equipment. Use conventional air type blast equipment. Do not use any type of water or vapor blast. Ensure that the air supplied for blasting has sufficient pressure at the nozzle to achieve the desired profile and is clean and free of oil and moisture. Ensure that surfaces prepared for metal spraying also remain free from oil and moisture until zinc coating has been applied.

b. Blast Cleaning. Perform the blasting operation in a block or sectional method and continue until all foreign matter and scale on the original surface has been removed and until the cleaned metal surface is bright and completely abraded by the abrasive.

Clean all steel surfaces to a white metal condition using the methods described in the Steel Structures Painting Council Surface Preparation Specification No. 5, White Metal Blast Cleaning (SSPC-SP5). Ensure that the steel surface temperature is a minimum of 5°F above the dew point. Use an abrasive as specified above. Ensure that the blast cleaning leaves a 2.0 to 4.0 mil deep profile in a dense uniform pattern of depressions and ridges. Measure and/or verify the surface profile depth with an Elcometer surface profile gauge, or equal, or Testex Replica Tape.

Remove all visible abrasive and dust from the surfaces to be thermal spayed. Transfer and preserve the erection marks for the field identification of members and weight marks. Remove any grease pencil marking by solvent wiping.

The Engineer will approve the preparation of all surfaces before any thermal sprayed zinc is applied.

827.03.2 Thermal Spraying Zinc.

a. Thermal Spraying. Ensure that all surfaces have been prepared according to Subsection 827.03.1.

Do not spray surfaces that demonstrate any sign of rust, scale, moisture, or foreign matter. Apply at least one single layer of the coating within a maximum of four hours of the blasting. Overlap the sprayed metal on each pass in a cross-hatch block pattern not to exceed 2 sq ft to ensure uniform coverage. Apply the specified thickness of the coating

in multiple layers, and ensure that not less than two passes of the spraying are made over the entire surface.

Ensure that the coating operations produce a uniform, even coating that is bonded firmly with the steel. Ensure that the coating is free from uncoated spots, lumps, or blisters, and has a uniform sprayed fine texture finish.

Ensure that the coating thickness is a minimum of 8.0 mils ±1 mil. Measure the coating thickness using the methods described in the Steel Structures Painting Council Paint Application Specification No. 2, Measurement of Dry Paint Thickness with Magnetic Gauges (SSPC - PA2).

Remove and recoat all steel coated with impure, unsatisfactory, or unapproved coating material. Respray areas not meeting the coating thickness requirements to the specified thickness after appropriate surface preparation.

b. Field Repair. Make all field repairs according to the material supplier's recommendations and these Specifications. Ensure that new steel is shop coated, including metalizing, painting, and sealing. Notify the Engineer when performing field repairs before beginning the work.

827.03.3 Subsequent Coatings.

Ensure that any top coating over the zinc complies with **Subsection 825.03.5**.

827.03.4 Approval Requirements.

a. Samples. Submit a sample steel plate approximately 12 in. × 12 in. to which zinc coating has been deposited at least 30 days before zinc metalizing application to the specified thickness, as checked with a fixed probe gauge, for acceptance by the Engineer for the grain size and texture of the sprayed metal. Take two samples — one for the Engineer and one to store at the applicator's shop for the applicator's reference. The plate will be used to determine the acceptance of the finished job. Prepare the sample plates by the same profiling process, and ensure that the plates have the same surface profile as the steel surface to be thermally sprayed. If the production coating is inferior to the sample, correct the coating by an acceptable repair method and perform a job comparable to the specimen submitted.

b. Qualification/Certifications. Provide a certification for each journeyman applicator to the Engineer before production assignment. If recertification is required, use the following procedure under the direction of the Engineer.

Perform the recertification in a suitable location removed from the area of ongoing work operations. Use a qualifying test for recertification in which the journeyman applies the coating system to the test panel according to the requirements of the application procedure(s) and includes at a minimum:

- Installing the thermal spray system according to the manufacturer's recommendations
- Adjusting the system operating parameters according to the manufacturer's recommendations
- Applying a steady and even application of sprayed metal to a right-angle joint to avoid an excessive buildup in the fillet area
- Repairing a defect made by means of a hammer and chisel in the test panel

c. Quality Control (Process Control). Use the following specific process control items. Provide technical supervision for shop and field applications. Maintain daily logs of air and surface temperature, dew point, and relative humidity. Measure and retain the surface profile of each beam using Testex (or equal) replica tape. Make this available to the Engineer upon request.

d. Safety and Health. Ensure that all personnel required to enter confined spaces are instructed on the OSHA requirements regarding the nature of the hazards involved, the necessary precautions to be taken, and the use of protective and emergency equipment required.

827.04 METHOD OF MEASUREMENT.

Thermal Sprayed Zinc Coating will be measured by the number of square feet of steel sprayed. As an option, the Contract may stipulate that Thermal Sprayed Zinc Coating is incidental to the Pay Item for the associated structural element.

827.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Thermal Sprayed Zinc Coating	SF

The price constitutes full compensation for all labor, materials, equipment, tools, technical supervision, and incidentals required to finish the work, complete and accepted.

SECTION 828 — BRIDGE BEARINGS

828.01 DESCRIPTION.

This work includes furnishing and installing bridge bearings. Bearing types specified in this provision include elastomeric pads, and pot and disc bearings. The components of bridge bearings include masonry, sole and shim plates, anchor bolts, elastomeric elements, TFE (Teflon) sheets or surfacing, lubricants, and adhesives.

828.01.1 Elastomeric Pad Bearings.

Elastomeric bearings include unreinforced pads (consisting only of elastomer) and pads reinforced with steel laminates.

828.01.2 Pot and Multi-Rotational Bearings.

The pot and multi-rotational bearings detailed in the Plans are conceptual only. Bearings fabricated by manufacturers listed in the Department's Approved Materials List or other qualified manufacturers will be accepted.

The overall width and/or length of pot and multi-rotational bearings must fit within the limits of the concrete beam seats. The overall height of the bearings must be known before the precise beam seat elevation can be determined. Therefore, submit the required details of the bearings to the Engineer within 60 days after Contract award.

828.02 MATERIALS.

828.02.1 Elastomeric Bearings.

a. Elastomer. Use raw elastomer that is virgin neoprene (polychloroprene). Classify the elastomer compound as low temperature grade 0, 2, 3, 4, or 5 as defined by the testing requirements in Section 14 of the AASHTO *LRFD Bridge Construction Specifications* and AASHTO M 251.

b. Steel Laminates. Use steel laminates for reinforcement that conforms to AASHTO M251. Use steel laminates that have a minimum nominal thickness of 14 gauges. Do not allow any holes in plates in manufacturing unless they have been accounted for in design. If guide pins or other devices are used to control the side cover, or if there are imperfections that result in less than the specified elastomer cover for the steel laminates, seal these areas flush with a bonded vulcanized patch material compatible with the elastomer.

c. Sole Plates, Shear Plates, and Anchor Plates. Ensure that these items comply with the applicable Plan notes.

d. Bond. Ensure that the vulcanized bond between fabric and reinforcement has a minimum peel strength of 30 lb/in. Ensure that steel laminated bearings develop a minimum peel strength of 40 lb/in. Perform peel strength tests according to ASTM D429 Method B.

828.02.2 Pot and Multi-rotational Bearings.

Use new materials in the manufacture of pot and multi-rotational bearings. Use pot and multi-rotational bearings that have been fabricated by a single manufacturer.

Use materials, including the elastomeric rotational element, sealant, sealing rings, steel, stainless steel, and TFE sheet, that conform to Subsection 18.3.2 of the AASHTO *LRFD Bridge Construction Specifications*.

828.02.3 Anchor Bolts and Pins.

Ensure compliance with **SECTION M05**.

828.03 CONSTRUCTION METHODS.

828.03.1 Elastomeric Bearings.

Ensure compliance with the RIDOT *Standard Details*, the Plan notes for elastomeric bearings, and the manufacturer's recommendations.

a. Fabrication. Use bearings with steel laminates that have been cast as a unit in a mold and are bonded and vulcanized under heat and pressure. Ensure that the internal steel laminates have been sandblasted and cleaned of all surface coatings, rust, mill scale, and dirt before bonding and that are free of sharp edges and burrs. The manufacturer shall protect external load plates (sole plates) from rusting, shall seal these areas flush with a bonded vulcanized patch material compatible with the elastomer and shall vulcanize the bearing pad to the sole plate. Ensure that bearings designed to act as a single unit with a given shape factor have been manufactured as a single unit.

   Plain pads may be molded, extruded, or vulcanized in large sheets and cut to size. Ensure that the cutting does not heat the material and produces a smooth finish.

b. Fabrication Tolerances. Use plain pads and laminated bearings that have been fabricated to the required dimensions within the tolerances required by AASHTO M 251.

c. Installation. Ensure that the bearing seat is finished straight and true with the plane of contact. Clean the concrete surface of the beam seat of all laitance and construction residue before placing the pads. Place pads on the beam seats before the application of concrete protective coating to bent caps. Do not cement pads to the girders. Ensure that the pads are not deformed during the setting of the girders in their final position. If bearing pads are deformed during the setting operation, lift the girders, thereby allowing the pads to resume their proper configuration and then reset. When further adjustment of elastomeric type bearing pads is necessary to accommodate for variations in ambient temperature at the time of erection, make the necessary adjustments according to the required alignment scheme. The Engineer will approve the method of adjusting the alignment before its use.

828.03.2 Pot and Multi-rotational Bearings.

a. Fabrication. Provide the Engineer with written notification 30 days before the start of bearing fabrication.

After fabrication, shop paint or coat steel surfaces exposed to the atmosphere, except stainless steel surfaces, to protect against corrosion. Before coating, clean the exposed steel surfaces according to the recommendations of the coating's manufacturer. For metal surfaces to be field welded, apply a coat of clear lacquer or other protective coating approved by the Engineer, if the time of exposure before welding occurs will exceed three months. Remove the lacquer coating at the time of welding. Perform the final painting or coating of these surfaces after welding.

Ensure that the stainless steel sheet is attached to its steel substrate with an approved epoxy to ensure total contact and then sealed with a continuous seal weld.

For pot bearings, ensure that the steel piston and the steel pot are each machined from a solid piece of steel. Ensure that the steel base pot of all bearings are either integrally machined, recessed into, or continuously welded to its bottom steel masonry plate. Ensure that the outside diameter of the piston is no more than 0.030 in. less than the inside diameter of the pot at the interface level of the piston and elastomeric rotational element. Bevel the sides of the pistons to facilitate rotation.

Ensure that all welding conforms to, and all welders are qualified, according to the ANSI/AASHTO/AWS D1.5 *Bridge Welding Code*.

Ensure that all bearing surfaces of steel plates are finished or machined flat within 0.010 in. per ft. Out-of-flatness greater than 0.010 in. per ft on any plate will be cause for rejection. Ensure that the bottom surfaces of lower bearing plates (masonry plates) designed to rest on bearing pads do not exceed an out-of-flatness value of 0.0625 in. per ft. Ensure that oxygen cut surfaces do not exceed a surface roughness value of 1000 micro-in., as defined by ANSI B-46.1.

Ensure that every bearing has the Project Identification Number, Lot Number, and individual bearing number indelibly marked with ink on a side that will be visible after erection.

b. Testing and Acceptance. The manufacturer shall select, at random, sample bearings from completed lots of bearings for testing by the manufacturer. The manufacturer shall complete the required testing and determine compliance with this Specification before submitting the lots(s) for quality assurance inspection, testing, and acceptance. Furnish the results of the manufacturer's tests to the Engineer.

c. Installation. Certify to the Engineer that a skilled representative of the bearing manufacturer will be available to provide advice and instruction during bearing installation.

Ensure that the manufacturer's representative will be present during the initial installation of the bearings. The representative shall remain on the job until the bearing installation is proceeding smoothly and the workmen are familiar with the work required for each installation. Arrange to have the representative present anytime as the Engineer may request.

Place the bearing at the predetermined locations at the time of structural steel erection. Remove all temporary restraints as directed by the bearing manufacturer. Adjust the expansion bearings from the normal position to allow for the ambient temperature at the time of erection according to the required alignment scheme. After all adjustments and with the approval of the Engineer, weld the bearing sole plate to the bottom flange.

828.04 METHOD OF MEASUREMENT.

Elastomeric Bearings, both plain and reinforced, Pot Bearings, and Multi-rotational Bearings, will be measured by the number of each type of bearing installed. Test bearings will not be measured for payment.

828.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Bearings (All Types)	EA

The prices constitute full compensation for all labor, materials, and equipment, including testing, services of the manufacturer's representative, when required, bedding pads, anchor bolts, and all incidentals required to finish the work, complete and accepted.

SECTION 829 — BRIDGE SCUPPER PIPING

829.01 DESCRIPTION.

This work includes providing polyvinyl chloride (PVC) scupper piping on bridges at the required locations.

829.02 MATERIALS.

829.02.1 Polyvinyl Chloride Scupper Piping.

a. Pipe. Use pipe that conforms to ASTM D 1785, PVC 1120, Schedule 80. Use solvent cement fittings that conforms to ASTM D 2467, Schedule 80.

b. Hardware. Use straps, angles, etc., that conform to **SECTION M05** and are galvanized according to AASHTO M111.

c. Manufacturer's Certification. Furnish the manufacturer's certification that the materials provided meet specification requirements.

829.03 CONSTRUCTION METHODS.

829.03.1 Polyvinyl Chloride (PVC) Scupper Piping.

a. Field Measurements. Make all appropriate field measurements and evaluate special conditions for installation before the preparation of Shop Drawings.

b. Shop Drawings. Submit Shop Drawings of the pipe assembly according to **Subsection 105.02**.

c. Handling. During handling and storage, avoid damage to the pipe from impact, bending, compression or abrasion.

d. Preparation. Cut pipe with saws or pipe cutters designed specifically for polyvinyl chloride material. Protect the pipe and fittings from serrated holding devices and abrasions. Remove all burrs and wipe clean dust and dirt from the jointing surface. Bevel pipe ends according to the manufacturer's recommendations.

e. Installation. Install and support the pipe, and construct joints according to the manufacturer's recommendations. Soften the jointing surface and make semi-fluid, and apply sufficient cement to fill the gap between pipe and fittings. Remove all excess cement.

829.04 METHOD OF MEASUREMENT.

Polyvinyl Chloride Scupper Piping will be measured by the number of linear feet of each type of drainpipe installed.

829.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Polyvinyl Chloride Scupper Piping	LF

The price constitutes full compensation for all labor, materials and equipment, including straps, hardware, bolts and all incidentals required to finish the work, complete and accepted.

SECTION 830 — METAL BRIDGE RAILING

830.01 DESCRIPTION.

This work includes the provision for metal bridge rail at the required locations. Ensure that all bridge rails are constructed according to the RIDOT *Standard Details*.

830.02 MATERIALS.

Use materials for bridge railing that conform to **SECTION M05** and the RIDOT *Standard Details*.

830.02.1 Galvanizing, Metalizing, and Painting.

For the following, use either metalizing or galvanizing and painting:

a. Steel Railing Assemblies. When specified on the Plans or in the Special Provisions, use steel railing assemblies that have been metalized according to **SECTION 827** or galvanized according to **SECTION 843**. Ensure that hollow section railings are hot dip galvanized.

b. Fasteners. Use fasteners including bolts, nuts, cap screws, washers, and lock washers that have been galvanized according to AASHTO M232.

c. Galvanized Railings. Galvanized railings may either remain unpainted or painted as set forth on the Plans or Special Provisions.

830.03 CONSTRUCTION METHODS.

Submit Shop Drawings to the Engineer, which shall include the sequence of assembly. Install posts vertical in the longitudinal plane of the bridge, except that, if no part of the rail has a gradient greater than 1½ percent, the posts may be mounted normal to the slope. Mount the bases in general level by using lead shims.

Install rails in the maximum practical lengths over several panels. Ensure that the Shop Drawings present the sequence of assembly to accomplish the necessary continuity. Draft or pitch the rail supports on posts to permit continuity of rails past the posts without cramping or crimping the rails.

If rails will be shop cut, check the positioning of anchor bolts in the field before cutting to establish rail lengths. As necessary, trim adjacent anchor bolts to present a visual uniformity of grips. Extend or trim the anchor bolts to a proper grip for the nut.

830.04 METHOD OF MEASUREMENT.

Metal Bridge Railing will be measured by the number of linear feet of each such type installed.

830.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Metal Bridge Railing	LF

The price constitutes full compensation for all labor, materials, and equipment, including anchor assemblies and all incidentals required to finish the work, complete and accepted.

SECTION 831 — PEDESTRIAN CHAIN LINK FENCE - ALUMINUM

831.01 DESCRIPTION.

This work includes providing aluminum chain link fence, of various colors and configurations, at the required locations.

831.02 MATERIALS.

Use materials for pedestrian chain link fence that conform to **SECTION M08** and the following additional requirements.

831.02.1 Wire Fabric.

Use aluminum chain link fence wire fabric that is No. 9 gauge (0.148-in. diameter) wire fabric and that has a uniform diamond mesh measuring approximately 2 in. between parallel sides. Use wire fabric that is woven from aluminum alloy 6061 T89-94 (ASTM B211) wire having a minimum tensile strength of 50,000 psi. After the fabric has been woven, clean to remove all weaving compounds and foreign matter.

831.02.2 Posts.

Use aluminum posts that are 2½-in. Schedule 40 (2.875-in. OD) pipe weighing 2.004 lb/ft. Use posts that are aluminum alloy 6061-T6 (ASTM B221).

831.02.3 Rails.

Use aluminum rails that are 1¼-in. Schedule 40 (1.660-in. OD) pipe weighing 0.786 lb/ft. Use posts that are aluminum alloy 6061-T6 (ASTM B221).

831.02.4 Fittings and Appurtenances.

Use fittings (tension bars, rail splices, washers and post connection clamps) that are aluminum alloy 6061-T6 (ASTM B221). Use nuts that are aluminum alloy 6061-T6 (ASTM B316). Use bolts that are aluminum alloy 2024-T4 (ASTM B316).

a. Wire Fabric Connections. Securely fasten the aluminum fabric to all terminal posts by 1 in. × ¼-in. tension bars with ⅞-in. × ⅛-in. tension bands (aluminum alloy 6063-T5, ASTM B221) spaced approximately 6 in. apart and to all line posts and rails with No. 6 gauge (0.194-in. diameter) wire ties (aluminum alloy 1100-H18) approximately 6 in. on center.

b. Tension Wires. Use tension wires that are 7-gauge (minimum) galvanized coil spring steel wire.

c. Anchorage Fittings. Use aluminum base plates that are aluminum alloy 6061-T6 (ASTM B221). Use anchor bolts that are ¾-in. diameter galvanized bolts 10 in. long (ASTM A193, AISI Type 304). Coat the portions of the aluminum base plate that will be in contact with

the concrete parapet and the steel anchor bolts with an approved aluminum impregnated caulking compound.

831.03 CONSTRUCTION METHODS.

Set the fence posts vertical with a maximum post spacing 8 ft – 0 in.

Secure the fabric with ties, stretchers, and tensioning devices sufficiently to resist wind and weather loadings without noticeable sagging, billowing, or skewing of the square patterns.

831.03.1 Tolerance.

Standard plus or minus mill tolerances on all framework members and chain link fabric will apply.

831.04 METHOD OF MEASUREMENT.

Pedestrian Chain Link Fence - Aluminum will be measured by the number of linear feet installed. Measurement will be along the top of the fence from centerline to centerline of end posts for each continuous run of fence.

831.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Pedestrian Chain Link Fence – Aluminum	LF

The price constitutes full compensation for all labor, materials, tools and equipment, and all incidentals required to finish the work, complete and accepted.

SECTION 832 — BRIDGE SIGNS

832.01 DESCRIPTION.

This work includes providing bridge identification signs and bridge minimum clearance signs on all bridges that intersect with highways, streets, or ramps. Install signs for all directions of travel at the required locations.

832.02 MATERIALS.

832.02.1 Reflectorized Sheeting.

Use Type III reflectorized sheeting that conforms to **Subsection M16.02**. Use white or silver-white for the bridge identifications signs and yellow for the bridge minimum clearance signs.

832.02.2 Aluminum Backing.

Use aluminum backing that conforms to ASTM B209, Alloy 6061-T6 and is 0.063 in. in thickness.

832.02.3 Black Paint.

Use black paint that is a one component lead and chromate free paint suitable for use as a finish coat on the properly prepared reflectorized sheeting surface and meets the Federal Standard Number 595, Color 17038 (gloss black). Submit the manufacturer's Product Data Sheets for approval by the Engineer before using the product.

832.02.4 Steel.

Use steel for wedge style anchors, clips, drop-in anchor bodies, and expansion plugs that meet ASTM A108.

832.02.5 Fasteners.

Use steel rivet fasteners to attach the signs to steel girders.

Use expansion anchor fasteners to attach bridge signs to concrete girders.

832.02.6 Plating.

Use plating for components that is zinc and meets the ASTM B633, SC-1, Type III.

832.03 CONSTRUCTION METHODS.

832.03.1 Location.

a. Bridge Identification Signs. Place the sign level on the web of the girder, face of concrete beam, wall, or parapet as appropriate. Ensure that the Bridge Identification Sign contains the Route Carried and is located close to the abutment for the lane(s) of travel.

b. Bridge Minimum Clearance Signs. The Engineer will provide the location of the signs and the measured minimum vertical clearance at each bridge. Ensure that the Bridge Minimum Clearance Sign uses the actual measured minimum vertical clearance rounded down to the nearest inch in the format XX′ FT-X″ IN. Place the sign above a travel lane at the point of minimum vertical clearance. Locate the sign both horizontally and vertically as close to the actual point of minimum vertical clearance as practical.

832.03.2 Fabrication.

Place the reflective sheeting to completely cover the aluminum backing sheet.

Center all lettering and numerals on the sign panel and drawn according to the FHWA *Standard Alphabets for Highway Design*. Ensure that all characters for bridge identification signs are 8 in. in height using a series D stroke (1.25 in. wide). Ensure that all characters for bridge minimum clearance signs are 12 in. in height using a series E stroke (2.0 in. wide) for roadways with posted speed limits of 40 mph or greater and 8 in. in height using a series E stroke (1.3 in. wide) for roadways with posted speed limit less than 40 mph.

832.03.3 Attachment.

a. Position. Position signs on the fascia girders as described in **Subsection 832.03.1**. Use a minimum of four fasteners per sign, evenly spaced so that the maximum distance between fasteners is no greater than 24 in.

b. Installation. Attach signs to be located on steel or concrete fascia girders as follows:

- Fabricate the sign panels with 9/32-in. diameter holes.
- Using the sign panel as a template, locate the center of each hole on the face of the girder.
- On steel girders, drill a ¼-in. diameter hole through the girder web. On concrete girders, drill a ¼-in. diameter hole for a depth of 1 in. For concrete girders, take care when drilling any holes in the concrete girders, especially with prestressed concrete. Ensure that the length of the fastener does not extend beyond the minimum concrete cover to the reinforcing steel or prestressing steel. If concrete cover becomes a hinderance to fastener selection, then additional fasteners can be used.
- Place the bridge signs against the girder fascias such that the holes line up.
- Place the anchors specified in **Subsection 832.02.5** through the sign and into the holes in the girders.
- With a hand hammer, drive the nail protruding from the head of the anchor until it is flush with the head.

832.03.4 Approvals.

Submit the following for approval by the Engineer.

- Complete Shop Drawings of the Bridge Identification Signs and Minimum Clearance Signs demonstrating that the signs comply with the Contract Documents. Ensure that the Drawings contain the proposed message for the signs, a bill of materials describing the proposed attachment hardware, and the manufacturer's specifications for the proposed hardware.
- A sketch indicating the specific proposed location of each sign.

832.04 METHOD OF MEASUREMENT.

Bridge Identification Signs and Bridge Minimum Clearance Signs will be measured for payment by the number of each sign installed.

832.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Bridge Identification Signs	EA
Bridge Minimum Clearance Signs	EA

The prices constitute full compensation for all labor, materials equipment, and for all incidentals required to finish the work, complete and accepted.

SECTION 833 — GRANITE IDENTIFICATION TABLETS

833.01 DESCRIPTION.

This work includes providing granite identification tablets on bridges at the required locations indicated on the Plans.

833.02 MATERIALS.

833.02.1 Granite Tablets.

Use granite that is fine grained, light gray granite of sound, compact structure, resistant to weathering action, uniform in color, and free from seams, cracks, laminations and minerals that by weathering would cause discoloration or deterioration.

a. Additional Requirements. Use granite tablets that conform to the following additional requirements.

- Granite Stone. Use granite stone that conforms to the material characteristics and physical requirements of ASTM C615, Standard Specification for Granite Dimension Stone.
- Finish. Sand rub the face.
- Thickness. 2 in. ±¼-in.
- Inscriptions.
  - Seal Tablets. Use seal tablets that include the Rhode Island State Seal and the year of construction. Use numerals that have a height of 1¾ in. The type and style of lettering and size of seal will be approved by the Engineer.
  - Name Tablets. Inscribe the letters having a minimum height of 1¼ in. to a maximum height of 2 in. Ensure that the numerals have a height of 2 in.
- Inscribing. To inscribe letters, numerals, and seals, use the blast abrasive method. Incise the seal, letters, and numerals, U-sunk to a depth of approximately ½-in. with all edges clear and sharp. Paint all sunken areas with blue acrylic lacquer. Submit the color samples to the Engineer for approval before using the lacquer on the sample tablet.
- Edges; Pitched and Straight. Ensure that these have no projection for the first inch and, for the remaining depth, plus zero, minus ¼-in.
- Details. Provide Granite Identification Tablets that are 10 in. × 2 in., plus zero, minus ¼ in., and a face that is 10 in. × 14 in., plus zero, minus ¼ in.

b. Shop Drawings. Draw the Granite Identification Tablets to actual size and indicate emblems, inscriptions, and all other pertinent information. Submit the Shop Drawings to the Engineer according to **Subsection 105.02**.

c. Packaging. Enclose the identification tablets in wooden boxes and provide adequate protection to prevent damage to the stones before installation.

833.02.2 Portland Cement Mortar.

Use mortar that conforms to **Subsection M04.03.5**.

833.03 CONSTRUCTION METHODS.

Set the granite identification tablets in a full mortar bed at the indicated locations. Ensure that the plane of the face of the identification tablets when in final position is flush with the plane of the surrounding concrete surface. Provide the location of the granite identification tablet with the bridge number in the six-digit format and the tablet with the State seal. Locate the tablet with the bridge number at the driving approach to the bridge, and locate the seal at the trailing end. The bridge number on the tablet must be approved by the RIDOT Bridge Inspection Section.

833.04 METHOD OF MEASUREMENT.

Granite Identification Tablets of the types and sizes specified will be measured by the number of each tablet installed.

833.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Granite Identification Tablets	EA

The price constitutes full compensation for all labor, materials, tools, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 834 — GRANITE CURB FOR BRIDGES

834.01 DESCRIPTION.

This work includes providing straight or circular granite curb at the required locations.

834.02 MATERIALS.

Use granite curb for bridges that conforms to **Subsection M09.05**.

834.03 CONSTRUCTION METHODS.

834.03.1 Shop Drawings.

Submit Shop Drawings for the curb layout. Ensure that the correct curb is being used and that the pieces fall into the appropriate locations (e.g., the piece across an expansion joint).

834.03.2 Installation.

Set the curb accurately to line and grade in a full mortar bed and with full mortar end joints before concrete in back of curb is placed. Grout anchors into curb stones as they are being set. Ensure that all spaces under stones and at joints are completely filled.

If indicated on Plans, rake the joints between ends of individual stones to the dimensions shown on the Plans and seal with the specified type of joint sealer. Otherwise, fill joints with cement mortar, neatly pointed on top and face. After pointing, clean the curb stones of all excess mortar.

When placing concrete behind the curb stones, avoid disturbing the line and grade of the stones.

834.04 METHOD OF MEASUREMENT.

Granite Curb for Bridges will be measured (along the front arris of the curb) by the number of linear feet of curb installed.

834.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Granite Curb for Bridges	LF

The prices constitute full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Curb joint sealer is considered incidental.

SECTION 835 — SCUPPERS

835.01 DESCRIPTION.

This work includes providing scuppers and connections to their drains at the required locations.

835.02 MATERIALS.

Use scupper frames and grates that conform to **Subsection M05.05.9(c)** and **(d)**.

835.03 CONSTRUCTION METHODS.

Not applicable.

835.04 METHOD OF MEASUREMENT.

Scuppers will be measured by the number of assemblies installed.

835.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Scuppers	EA

The price constitutes full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 836 — STRUCTURAL CONCRETE CRACK REPAIR BY EPOXY RESIN BASE ADHESIVE INJECTION

836.01 DESCRIPTION.

This work includes repairing cracks in concrete by furnishing and injecting epoxy-resin base adhesives into the cracks. The work also includes surface preparation, setting injection ports, and cleaning surfaces following repairs.

836.02 MATERIALS.

Ensure that all products indicated below are on the Department's Approved Materials List.

836.02.1 Injection Material.

Use injection material that is a low viscosity, two-part epoxy-resin system conforming to ASTM C-881, Type IV and are the required grade and class to satisfactorily perform its function.

a. Quality Control. Provide testing and certification of each lot of the adhesive.

b. Surface Seal. Use a surface seal material as recommended by the adhesive manufacturer to confine the injection adhesive in the crack during injection and curing. Ensure that the material has adequate strength to hold injection fittings or ports and prevent vent leakage during injection.

836.03 CONSTRUCTION METHODS.

836.03.1 Surface Preparation.

Remove all deteriorated concrete adjacent to the cracks and areas of application before proceeding with crack repairs.

Clean surfaces adjacent to cracks or other areas of application of dirt, dust, grease, oil, efflorescence, or other foreign material matter detrimental to the bond of the epoxy injection-surface seal system. Do not use acids or other corrosives. Ensure that cleaning methods do not introduce foreign materials into the crack repair area such that the penetration of the epoxy adhesive is hindered.

Provide entry ports along the crack at intervals recommended by the manufacturer.

836.03.2 Component Ratio Calibration Test.

Disconnect the mixing head of the injection equipment, and pump the two adhesive components simultaneously through two independent valved nozzles. Simultaneously discharge both adhesive components during the same time period so that they can be compared to determine the volume.

The Engineer, at any time and without prior notification, may request the Contractor to conduct the calibration test specified above.

836.03.3 Epoxy Injection.

Perform epoxy injection according to the manufacturer's recommended methods.

836.03.4 Finishing.

When cracks are completely filled, cure the epoxy for sufficient time according to the manufacturer's recommendations.

Remove surface seal material and injection adhesive runs or spills from concrete surfaces as recommended by the manufacturer.

Finish the face of the crack flush to the adjacent surface, and ensure that the finish has no indentations or protrusions caused by the placement of entry ports.

836.04 METHOD OF MEASUREMENT.

Structural Concrete Crack Repair by Epoxy-Resin Base Adhesive Injection will be measured by the number of linear feet, port to port, repaired.

836.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Structural Concrete Crack Repair by Epoxy-Resin Base Adhesive Injection	LF

The price constitutes full compensation for all labor, tools, materials, equipment, including scaffolds, and all incidentals required to finish the work, complete and accepted.

SECTION 837

This Section has been Reserved for Future Use.

SECTION 838

This Section has been Reserved for Future Use.

SECTION 839 — REMOVE AND DISPOSE ASPHALT CONCRETE PAVEMENT FROM CONCRETE BRIDGE DECKS – PARTIAL-DEPTH AND FULL-DEPTH

839.01 DESCRIPTION.

839.01.1 Partial-Depth Removal.

This work includes the removal and disposal of a portion of the existing asphalt pavement overlay from the concrete bridge deck within the required limits.

839.01.2 Full-Depth Removal.

This work includes the complete removal and disposal of the existing asphalt pavement overlay, including the waterproofing membrane, from the concrete bridge deck within the required limits.

839.02 MATERIALS.

Not applicable.

839.03 CONSTRUCTION METHODS.

839.03.1 Partial-Depth Removal.

Ensure that the process of partial pavement removal will not cause any damage to the waterproofing membrane, underlying concrete deck, and/or bridge joints to remain. Ensure that the method proposed will remove the specified layer thickness of the asphalt wearing surface. Full depth removal is prohibited. Submit the specifications, including gross weight(s) of the proposed equipment and/or machinery to be used for the removal operation, to the Engineer for consistent with **Subsection 105.02** before the start of work; the Engineer will respond to the Contractor consistent with **Subsection 105.02**.

Ensure that the proposed equipment and/or machinery loads do not exceed the legal load limit or the posted load limit for the bridge, whichever is less. Use equipment and/or machinery that has the capability and precision necessary to adhere to the pavement removal depth requirements.

Where required, saw cut the pavement to prevent overbreakage into the vehicular traveled way. If this type of over-breakage does occur, immediately patch the damaged asphalt areas using an asphalt patching material that conforms to **SECTION 410**.

839.03.2 Full-Depth Removal.

Ensure that the process of removing the pavement and the waterproofing membrane will not cause any damage to the underlying concrete deck and/or bridge joints to remain. Ensure that the method proposed will completely remove the existing waterproofing membrane to allow for the proposed deck patching repairs and new waterproofing system installation.

Submit the specifications, including gross weight(s) of the proposed equipment and/or machinery to be used for the removal operation, to the Engineer for approval consistent with **Subsection 105.02** before the start of work; the Engineer will respond to the Contractor

consistent with **Subsection 105.02**. Ensure that the proposed equipment and/or machinery loads do not exceed the legal load limit or the posted load limit for the bridge, whichever is less.

Where required, saw cut the pavement to prevent overbreakage into the vehicular traveled way. If this type of overbreakage does occur, immediately patch the damaged asphalt areas using an asphalt patching material that conforms to **SECTION 410**.

839.04 METHOD OF MEASUREMENT.

Partial-Depth Removal and Disposal of Asphalt Pavement from Concrete Bridge Decks and Full-Depth Removal and Disposal of Asphalt Pavement from Concrete Bridge Decks will be measured by the number of square yards of each removed.

839.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Partial-Depth Removal and Disposal of Asphalt Pavement from Concrete Bridge Decks	SY
Full-Depth Removal and Disposal of Asphalt Pavement from Concrete Bridge Decks	SY

The prices constitute full compensation for the complete removal and disposal of asphalt pavement and all materials, labor, tools, equipment, saw cutting, and incidentals necessary for the proper completion of the work specified, complete and accepted.

SECTION 840 — DECK SURFACE CONCRETE REMOVAL BY HYDRODEMOLITION

840.01 DESCRIPTION.

This work includes the removal of deteriorated concrete from reinforced concrete bridge deck surfaces using hydrodemolition methods, the provision of adequate containment measures under the bridge deck, the control and diversion of runoff during the hydrodemolition operations, disposal of all concrete and other materials removed by hydrodemolition, and all other incidentals as necessary to complete the work.

840.02 EQUIPMENT.

Remove the concrete by hydrodemolition equipment that produces a high-pressure water stream capable of removing concrete, asphalt, oil, dirt, concrete laitance, and rust from the exposed reinforcing bars by direct impact. Do not use rotary milling or mechanical abrading machines.

Use hydrodemolition equipment that includes filtering and pumping units operating in conjunction with a remote-controlled robotic device and, if applicable, that can use river, stream, or lake water. Do not withdraw water from any body of water under the jurisdiction of the RI Department of Environmental Management (RIDEM) or the Coastal Resources Management Council (CRMC) unless authorized by a permit issued by the appropriate regulatory agency.

Use hydrodemolition equipment that can produce a water jet through an orifice at a pressure of at least 17,000 psi. Ensure that the machine can move the jet transversely across the area and forward or backward so that the entire deck is exposed to the water jet. Use mechanical means to move the jet; do not manually move the water jet except at inaccessible areas such as proximity to the curb and temporary barriers or at bridge deck expansion joints.

Use equipment that operates at a noise level of less than 90 decibels at a distance of 50 ft from either the powerpack unit or the remote robot.

840.02.1 Controls.

Ensure that the hydrodemolition equipment has sufficient controls to control and vary the following functions of the machine:

- Water pressure
- Angle and distance of the orifice relative to the deck surface
- Limits of transverse and longitudinal movement of the orifice
- Speed of the orifice in the transverse and longitudinal direction

840.02.2 Submissions and Qualifications.

Assume responsibility for any delay if the post-qualification criteria are not satisfied.

Submit the required post-qualification information on the hydrodemolition operations for approval by the Engineer. The Contractor may submit more than one set of documentation. Adhere to the following requirements:

a. Minimum Requirements. Include the following post-qualification documentation at a minimum:

- The name and location of all projects completed, a brief description of the work performed, equipment specifications, estimated production rates, and references of personnel
- Specifications for all equipment to be used for the concrete removal, surface preparation, and clean-up operations
- Anticipated rate of production
- An inventory of all common spare parts and replacement accessories required for the equipment
- Number of personnel, machine operators, and supervisors, and their relevant experience
- Proposed method and sequencing of operation for all phases of the concrete removal and surface preparation operations

Compliance with the post-qualification criteria applies regardless of the arrangements made by the Contractor to accomplish the hydrodemolition work. Ensure that Subcontractors meet the above post-qualification requirements.

840.02.3 Shielding Requirement.

Submit Shop Drawings showing details, design, and catalog cuts for the temporary protective shield system to the Engineer for approval consistent with **Subsection 105.02**. Ensure that the shield system will protect pedestrians, vehicle and/or railroad traffic, and utility infrastructure, and ensure that no material or debris associated with the hydrodemolition operation falls below the structure. Ensure that the system is designed for the anticipated weight of all material to be supported.

840.03 CONSTRUCTION METHODS.

840.03.1 Concrete Removal.

Adjust the hydrodemolition equipment so that the depth of concrete removed from areas of sound concrete is approximately ½ in. Where deteriorated concrete is encountered, the Engineer will establish the removal depth.

Use the following trial test procedure to ensure that the correct amount of sound concrete is removed by the hydrodemolition machine:

1. The Engineer will locate and record the limits of a trial test of sound concrete approximately 30 sq ft in size.
2. An area of sound concrete is defined as an area free from chemical defects, delamination, spalling, and/or cracking. To locate and identify the area of sound concrete, test the deck

surface for soundness in the presence of the Engineer and following the removal of the asphalt wearing surface.

3. Perform chain dragging, tapping with a hammer, or other means of testing approved by the Engineer.

4. Advance the hydrodemolition machine over this area, and adjust the operating parameters to remove 2 in. of sound concrete within the test area. The Engineer will measure the depth of concrete removal.

5. If the adjustment is such that the machine is removing too much or too little concrete, calibrate the machine and repeat the above procedure as many times as necessary to achieve the required depth.

6. Perform one test for each stage of deck surface concrete removal.

Ensure that the equipment is operated by qualified personnel certified by the equipment manufacturer. Submit the operator certification to the Engineer for approval before beginning the concrete removal operation.

Ensure the availability of service personnel and an inventory of common wear parts and replacement accessories for the equipment to guarantee that the removal operation will not be interrupted for an extended period of time if an equipment breakdown occurs.

Submit a list of operating parameters to be used for the hydrodemolition work to the Engineer before the commencement of concrete removal.

Once the operating parameters are established by programming or calibration, do not change the parameters as the machine progresses across the bridge deck except to prevent unnecessary removal of sound concrete below the required minimum removal depth. If, after calibrating the hydrodemolition equipment and beginning production work in a specific area, insufficient removal of concrete is being obtained, recalibrate the equipment for that area to ensure removal of concrete to the specified depth.

Remove any areas of the prepared surface that have been contaminated by oil or other materials detrimental to maintaining a good bond to the depth required. Perform the cleaning or removal at no additional cost to the Department, and assume responsibility for any resulting delays.

840.03.2 Control of Debris and Water.

Provide structurally adequate shields so that the water jet and broken concrete will not be a hazard to workers, traffic on adjacent lanes, or pedestrians and property below or adjacent to the bridge. Continually drain the water from the bridge, and ensure that the excess water does not accumulate to avoid damaging the area below the bridge.

Remove all debris immediately following the hydrodemolition operation by employing a vacuum recovery system to prevent rebonding to the remaining surface. Remove all debris that resettles or rebonds to the surface of the sound concrete. Avoid damage to the remaining sound concrete and reinforcing steel.

Use methods for the control, maintenance, and disposal of hydrodemolition runoff that conform to **SECTION 214**.

Ensure that the runoff control features are in place and operational before beginning concrete removal. Prevent runoff across traveled way, into bridge drainage devices, or into areas below or adjacent to the bridge, except for the containment basin.

840.03.3 Reinforcing Steel.

Following the hydrodemolition operation, inspect all exposed reinforcing steel to ensure that it has been cleaned of all rust and corrosive products, including oil, dirt, concrete fragments, laitance, loose scale, and other coatings that could destroy or inhibit the bond with the new concrete. Reclean exposed reinforcing steel not adequately cleaned by the initial hydrodemolition process. If the bars are deteriorated such that they have lost 25 percent or more of their original diameter, replace the steel as specified according to either the Contract or **SECTION 818**.

When cleaned reinforcing steel is exposed for more than seven calendar days, protect the steel from contamination by the type of materials listed above. A light coating of rust can be expected to form on the reinforcing; this is not considered contamination.

840.03.4 Concrete Placement.

Conduct the placement and finishing of concrete for deck repairs and deck overlays as specified in **SECTION 818**.

840.04 METHOD OF MEASUREMENT.

Deck Surface Concrete Removal by Hydrodemolition will be measured by the number of square feet of deck surface removed.

840.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Deck Surface Concrete Removal by Hydrodemolition	SF

The price constitutes full compensation for the removal of the bridge deck surface concrete to the limits shown in the Contract, including all labor, equipment, tools, design and installation of protective shields, runoff diversion and incidentals necessary for proper completion of the work, complete and accepted.

Supplemental steel reinforcement will be paid separately under **SECTION 810**.

No additional payment will be made for the removal of deteriorated concrete in excess of 2 in. with the hydrodemolition equipment unless specified on the Plans or for any miscellaneous trim

work along the curb, temporary barriers, or on the deck, as required to fulfill the requirements of this Specification.

SECTION 841 — PRE- AND POST-CONSTRUCTION CONDITION SURVEYS

841.01 DESCRIPTION.

The work includes all labor, equipment, and materials necessary to conduct pre- and post-construction condition surveys of all structures and/or properties identified in the Contract.

In addition, the work includes conducting structure condition surveys of all structures within 200 ft for all vibration-inducing activities resulting from the Contractor's construction.

The following identifies the structures that require condition surveys or any other structures identified in the Contract:

- Existing bridge foundations, abutments and piers, and superstructures
- Private commercial and residential buildings and other structures
- Retaining walls
- Culverts

Submit a comprehensive list of all affected properties and structures as part of the Project schedule development process.

Conduct preconstruction surveys before the commencement of construction operations and vibration-inducing activities. This includes driving and removal of piles and sheeting, drilling, boring, blasting, structural demolition, and any other vibration-inducing activity resulting from the operations. Do not initiate any work that may result in damage to properties or structures until all preconstruction survey reports have been submitted and approved by the Engineer.

Perform post-construction surveys upon substantial completion of the Contract with the consent of the Engineer, and follow the same procedures and protocols used for preconstruction surveys.

841.02 QUALIFICATIONS AND SUBMITTALS.

841.02.1 Qualifications.

A Professional Engineer licensed by the State of Rhode Island who possesses relevant experience in performing structure condition surveys shall conduct the pre- and post-construction surveys.

841.02.2 Submittals.

Submit to the Engineer for approval the following:

- Documentation substantiating the qualifications of the survey engineer according to **Subsection 841.02.1**.
- For both the pre- and post-construction condition surveys, submit an original report and copies with all documentation to the Engineer for review. Ensure that each report contains a DVD or CD with a complete electronic version of the report in PDF format and all video and still photography taken during the survey.

- Provide the pre-construction surveys to the Engineer a minimum of two weeks before starting work.
- Retain one copy of all results of the pre- and post-construction surveys in a suitable location on site. Ensure the availability of the documents for viewing during normal working hours. Do not produce any duplicates, other than as specified above, of any survey information without the written consent of the Engineer and the property owner.

841.03 CONSTRUCTION METHODS.

Conduct pre-construction surveys before initiating construction operations and all vibration-inducing activities.

Ensure that the documentation includes photographs, video, sketches, and a written report of findings. Provide visual imaging for pre- and post-construction surveys that includes high resolution color image acquisition in a format compatible with subsequent image enhancement analysis and feature extraction. Provide adequate lighting equivalent to a minimum of 55-watt bulb illumination during still and video photography. Emphasize the following:

- Locations and sizes of cracks in interior and exterior walls, floors and ceilings, and missing mortar, plaster, or other surface materials
- Damaged masonry, chimney liners and flues, and roofing, including evidence of leakage or poor roof/gutter drainage such as staining
- Damaged or out-of-square doorways and windows including tightness of fit and ease of operation
- Walls that are not plumb, floors or ceilings that are not level, and walls, floors, or ceilings that are uneven and the extent to which they are not planar
- Condition of the foundation walls and basement floors, especially cracking, differential movements, and signs of dampness or moisture
- Condition and grading of the ground surface around the exterior of the structure including evidence of drainage towards walls, low spots that pond water, and cracks and irregularities in asphalt, concrete, brick or stone pavements, sidewalks, and steps
- Evidence of previous repairs to the structures
- For post-construction surveys, all changes from the pre-construction survey

Perform a post-construction survey upon substantial completion of the Contract.

If the Contractor and/or survey engineer are unable to gain access, encounter difficulty, or are refused entry to a property, document the refusal in the report and inform the Contractor and Engineer of the incident in writing. Absent a resolution, the survey engineer shall limit the structural condition survey to information that may be gained from observations outside the structure or property boundary, and document the findings in the final report.

Repair all damage sustained by the properties or structures surveyed due to construction operations to the satisfaction of the Engineer at no additional cost to the Department or property owner.

841.04 METHOD OF MEASUREMENT.

Pre- and Post-Construction Condition Surveys will not be measured for payment.

841.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Pre- and Post-Construction Condition Surveys	LS

The price constitutes full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work, complete and accepted.

SECTION 842 — ANTI-GRAFFITI COATING

842.01 DESCRIPTION.

This work includes furnishing and installing an anti-graffiti coating system on designated exterior exposed surfaces of all material types.

842.02 MATERIALS.

Comply with the anti-graffiti system as specified in **SECTION M19**.

842.03 CONSTRUCTION METHODS.

842.03.1 Submittals.

Submit to the Engineer for approval the manufacturer's specifications, including product data sheets for installation requirements, application procedures, coverage rates, and the applicator's qualifications. Upon approval of the Engineer, the manufacturer's specifications become a part of this Specification and will be used as the basis for approval or rejection of the work.

Provide documentation of quantities for each product used in the work. This information is required as a prerequisite to job acceptance and final payment.

842.03.2 Quality/Process Control.

Perform the application in conformance with the manufacturer's specifications. Submit evidence of the applicator's qualifications and experience for the Engineer's approval before commencing work.

The manufacturer shall be available to make recommendations specific to the Project, substrate, coating appearance, and cleaning options.

842.03.3 Anti-Graffiti Coating.

a. Surface Preparation. Ensure that all substrates to receive the coating are structurally sound, dry, clean, and free of paint not specified to remain, dust, dirt, grime, oils, scale, rust, silicones, curing compounds, alkali, acid residues, or any other material that may inhibit bond.

   Perform all surface preparation and application of subsequent coats for all substrates according to the manufacturer's specifications. Do not apply the product to surfaces below 45°F or above 90°F.

   In addition, adhere to the following:

   - Ensure that new concrete masonry and cement plaster to receive the system is cured as per the manufacturer's specifications but no less than 30 days.

   - Ensure that the moisture content of all bare masonry surfaces to receive the system, as indicated on a calibrated moisture meter, does not exceed the manufacturer's

maximum allowable percentage or is no higher than 15 percent if no manufacturer guidance is given.

b. Application. Follow the manufacturer's current instructions for application, and allow the coating to cure before applying subsequent coats to achieve a uniform and continuous coating free of pinholes and holidays.

c. Cleanup and Protection. Remove discarded coating materials, rubbish, cans, and rags at the end of each workday.

Protect all adjacent areas not to be coated against damage by the coating and finish work. Correct all damage by cleaning, repairing, or replacing and recoating.

842.04 METHOD OF MEASUREMENT.

Anti-Graffiti Coating will be measured by the square foot of anti-graffiti coating applied.

842.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Anti-Graffiti Coating	SF

The price constitutes full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work, complete and accepted.

SECTION 843 — GALVANIZED STRUCTURAL STEEL

843.01 DESCRIPTION.

This work includes cleaning, preparing surfaces, and applying a hot-dip galvanized coating to the surfaces of new structural steel and its components at the required locations.

843.02 MATERIALS.

Use materials that conform to **Subsection M05.06**.

843.02.1 Submittals.

Submit a Shop Drawing with all specified documentation, including working drawings, QC plan, test data, supporting details, and method of application to the Engineer for approval.

Provide the manufacturer/supplier with the following information:

a. Analysis of Galvanizing. Submit an assay of the galvanize bath constituents and state how often the bath is tested.

b. Warranty. Provide the galvanizer's standard warranty that the galvanized substrate shall be free from 10 percent or more visible red rust for 20 years.

c. Certificate of Compliance for Items Coated by Galvanizer. Submit a notarized Certificate of Compliance for galvanization, signed by the galvanizer and indicating compliance with the requirements of these specifications. Include the scope of services provided, an itemized description of items processed, and their quantities.

d. Item Identification by Galvanizer. The galvanizer shall mark all lots of material with a clearly visible tag indicating the name of the galvanizer, the type and weight of the coating, and the applicable ASTM standards.

e. Quality Control (QC) — Testing and Certification. The manufacturer shall certify that every batch or lot of material conforms to this specification and shall submit test results for every batch or lot of materials. Galvanizers using the wet kettle process shall show how their QC program addresses the potential for flux inclusion.

   Provide a QC plan for the coating process, including:

   - Qualifications and responsibilities of the QC manager
   - Qualification and training for workers, including the frequency of checks on quality of work
   - How environmental conditions for the various stages of the process are monitored and maintained
   - Any pretreatment of the steel before the galvanizing and how these processes are monitored and maintained

- How the zinc dipping and prep bath(s) are monitored and maintained
- How the adhesion of the coating systems is verified and at what frequency. Ensure that testing conforms to ASTM D4541.
- How the dry film thickness (DFT) of the galvanize thickness will be measured for verification of values according to the specification
- Documentation of any equipment used for QC operations and calibration records as applicable
- Methods to protect all items to be galvanized from damage during storage and shipping
- Method to mask areas not receiving galvanizing, such as the top of bridge beams and around edges to be welded
- Format of QC documentation records and how they are maintained

Ensure that each item references the relevant standards. Provide documentation of all testing. Any destructive testing shall be the Contractor's responsibility at no additional cost to the Department. Do not initiate work until the QC plan is approved by the Engineer.

843.03 CONSTRUCTION METHODS.

843.03.1 Surface Preparation for Hot Dip Galvanize.

Prepare the steel before galvanization according to ASTM A385.

843.03.2 Hot Dip Galvanize.

a. Masking of Areas not to be Galvanized. When masking the tops of bridge beams, do not mask the outer perimeter of the top surface of each beam for a distance of 1 in. from the edge. For areas to be welded, provide an ungalvanized surface to the masked area at least 1 in. beyond the anticipated heat affected zone.

b. Application of Galvanize. Ensure that the application and minimum thickness are according to AASHTO M111 or AASHTO M232, as applicable.

c. Galvanize Thickness. Measure the galvanize thickness using the methods described in the Steel Structures Painting Council Paint Application Specification No. 2 - Measurement of Dry Paint Thickness with Magnetic Gauges (SSPC - PA2).

d. Appearance and Condition of Galvanize. Strip any items with defects or damage to the final condition of the galvanize that expose the steel substrate or with thicknesses below the applicable AASHTO standard completely of the zinc using the standard preparation methods and regalvanized.

e. Field Touchup. Verify that all surfaces to be touched up in the field are cleaned of dirt, grease, oil, chalk, bird droppings, lubricants, and other surface interference material. Use

hand tools, power tools, or blast cleaning to remove rust and for spot repair of localized damage to the galvanizing and coating system. Do not touchup or paint until the Engineer has accepted the surface cleaning and dry surface condition.

Make all field repair to the galvanized exposed steel by a field application of a zinc rich paint (minimum 92 percent zinc) according to the repair material supplier's recommendations and these Specifications, which must be approved by the Engineer. Strip pieces with damage exceeding 2 percent of the steel substrate of all galvanize and other coatings using the standard preparation methods and regalvanized.

843.03.3 Subsequent Coatings.

Ensure that any top coating over the required galvanize is compatible with the galvanization and is applied according to the applicable Specifications. Prepare hot dip galvanize according to ASTM D7803, Section 5.1.1.

843.03.4 Approval Requirements.

a. Qualification/Certifications. Provide proper training for each worker and any certifications to ensure that the final product meets the specifications.

b. Quality Control (Process Control). In addition to the general process control requirements, provide technical supervision for all applications. Maintain daily logs of air and surface temperature, dew point, and relative humidity for at least five years after Project completion and provide to the Engineer upon request.

c. Safety and Health. Instruct all employees required to enter confined spaces where the work may be conducted on the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. Conform to all pertinent OSHA regulations.

843.04 METHOD OF MEASUREMENT.

Galvanized Structural Steel will not be measured for payment.

843.05 BASIS OF PAYMENT.

Galvanized Structural Steel will not be paid separately and will be considered incidental to the cost of items being galvanized.

SECTION 844 — MICROPILES

844.01 DESCRIPTION.

This work includes constructing, inspecting, and testing of micropiles and pile top attachments that meet the design load. This work includes drilling, furnishing, and placing the reinforcing steel and casing, grouting, pile top attachments, site drainage control, layout, elevation and location control, measurement, and marking, all asphalt removal, excavation, backfilling, and asphalt patching associated with the pile installation.

When the Contract designates Contractor Designed, the Contractor is responsible for the design and shall select the micropile type, size, and pile top attachment; estimate the ground-grout bond value; determine the required bond length and final micropile diameter; and verify the micropile load resistance by proof load testing as required.

844.02 MATERIALS.

Provide the following materials for micropiles.

844.02.1 Centralizers and Spacers.

Fabricate centralizers and spacers from schedule 40 PVC pipe or tube, steel, or material non-detrimental to the reinforcing steel. Do not use wood.

844.02.2 Galvanization.

Use galvanization that complies with ASTM A-153.

844.02.3 Grout.

Ensure that all grout mixture components conform to **SECTION 601**.

Use a RIDOT-approved neat cement or sand/cement mixture with a minimum three-day compressive strength of 2000 psi and a minimum 28-day compressive strength of 4000 psi per AASHTO T106/ASTM C109.

844.02.4 Permanent Casing Pipe.

Use permanent steel casing/pipe that has the diameter and at least the minimum wall thickness shown on the approved working drawings. Use permanent steel casing/pipe that complies with the following requirements:

- The tensile requirements of ASTM A252, Grade 3, except ensure that the yield strength is a minimum of 50,000 psi or as used in the design submittal.
- May be new structural grade (a.k.a., mill secondary) steel pipe with Engineer approval. Ensure that the steel pipe meets the above requirements but without a Mill Certification and must be free from defects (dents, cracks, tears) and with two coupon tests per truckload delivered to the fabricator.

For permanent casing/pipe that will be welded for structural purposes:

- Ensure that the carbon equivalency (CE), as defined in AWS D1.1, Section XI5.1, does not exceed 0.45, as demonstrated by mill certifications.
- Ensure that the sulfur content does not exceed 0.05 percent, as demonstrated by mill certifications.

844.02.5 Plates and Shapes.

Use structural steel plates and shapes for pile top attachments that conform to ASTM A709/AASHTO M270, Grade 50.

844.02.6 Reinforcing Bars.

Use reinforcing steel that are galvanized deformed bars according to **Subsection M05.06**. For ungalvanized bars use those that conform to **Subsection M05.02**. If threads are cut into a reinforcing bar, provide the next larger bar number designation from that shown on the Plans. Do not use galvanization on high strength bars. Use Grade 150 reinforcing bar couplers of the same material and coating as the bars being connected.

844.02.7 Water.

Use water in the grout mix that conforms to AASHTO T 26 and is potable, clean, and free from substances that may damage cement and steel.

844.02.8 Micropile Diameter.

Ensure that the cased length of the micropile has a nominal pile diameter as shown on the Plans or larger.

844.02.9 Casing Steel.

Ensure that the casing steel has a minimum thickness of 0.5 in.

844.02.10 Compressive Strength.

Ensure that the minimum 28-day compressive strength of concrete or cement grout is 4000 psi.

844.03 CONSTRUCTION METHODS.

844.03.1 Pre-Construction Meeting.

The Engineer will schedule a preconstruction meeting before the start of micropile construction. The Engineer, prime Contractor, micropile specialty Contractor, micropile design engineer, RIDOT designer (EOR), excavation Contractor and geotechnical instrumentation specialist (if applicable) shall attend the meeting. Attendance is mandatory. The preconstruction meeting objectives are to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and the delineation of

responsibilities among the Prime Contractor and the various Subcontractors, specifically those pertaining to excavation for micropile structures, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control, and site drainage control.

Before the start of any micropile construction activity, the Contractor and Engineer shall jointly inspect the site as stipulated in **SECTION 841**.

844.03.2 Site Drainage Control.

Control and properly dispose of drill flush and construction related waste, including excess grout. Provide positive control and discharge of all surface water that will impact construction, and maintain all pipes or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost. Upon substantial completion of the work, remove surface water control pipes or conduits from the site.

844.03.3 Contractor Designed Micropiles.

a. Micropile Contractor's Experience Requirements. The micropiles shall be designed by a Registered Professional Engineer licensed by the State of Rhode Island with experience in the design of at least three successfully completed micropile projects over the past five years with micropiles of similar capacity to those required. The micropile design engineer may be either an employee of the Contractor or a separate consultant design engineer meeting the experience requirements.

b. Design Requirements. Design the micropiles to meet the specified loading conditions. Design the micropiles and pile top-to-footing connections using the procedures contained in the FHWA *Micropile Design and Construction*, Report No. FHWA NHI-05-039 and the AASHTO *LRFD Bridge Construction Specifications*. Comply with the following minimum requirements:

- Resistance Factor. Ensure that the required geotechnical resistance factor is 0.55 according to the AASHTO *LRFD Bridge Design Specifications*.
- Micropile Diameter. Ensure that the cased length of the micropile has a nominal pile diameter of 8 in. or larger.
- Grout Cover. Provide a 2-in. concrete or grout cover over all steel reinforcing. Use centralizers attached to the reinforcing bar steel to ensure the minimum grout cover. Provide a minimum of 1 in. of cover over reinforcing bar couplers.
- Casing Steel. For the structural design of any individual micropile structural elements not covered by the FHWA Manual, use the LRFD design method that conforms to the appropriate articles of the AASHTO *LRFD Bridge Design Specifications*.
- Compressive Strength. Ensure that the minimum 28-day compressive strength of concrete or cement grout is 4000 psi.

c. Design Submittals. Before the planned start of micropile structure construction, submit the completed design calculations and Shop Drawings to the Engineer for review and approval in compliance with **Subsection 105.02**. Ensure that the submittal includes:

- An installation narrative
- All details and dimensions
- Quantities
- Ground profiles
- Cross sections

as necessary to construct the micropile structure. Provide details on the:

- Specific method of construction
- Proposed procedure for by-pass of obstructions
- Proposed equipment for micropile installation
- Means and methods for measuring grout quantities and pressures during installation

Describe the proposed record keeping format, and provide a sample installation form for approval. Verify the limits of the micropile structure and ground survey data before preparing the detailed working drawings.

The approved drawings and calculations shall be signed and sealed by the Contractor's Professional Engineer registered in the State of Rhode Island or by the consultant designer's Professional Engineer (if applicable) registered in the State of Rhode Island. If a consultant design engineer is used to prepare the design, the micropile Contractor shall still have overall Contract responsibility for both the design and the construction.

d. Design Calculations. Ensure that the design calculations include:

- A written summary report that describes the overall micropile design
- Applicable code requirements and design references
- Micropile structure-critical design cross-section(s) geometry including soil/rock strata and piezometric levels and location, and magnitude and direction of design applied loadings, including slope or external surcharge loads
- Design criteria including soil/rock shear strengths (friction angle and cohesion), unit weights, ground-grout bond values, and micropile drillhole diameter assumptions for each soil/rock strata
- Factors of safety and allowable stresses used in the design on the ground-grout bond values, surcharges, soil/rock and material unit weights, steel, grout, and concrete materials
- Design calculation sheets (both static and seismic) with the Project number, micropile structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page with the design calculations

- Design notes including an explanation of any symbols and computer programs used in the design

- Micropile-to-footing connection calculations

e. Working Drawings. Provide working drawings that include all information required for the construction and quality control of the piling. Ensure that the working drawings include:

- Plan View. A plan view of the micropile structure(s) identifying:

  - A reference baseline and elevation datum

  - The offset from the construction centerline or baseline to the face of the micropile structure at all changes in horizontal alignment

  - Beginning and end of micropile structure stations

  - Right-of-way and permanent or temporary construction easements limits, location of all known active and abandoned existing utilities, adjacent structures, or other potential interferences

  - Subsurface exploration locations shown on a plan view of the proposed micropile structure alignment with appropriate reference base lines to fix the locations of the explorations relative to the micropile structure

- Elevation View. An elevation view of the micropile structure(s) identifying:

  - Elevation view showing micropile locations and elevations, vertical and horizontal spacing, and batter and alignment

  - Existing and finished grade profiles both behind and in front of the micropile structure

- Design Parameters. Design parameters and applicable codes.

- Notes. General notes for constructing the micropile structure including construction sequencing or other special construction requirements.

- Quantities. A listing of the summary of quantities on the elevation drawing of each micropile structure showing pay item estimated quantities.

- Sections. Micropile typical sections including micropile spacing and inclination; minimum drillhole diameter; pipe casing and reinforcing bars sizes and details; splice types and locations; centralizers and spacers; grout bond zone and casing plunge lengths (if used); corrosion protection details; and connection details to the substructure footing, anchorage, plates, etc.

- Test Pile Details. A typical detail of verification and production proof test micropiles defining the micropile length, minimum drillhole diameter, inclination, and load test bonded and unbonded test lengths.

- Details. Details, dimensions, and schedules for all micropiles, casing, and reinforcing steel, including reinforcing bar bending details.

Revise the working drawings when plan dimensions are changed due to field conditions or for other reasons. Within 30 days after completion of the work, submit as-built drawings to the Engineer. Provide revised design calculations signed by the approved State of Rhode Island registered Professional Engineer for all approved design changes made during the construction of the micropile structure.

f. Construction Submittals. Submit to the Engineer the following for the micropile system or systems to be constructed:

- Step-by-Step Procedure. A detailed, step-by-step description of the proposed micropile construction procedure, including personnel, testing, and equipment to ensure quality control. Document the procedure on the working drawings in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.

- Start Date. A proposed start date and time schedule and micropile installation schedule and a plan with the proposed micropile layout(s) and the micropile numbering system.

- Welding. If welding of the casing is proposed, ensure that the proposed welding procedure has been certified by a qualified welding specialist according to the AWS *Bridge Welding Code*.

- Equipment. Information on headroom and space requirements for installation equipment that verifies that the proposed equipment can perform at the site.

- Disposal. A plan describing how surface water, drill flush, and excess waste grout will be controlled and legally disposed.

- Mill Tests. Certified mill test reports for the reinforcing steel or coupon test results for permanent casing without mill certification. Include the ultimate strength, yield strength, elongation, and material properties composition. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.

- Proposed Grouting Plan. A grouting plan including complete descriptions, details, and supporting calculations for the following:

    - Grout mix design and type of materials to be used including certified test data and trial batch reports.

    - Methods and equipment for accurately monitoring and recording the grout depth, grout volume, and grout pressure as the grout is being placed.

    - Grouting rate calculations, when requested by the Engineer. Base the calculations on the initial pump pressures or static head on the grout and losses throughout the placing system, including anticipated head of drilling fluid (if applicable) to be displaced.

- Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one year of the start of grouting may be submitted for initial verification and acceptance and start of production work.

- Procedure and equipment for monitoring of grout quality.

- Load Testing. Submit detailed plans for the proposed micropile load testing method. Include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads, and pile top movements.

- Calibration. Calibration reports and data for each test jack, pressure gauge, master pressure gauge, and electronic load cell to be used. Ensure that the calibration tests have been performed and certified by an independent testing laboratory within 90 calendar days of the date submitted.

844.03.4 Obstructions.

When obstructions are encountered during the installation of micropiles, notify the Engineer. Make all reasonable efforts to install the piles at the required location and to the proper depth. Excavate to remove the obstruction or employ all usual methods to install piles. Do not relocate piles until the Contractor submitted Shop Drawings have been approved by the Engineer.

844.03.5 Allowable Construction Tolerances and Acceptance Criteria.

Ensure that:

- The center of gravity of the entire group of micropiles at an individual abutment is not more than 2 in. from the required center of gravity for the group.
- The centerline of piling is not more than 3 in. from the required location.
- The pile is plumb within 2 percent of the total-length plan alignment.
- The top elevation of pile is plus 1 in. or minus 2 in. maximum from the required vertical elevation.
- The centerline of reinforcing steel is not more than ¾ in. from the required location.

The Engineer will not accept piles that are damaged or defective due to defective materials or an improper installation procedure, or piles that have an installed volume of cement grout not exceeding a volume equal to 110 percent of the theoretical volume of the drill hole.

Cut off piles that are damaged or defective 1 ft below bottom of footing elevation, and document on the as-built drawing. Replace these piles by additional pile(s) installed adjacent to the removed/abandoned pile, and ensure that the replacement piles comply with **Subsection 844.03.3**. Install the replacement pile(s) where the center of gravity of the group complies with the location criteria above. The Engineer must approve in writing any modification that necessitates changes to the structure.

Correct piles that are mislocated beyond the specified tolerances by installing an additional pile at no additional cost to the Department. Ensure that the center of gravity of the combination of the two piles is within the location tolerance for the original location and the allowable tolerance for the abutment.

844.03.6 Installation.

Select the drilling method, the grouting procedure, and the grouting pressure used for the installation of the micropiles. Determine the micropile casing size, final drillhole diameter and bond length, and central reinforcement steel sizing necessary to develop the specified load capacities and load testing requirements. Estimate the grout take.

Ensure that the drillhole is open along its full length to at least the design minimum drillhole diameter before placing grout and reinforcement.

Use temporary casing or other method of pile drillhole support in caving or unstable ground to permit the pile shaft to be formed to the minimum design drillhole diameter. The Engineer will review and approve the proposed method(s) to provide drillhole support and to prevent detrimental ground movements. Detrimental ground movement is defined as movement that requires remedial repair measures. Do not use drilling fluid containing bentonite.

During construction, observe the conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence, and immediately notify the Engineer if signs of movements are observed. Immediately suspend or modify drilling or grouting operations if:

- Ground heave or subsidence is observed
- The micropile structure is adversely affected
- Adjacent structures are damaged from the drilling or grouting

If the Engineer determines that the movements require corrective action, take corrective actions necessary to stop the movement or perform repairs.

Immediately before grouting, ensure that the hole is flushed with clean water to remove all contaminated water and cuttings with the grout pipe located at the bottom of the hole. Pump the water at a high velocity until the wash water at the top of the casing is clear.

Place reinforcement into the drillhole before grouting and before temporary casing (if used) is withdrawn. Ensure that the reinforcement surface is free of deleterious substances such as soil, mud, grease, or oil. Ensure that pile cages and reinforcement groups, if used, can withstand the installation and grouting process and the withdrawal of the drill casings without damage or disturbance.

Check pile top elevations and adjust all installed micropiles to the required elevations.

Provide centralizers and spacers at a maximum 10-ft on center spacing to provide a minimum 2 in. of grout cover over all steel reinforcing. Locate the upper and lower most centralizer a maximum of 5 ft from the top and bottom of the micropile. Ensure that centralizers and spacers permit the free flow of grout without misalignment of the reinforcing bar(s) and permanent casing. Lower the central reinforcement bars with centralizers into the stabilized drillhole and set. Insert the reinforcing steel into the drill hole to the desired depth without difficulty. Do not drive or force

partially inserted reinforcing bars into the hole. Redrill and reinsert reinforcing steel when necessary to facilitate insertion.

Secure the lengths of casing and reinforcing bars to be spliced in proper alignment and to avoid eccentricity or angle between the axes of the two lengths to be spliced. Locate threaded pipe casing joints at least two casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, stagger bar splices at least 12 in.

Grout the micropiles the same day that the load transfer bond length is drilled. Use a stable, neat, cement grout or a sand cement grout with a minimum 28-day unconfined compressive strength of 4000 psi. Mix admixtures, if used, according to the manufacturer's recommendations. Ensure that the grouting equipment produces a grout free of lumps and undispersed cement. Measure the grout quantity and pumping pressure during the grouting operations. Equip the grout pump with a pressure gauge to monitor grout pressures. Place a second pressure gauge at the point of injection into the pile top. Ensure that the pressure gauges can measure pressures of at least 150 psi or twice the actual grout pressures used, whichever is greater. Ensure that the grout remains in agitation before placing. Place grout within one hour of mixing. Size the grouting equipment to enable each pile to be grouted in one continuous operation.

Inject the grout from the lowest point of the drill hole, and continue the injection until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow-stem augers, or drill rods. Extract temporary casing, if used, in stages ensuring that, after each length of casing is removed, the grout level is elevated to the ground level before the next length is removed. Ensure that the tremie pipe or casing always extends below the level of the existing grout in the drillhole. Control the grout pressures and grout takes to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole but must be filled with grout.

Allow the grout within the micropiles to attain the required design strength before being loaded.

If the Contractor elects to use a post-grouting system, submit the working drawings and details to the Engineer for review and approval.

Ensure that the grout within the micropile verification and proof test piles attains the minimum required three-day compressive strength of 2000 psi before load testing. During production, test the micropile grout for compressive strength according to AASHTO T106/ASTM C109 at a frequency of no less than one set of three 2-in. grout cubes from each grout plant each day of operation or for every 10 piles, whichever occurs more frequently. Complete unconfined compressive testing at three, seven, and 28 days. Use the average of the three cubes tested for the compressive strength.

Take grout samples directly from the onsite grout plant. Provide grout cube compressive strength and grout density test results to the Engineer within 24 hours of testing.

Install micropiles under the full-time inspection of the Engineer or authorized representative. Notify the Engineer a minimum of 48 hours before any initiating any micropile operations. The Engineer will not accept any pile installed when the representative of the Engineer is not present to obtain the necessary records. Install additional pile(s) to replace any pile(s) constructed without the presence of the Engineer, as directed, and at no additional cost to the Department.

844.03.7 Installation Records.

Submit to the Engineer full-length installation records for each micropile installed within one work shift after that pile installation is completed. Record the data on the micropile installation log. Provide a separate log for each micropile. Submit for approval a pile numbering plan identifying a unique pile designation number for each micropile. The Engineer will keep an independent record of each micropile installation.

Ensure that each micropile installation log includes the following information:

- Top of pile elevation immediately after installation to the nearest 0.1 ft
- Pile cut-off elevation as installed to the nearest 0.1 ft
- Bottom of pile casing elevation to the nearest 0.1 ft
- Pile tip elevation as installed to the nearest 0.1 ft
- Deviation from specified plan location in inches to the nearest ½ in.
- Pile length immediately after installation to the nearest 0.1 ft
- Pile designation number
- Damage (if any) to pile and any required corrective action taken
- Grout takes and pressures

844.03.8 Verification Testing.

Before starting the work, submit to the Engineer for approval a pile load test plan including a written description of the equipment and methods to be used. Ensure that the methods are an approved type and are revised as necessary to meet the approval of the Engineer. Ensure that the pile load test plan and description are stamped by a Professional Engineer registered in the State of Rhode Island.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions such that excessive deformation of the testing equipment does not occur. Ensure that this determination, and the possible design of any required bracing, are performed by a Professional Engineer registered in the State of Rhode Island. Submit the calculations, procedures, and working drawings stamped by the Professional Engineer for approval before the start of any load test work.

Construct the test pile consistent with the production piles. Ensure that the drilling and grouting method, casing length and outside diameter, reinforcing bar lengths, and depth of rock socket for the test micropile are consistent with the specifications for the production piles, increasing steel sizes as needed for test loads. Size the verification test micropile structural steel sections to safely resist the maximum test load.

The testing can be performed as a tension or compression test using other piles, earth anchors, or dead load as reaction. Perform compression load testing according to ASTM D1143, and perform tension load testing according to ASTM D3689, except as modified herein.

Perform pile load testing to verify the design of the pile system and the construction methods proposed before the installation of any production piles. Construct the test piles in conformance with the approved working drawings at the required locations.

Perform load tests to verify that the installed micropiles will meet the required load capacities and load test acceptance criteria and to verify that the length of the micropile bond zone is adequate.

The micropile load test results must verify the Contractor's design and installation methods and be reviewed and accepted by the Engineer before the installation of production micropiles.

Ensure that the maximum test loads applied to the micropile do not exceed 80 percent of the structural capacity of the micropile structural elements, including steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. If there is any required increase in strength of the verification test pile elements above the strength required for the production piles, provide this at no additional cost to the Department.

Position the jack at the beginning of the test so that unloading and repositioning during the test will not be required.

Use testing equipment that includes dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. Provide a description of the test setup and jack, pressure gauge, and load cell calibration curves.

Design the testing reaction frame to be sufficiently rigid and of adequate dimensions so that excessive deformation of the testing equipment does not occur. Align the jack, bearing plates, and stressing anchorage so that unloading and repositioning of the equipment will not be required during the test.

Apply the test load and measure using a hydraulic jack and pressure gauge. Use a pressure gauge that is graduated in 100 psi increments or less. Use a jack and pressure gauge that have a pressure range not exceeding twice the anticipated maximum test pressure. Ensure that the jack ram travel allows the test to be performed without resetting the equipment. Monitor the creep test load hold during testing with both the pressure gauge and the electronic load cell. Use the load cell to accurately maintain a constant load hold during the creep test load hold increment of the test.

Provide an independently supported reference beam with supports firmly embedded in the ground at a distance of between 8 ft to 10 ft from the test pile. Ensure that one end of the reference beam is free to move as the length of the beam changes due to temperature variations.

Measure pile top movement using three dial gauges mounted equidistant from the center of the test pile at 120° intervals around the pile. Rigidly attach the dial gauges to the reference beam. Vertically align the gauge stems on a smooth glass horizontal bearing surface. Ensure that the dial gauges can measure to 0.001 in. and have a travel sufficient to allow the test to be performed without having to reset the gauge.

Establish reference points on the test pile at each end or at the center of the reference beam and on critical points of the reaction frame. Ensure that the reference points include graduated scales machine divided into 0.02 in. and attached securely to the pile, reference beam, and other locations. Monitor the reference points during the pile load test.

Protect the pile movement measuring system against rain, wind, frost, and any other disturbances that could affect the reliability of the movement measurements. Provide sun shading for the measuring system for the duration of the test and for a minimum of one hour before the start of the test.

Install two telltales, one extending to the bottom of the test pile and a second extending to the bottom of the cased section or top of the bond zone. Use the telltales to determine movement at the top of the bond zone and at the pile tip.

The Micropile Contractor's Engineer will record the required load test data, and the Engineer will keep an independent record of the data.

Test the piles to a maximum test load of 2.0 times the required micropile design load shown on the Plans or working drawings. Perform the pile load tests by incrementally loading the micropile according to the following cyclic load schedule for both compression and tension loading.

Step	Loading	Applied Load	Hold Time (Min.)
1	Apply AL		2.5
2	Cycle 1	0.15 DL 0.30 DL 0.45 DL AL	2.5 2.5 2.5 1
3	Cycle 2	0.15 DL 0.30 DL 0.45 DL 0.60 DL 0.75 DL 0.90 DL 1.00 DL AL	1 1 2.5 2.5 2.5 2.5 2.5 1
4	Cycle 3	0.15 DL 1.00 DL 1.15 DL 1.30 DL 1.45 DL AL	1 1 2.5 10 to 60 2.5 1
5	Cycle 4	0.15 DL 1.45 DL 1.60 DL 1.75 DL 1.90 DL 2.00 DL 1.50 DL 1.00 DL 0.50 DL AL	1 1 1 2.5 2.5 10 5 5 5 5

AL = Alignment Load, DL = Design Load

Measure pile top and pile tip movement at each load increment. Start the load-hold period as soon as each test load increment is applied. Monitor the test pile for creep at the 1.30 DL. Measure and record pile movement during the creep test at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50, and 60 minutes. Ensure that the alignment load does not exceed 5 percent of the DL. Reset dial gauges to zero after the initial AL is applied.

The acceptance criteria for micropile verification load tests are:

- Ensure that the pile sustains the first compression or tension 1.0 DL test load with no more than 0.50 in. total vertical movement at the top of the pile, relative to the position of the top of the pile before testing.
- At the end of the 1.30 DL creep test load increment, ensure that test piles have a creep rate not exceeding 0.04 in./log cycle time (1 to 10 minutes) or 0.08 in./log cycle time (6 to 60 minutes or the last log cycle if held longer). Ensure that the creep rate is linear or decreasing throughout the creep load hold period.
- Take the maximum test load as 50 percent of the applied test load that results in a movement under load of 0.5 in. at the pile tip. Measure the movement at the pile tip directly by the telltale.
- Failure does not occur at the 2.0 DL maximum test load. Failure is defined as the load where the slope of the load vs. head settlement curve first exceeds 0.025 in./kip.

The Engineer will provide written confirmation of the micropile design and construction methods for production piles within three working days of the submission of the micropile load test results report. Do not install production piles until approved by the Engineer.

If a tested micropile fails to meet the acceptance criteria, modify the design, the construction procedure, or both, which may include modifying the installation methods, increasing the bond length, or changing the micropile type. The Engineer must provide a prior review and approval for any modification that necessitates changes to the structure. Any modifications of design or construction procedures or cost of additional piles and load testing shall be at the Contractor's expense.

Test piles may be used as production piles provided that no failure has occurred. Cut off piles that are not used as production piles as indicated in the Contract and at least 1 ft below the bottom of the footing elevation and document on the as-built drawing.

844.03.9 Proof Testing.

Protect the pile movement measuring system against rain, wind, frost, and any other disturbances that could affect the reliability of the movement measurements. Provide sun shading for the measuring system for the duration of the test and for a minimum of one hour before the start of the test.

The required load test data shall be recorded by the Micropile Contractor's Engineer. The Micropile Contractor's Engineer shall submit a report of the results indicating the performance and acceptability of the test pile for the required factored axial load and displacement criteria specified below. Do not install production piles until approved by the Engineer.

Test designated piles to a maximum test load of 1.60 times the Factored Axial Load (FAL). Conduct the tests by incrementally loading the micropile according to the following schedule, to be used for both compression and tension loadings.

Design and use equipment as detailed under **Subsection 844.03.8**.

Step	Loading	Applied Load	Hold Time (min.)
1	Apply AL	AL	4
2	Cycle 1	0.15 FAL	4
		0.30 FAL	4
		0.50 FAL	4
		AL	4
3	Cycle 2	0.15 FAL	4
		0.30 FAL	4
		0.45 FAL	4
		0.60 FAL	4
		0.75 FAL	4
		0.90 FAL	4
		1.00 FAL	4
		AL	4
4	Cycle 3	0.30 FAL	4
		0.60 FAL	4
		0.90 FAL	4
		1.20 FAL	4
		1.30 FAL	60 (MIN)
		AL	4
5	Cycle 4	0.30 FAL	4
		0.60 FAL	4
		0.90 FAL	4
		1.20 FAL	4
		1.50 FAL	4
		1.60 FAL	10
		1.20 FAL	4
		0.90 FAL	4
		0.60 FAL	4
		0.30 FAL	4
		AL	4

AL = Alignment Load, FAL = Factored Axial Load

At the 1.30 FAL Test Load, maintain the load for a minimum of 60 minutes and until the settlement (measured at the lowest point on the pile which measurements are made) over a 60 minute period is not greater than 0.08 in. Ensure that the alignment load (AL) does not exceed 5 percent of the design load.

Comply with the following acceptance criteria for micropile proof load tests:

- Compression. Ensure that the pile sustains the compression or tension 1.00 FAL test load with no more than 0.75 in. total vertical movement at the top of the pile, relative to the position of the top of the pile before testing.
- Load Increment. At the end of the 1.30 FAL creep test load increment, ensure that the test pile has a creep rate not exceeding 0.08 in./hour. Ensure that the creep rate is linear or decreasing throughout the creep load hold period.

- Failure. Failure does not occur at the 1.60 FAL maximum test load. Failure is defined as the load where the slope of the load versus head settlement curve first exceeds 0.025 in/kips.

If a micropile fails to meet the acceptance criteria, test another micropile at a location determined by the Engineer. For failed piles and further construction of other piles, modify the construction procedures. The Engineer must review and accept any modification that necessitates changes to the structure design. Any modifications of construction procedures, or cost of additional test piles and load testing, or replacement production micropiles will be at no additional cost to the Department.

844.04 METHOD OF MEASUREMENT.

844.04.1 Mobilization & Demobilization of Micropile Equipment.

This item does not require measurement for payment.

844.04.2 Micropile.

Micropile will be measured by the number of micropiles installed.

844.04.3 Verification Load Test.

Verification Load Test will be measured by the number of accepted load tests performed.

844.04.4 Proof Load Test.

Proof Load Test will be measured by the number of accepted load tests performed.

844.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Mobilization & Demobilization of Micropile Equipment	LS
Micropile	EA
Verification Load Test	EA
Proof Load Test	EA

844.05.1 Mobilization & Demobilization of Micropile Equipment.

The price constitutes full compensation for all labor for moving materials and equipment to the site and for removing of these items upon completion of the work. Fifty percent of the Contract unit price will be paid when all of the Micropile equipment has been brought on site. The remaining 50% will be paid when the Micropile equipment is removed from the site. The Department will only pay once for mobilization and demobilization, regardless of the number of phases.

844.05.2 Micropile.

The price constitutes full compensation for all design, labor, materials, tools, equipment, and other incidental items of work necessary to finish the work, complete and accepted, including drilling, furnishing, and placing the reinforcing steel and casing, grouting, and pile top attachments. The micropile Contractor is also responsible for estimating the grout take. No extra payment will be made for grout overruns.

844.05.3 Verification Load Test.

The price constitutes full compensation for all labor, materials, and equipment, including instrumentation and report, and all other incidentals required to finish the work, complete and accepted by the Engineer.

844.05.4 Proof Load Test.

The price constitutes full compensation for all labor, materials, tools, equipment, including instrumentation and report, and other incidentals required to complete the work, complete and accepted by the Engineer.

SECTION 845 — DRILLED SHAFTS

845.01 DESCRIPTION.

The work includes the construction of steel cased, cast-in-place, concrete-filled, straight drilled shafts with steel reinforcement and the excavation, backfilling, dewatering, and disposal of obstructions encountered within the limits of the drilled shaft construction, at the required locations, lines and grades. The drilled shafts will be advanced into soil or bedrock to support the structure and design loads.

845.02 MATERIALS.

845.02.1 Concrete.

Provide a concrete mix that complies with Class XX modified as a SCC mix as specified in **SECTION 601**.

845.02.2 Grout.

Provide a cement water grout mix using Type II cement and water. Use a cement grout mixture that has a minimum seven-day compressive strength (f'_c) of 5000 psi.

845.02.3 Reinforcing Steel.

Use galvanized reinforcing steel that conforms to **Subsection M05.06**.

845.02.4 Crosshole Sonic Logging Tubes.

Provide access tubes for crosshole sonic logging (CSL) that are 2 in. ID, Schedule 40 steel pipe conforming to ASTM A53, and Grade A or B, Type E, F, or S.

845.02.5 Permanent Drilled Shaft Casing.

Use high strength steel conforming to **Subsection M05.05.1**.

845.02.6 Slurry.

Provide a slurry that is a stable suspension of mineral or polymer in potable water. Do not use polymer-mineral/bentonite blended slurries. Do not use mineral/polymer blended slurries.

845.02.7 Excavation Monitoring Devices.

Use the Shaft Inspection Device (SID) as manufactured by GPE, Inc., of Gainesville, Florida or approved equivalent.

845.02.8 Permanent Steel Casings.

Provide permanent steel casing that conforms to ASTM A252 Grade 3 steel. Use permanent casing wall thickness as specified, but not less than ⅜ in.

845.03 CONSTRUCTION.

845.03.1 Lines and Grades.

a. Benchmarks. The Engineer will provide benchmarks located on or close to the site. Maintain and protect the benchmarks and all location stakes.

b. Location. Employ a Professional Land Surveyor registered in the State of Rhode Island to establish the lines and levels. Establish the location of the drilled shafts with the approval of the Engineer. Identify the location of the center of completed drilled shafts on an engineering drawing relative to the design location and submit to the Engineer within two working days after completing the unit. Ensure that the drawings certified by the Contractor's surveyor include:

- Baseline and north arrow
- Drilled shafts clearly identified
- Deviation in inches, to the nearest ½ in., from plan location at cutoff elevation

845.03.2 Submittals.

a. General. Do not initiate any work until the Engineer has received, reviewed, and approved in writing each required submittal.

b. Submittal Documentation. Submit for review the names and qualifications of the Contractor/Subcontractor's engineers and superintendents responsible for the work specified. Document, by resume and project lists, that each proposed individual has a minimum of five years' experience for the work specified. In the submitted resumes and project lists, include a description of the formal training and experience, including a general description of subsurface soils encountered and drilling equipment used and a list of a minimum of three projects successfully drilled to the diameter range and depth required on the project in the last five years.

c. Shop Drawings. Submit Shop Drawings according to **Subsection 105.02**.

d. Site Plan. Submit a site plan including the method to access the site (timber cribbing, etc.), proposed equipment laydown area, method to secure the area from unauthorized access, and method to temporarily support equipment. The plan will be subject to permit agency review and acceptance. If requested by the permitting agencies, modify the proposed methods at no additional cost to the Project.

Submit a detailed description of work that, at a minimum, addresses each of the following items of work:

- Details of proposed equipment
- Methods and sequence of operations to be used to install casings

- Excavating soil and maintaining a stable excavation
- Removing and disposing of obstructions within the limits of the shaft excavation
- Cleaning the shaft walls and bottom so that less than 3 in. of loose, soft material remains
- Monitoring the diameter and plumbness of shafts
- Producing, maintaining, mixing, circulating, and reclaiming slurry to maintain a clean bottom and to remove soil cuttings from the borehole
- Installing reinforcing steel without damaging the excavated sidewalls of the drilled shaft
- Placing concrete by continuous tremie methods so that no defects or voids occur in the concrete column
- Using means and methods reviewed and approved by the Engineer in writing to separate the drill slurry from the concrete during tremie pours
- Backfilling

Ensure that the submittal includes provisions for protecting any existing bridges, adjacent residential structures and property, and nearby utilities during drilled shaft installation. In addition, submit the following:

- The type of proposed access tubes and associated materials to prepare drilled shafts for CSL
- The type and installation of any jointing section to extend CSL tubes or instrumentation housings
- Shop Drawings detailing the installation of materials
- Procedures and Shop Drawings detailing proposed means of protecting and maintaining the specified spacing of CSL access tubes and instrumentation housings during drilled shaft installation, especially in the rock socket below the bottom of the reinforcing cage

e. Welding Procedures. Submit welding procedures and qualifications of welders and tackers as specified in AWS D1.5 for casing steel and AWS D12.1 for reinforcing steel.

f. Slurry Data. Submit the following:

- Slurry data from the supplier identifying the recommended physical and chemical properties of the slurry, the proposed slurry mix design and additives, if any, and the details and description of slurry equipment and overall plant operation
- During construction, the results of quality control tests performed on the slurry promptly after the tests are completed
- Record copies each week
- Shop Drawing details for the management of slurry disposal
- Information on the proposed off-site facility for the disposal of spent slurry

g. Test Reports and Installation Logs. Submit test reports and installation logs as specified herein and in **Subsection 845.03.4**. Submit proposed installation log forms for acceptance.

h. Shaft Monitoring. Submit a description of the monitoring method, such as with the Shaft Inspection Device (SID) or equivalent, and the method of providing and checking the cleanliness of shaft bottoms and identifying the type of bearing material for consistency with design assumptions before placing concrete.

i. Drilled Shafts. Submit the method of monitoring and continuously maintaining slurry level in the drilled shafts.

j. Shaft Excavation. Submit the method of monitoring verticality of the shaft excavation in two principal perpendicular planes during excavation, and submit the details of proposed corrective measures to be implemented as necessary. For personnel who will perform verticality monitoring, submit documentation of training by the manufacturer in the use of the device or instrumentation to monitor verticality.

k. Shaft Diameter. Submit the method of measuring the diameter of the shaft excavation in the rock socket after excavation (such as sonic caliper technology or equivalent). For personnel who will perform the diameter monitoring, submit documentation of training by the manufacturer in the use of the device or instrumentation to monitor the diameter with shaft depth.

l. Centering Shaft. Submit the method of placing, securing, and maintaining the position of steel reinforcing centered in the drilled shaft.

m. Concrete Placement. Submit the method of placing concrete, including number, location, and details of tremie pipes.

n. Remedial Action Plan. Submit the remedial action plan, including calculations, methods, and materials necessary to complete corrections for out-of-tolerance drilled shaft foundations.

o. Obstruction. Submit the details of proposed equipment, methods, and sequence of operations to remove and dispose of obstructions.

p. Concrete Mix. Submit the concrete mix design, trial batch reports, and laboratory test data. Prepare the submittal on Department forms according to **SECTION 601**. Submit the grout mix design, trial batch reports, and laboratory test data. Prepare the submittal on Department forms according to **SECTION 601**.

q. Excavated Material. Submit the plan for handling, controlling, and managing on-site and off-site excavated soils, rock, and groundwater and their disposal site.

r. Completed Drilled Shaft Location Plan. At the completion of drilled shaft operations, and at least five working days before removal of drilled shaft equipment from the site, submit a final, as-installed drilled shaft location plan indicating:

- Surveyed location
- Shaft designation
- Shaft bottom elevation
- Permanent steel casing tip elevation and cutoff elevation

as certified by a Registered Professional Engineer licensed in the State of Rhode Island.

s. Hydrostatic Pressures. Use appropriate means to satisfactorily manage hydrostatic conditions to minimize impacts to the work during foundation installation.

845.03.3 Tolerances.

a. Drilled Shaft Diameter. Ensure that the minimum diameter is not less than specified, and that the maximum diameter does not exceed the specified diameter by more than 3 in.

b. Drilled Shaft Rock Socket Diameter. Ensure that the minimum diameter is not less than specified, and that the maximum diameter does not exceed the specified diameter by more than 3 in.

c. Drilled Shaft Rock Socket Bearing Elevation. Drill rock sockets to within 6 in. of the specified bearing elevation as determined by the Engineer using the construction phase boring data.

d. Maximum Variation from Vertical. 1 percent.

e. Elevation of the Top of Shaft. Within 3 in. of the preliminary cut-off elevation.

f. Steel Cage. After all concrete is placed, ensure that the top of the reinforcing steel cage is no more than 6 in. above and no more than 3 in. below the required position.

g. Completed Shaft. Design the excavation equipment and methods so that the completed shaft excavation will have a planar bottom. Ensure that the cutting edges of excavation equipment used to prepare the final drilled shaft tip configuration is normal to the vertical axis of the equipment within a tolerance of ±⅜ in. per foot of diameter.

h. Concrete Volume. Compare the volume of concrete placed to the theoretical volume required to fill a unit length of shaft. Make the comparison at the top of the rock socket and at the third point along the length of the shaft. Use the top of shaft as the final point of comparison. Report the actual versus theoretical rise in concrete level immediately to the Engineer. The Engineer will evaluate the dimension and quality of concrete by CSL testing.

i. Reinforcing Steel. Ensure that the reinforcing steel in the shaft is tied and supported so that the reinforcing steel will remain within allowable tolerances until the design seven-day concrete strength is verified. Use concrete spacers or other approved non-corrosive spacing devices at sufficient intervals (within 1 ft of the bottom and at intervals not exceeding 10 ft vertically up the shaft) to ensure concentric spacing for the entire cage length. Construct spacers of approved material equal in strength, quality, and durability

to the concrete specified for the shaft. Ensure that the spacers have adequate dimension to ensure the required clearance.

845.03.4 Record Information.

a. Drilled Shaft Installation Log. For each drilled shaft installed, record on the drilled shaft installation log the:

- Identification number of drilled shaft
- Location
- Alignment
- Dimensions (plan & as-built)
- Elevations of top and bottom (plan & as-built)
- Depth of bearing stratum penetration
- Description of materials encountered at all elevations
- Elevation of water table and drilling fluid during excavation
- Condition of bottom of excavation
- Method of construction
- Slurry test data (indicate elevation of bottom of hole at time of introduction)
- Concrete data (slump & sample identification)
- Time & date of concreting
- Verticality and deviation from plan location
- Other data called for on the report form or pertinent to the drilled shafts

Include the results of the bottom shaft, diameter, and verticality monitoring. Record the theoretical volume of excavation, volume of concrete placed vs. depth, and total volume of concrete placed. Provide a plot of actual concrete volume vs. theoretical volume and actual rise of concrete in the shaft. Report observed irregularities to the Engineer within 24 hours of discovery.

b. Draft Information. Submit the draft record information for each completed drilled shaft weekly. Submit the final record drawings for each drilled shaft no more than one week after completion of the work.

c. Daily Job Records. Maintain daily job records of mineral or polymer slurry testing performed under **Subsection 845.03.5**. Submit records on a weekly basis and more frequently if variations occur.

845.03.5 Control Testing of Slurry.

a. Testing Control. Perform control testing of mineral slurry according to API Standard RP 13B, Standard Procedure for Testing Drilling Fluids as witnessed by the Engineer and submit a Certificate of Compliance. If polymer slurry is used, modify the parameters according to the slurry manufacturer's recommendations. Demonstrate experience in testing on at least three projects, and submit a summary to the Engineer for written approval.

b. Slurry Testing. Test the slurry using the specified apparatus to determine the following:

- Freshly Mixed Slurry. Measure density, pH, and Marsh Cone viscosity of freshly mixed slurry. Perform API fluid loss test on freshly mixed mineral slurry and:

  - Calibrate density measuring devices at the start of the Project and monthly thereafter or more often if there is evidence of needed calibration to an accuracy of ±0.05 lb/cu ft.

  - Perform API fluid loss test according to American Petroleum Institute Standard 13A. Ensure that fluid loss does not exceed 25cc in 30 minutes.

- Slurry Inside Excavation. Perform the tests specified below to verify that the slurry properties inside excavations are within the specified limits. Obtain samples from the top, middle, and bottom of the shaft, and perform the following tests once every four hours:

  - Density, by mud density balance
  - Viscosity, by Marsh Cone Method
  - pH
  - Sand content

- Perform fluid loss measurements in the shaft at the beginning or end of every shift.

- Perform the API fluid loss test for polymer slurry once every three days at times directed by the Engineer. Ensure that fluid loss does not exceed 25cc in 30 minutes.

c. Slurry in Excavation Before Placing Concrete. Immediately before placing concrete, take slurry samples using a sampling tool approved by the Engineer and test for density, Marsh Cone Viscosity, pH, and sand content. Extract slurry samples from the base of the shaft and at intervals not exceeding 10 ft up the slurry column in the shaft until two consecutive samples produce acceptable values for density, viscosity, and pH. Circulate and clean the slurry using an airlift and desanding unit. Modify or replace the slurry in the shaft if the test parameters exceed the limits specified. Anticipate encountering soil fill, potentially contaminated groundwater, and other agents that may be deleterious to the slurry. Modify the slurry mix as required to maintain a stable suspension at all times.

d. Loss of Fluid. Limit the fluid loss in the open borehole to a drop in the slurry level of no greater than one in. per hour per 20 ft of excavation depth, and no more than 2 ft total in a 24-hour period. For areas subject to recurring fluctuations (e.g., tidal areas), document this in the test results.

e. Mineral Slurry. Premix mineral slurry with potable water. Use mineral slurry of the high swelling, pure, premium grade sodium, bentonite-based type. Do not use the slurry mix until the bentonite mix has been allowed to swell and hydrate according to the time recommendations provided by the mineral manufacturer. Use slurry tanks of adequate capacity for slurry circulation, storage, and treatment. Desand the equipment as necessary to control slurry sand content to less than 4 percent by volume at any point

in the borehole at the time the slurry is introduced. Prevent the slurry from "setting up" in the shaft. Such methods may include, but are not limited to:

- Agitation
- Circulation
- Adjusting the properties of the slurry

Properly dispose of all slurry at an off-site location.

Conduct control tests using a suitable apparatus on the mineral slurry to determine density, viscosity, and pH. An acceptable range of values for those physical properties is as follows:

- A suspension of powdered Wyoming or Dakota bentonite, attapulgite, or approved equivalent
- Density of slurry in the excavation — 65 to 75 lb/cu ft
- Density of slurry before concrete placement — 65 to 70 lb/cu ft
- Viscosity of slurry in the excavation — 30 to 45 seconds per quart by Marsh Cone Method
- pH of slurry in the excavation — 8.0 to 11.0
- Yield — 90 barrel per ton, minimum
- Dwell time in the mixer — 10 minutes, minimum
- Storage time to allow hydration — 6 hours, minimum
- Sand content — Less than 1 percent by volume measured within 12 in. of the bottom of the drilled shaft immediately before concrete placement
- Fluid loss — 25cc maximum in 30 minutes using a filter press by API 13A. Note:
    - Perform tests only when the slurry temperature is above 4.5 degrees Celsius (40 degrees Fahrenheit).
    - If desanding is required, ensure that the sand content does not exceed 4 percent by volume at any point in the borehole as determined by the American Petroleum Institute sand content test (API RP 13B-1) when the slurry is introduced.

Perform tests to determine density, viscosity, and pH value during the shaft excavation to establish a consistent working pattern. Conduct a minimum of four sets of tests, at least one test every two hours, during the first eight hours of slurry use. When the results of four consecutive tests show consistent behavior, the testing frequency may be decreased to one set every four hours of slurry use.

f. Polymer Slurry. Use polymer slurry that consists of either natural or synthetic materials. Submit the polymer data to the Engineer for approval. Ensure that the slurry properties at

the time of mixing and at the time of concreting conform to the written recommendations of the manufacturer, except that the sand content at the base of the drilled shaft excavation shall not exceed 1 percent when measured by Method API 13B-1, Section 5, immediately before concreting.

Submit for review and approval by the Engineer a detailed report specific to the Project prepared and signed by a qualified slurry consultant describing all slurry materials, mix proportions, mixing methods, and quality control methods. Ensure that the submittal includes all properties and ranges for density of slurry in the excavation, viscosity of slurry in the excavation, and pH of slurry in the excavation.

Property	Requirement	Test
Density (lb/cu ft) during drilling Just before placing concrete	Less than or equal to 64.0 lb/cu ft	Mud Weight (Density) API 13B-1
Viscosity (sec/qt) during drilling just before placing concrete	32-108 less than or equal to 60 lb/cu ft	Marsh Funnel and Cup API 13B-1 Section 2.2
pH	8.0 to 11.0	Glass electrode, pH meter or pH paper
Sand Content (%) By volume Before final cleaning Just before placing concrete	Less than or equal to 1.0 %	Sand Content Kit API 13B-1 Section 5
When approved by the Engineer, slurry may be used in salt water. The allowable density may be increased up to 2 lb/cu ft. The slurry temperature must be at least 40º Fahrenheit (4º Celsius) when tested.		

845.03.6 Excavation.

a. General.

- Excavate for the drilled shaft using non-displacement methods to advance the excavation through overburden materials and to maintain a stable excavation. Form the rock socket by methods such as coring, rotary drilling, chiseling, or other methods.

- Do not allow vibration or excessive wheel loads to affect the drilled shaft during construction.

- Seat permanent surface steel casing in bedrock by vibratory, drilling, or driving methods reviewed and approved by the Engineer.

- During excavation, prevent instability or displacement of the surrounding earth, excessive water intrusion, or damage from construction operations.

- Ensure that the completed shaft excavation has a planar bottom around the perimeter of the shaft tip. Ensure that the bottom of the shaft slopes uniformly and is free of depressions exceeding 0.25 ft deeper than the adjacent surfaces. Ensure that the cutting edges of excavation equipment are normal to the vertical axis of the equipment within a tolerance of ⅜ in. per foot of diameter.

- Evaluation of the shaft installation at any stage may be made by the Engineer. Measure the depth to the bottom of the shaft bearing stratum at the request of the Engineer to determine compliance with the specification requirements. If the Engineer concludes that the bedrock at the foundation bearing level cannot support the design load, the Engineer may request the Contractor to drill deeper. Do not concrete the drilled shafts until the hole has been observed, evaluated, and approved by the Engineer in writing.

- Upon initial contact with bedrock, regardless of the depth and rock quality, cease drilling and notify the Engineer, who will determine the actual depth.

- If an obstruction is encountered, notify the Engineer immediately. Obstructions are defined as natural, man-made, or man-placed objects, materials, or structures (e.g., granite blocks, concrete, timber, logs, piles, cobbles, boulders) encountered at or below ground surface that unavoidably and completely halt the progress of the shaft excavation or subsurface drilling work for more than one hour per incident as determined by the Engineer. These efforts include adjustment of drilling rate, down pressure, change of drill tools, and use of chisel tools to break past or remove the obstruction. Probe to locate the extent of any obstruction and propose a method of passing or removing it.

- Do not consider as obstructions any drilling tools that are lost in the excavation. Remove these tools. Repair the hole when removal operations cause damage. Tool removal and hole repairs will be at no additional cost to the Department.

b. Groundwater Control.

- Provide groundwater control using drilling slurry and permanent casing, if necessary.

- If dewatering is required, coordinate with RIDOT, the Rhode Island Department of Environmental Management (RIDEM), all utility companies, and municipal or other agencies, including agencies governing the discharge of water from dewatering operations.

c. Inspection.

- The approximate design bottom elevation of the drilled shafts is based on design criteria developed by the Engineer using subsurface conditions shown on the boring logs. The Engineer may adjust the required bottom elevation based on the elevation and quality of the bearing material encountered during drilling of more recent test

borings and during installation of the drilled shafts. The Engineer will be the sole judge for classifying the material encountered.

- Sound, measure, and record the depth to the final bottom of shaft in the presence of the Engineer to verify that soil or sediment from the sides of the shaft has not fallen into the shaft and collected on the shaft bottom. Ensure that the maximum depth of sediment does not exceed 1½ in. with at least 50 percent of the base with no more than ½ in. of sediment. Perform depth measurements at the following times:
  - Immediately after excavation has been performed to the final depth.
  - Immediately after the excavation has been cleaned of all loose material and has been desanded.
  - Immediately before placing reinforcing steel in the slurry-filled shaft.
  - During installation of the reinforcing cage through dedicated access tubes, location, and type to be proposed by the Contractor and reviewed by the Geotechnical Engineer.
  - Immediately before concrete placement.
- Ensure that the average measured depth at each stage does not vary by more than +0.1 ft or -0.2 ft. Record and average a minimum of six, equally spaced soundings to determine the depth. The Engineer will investigate the measurements that exceed the tolerances. Complete any additional cleaning or drilling until the measurements satisfy the specified tolerances. Ensure that water at the base of the shaft does not exceed 3 in. before the placement of concrete.
- Before placement of reinforcing steel and concrete, ensure that loose material from the bottom and sides of the excavation has been removed and that the shaft is within the specified tolerances. Remove all loose material at the bottom of shaft. Document the drilled shaft excavation dimensions vs. depth and verticality using the specified monitoring device to verify that the shaft is within the specified tolerances.

d. Monitoring. Provide monitoring devices and qualified technicians for monitoring the following:

- Shaft Bottom Cleanliness. Use the Shaft Inspection Device (SID) as manufactured by GPE, Inc. of Gainesville, Florida or approved equivalent.
- Shaft Verticality Measurement Device. Provide equipment and a qualified technician for monitoring the dimensions and verticality of drilled shaft excavations. At a minimum, take measurements using equipment attached to the top of the drill rig (Kelly bar).
- Shaft Diameter Measurement Device. Provide equipment and a qualified technician for monitoring the dimensions of drilled shaft excavations. Provide sonic caliper technology or approved equivalent.

e. Mineral Slurry Level. Maintain the level of mineral slurry at not less than 4 ft above the highest observed piezometric pressure head at all times during excavation.

f. Polymer Slurry. Maintain the level of polymer slurry at a level not less than 6 ft above the highest observed piezometric head.

845.03.7 Installation of Casings.

a. Permanent Casing. Furnish and install permanent casing that will remain in place and is included in the design of the drilled shaft. Permanent casing may be oversized up to 3 in. if necessary to facilitate temporary casing installation. Comply with the following:

- Use permanent casing on all drilled shafts, unless otherwise stipulated in the Contract.
- Ensure that permanent casing is continuously joined.
- Advance the permanent surface casing and seat in bedrock.
- Stabilize the sidewalls of the shaft by slurry, steel casing, placement and redrilling of concrete fill, or other means, as proposed and after review and approval by the Engineer.
- Use permanent steel casing that complies with ASTM A252, Grade 3 steel. Ensure that the permanent casing wall thickness is as required to support soil and water pressures, handling, installation, construction, and transportation loads, but not less than ⅜ in.
- Ensure that the permanent casing has a minimum diameter as indicated on the Plans.
- For vertical and horizontal joints in permanent casings, provide full penetration welds that conform to AWS Dl.5 requirements.

b. Temporary Casing. When stipulated in the Contract, use casing to facilitate shaft construction and prevent sloughing and caving of the shaft sidewalls. The Contract may specify temporary casing minimum elevations. Place the temporary casing deeper, if necessary, to prevent material from entering the shaft excavation. Use casing with an outside diameter no less than the specified diameter of the shaft. Limit the excavation in advance of the casing tip to no more than 10 ft unless synthetic slurry is being used. During casing extraction, maintain a sufficient level of fluid in the casing to counteract external hydrostatic pressures but no less than 5 ft of positive head. Maintain an adequate level of concrete within the casing to ensure that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the shaft concrete. Temporary casings that have become bound or fouled during shaft construction and cannot be removed represent a defect in the drilled shaft. Correct defective shafts using approved methods at no cost to the Department.

Corrective action may include the following:

- Removing the drilled shaft concrete and extending the drilled shaft deeper to compensate for the loss of frictional capacity to the cased zone

- Providing straddle drilled shafts to compensate for capacity loss
- Providing a replacement drilled shaft

845.03.8 Installation Requirements for Crosshole Sonic Logging.

a. Preparation of Crosshole Sonic Logging (CSL) Access Tubes. Install the access tubes as shown on the approved Shop Drawings. Fasten the tubes at 3-ft intervals to the interior of the reinforcement cage in a parallel manner. Immediately after concrete placement of the drilled shafts, fill the tubes with clean water and cap the tubes. Wait a minimum of 24 hours after concrete placement before completing CSL.

   Repair or replace (by coring) damaged or blocked tubes.

b. Tube Criteria. Install the access tubes in the drilled shafts in a regular, vertical, symmetric pattern so that four tubes are equally spaced.

c. Measurement. Record the spacing between the centerline of adjacent at the third points of the reinforcing cage to an accuracy of 0.25 in. Provide measurements to the Engineer before placement of the steel reinforcing cage in the shaft.

d. Access Tubes. Ensure that the access tubes for Crosshole Sonic Logging (CSL) are 2 in. ID, Schedule 40 steel pipe conforming to ASTM A53, Grade A or B, Type E, F, or S. Ensure that the access tubes extend the entire length of the shaft to the shaft tip (bottom of drilled shaft/rock socket), and have a round, regular internal diameter free of defects and obstructions in the tube and at joints to permit free, unobstructed passage of the source and receiver probes. Ensure that the tubes are watertight and free from corrosion, with clean internal and external surfaces to ensure good bond between the concrete and tubes. Construct the tubes with threaded steel caps at top and bottom ends. Ensure that the tubes are vertical over their entire length. Provide additional reinforcing/carrier cage to the bottom of the drilled shafts to stabilize and position the access tubes.

e. Inspection. Before the placement of the drilled shaft concrete, inspect the CSL tubes to confirm that they are continuous and properly installed. If they require any remedial work, perform this work before the placement of concrete at no cost to the Department.

f. Testing. Ensure that all drilled shafts are CSL tested. Before CSL testing by the Engineer, ensure that the test probes can pass through every tube to the bottom. If a tube is obstructed, clear the tube by an acceptable means to allow passage of the probe the full length of the tube. If the tube cannot be cleared, core a hole within the shaft near the obstructed tube that is large enough to accommodate the probe for the full length of the drilled shafts. Perform all of this at no additional cost to the Department.

845.03.9 Installation of Reinforcing Steel.

a. Delivery. If it is not practical to deliver the assembled reinforcing steel to the jobsite as a complete unit ready for installation, make splices on site before lowering the assembly into the hole.

b. Cleaning. Before installation, inspect and clean reinforcing steel of materials that prevent effective bonding of concrete on steel.

c. Placement. Place reinforcing steel in the excavation shaft immediately after cleaning the bottom.

d. Reinforcing Steel. If the shaft cannot be completely concreted within eight hours of the completion of excavation, do not place the reinforcing steel in the excavation. Recirculate and reclean the slurry using airlift equipment and a desanding unit immediately before placement of the reinforcing steel and concrete.

e. Centralizers. Equip reinforcing steel with non-corrosive, non-metallic centralizers that have sufficient strength to resist any loads they will be subjected to during construction and to maintain the specified minimum concrete cover. Space centralizers at intervals necessary to maintain the specified cover but do not provide a vertical spacing greater than 20 ft. Do not drop or force reinforcing steel into the shaft. If the reinforcing steel does not smoothly enter the excavation, due to misalignment of the reinforcing cage, steel casing, open borehole, or obstructions, remove the cage and adjust and clean the excavation as specified until the reinforcing fits smoothly.

f. Sediment. After installation of reinforcing steel and immediately before concrete placement, the Engineer will measure the bottom of the excavation to determine if sediment has accumulated on the shaft bottom in excess of the requirements. If excess sediment is found to have accumulated on the shaft bottom, clean the bottom of the excavation with equipment that can remove the sediment.

845.03.10 Placing Concrete.

a. Timing. Place concrete immediately after inspection and approval by the Engineer of the completed excavation and placement of reinforcement. If the shaft is not concreted within eight hours after completion of excavation, recirculate and reclean the slurry using airlift equipment and a desanding unit to maintain slurry uniformity throughout the depth of the shaft before placing concrete.

b. Tremie Pipe Sections. Ensure that the tremie pipe inside diameter is not less than 10 in. Replace any pipe sections showing signs of wear or defects. Secure tremie pipe joints with power equipment. Secure pipe sections with safety chains.

c. Placement. Place concrete in one continuous operation through a tremie pipe directly from the concrete truck or from a concrete pump. Ensure that no concrete is allowed to free fall when placed. Use a disposable plug, reviewed and approved by the Engineer, to separate the slurry from the concrete at the top of the tremie pipe. Ensure that the plug provides continuous separation between the slurry and the concrete for the entire length of the tremie pipe. Ensure that the bottom of the tremie pipe or the concrete pump pipe is at the bottom of the open borehole before pumping concrete.

   If during the placement of concrete, any of the following occur:

   - There is a sudden drop in concrete level is detected
   - The tremie seal is compromised

- The tremie placement is suspended for more than two hours
- The theoretical volume of concrete deviates more than 10 percent from actual

then, core the shaft at a minimum of four plan locations selected by the Engineer to detect potential voids, unacceptable concrete, or other defects. Perform the coring and the remedial actions needed to correct any voids, unacceptable concrete, or other defects.

845.03.11 Additional Requirements for Slurry Displacement Method.

a. Transport. Use equipment that produces a stable suspension and provides mechanical agitation. Transport slurry by means of a temporary pipeline between tank locations and the drilled shafts.

b. Removal. Use drilling clean-out buckets and slurry screening equipment that can remove soil and rock drilling spoil material from the slurry.

c. Slurry Level. Maintain the mineral slurry level to a minimum of 3 ft or polymer slurry level to a minimum 3 ft above the groundwater level or surface water level to prevent caving or sloughing of earth.

d. Slurry Consistency. Test the slurry to verify satisfactory characteristics before concrete placement is started. Place concrete within the time the excavation remains stable and clean. Pump the displaced slurry to holding tank(s) sufficient to store the entire displaced volume of the drilled shaft. Do not spill slurry on the site or in the surface water and do not use excavated holding pits. When no longer needed, properly dispose of slurry at an off-site location.

e. Concrete Placement. Place concrete through a tremie pipe directly from the concrete truck or from a concrete pump. Ensure that the bottom of the tremie pipe or the concrete pump pipe is at the bottom of the open borehole before pumping concrete. Use a minimum 10-in. inside diameter tremie pipe. Do not use aluminum components. Clean and smooth the inside and outside surface of the tremie pipe to permit both the flow of concrete and the unimpeded withdrawal during concreting. In addition:

   - Place a spherical separator or other device approved by the Engineer in the tremie pipe immediately before the introduction of concrete to positively separate the concrete from the slurry. The methods acceptable for review are vermiculite plugs, commercially available plastic, and rubber inflatable or non-inflatable plugs. Do not use paper or plastic bags to separate the slurry and the concrete.

   - Keep the bottom of the tremie pipe within 10 in. of the excavation bottom until the separator floats to the surface of the shaft. Retrieve the separator plug from the excavation, or submit documentation, for the Engineer's written approval, that the plug material will not cause a shaft defect if it remains.

   - Keep the tremie pipe embedded at least 5 ft below the top of the concrete/slurry interface throughout the concrete placement. If the tremie pipe is raised above the fluid concrete level, the Engineer will reject the shaft.

- Remove and dispose of the upper portion of concrete, contaminated with slurry, that reaches the top of the shaft. The Engineer will observe the depth to which contaminated concrete has been removed. The Engineer will determine if sufficient contaminated concrete has been removed or if additional contaminated concrete requires removal. Alternative methods of concrete placement that limit the mixing of slurry with concrete may be proposed for review and approval by the Engineer in writing.

845.03.12 Acceptance and Rejection of Drilled Shafts.

a. Acceptance Tests. The drilled shafts will be accepted for payment only after the CSL tests and the results of concrete tests provide verification of the structural integrity of the drilled shafts, as approved by the Engineer in writing. If the CSL record is complex or inconclusive, drill coreholes in the drilled shaft for evaluation of the drilled shaft. When a defect is confirmed by coring, perform the coring and subsequent grouting of the defect and corehole at no additional cost to the Department. However, if no defects are found, the Department will pay for the coring costs, including pressure grouting of the coreholes.

b. Remedial Action. If the Engineer determines that the drilled shafts are unacceptable, submit a plan for remedial action to the Engineer for review and approval. Ensure that calculations and working drawings for the remedial action plan are stamped by a Registered Professional Civil Engineer in the State of Rhode Island.

c. Final Acceptance. Following final acceptance of the drilled shafts by the Engineer, tremie grout the CSL access tubes with a minimum 5000 psi cement grout.

845.04 METHOD OF MEASUREMENT.

Drilled Shaft – Furnish and Install in Soil will be measured by the linear foot for the total length in place from the bottom of the permanent casing to the drilled shaft cut off elevation as accepted by the Engineer.

Transportation, processing, and proper off-site disposal of excavated materials will be measured for separately under the applicable provisions of **PART 200**.

Drilled Shaft – Obstruction Removal will be measured by the linear foot for the length of obstruction removed as follows:

- Measurement for obstruction drilling will begin at the larger of the following rates of advance:
  - When the rate of advance of the drilled shaft excavation using customary soil excavation tools and equipment has slowed to less than 10 percent of the average measured and computed rate of advance for the same soil strata encountered at the site, or
  - When the rate of advance has decreased to less than 0.5 ft per hour. The time spent drilling obstructions will not be included in the determination of the average rate of advance in the strata.

- Measurement for obstruction drilling will end when the rate of advance exceeds 20 percent of the average rate of advance in the strata.
- All material between obstructions, defined by the above, will not be measured for payment under this item but will be measured under Drilled Shaft – Furnish and Install in Soil.

Drilled Shaft – Furnish and Install Rock Socket will be measured by the linear foot for the total length in place from the bottom of the accepted drilled shaft rock socket tip elevation to the bottom of the permanent casing as accepted by the Engineer.

845.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Drilled Shaft – Furnish and Install in Soil	LF
Drilled Shaft – Obstruction Removal	LF
Drilled Shaft – Furnish and Install Rock Socket	LF

Payment at the Contract unit price is full compensation for all resources necessary to complete the item of work, including costs for engineering, mobilization, and demobilization, set-up, equipment, labor, and materials, and for additional engineering services and remedial work required due to drilled shafts not installed according to the Contract.

The following incidental items will not be reimbursed:

- Any dewatering operations
- Constructing diameters larger than the diameter shown in the Contract Documents
- Making an embedment below the specified bearing elevation as determined by the Engineer using all data available at the time of construction
- Obstructions for any item whose penetration, demolition, removal, or excavation is included clearly and expressly in the work of any other pay item
- All costs due to lost tool removal and replacement, including costs associated with hole degradation due to obstruction removal operations or the time the hole remains open
- Remedial measures, including engineering analysis and redesign, to correct for out-of-tolerance drilled shaft construction
- The design, labor, and materials necessary to perform the remediation

Part 900
INCIDENTAL CONSTRUCTION AND SERVICES

SECTION 901 — STEEL BEAM GUARDRAIL

901.01 DESCRIPTION.

Use steel beam guardrail, steel beam guardrail long span, cable guardrail, and guardrail end treatment sections that comply with the currently adopted edition of the AASHTO *Manual for Assessing Safety Hardware* (MASH). Use steel thrie beam guardrail and steel beam guardrail thrie beam transition panels that comply with the National Cooperation Highway Research Program (NCHRP) 350 *Recommended Procedures for the Safety Performance Evaluation of Highway Features*. Ensure that all traffic control devices (e.g., object markers, reflectors) comply with the currently adopted edition of the *Manual on Uniform traffic Control Devices* (MUTCD). Use trimming and grading and millings beneath all guardrail types installed in earth. Ensure that all guardrail details conform to the RIDOT *Standard Details*.

901.01.1 Steel Beam Guardrail.

Steel beam guardrail includes both W-beam and thrie beam guardrail. Furnish and install galvanized coated steel beam guardrail at the required locations.

901.01.2 Steel Beam Guardrail Approach End Treatment.

Furnish and install a steel beam guardrail approach end treatment, at the required locations, that is an energy absorbing terminal section. Furnish an object marker and affix to the approach end of the guardrail terminal.

901.01.3 Guardrail End Treatment Platform.

Construct the Guardrail End Treatment Platform to correspond to the grading around the end treatment. Grade the guardrail platform area to the required lines and slopes and grade the soil along the length of the guardrail in conformance with the manufacturer's recommendations.

901.01.4 Steel Beam Guardrail Anchorage Trailing End Section.

Furnish and install the Steel Beam Guardrail Anchorage Trailing End Section for all guardrail termini that are outside of the clear zone for approaching traffic from the opposite direction.

901.01.5 Steel Beam Guardrail Encased Post for Shallow Installation.

Furnish and install Steel Beam Guardrail Encased Post for Shallow Installation at the required locations that require additional steel post depth to provide additional lateral support.

901.01.6 Steel Beam Guardrail Long Span.

Furnish and install a Steel Beam Guardrail Long Span at the required locations.

901.01.7 Steel Thrie Beam Guardrail Long Span.

Furnish and install a Steel Thrie Beam Guardrail Long Span at the required locations.

901.01.8 Steel Beam Guardrail Thrie Beam Transition Panel.

Furnish and install a Steel Beam Guardrail Thrie Beam Transition Panel at the required locations.

901.02 MATERIALS.

901.02.1 Steel Components for Guardrail Hardware.

Use steel components for guardrail hardware that conform to **Subsections M08.03** and **M08.08**.

901.02.2 Guardrail End Treatment, Energy Absorbing Terminal.

For energy absorbing terminals, use products listed on the Department's Approved Materials List or approved equivalents. Ensure that any products not on the Approved Materials List have been tested and verified to meet all applicable criteria for MASH. If the product is not on the AML, provide supporting documentation such as an FHWA acceptance letter or crash testing results.

Ensure that the object marker affixed to the approach end of the guardrail terminal meets the requirements of the latest MUTCD and that every terminal has an object marker. Ensure that the object marker conforms to the size and shape of the approach end of the guardrail terminal with alternating black and retroreflective yellow stripes sloping downward at an angle of 45 degrees toward the side of the guardrail on which traffic is to pass. Use high intensity retroreflective sheeting for the object marker, and ensure that the sheeting conforms to AASHTO M 268, Type A, Standard Specification for Retroreflective Sheeting for Flat and Vertical Traffic Control Applications. Ensure that the object marker has a smooth weather-resistant outer surface, a pre-coated pressure sensitive adhesive backing, and adhere to steel. Ensure that the adhesive has no staining effect on the retroflective sheeting and is mildew resistant.

901.03 CONSTRUCTION METHODS.

901.03.1 Installation.

a. Posts. Set posts plumb and in alignment with the rail elements.

- Steel Posts. Mechanically drive steel posts, with the exception of end anchor posts. Where boulders or other unsuitable materials are encountered in driving, remove and replace with suitable material to permit the setting of the post.

  In driving steel posts, provide suitable driving caps and equipment to prevent battering or damage to the posts and to prevent the galvanizing on the posts above the ground line from being scratched, defaced, or damaged.

- Wood Posts. Set wood posts in dug holes or drive into the ground, and backfill and compact the dug posts and the area adjacent to the post.

Remove and properly dispose of any surplus material remaining after the completed installation.

- Steel Beam Guardrail Encased Post for Shallow Installation. Ensure that the installation conforms to the currently adopted AASHTO *Roadside Design Guide*.

b. Rail Elements. Erect rail elements, including brackets and backup rails where required, to produce a smooth, continuous installation. Draw tight all bolts, except adjustment bolts.

c. Steel Beam Guardrail Anchorage Trailing End Sections. Draw taut the wire rope for all anchorages and fasten securely. Before the installation of the longitudinal guardrail (parallel to traffic) begins, ensure that the required end sections are in place.

Do not use an unprotected blunt end facing traffic. By the end of each working day, bury blunt trailing ends that are within the clear zone of the opposing traffic flow (see **Subsection 106.05(a)** in either earth or earth embankment such that the tip of the rail is at least 6 in. below ground or mound level. The blunt end may also be protected by an approved temporary barrier or temporary crash cushion.

d. Reflectorized Triangular Delineators. Install silver reflectors on the right side of the road and amber on the left side. Place the reflectorized aluminum washer in the valley of the beam when mounting the beam onto each sixth post. See **SECTION T18**.

e. Steel Beam Guardrail Approach End Treatment. Install the guardrail end treatment and affix the object marker according to the manufacturer's written instructions. Ensure that the object marker is free of burrs, scratches, or damage and has a smooth surface.

f. Guardrail End Treatment Platform. Construct the guardrail end treatment platform to meet the required soil regrading according to the manufacturer's written instructions for the type of guardrail end treatment.

g. Erosion, Sediment, and Pollution Prevention. Ensure compliance with **SECTION 206**.

901.03.2 Cut Galvanized Elements.

Before final erection for all galvanized elements that have been cut or worked to destroy the zinc coating and cause the base metal to be exposed, clean and paint the exposed base metal with one coat of zinc dust-zinc oxide paint and a finish coat of aluminum paint that is compatible with the zinc rich paint.

901.03.3 Submittals.

Before the installation of any steel beam guardrail system components, furnish three copies of the manufacturer's installation manual to the Engineer. Submit for approval the Shop Drawings for steel beam guardrail and guardrail terminals not on the Approved Materials List according to **Subsection 105.02**.

901.03.4 Repair and/or Replace Guardrail.

901.03.4.1 Permanent Installations.

For permanent guardrail within the Limits of Disturbance (LOD) that is damaged by traffic after installation but before Final Acceptance of the Contract, repair or replace the damaged elements based on **Subsection 109.04(d)**. If the damaged guardrail is outside the LOD, the guardrail will be repaired or replaced via RIDOT's Statewide Guardrail Repair Contract.

Repair or replace existing guardrail that is damaged by traffic, and/or perform maintenance of the system if required as determined by the Engineer. This work includes 1) repairing components of an existing guardrail system, or 2) replacing the existing guardrail with new guardrail and removal of the existing components and/or system. Remove and dispose of all damaged material and debris and all associated snow removal up to a depth of 13 in. as measured by the Engineer.

Complete repairs required as a result of manufacturing defects, installation defects, or Contractor operations at no additional cost to the Department.

When required, furnish replacement parts and repair the unit as necessary after notification from the Engineer. Comply with the following timeframes:

- 48 hours for cable guardrail repairs
- 72 hours for guardrail end treatments
- 10 days for all other guardrail repairs

Notify the Engineer if the work cannot be completed within the required timeframe.

Before initiating repairs, ensure that the area is protected and that the work continues until all repairs are complete. Ensure that the repaired system complies with the manufacturer's specifications for a new system.

901.03.4.2 Temporary Installations.

Comply with **Subsections 104.08** and **107.08** and **SECTION 937** regarding the Contractor's responsibilities for repairing or replacing temporary guardrail installations. Where applicable, comply with the manufacturer's recommendations for guardrail repair or replacement. Repair or replace temporary guardrail at no additional cost to the Department.

901.03.4.3 Statewide Guardrail Repair Contract.

Repairs or replacements of damaged guardrail adjacent to active construction Projects (i.e., outside of the LOD) will be made through RIDOT's Statewide Guardrail Repair Contract.

901.03.4.4 Design-Build Contracts.

On Design Build Contracts where guardrail (permanent or temporary) is shown on the Base Technical Conceptual (BTC) plans for repairs, replacement, or as temporary traffic control, repair or replace the damaged guardrail based on **Subsection 109.04(d).**

On Design Build Contracts where guardrail is not shown on the BTC plans (i.e., the guardrail installation had been designed by the DB Team) for either temporary or permanent conditions, repair or replace the damaged guardrail at no additional cost to the Department.

901.04 METHOD OF MEASUREMENT.

901.04.1 Steel Beam Guardrail.

Steel Beam Guardrail will be measured by the number of linear feet, end-to-end of continuous sections installed. This measurement does not include the guardrail end sections (either Steel Beam Guardrail Approach End Treatment or Steel Beam Guardrail Anchorage Trailing End Sections). This measurement includes all installations of Steel Beam Guardrail Long Span, Steel Thrie Beam Guardrail Long Span, and/or Steel Beam Guardrail Thrie Beam Transition Panel. Guardrail end sections will be considered the first 50 linear feet of the guardrail run at either end for the purpose of measuring the linear feet of the Steel Beam Guardrail for payment.

901.04.2 Steel Beam Guardrail Approach End Treatment.

Steel Beam Guardrail Approach End Treatment will be measured by the number of units installed.

901.04.3 Guardrail End Treatment Platform.

Guardrail End Treatment Platform will be measured by the number of end treatment units installed.

901.04.4 Steel Beam Guardrail Anchorage Trailing End Sections.

Steel Beam Guardrail Anchorage Trailing End Sections of the various types will be measured by the number of sections installed.

901.04.5 Steel Beam Guardrail Encased Post for Shallow Installation.

Steel Beam Guardrail Encased Post for Shallow Installation will be measured by the number of posts installed.

901.04.6 Repair and/or Replace Guardrail.

Repair or replacement is performed under **Subsection 901.03.4** will be measured under **Subsection 901.04** for Contracts with guardrail bid items.

901.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Steel Beam Guardrail	LF
Steel Beam Guardrail Approach End Treatment	EA
Guardrail End Treatment Platform	EA
Steel Beam Guardrail Anchorage Trailing End Sections	EA
Steel Beam Guardrail Encased Post for Shallow Installation	EA

901.05.1 Steel Beam Guardrail.

The price constitutes full compensation for all labor, materials, and equipment, including hardware, nuts, bolts, washers, splice plates, reflectorized triangular delineators, posts driven in earth, trimming and fine grading, and all incidentals required to finish the work, complete and accepted. The price also includes the installation of any Steel Beam Guardrail Long Span, Steel Thrie Beam Guardrail Long Span, and/or Steel Beam Guardrail Thrie Beam Transition Panel.

Millings are paid for separately under **SECTION 213**.

901.05.2 Steel Beam Guardrail Approach End Treatment.

The price constitutes full compensation for all labor, materials, trimming and fine grading, millings, equipment and incidentals required to finish the work, complete and accepted.

901.05.3 Guardrail End Treatment Platform.

The price constitutes full compensation for all labor, materials, equipment and incidentals required to finish the work, complete and accepted.

901.05.4 Steel Beam Guardrail Anchorage Trailing End Sections.

The price constitutes full compensation for all labor, materials, and equipment, including hardware, nuts, bolts, washers, splice plates, trimming and fine grading, millings, and all incidentals required to finish the work, complete and accepted.

901.05.5 Steel Beam Guardrail Encased Post for Shallow Installation.

The price constitutes full compensation for all labor, materials, and equipment, including rock excavation and all incidentals required to finish the work, complete and accepted.

901.05.6 Repair and/or Replace Guardrail.

Work performed under **Subsection 901.03.4,** for which there is no item of work in the Contract including snow removal in excess of 13 in., will be paid under **Subsection 104.05.**

SECTION 902 — TENSIONED CABLE GUARDRAIL

902.01 DESCRIPTION.

This work includes furnishing and installing Tensioned Cable Guardrail and a Tensioned Cable Guardrail Terminal at the required locations that complies with the currently adopted edition of the AASHTO *Manual for Assessing Safety Hardware* (MASH) and all applicable details in the RIDOT *Standard Details*.

902.02 MATERIALS.

902.02.1 Crashworthiness.

Before approval, provide a FHWA Acceptance Letter that verifies conformity to MASH. A list of crashworthy cable barriers is available from the FHWA Office of Safety website.

The basis of acceptance of the Tensioned Cable Guardrail and Tensioned Cable Guardrail Terminal furnished will be based on the following:

- Unless otherwise noted on the Contract drawings, ensure that the maximum deflection distance is equal to or greater than 8 ft.
- Receipt of manufacturer's certification and material test reports confirming that all hardware furnished has the same physical properties as that submitted for FHWA acceptance.
- Receipt of manufacturer's certification that the product is suitable for the Project site characteristics, including ambient temperature, soil type, segment lengths, and alignment and that the completed installation will meet the FHWA crashworthiness requirements.
- Receipt of manufacturer's required embedment depth for all concrete footings.
- Receipt of manufacturer's installation and maintenance guidelines that define the correct cable tension and methods for measuring tension to ensure proper performance.

902.02.2 Other Materials.

Use cable that complies with **Subsection M08.05**. Ensure that all other steel components are galvanized or stainless.

Use Class XX concrete for the installation of the Tensioned Cable Guardrail and Tensioned Cable Guardrail Terminal that complies with **SECTION 601**.

902.03 CONSTRUCTION METHODS.

Coordinate with a designated representative of the manufacturer for the installation of each Tensioned Cable Guardrail and Tensioned Cable Guardrail Terminal specified in the Contract. The manufacturer or their designated representative shall provide any instructions and drawings that are necessary to properly complete the installation according to the Contract.

Before the installation of the cable guardrail system components, furnish three copies of the manufacturer's installation manual to the Engineer. Submit for approval the Shop Drawings for

the cable guardrail and guardrail terminals not on the Approved Materials List according to **Subsection 105.02**. Verify in the field verify all information that may be pertinent to the installation of this item.

Set the Tensioned Cable Guardrail post installation into a socket within a concrete footing. Adjust the post spacing as necessary to avoid the drainage system and still maintain the required deflection distance. Trowel finish the top surface of concrete footings to enable access to all anchor hardware for future repairs and to drain properly.

902.04 METHOD OF MEASUREMENT.

Tensioned Cable Guardrail will be measured by the number of linear feet, end-to-end of continuous sections installed, including the Tensioned Cable Guardrail Terminal and associated concrete platform, per the manufacturer's specifications.

902.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Cable Guardrail	LF

The price constitutes full compensation for all labor, materials, and equipment, including hardware, nuts, bolts, washers, splice plates, posts driven in earth, trimming and fine grading; for installing all posts with caps, wire rope, reflectors, and fittings; for excavating, placing concrete, and backfilling; and all incidentals required to finish the work, complete and accepted.

SECTION 903 — FENCES

903.01 DESCRIPTION.

903.01.1 General.

This work includes providing woven wire fence of the chain link design, including gates, posts and post foundations, hardware, and appurtenances of various types (e.g., snow fence), colors and configurations at the required locations. This Section addresses fencing for temporary and permanent locations on roadways. It does not address fencing on bridges.

903.01.2 Permanent Chain Link Fence.

This work includes the furnishing and installation of permanent chain link fencing for protecting and controlling access.

903.01.3 Temporary Chain Link Fence.

This work includes the furnishing, installation, and removal and disposal of temporary chain link fencing for protecting and controlling access. This work also includes the relocation of temporary fencing to various locations within the Project limits over the duration of the Project, as necessary.

903.01.4 Split Rail Fence.

This work includes constructing split rail fencing and gates, including posts, post foundations, and all necessary hardware.

903.01.5 Fence Post Replacement.

When a fence post requires replacement at locations as directed by the Engineer but continuous sections of fence do not require replacement, installing and attaching a new fence post to existing fabric is a separate Pay Item. This work consists of performing all operations necessary to furnish and install all components of the fence post replacement, including attachment to existing fence fabric at locations as directed by the Engineer and the removal and disposal of the existing fence post off site. This includes all types, materials, and finishes of fence posts. The types include, but are not limited to, end, corner, intermediate, line, and gate posts. Gate posts are part of the gate items and will only be paid for separately if the gate post but not the gate requires replacement.

903.01.6 Fence Fabric Replacement.

When fence fabric requires replacement at locations as directed by the Engineer but continuous posts do not require replacement, installing and attaching new fence fabric to existing posts is a separate item. This work consists of performing all operations necessary to furnish and install all components for the replacement of fence fabric, including attachment to existing posts and the removal and disposal of the existing fence fabric off site. This includes all types, materials, and finishes of fence fabric.

903.02 MATERIALS.

Use materials for chain link fences, gates, posts and post foundations, hardware, and appurtenances that conform to **SECTION M08**.

903.02.1 Chain Link Fence.

For permanent and temporary chain link fencing, use gates, posts, fittings, and related hardware that conform to **Subsection M08.02**. For fittings and other hardware not specifically included in these specifications, use standard commercial grade.

903.02.2 Split Rail Fence.

Use materials for split rail wood fences, gates, posts, and all related hardware that conform to **Subsections M08.04** and **M08.06**.

903.02.3 Fence Post/Fabric Replacement.

Use materials and finishes that match the existing fence's original application.

903.03 CONSTRUCTION METHODS.

903.03.1 General.

Perform clearing as necessary to construct the fence to the required grade and alignment. At locations with small streams or drainage ditches where it is not practical to conform the fence to the general contour of the ground surface, span the opening below the fence with wire fastened to stakes of the length required. Tie new fence to the terminals of existing fences, and stake down the chain link fence at several points between posts. At each location where electrical transmission or distribution lines cross any fence type covered by this Specification, furnish and install a ground conforming to Section 9 of the National Electric Safety Code.

903.03.2 Installing Posts.

Set posts in Class A concrete when the Contract requires that posts, braces, or anchors be imbedded in concrete, and install temporary guys or braces as required to support the posts in proper position until the concrete has set sufficiently to anchor the posts. Do not place materials on posts or place strain on guys and bracing that are set in concrete until directed by the Engineer. Extend concrete footings to the required depth and dimensions.

Where rock is encountered within the required depth to which the post will be erected, drill a hole of a diameter slightly larger than the largest dimension of the post into the rock, and grout the post in. Place the regular dimensioned concrete footing between the top of the rock and required grade.

Use hollow pipe and tube type post that is fitted with post tops. Ensure that the bases of the post tops have flanges that fit around the outside of the posts and are secured.

Use tension wires in sections of chain link fence. Place the top and bottom tension wire, stretched taut and secured at ends, to all posts in a satisfactory manner before fabric is placed.

903.03.3 Installing Fabric.

Place the fabric on the outside of the fence. Splice the rolls of fabric together.

At end, corner, or gate posts, slip the stretcher bar through the end picket of the fabric and the stretcher bar bands at the same time. Tighten the bolts in the stretcher bar bands. Stretch the fence at intervals of 100 ft.

Secure one end of the fabric and apply sufficient tension to remove all slack before making the subsequent attachments. Tie the fabric to the tension wire with fabric ties spaced not more than 24 in. apart. Attach the fabric to the line posts with fabric ties spaced not more than 14 in. apart. Place the topmost clip on the line post as near to the top of the fabric as possible and the lowest clip as near to the bottom of the fabric as possible. At terminal sections (end, corner, and pull) and gate posts, fasten the fabric stretcher bars and bands. Space the fastenings not more than 14 in. on center for terminal sections (end, corner, and pull) and gate posts. Place the topmost band on these posts as near to the top of the fabric as possible and the lowest band as near to the bottom as possible.

Before making a closure, fasten the other end of the run to the end, corner, or gate post as described previously. Use the following for the operation of making a closure of a run. Clamp the stretching equipment on the ends of the fabric parallel to each other and approximately 5 ft apart when the tension is first applied. Continue the stretching until the slack has been removed from both sections of the fabric. If the ends overlap, cut the fabric to match. Join the ends by the insertion of a picket.

903.03.4 Braces.

When top rail is not used, place braces 12 in. down from the top of the terminal posts and extend from the terminal (end, corner, and pull) post and gate posts to the brace post. Fasten the braces to the post, and truss the braces from the brace post back to terminal post with round rod and turnbuckle.

903.03.5 Gates.

Place the lower hinge (ball and socket type) on top of the concrete in which the gate post is set. Set the sockets for the cone and foot bolt in concrete so that the plunger pin will fit perfectly in the socket when the gate is in a closed position. Erect the gates to swing in the direction indicated and provide with gate stops. Ensure that all hardware is secured, properly adjusted, and left in perfect working order. Adjust hinges and diagonal bracing in gates so that gates will hang level.

903.03.6 Existing Fence Connection.

Where a new fence joins an existing fence, set the corner post with brace post at the junction and brace the corner posts. If the connection is made at other than the corner of the new fence, ensure that the last span of the old fence contains a brace span.

903.03.7 Chain Link Fence.

Permanent or temporary chain link fence may be supported by fence posts that provide adequate support. When used, fence posts set in the ground may be stabilized with grout or concrete or may be supported by holes cored into asphalt or concrete pavement when specified in the Contract or permitted by the Engineer.

Fence sections may be fabricated in modular panels if the panels are fastened together with approved clamping devices.

903.03.8 Split Rail Fence.

Set posts plumb at a minimum depth of 3 ft - 0 in. in concrete footings or in holes backfilled and compacted, and set in alignment with the horizontal rail elements.

903.03.9 Repair and/or Replace Fencing.

If existing, permanent fences are damaged by traffic, wildlife, vandals, etc., after installation but before Final Acceptance of the Contract, repair or replace the damaged elements based on **Subsection 104.05**.

Repair or replace existing fencing that is damaged by traffic, wildlife, vandals, etc., and/or perform maintenance of the system if required as determined by the Engineer. This work includes 1) repairing components of an existing fence, or 2) replacing the existing fence with new fence and removal of the existing components and/or system.

Complete repairs required as a result of manufacturing defects, installation defects, or Contractor operations at no additional cost to the Department.

When required, furnish replacement parts and repair the fence as necessary, but in no case more than 10 working days after notification from the Engineer. Once the Contractor has initiated repairs, ensure that the area is protected and that the work continues until all repairs are complete.

Notify the Engineer if the work cannot be completed within the required timeframe.

903.04 METHOD OF MEASUREMENT.

903.04.1 Fence.

Fence of the various types indicated will be measured in linear feet, end to end along the top of fence, of continuous sections installed.

903.04.2 Gates.

Gates will be measured by the number of units installed.

903.04.3 Post Holes in Ledge for New Fence.

Post Holes in Ledge for New Fence will be measured by the number of holes installed.

903.04.4 Chain Link Fence and Gate.

Chain Link Fence will be measured in linear feet, end to end along the top of fence of continuous sections installed.

Chain Link Gate will be measured by the number of units installed.

903.04.5 Split Rail Fence and Gate.

Split Rail Fence will be measured in linear feet along the top of fence between post centerlines for the sections installed.

Split Rail Gate will be measured by the number of units installed.

903.04.6 Fence Post.

Fence Post will be measured by the number of posts installed when installed and attached to existing fence fabric. When installing new fence posts and new fence fabric, refer to **Subsection 903.04.1**.

903.04.7 Fence Fabric.

Fence Fabric will be measured in linear feet, end-to-end along the top of fence, of continuous fence fabric installed and attached to existing posts. When installing new fence fabric and new posts, refer to **Subsection 903.04.1**.

903.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Fence	LF
Gates	EA
Post Holes in Ledge for New Fence	EA
Chain Link Fence	LF
Chain Link Gate	EA
Split Rail Fence	LF
Split Rail Gate	EA
Fence Post	EA
Fence Fabric	LF

903.05.1 Fence.

The price constitutes full compensation for all labor, materials, foundations or supports (all types), and equipment, including clearing and all incidentals required to finish the work, complete and accepted.

903.05.2 Gates.

The price constitutes full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

903.05.3 Post Holes in Ledge in New Fence.

The price constitutes full compensation for all labor, materials, and equipment, including nonshrink grout, and all incidentals required to finish the work, complete and accepted.

903.05.4 Chain Link Fence and Gate.

The price constitutes full compensation for all labor, materials, tools, equipment, foundations or supports (all types), and incidentals required to finish the work, complete and accepted.

No separate payment will be made for relocating and resetting fencing required by the Contract or to accommodate the Contractor's operations or for removal at the conclusion of the Project. Install, maintain and/or remove the fences and gates throughout the duration of the Contract at no additional cost to the Department.

903.05.5 Split Rail Fence and Gate.

The price constitutes full compensation for all labor, material, tools, equipment, foundations or supports (all types), and incidentals required to finish the work, complete and accepted.

903.05.6 Fence Post.

The price constitutes full compensation for all labor, materials, hardware, tools and equipment, clearing and grubbing, surface preparation, removal of existing fence post and disposal off site, removal of debris and disposal off site, removal of snow up to a depth of 13 in. and disposal off site, and all other incidentals required to finish the work, complete and accepted. When installing new fence posts and new fence fabric, refer to **Subsection 903.05.1**.

903.05.7 Fence Fabric.

The price constitutes full compensation for all labor, materials, hardware, tools and equipment, clearing and grubbing, surface preparation, removal of existing fence fabric and disposal off site, removal of debris and disposal off site, removal of snow up to a depth of 13 in. and disposal off site, and all other incidentals required to finish the work, complete and accepted. When installing new fence fabric and new fence posts, refer to **Subsection 903.05.1**.

SECTION 904 — REMOVE AND RESET FENCE

904.01 DESCRIPTION.

This work includes dismantling, rehandling, stockpiling, and removing the sections of fence and the subsequent resetting of the fence at the new, required locations.

904.02 MATERIALS.

Use the materials that have been dismantled and removed from the existing fence as it is reset except, where necessary, furnish new materials including new posts.

Use new and replacement materials necessary for the proper reconstruction of fences that conform to **SECTION M08**.

904.03 CONSTRUCTION METHODS.

904.03.1 Dismantling.

Dismantle and detach the fence rails, gates, fittings, anchorages, and appurtenances and other materials suitable for reuse from the posts, and neatly store and protect the items from damage. Clean, store, and protect all salvaged material until it is reset.

Backfill all excavated post holes and other holes with approved granular material and thoroughly compact. If post holes are located in a paved area, replace the material in kind.

904.03.2 Resetting.

Reset the fence to be plumb according to the requirements for new work of the same or similar type as set forth in other Sections. Where conflicts exist, the directions of the Engineer will govern.

Use backfill around the fence posts that consists of approved granular material that is thoroughly compacted. If the fence posts were originally set in Portland cement concrete, reset the posts in their new locations in concrete. Galvanized fence materials and fittings will not be required to be painted.

Construct post holes in ledge according to **Subsection 903.03.2**.

904.04 METHOD OF MEASUREMENT.

904.04.1 Remove and Reset Fence.

Remove and Reset Fence will be measured in linear feet, outside to outside of end posts of fence installed.

904.04.2 Fence Post Replaced.

Fence Post Replaced will be measured in linear feet, outside to outside of end posts of fence installed.

904.04.3 Post Holes in Ledge for Resetting Existing Fence.

Post Holes in Ledge for Resetting Existing Fence will be measured by the number of holes constructed.

Replace fence posts unsuitable for resetting through no fault of the Contractor with new posts, and the new posts will be measured for payment by the number of posts furnished and installed.

904.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Remove and Reset Fence	LF
Fence Post Replaced	EA
Post Holes in Ledge for Resetting Existing Fence	EA

904.05.1 Remove and Reset Fence.

The price constitutes full compensation for all labor, materials, equipment, backfill, pavement patch, clearing, and incidentals required to finish the work, complete and accepted.

904.05.2 Fence Post Replaced.

The price constitutes full compensation for all labor, materials, equipment, foundations or supports (all types), and incidentals required to finish the work, complete and accepted.

904.05.3 Post Holes in Ledge for Resetting Existing Fence.

The price constitutes full compensation for all labor, materials, equipment, including non-shrink grout, and all incidentals required to finish the work, complete and accepted.

SECTION 905 — SIDEWALKS, CURB RAMPS, AND DRIVEWAYS

905.01 DESCRIPTION.

This work includes constructing sidewalks, curb ramps, and driveways on prepared gravel bases at the required locations.

This work also includes providing and installing detectable warning panels (DWPs), which are panels with truncated domes in an arrayed pattern, which is compliant with the Americans with Disabilities Act (ADA) warning and directional systems for the visually impaired.

905.02 MATERIALS.

905.02.1 Portland Cement Concrete.

Use Portland cement concrete for sidewalks, curb ramps, typical driveways, and commercial driveways that conform to **SECTION 601**. Use Class A for sidewalks and Class XX for driveways.

905.02.2 Asphalt Concrete.

Use asphalt concrete for sidewalks, curb ramps, and driveways that conforms to **SECTION 401**.

Use performance-graded asphalt cement that conforms to **Subsection M03.02.1**.

905.02.3 Detectable Warning Panels.

Provide panels that are gray cast iron conforming to AASHTO M105 and AASHTO M306. Ensure that the panels have integrally cast domes (detectable surface) that conforms to the Americans with Disabilities Act guidelines and have integrally cast embedment lugs for installation in fresh, unset Portland cement concrete. Provide panels for installation in such sizes and shapes necessary to create the intended surface indicated in the Plans or RI Standard Specifications.

Ensure that panels are not less than 2 ft × 2 ft and are square shaped or “pie-shaped” to follow the radius of corners as necessary. Do not cut the panels.

Ensure that all panels are new and unused. Panels that appear to have been mishandled or improperly stored will not be accepted for use.

905.02.4 Other Materials.

a. Gravel Borrow. Use gravel borrow that conforms to **Subsection M01.02**.

b. Reinforcing. Use reinforcing, when required, that is wire-fabric that conforms to **Subsection M05.03.1**.

905.03 CONSTRUCTION METHODS.

905.03.1 Scheduling Construction.

Schedule sidewalk, curb ramp, and driveway construction activities to ensure that no areas are without concrete or asphalt sidewalks for more than seven consecutive calendar days. The seven days do not include the curing time.

Remove sidewalks according to **Subsection 201.03.7**.

The Contractor may be required to saw cut and remove the existing sidewalk 2 ft behind the face of the curb and complete the curb-related activities before removing the adjacent remaining sidewalk area. Where performed, saw cutting and any required temporary sidewalk patching material will be paid for under separate pay items.

905.03.2 Compliance with the Americans with Disabilities Act.

Verify that the sidewalk can be constructed according to the Plans before commencing sidewalk, curb ramp, and driveway work. Do not remove existing sidewalk nor construct new sidewalks without prior approval from the Engineer if the sidewalks cannot be constructed per the Plans.

905.03.3 Portland Cement Concrete Sidewalks and Driveways.

a. Excavation. Ensure that all excavation complies with **PART 200**.

b. Gravel Borrow Subbase. Ensure that the placement and compaction of the subbase complies with the applicable sections of **PART 300**.

c. Concrete Driveways. Ensure that the concrete depth of concrete and associated wire mesh reinforcement comply with the RIDOT *Standard Details*.

d. Box Forms. Use box forms around all appurtenances that extend into and through the sidewalk. Fill all box forms with sand immediately upon placement of the sidewalk. Ensure that the sand is flush with the sidewalk surface. For the final material used to fill inside the box form areas, use the same as that specified for the sidewalk.

e. Placing Concrete. Immediately moisten the prepared base before placing the concrete. Ensure that the proportioning, mixing, and placing of the concrete complies with the requirements for the class of concrete specified. Ensure that the thickness of the concrete is according to the RIDOT *Standard Details* with a maximum tolerance of ½ in. Comply with all applicable requirements of **Subsection 601.03**.

f. Finishing**.** Finish the surface as required on Plans. Apply a medium broom finish to all sidewalks, curb ramps, and driveways. Edge all outside edges of the slab and all joints with a ¼-in. radius edging tool.

g. Joints. Ensure that the expansion joints are filled with an approved, premolded expansion joint filler that is ¼ in. thick and extends through the entire thickness of the concrete. Divide sidewalks and driveways into sections by control joints formed by a jointing tool or other acceptable means as directed. Extend the control joints into the concrete for at least

⅓ of the depth and provide an approximate width of ⅛ in. Do not allow the distance between transverse and/or longitudinal dummy joints to exceed 5 ft.

Form construction joints around all appurtenances extending into and through the sidewalk. Install premolded expansion joint filler ¼ in. thick in the joints. Locate expansion joints every 20 ft. Do not force premolded expansion joint filler into freshly placed concrete.

Install expansion joint filler between concrete sidewalks and any fixed, smooth structure such as a building or bridge. Extend the expansion joint material for the full depth of the sidewalk. If the sidewalk abuts an irregular wall, foundation, or stationary object, locate the expansion joint filler 4 in. from the irregular surface and place concrete between the irregular surface and the expansion joint material.

h. Curing. Allow concrete to cure for at least 72 hours or until the concrete reaches a compressive strength of 1500 psi. Use moist burlap mats or other approved methods in **Subsection 601.03.7**. During the curing period, prohibit all traffic, both pedestrian and vehicular. Prohibit vehicular traffic for additional time as the Engineer may direct.

i. Cutting and Matching Existing Concrete Sidewalks or Driveways. Where a newly constructed sidewalk and/or driveway abuts an existing sidewalk or driveway, saw cut the existing sidewalk or driveway.

After installation of the concrete driveway, match asphalt pavement adjacent to parking areas, walkways, and driveways within seven days.

j. Washout Facilities. Provide washout facilities to comply with any permits or requirements.

905.03.4 Asphalt Sidewalks and Driveways.

a. Excavation and Forms. Perform excavation and use forms that comply with **Subsection 905.03.3(a)** and **(c)**. Remove and replace all material within the limits of excavation with gravel borrow subbase.

b. Gravel Borrow Base. Compact gravel material in maximum 6-in. layers and loose in depth; the Contractor may compact one maximum 8-in. lift. Compact each layer as specified in **Subsection 301.03.2**.

c. Placing Asphalt Sidewalk and Driveway Material. Place asphalt sidewalk and driveway material on the compacted base in one or more courses according to **SECTION 401**, and uniformly compact to the required depth and density. Provide compaction with a vibratory roller acceptable to the Engineer. In areas inaccessible to the roller, a plate compactor or hand roller will be permitted. Hand tamping is allowed only with the approval of the Engineer.

Ensure that the elevation of the paved roadway matches the elevation of the existing driveway.

905.03.5 Detectable Warning Panels.

Set the panels flush into fresh unset concrete at the required line and grade in accordance with the manufacturer's instructions. Ensure that the alignment of the panel is flush with the walking surface and oriented as shown on the Plans or the RI Standard Details. Ensure that there is no physical conflict with other castings, fittings, structures, foundations, or appurtenances.

Ensure that panels extend across the full width of the curb ramp, blended transition, or path/trail that warranted the installation of the panels. Install panels utilizing their integral, interlocking or bolted connections to ensure that panels remain properly oriented to each other. Tamp the panels into place such that trapped air escapes and fresh cement concrete fills the vent holes. Do not use the holes to bolt panels into place unless expressly required by the manufacturer.

905.04 METHOD OF MEASUREMENT.

Sand placed in box out areas will not be measured for payment for either the material, placement, or removal.

Excavation and gravel borrow subbase is measured under appropriate work items.

Detectable warning panels, removal and disposal of existing sidewalk, forms, trimming and fine grading, saw cutting of asphalt or concrete, expansion joint material, reinforcement, and washout facilities are not measured for payment. These items are incidental.

905.04.1 Portland Cement Sidewalks, Curb Ramps, and Driveways.

Portland Cement Concrete Sidewalks, Curb Ramps, and Driveways will be measured by the square yard, and includes concrete under detectable warning panels.

905.04.2 Asphalt Concrete Sidewalks and Driveways.

Asphalt Concrete Sidewalks and Driveways will be measured by the square yard.

905.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Portland Cement Concrete Sidewalks and Driveways	SY
Asphalt Concrete Sidewalks and Driveways	SY

The prices constitute full compensation for all labor, materials, and equipment, and all incidentals required to finish the work, complete and accepted.

SECTION 906 — CURB FOR ROADWAYS

906.01 DESCRIPTION.

This work includes the construction of curb on prepared gravel bases and/or the construction of asphalt berm on underlying pavement courses at the required locations. This Section applies to 1) the removal and disposal of existing curb and installing a new curb, or 2) installing a new curb where none currently exists. **SECTION 201** applies to only the removal and disposal of existing curbs.

906.01.1 Types of Curb.

The following types of curb are designated as follows:

- Granite Curb
- Precast Concrete Curb
- Asphalt Berm
- Straight, Transition, and/or Circular and Lot Curb

906.01.2 Curb Details.

Granite Curb includes the following:

- Granite Curb-Straight
- Granite Curb-Circular
- Granite Curb Corners
- Granite Curb Transitions
- Granite Curb Apron Stones
- Granite Curb Inlet Stones
- Granite Curb Ramp Transition
- Granite Ramp Stones

Precast Concrete Curb includes the following:

- Precast Concrete Curb-Straight
- Precast Concrete Curb-Circular
- Precast Concrete Curb Corners
- Precast Concrete Curb Transitions
- Precast Concrete Curb Apron Stones
- Precast Concrete Curb Inlet Stones
- Precast Concrete Curb Ramp Transition
- Stones and Precast Concrete Ramp Stones

906.02 MATERIALS.

906.02.1 Granite Curb.

Use granite curb that conforms to **Subsections M09.01** and **M09.02**.

906.02.2 Precast Concrete Curb.

Use Class Z concrete for curb that conforms to **SECTION 601**.

906.02.3 Asphalt Berm.

Use asphalt material for berm that conforms to the RIDOT *Standard Details* and **Subsection 401.02**. Use tack coat that conforms to the requirements for emulsified asphalt in **SECTION 403**. Use highway joint sealant material that is listed in the Department's Approved Materials List.

906.02.4 Gravel Borrow.

Use Gravel Borrow that conforms to **Subsection M01.02**.

906.02.5 Curb Lock.

Use Class A for the Portland cement concrete.

906.03 CONSTRUCTION METHODS.

906.03.1 Granite Curb.

a. Excavation. Ensure that all excavation complies with **PART 200**.

b. Gravel Borrow Subbase. Ensure that the placement and compaction of the subbase complies with the applicable sections of **PART 300**.

c. Installation. Set the curb so that the front top arris line conforms to the required line and grade.

d. Joints. Place curb units end-to-end as close as possible. Do not allow more than ½-in. opening to be visible for the full width of the top and the top 8 in. of the vertical joint.

e. Backfilling. After the curb has been set, backfill any remaining excavated areas with approved material and thoroughly compact back and front to grade. Ensure that the methods of compaction preserve the line and grade of the curb. If curb lock concrete is used, provide a washout facility.

906.03.2 Precast Concrete Curb.

Ensure that the construction of precast concrete curb conforms to **Subsection 906.03.1**.

906.03.3 Asphalt Berm.

Place the asphalt berm on the underlying pavement course as follows:

Place the berm at the same time as the asphalt surface course in one operation. Broom clean and tack the underlying pavement before placement. Place the asphalt berm in one lift, and compact by a smooth steel wheel roller of a type and weight acceptable to the Engineer.

906.03.4 Remove, Handle, Haul, Trim, and Reset Curb and Edging, Straight and/or Circular, All Types.

Remove the existing curb or edging to minimize damage to the units and adjacent pavement or sidewalks. Haul and stockpile the curb or edging as required. Trim and cut the individual units as necessary so that the ends are squared, the joints of the installed curb or edging are tightly butted, and no more than a ½-in. opening is visible at the full width of the top and the top 8 in. of the vertical joint. Clean all curb or edging before resetting.

This work includes trimming that may require saw cutting the curb in the field to meet field conditions and to provide the required lengths.

Ensure that the construction of reset curb and edging, straight and/or circular, conforms to **Subsection 906.03.1**.

The Contractor is responsible for maintaining the proper condition of the existing curb or edging in its removal and handling. Replace with new material any existing curb or edging that was intended to be reset that is lost, damaged, or destroyed as a result of either the Contractor's construction operations or failure to properly clean, store, and protect the units, at no additional cost to the Department.

906.04 METHOD OF MEASUREMENT.

906.04.1 Granite Curb.

Granite Curb and all of its details will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of curb installed.

906.04.2 Precast Concrete Curb.

Precast Concrete Curb and all of its details will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of curb installed.

Washout facilities are incidental and not measured for payment.

906.04.3 Asphalt Berm.

Asphalt Berm will not be measured for payment.

906.04.4 Remove, Handle, Haul, Trim, and Reset Curb and Edging, Straight and/or Circular, All Types.

Remove, Handle, Haul, Trim, and Reset Curb and Edging, Straight and/or Circular (all types) will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of curb reset.

Curb corners, curb transitions, apron stones, inlet stones, curb ramp transition stones, and ramp stones will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of curb reset. Deductions in length will be made for new drainage structures installed along the curb line such as catch basins, drop inlets, etc.

906.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Granite Curb	LF
Precast Concrete Curb	LF
Remove, Handle, Haul, Trim, and Reset Curb and Edging, Straight and/or Circular (All Types)	LF

906.05.1 Granite Curb.

The price constitutes full compensation for all labor, materials, and equipment, including excavation, joints, gravel borrow subbase course (including compaction and trimming and fine grading), saw cutting existing or new granite curb to meet field conditions, Portland cement concrete curb lock, backfilling, compacting, saw cutting (flexible or rigid pavement (all depths)), removal and disposal of existing pavements (both rigid and flexible), removal and disposal of existing sidewalks, and all incidentals required to finish the work, complete and accepted.

906.05.2 Precast Concrete Curb.

The price constitutes full compensation for all labor, materials, and equipment, including excavation, joints, gravel borrow subbase course (including compaction and trimming and fine grading), backfilling, compacting, curb lock, saw cutting (flexible or rigid pavement (all depths)), removal and disposal of existing pavements (both rigid and flexible), removal and disposal of existing sidewalks, and all incidentals required to finish the work, complete and accepted.

906.05.3 Asphalt Berm.

The quantity of asphalt material used in the berm is not included in the Contract unit price but, rather, is included in the unit price listed for HMA Class 9.5.

906.05.4 Remove, Handle, Haul, Trim and Reset Curb and Edging, Straight and/or Circular, All Types.

The price constitutes full compensation for all labor, materials, and equipment, including removal and disposal of existing pavement structure (all types), excavation for removal and resetting, unless otherwise noted that resetting and excavation is to be paid for separately, all handling, hauling and stockpiling, cleaning all sections to be reset, cutting and trimming as necessary to provide the maximum ½-in. opening across the top and down the front of the curb, gravel borrow

subbase course including compaction and trimming and fine grading, unless otherwise noted, the resetting of the curb or edging to line and grade, backfilling, compacting, Portland cement concrete curb lock, saw cutting existing or new granite curb to meet field conditions, saw cutting (flexible or rigid pavement (all depths)), sidewalks, and all incidentals required to finish the work, complete in place and accepted.

SECTION 907 — DUST CONTROL

907.01 DESCRIPTION.

This work includes furnishing and applying water and/or calcium chloride or other dust palliative approved by the Engineer to reduce dust nuisance and hazard within the Project limits.

This work includes both roadway dust and dust from other operations, including bridge demolition, material processing/stockpiles, saw cutting residue, etc. When hosing down a bridge demolition to control dust, contain the slurry and protect the inlets.

907.02 MATERIALS.

907.02.1 General.

Use water for dust control that is fresh and free from deleterious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.

907.02.2 Calcium Chloride.

Use calcium chloride for dust control that conforms to **Subsection M10.02**.

907.03 CONSTRUCTION METHODS.

907.03.1 Water.

Take all necessary measures to control the dust. Provide separate water meters to ensure environmental compliance and as needed for all construction activities.

907.03.2 Calcium Chloride.

In the use of calcium chloride, take all necessary measures to control the dust and to ensure environmental compliance, and use as needed for all construction activities.

907.04 METHOD OF MEASUREMENT.

907.04.1 Water.

Water for dust control is incidental and will not be measured for payment.

907.04.2 Calcium Chloride.

Calcium chloride or other approved dust palliative is incidental and not measured for payment.

907.05 BASIS OF PAYMENT.

Dust control is incidental and not paid separately. Include the costs for dust control in the bid items requiring dust control.

907.05.1 Failure to Comply.

If, in the judgment of the Engineer, the Contractor fails to adequately control dust according to this Specification, or as directed, the daily charge set forth in **SECTION 110** will be deducted from monies then due the Contractor as a charge for failure to comply with this Specification. The stated daily charge will continue for each consecutive calendar day thereafter until dust is adequately controlled.

If the Department's Maintenance Division is required to perform dust control operations due to the failure of the Contractor to comply with this Specification, all costs associated with the operations of the Maintenance Division will be deducted from monies then due the Contractor.

SECTION 908 — RUMBLE STRIPS

908.01 DESCRIPTION.

This work includes constructing rumble strips on paved highway shoulders by cutting depressions into finished asphalt concrete surfaces.

This work also includes the removal and disposal of existing rumble strips and overlaying the area with asphalt pavement.

908.02 MATERIALS.

For the asphalt paving, use materials that conform to **SECTION 401**.

908.03 CONSTRUCTION.

908.03.1 Installation.

Ensure that the cutting tool is equipped with guides to provide consistent alignment of each cut in relation to the roadway and to provide uniformity and consistency throughout the Project. Remove excess pavement material from the operation immediately and dispose at an approved off-site location. Clean the pavement by sweeping according to **SECTION 932** within the same lane closure setup as for grinding the rumble strip. Set up traffic control according to the currently adopted edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) for mobile operation on multi-lane roads. At the end of each working day, move all equipment to a location where the equipment does not present a hazard to traffic. Demonstrate to the Engineer the ability to achieve the desired surface inside each depression without tearing and snagging the asphalt before beginning the work.

908.03.2 Remove and Dispose.

Remove the rumble strip by micromilling. Dispose of all waste material in conformance with all applicable Department guidelines. Sweep the micromilled surface of any remaining dust, and remove with an air wand. Apply a uniform layer of tack coat to the milled surface, including the edges. Place asphalt pavement (Class 4.75) into the milled depression and match the adjacent roadway grade. If the total length placed will exceed 300 ft, place the Class 4.75 HMA using a suitable approved paving machine.

908.04 METHOD OF MEASUREMENT.

Rumble Strip will be measured by the linear foot of rumble strip installed parallel to the traffic.

Remove and Dispose Rumble Strip will be measured by the linear foot for each foot of rumble strip removed and overlaying the area with asphalt pavement.

908.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Rumble Strip	LF
Remove and Dispose Rumble Strip	LF

For Rumble Strip, the price constitutes full compensation for grinding rumble strip; sweeping of pavement; disposal of material; and all labor, equipment, tools, materials, and incidentals necessary to finish the work, complete and accepted.

For Remove and Dispose Rumble Strip, the price constitutes full compensation for all tools, labor, materials, and equipment necessary to perform the required work, including overlaying the area with Class 4.75, complete and accepted. Payment also constitutes full compensation for all costs encumbered in the preparation of the areas to be repaired and for the proper disposal of all material removed as part of the surface preparation procedures.

SECTION 909 — CONCRETE BARRIER

909.01 DESCRIPTION.

This work includes providing MASH compliant concrete barriers on previously prepared gravel borrow subbase courses at the required locations. This work also includes installing barrier delineators as required.

909.02 MATERIALS.

909.02.1 General.

a. Portland Cement Concrete. Use Class HP concrete that conforms to **SECTIONS 601** and **M02**. Field coat all exposed concrete after final installation with a white film forming a concrete sealer. Ensure that cast in place concrete cures not less than 28 days before coating. Use white film forming the concrete sealer that conforms to **SECTION M12**.

b. Reinforcement. Use galvanized bar reinforcement that conforms to **Subsection M05.02**. Use dowels that conform to ASTM A36 and that are galvanized according to **Subsection M05.06**.

c. Anchor Bolts for Light Standards. Use bolts and nuts that conform to **Subsection M05.05.4(a)**. Ensure that the top exposed 4 in. of anchor bolts are galvanized, together with their nuts according to **Subsection M05.06**.

d. Barrier Delineators. Use delineators that have a minimum of 9 sq in. of reflective surface area and that can be mounted on the side of the barrier by use of an adhesive or other method approved by the manufacturer. Use delineators that are on the Department's Approved Materials List.

909.03 CONSTRUCTION METHODS.

909.03.1 Plant Requirements.

a. Manufacture. Manufacture concrete barrier units according to **SECTION 601** and **SECTION 809**.

b. Reinforcement. Ensure that all reinforcing bars have a minimum cover of 2 in.

c. Dowels, Light Standard Bolts. Set dowels accurately and maintain the dowels at right angles to the plane of the end of the unit. Space anchor bolts for light supports accurately in the required bolt circle and maintain vertical to the plane of the bottom of the recess.

d. Casting. Cast the units with the forms in a 180-degree inverted position.

Devices cast flush with the bottom of the barrier to facilitate removal from the forms may remain in place with the approval of the Engineer. Locate the lifting devices so that the unit will not be over-stressed while lifting in the inverted position. Ensure that the finish on all exposed surfaces is smooth and dense concrete with a reasonably uniform appearance. No rub will be required, but immediately fill and finish any air holes after form removal to the satisfaction of the Engineer.

Do not remove units from forms before attaining the minimum seven-day compressive strength.

e. Inspection. Inspect all precast concrete barrier units both at the points of manufacture and on the Project site. Remove and replace any units showing defects or damage at no additional cost to the State.

f. Tolerances. Ensure that the concrete barrier units are cast true and square according to the applicable details. Ensure that the dimensions of units are accurate within the following tolerances:

Dimension	Tolerance ±
Greater than 0 in. to 12 in.	¼ in.
Greater than 12 in. to 24 in.	½ in.
Greater than 24 in. to 72 in.	¾ in.
Greater than 6 ft to 20 ft	1 in.

g. Barrier Delineators. Install white reflectors on the right side of the road and amber on the left side. Affix the delineators to the top of the barrier. If there is an object that prohibits the installation on the top, install the delineator on the face of the barrier facing the direction of traffic.

909.03.2 Preparation of Subbase.

Place the subbase according to **Subsections 302.03.1** and **302.03.2**.

909.03.3 Setting.

Place units on previously prepared gravel borrow subbase to the required lines and grades. Use precast concrete blocks previously set in the compacted subbase and flush with the finished grade.

When single-faced barrier units are installed on horizontal curves and/or at locations where they are back-to-back because of a grade difference between roadways, the Contractor will be allowed to use 2-in. × 4-in. timbers as spacers to facilitate the installation of the units. Fill the space between the units with a cement concrete grout mixture approved by the Engineer.

Haul, store, hoist, and handle the units to prevent cracking or damage. Remove and replace any units showing defects or damage at no additional cost to the State.

909.04 METHOD OF MEASUREMENT.

Concrete Barrier is measured by the number of linear feet installed.

Standard precast concrete barrier light units and transition units and barrier delineators are incidental to the Concrete Barrier and will not be measured separately for payment.

909.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Concrete Barrier	LF

The price constitutes full compensation for all labor, materials, and equipment for furnishing and placing units on previously prepared compacted subbase courses, including spacer timbers and concrete grout where applicable, and for the standard precast concrete barrier light units and transition units, barrier delineators, all incidentals required to finish the work, complete and accepted.

Payment for compacted gravel borrow subbase course is not included in the Contract unit prices for concrete barrier units.

SECTION 910

This Section has been Reserved for Future Use.

SECTION 911 — STONE MASONRY WALLS

911.01 DESCRIPTION.

This work includes providing wet stone masonry walls of standard designs at the required locations.

911.02 MATERIALS.

911.02.1 General.

a. Stone. Use stone for masonry walls that conforms to **SECTION M14**.
b. Mortar. Use mortar that conforms to **Subsection M04.03.5**.

911.03 CONSTRUCTION METHODS.

911.03.1 Weather Limitations.

Ensure that the temperature and weather conditions for stone masonry wall construction conform to **Subsection 807.03.1**.

911.03.2 Mixing of Mortar.

Ensure that the mixing of mortar conforms to **Subsection 807.03.2**.

911.03.3 Selecting and Storing Stone.

Keep a sufficient stock of the approved stone on site to permit adequate selection and blending of stones by the masons. Keep the stones free from dirt, oil, or any other injurious material that may prevent the proper adhesion of the mortar or detract from the appearance of the exposed surfaces.

911.03.4 Shaping and Dressing Stones.

Use selected stone, roughly squared and pitched to line, at all angles and wall ends. Perform all shaping and dressing of stone before the stone is laid in the wall. Do not use any dressing or hammering that will loosen the stone after it is placed. If a stone is loosened after the mortar is set, remove the stone, clean the mortar, and relay the stone in fresh mortar.

911.03.5 Laying Stone.

Lay the wall compactly with all vertical joints in the interior of the wall completely filled with suitable stones or spalls thoroughly bedded in mortar. Clean and wet each stone to be set in mortar before being set in a full bed of fresh mortar. Ensure that the stones are settled in place before the mortar has set. Remove any mortar in which initial set has commenced from the mixing boards or receptacles; do not reuse the mortar in the work. Do not retemper any mortar. When laying is interrupted, leave the top courses unplastered.

Lay the masonry to line and in the required pattern. Lay the stone with bearing beds parallel to the natural bed of the material. Restrict the use of chinking stones in the face to a minimum, which will be permitted only in the horizontal joints to provide firm bearing of stones. Do not chink vertical joints in the face. Prevent the bunching of small stones or stones of similar size. When weathered or colored stones, or stones of varying textures are being used, distribute the various kinds of stones uniformly throughout the exposed faces of the work. Ensure that the foundation (base) of the wall is composed of large stones (stones that are distinctly larger than the majority of the stones in the wall) that are laid to form a relatively flat surface upon which the succeeding courses may be placed. Use large stones for the bottom courses and, in general, decrease these stones in size from the bottom to the top of the work.

Ensure that at least one-fourth of the stones in the face are headers (a stone laid with its end toward the face of the wall) and evenly distribute these stones. Extend headers not less than 12 in. into the core (or the stones that make up the center) of the wall. Ensure that headers are uniform in height and width throughout their length. Extend headers in walls 2 ft or less in thickness entirely through the wall.

Lay all stones to break joints and to thoroughly bond the work. Place stones to form bonds with the stones of adjoining courses of not less than 12 in. ashlar (squared and dressed stone) and split face masonry and not less than 6 in. rubble masonry. Place headers over stretchers (stones laid with their length parallel to the face of the wall) and, in general, ensure that the headers of each course equally divide the spaces between the headers of adjoining courses. Do not place any header over a joint and do not make any joint over a header. Place headers in each course, which must have a width of not less than 1½ times their thickness and must be spaced no further than 8 ft apart, center to center. Ensure that stretchers have a length of bed not less than 2 times nor more than 3½ times their thickness and not less than 3 ft.

Finish the tops of walls flat. Ensure that capstones, if required, are flat on the upward side and are not less than 6 in. in thickness for ashlar and split face masonry and 3 in. in thickness for rubble masonry. Ensure that at least one-fourth of the stones used on the top of the wall are tie stones and extend entirely across the top. Ensure that the remaining stones used in constructing the top course are of a size that allows the top course to be constructed by the placement of no more than two stones across the width of the wall and that are no less than 8 in. in width.

911.03.6 Joints.

Finish joints requiring pointing so that the mortared joint is filled to the face line of the wall. Finish the mortar so that it is pitched downward and away from the center of the wall. Ensure that joints on the top of the wall are pointed flush with the top of the wall and are slightly pitched to direct water off of the wall. When possible, ensure that joints are properly pointed before the mortar becomes set. For joints that cannot be pointed, prepare these for subsequent pointing by raking the mortar out to a depth of 2 in. before the mortar has set. Wet joints that are not pointed at the time the stones are laid with clean water, and fill the joints with mortar. Ensure that the mortar is well driven into the joints and finished with a pointing tool.

Ensure that the maximum widths of joints in the faces and tops of stone masonry walls are as follows:

	Ashlar	Split Face	Rubble
Face	½ in.	1 in.	1 in.
Top	½ in.	¾ in.	1 in.

911.03.7 Weep Holes.

Furnish and install drainage holes and weep holes as detailed and at the required locations.

911.03.8 Excavation.

Perform any excavation below the designated slope or subgrade and subsequent backfilling according to **SECTION 203**.

911.03.9 Backfilling.

Perform the backfilling with approved pervious materials placed in layers of not more than 6 in. in thickness. Compact each layer before the succeeding layer is placed.

911.03.10 Cleaning.

After the mortar has set, clean the wall and leave the wall in a neat and workmanlike condition.

911.04 METHOD OF MEASUREMENT.

Stone masonry walls will be measured by the number of cubic yards of masonry installed.

911.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Stone Masonry Wall	CY

The price constitutes full compensation for all labor, materials, and equipment, including mortar, stone masonry, weep holes, backfilling, protection during curing, and all incidentals required to finish the work, complete and accepted.

When the Contractor is directed/authorized to excavate below the designated slope, excavation below the designated slope or subgrade line will be paid for according to **SECTION 203**.

SECTION 912 — REMOVE AND REBUILD OR CONSTRUCT NEW DRY-LAID STONE WALLS

912.01 DESCRIPTION.

This work includes the removal and resetting of existing sections or the construction of new sections of dry-laid stone walls at the required locations. Walls will be considered double faced.

912.02 MATERIALS.

Use stones to construct new walls that conform to **SECTION M14**. Use stones in walls designated to be removed and reset that include the stones in the existing wall and any additional stones required to complete the work. Use any additional stones necessary to complete the wall sections that conform to the existing stones relative to shape, texture, color, and geological composition. For existing walls comprised predominantly of flat stones, ensure that any additional stones required are not less than 3 in. thick, 10 in. wide, and 12 in. long in size. For walls comprised mostly of round stones, ensure that any additional stones required are not less than 9 in. thick, 12 in. wide, and 12 in. long in size. Stones that are smaller than these dimensions may be used only for pinning and/or filling interstices within the wall.

912.03 CONSTRUCTION METHODS.

912.03.1 Trenching.

Excavate trenches for constructing stone to a depth of 12 in. and to a width of 36 in.

912.03.2 Laying Stone.

Lay the stones to line and in courses roughly leveled up. Ensure that the bottom, or foundation, courses are composed of large stones and are laid to form a relatively flat surface upon which the succeeding courses may be placed. Fill the open spaces around the foundation (or base) of the wall with suitable material excavated from the trench. Lay all stones with bearing beds parallel to the natural bed of the material. Use select stones, roughly squared, at the ends and at angles in the wall. Ensure that the foundation courses consist of the large stones and that the thinnest courses are placed towards the top of the wall.

Provide a stone wall that has a width of not less than 24 in. and a height of 3 ft above the surrounding ground surface. These dimensions may be increased or decreased where necessary to conform to adjoining walls that will remain in place. If, to complete the wall, it becomes necessary to use stones other than those that are in the existing wall, use the additional stones in the foundation and distribute evenly throughout the wall.

Ensure that each stone takes a firm bearing at not less than three separate points upon the underlying course. Chink open joints and fit spalls to provide firm bearing throughout the length of the stone. Ensure that face joints do not exceed 1 in. in width. Chinking will be permitted only in horizontal joints in the faces. Do not chink vertical joints in the faces of the wall.

Ensure that header stones hold in the heart of the wall and extend not less than 12 in. into the core and that they occupy not less than one-fourth of the face area of the wall and are evenly distributed. Extend header stones in walls 2 ft or less in thickness entirely through the wall.

Finish the top of the wall flat, and ensure that the wall contains tie stones that extend entirely across the width of the wall. Ensure that tie stones consist of no less than one-fourth of the stones in the course. Ensure that all stones used in the top course have a width of at least 8 in. and a thickness of at least 3 in.

912.04 METHOD OF MEASUREMENT.

Remove and Rebuild New Dry-Laid Stone Walls or Construct New Dry-Laid Stone Walls will be measured by the number of linear feet of continuous runs of the constructed or reconstructed walls installed.

912.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Remove and Rebuild New Dry-Laid Stone Walls	LF
Construct New Dry-Laid Stone Walls	LF

The prices constitute full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Excavation below the designated slope or subgrade line for the installation of dry-laid stone walls will be paid for according to **SECTION 203**.

Stones required for the construction of new walls will be included in the Contract price for Construct New Dry-Laid Stone Walls. Stones provided by the Contractor to supplement quantities of existing stones from existing walls to meet the requirements of this Specification will be paid for separately under the bid item, Supplementary Stones for Walls.

SECTION 913 — LAW ENFORCEMENT OFFICERS

913.01 DESCRIPTION.

This work includes providing law enforcement officers as deemed necessary by the Engineer for the direction and control of both vehicular traffic and pedestrians within the limits of the Project.

913.02 QUALIFICATIONS.

Use law enforcement officers that wear regulation uniforms who should be regular, reserve, or special officers of the communities in which they serve. Ensure that the officers use high visibility safety apparel that conforms to **Subsection 107.08**.

913.03 CONSTRUCTION METHODS.

The primary function of uniformed law enforcement officers, with or without marked cruisers, is to supplement (not replace) the traffic control devices used to move road users safely and expeditiously through and/or around work areas while protecting on-site workers and equipment. Ensure that the number of law enforcement officers used at any location is no greater than the number necessary to adequately alert, slow, and/or control road users through or around the work zone.

The following presents guidance on the appropriate use of law enforcement officers in a work zone:

- Frequent worker presence adjacent to high-speed traffic without positive protection devices
- Traffic control setup or removal that presents significant risks to workers and road users
- Complex or very short-term changes in traffic patterns with significant potential for road user confusion or worker risk from traffic exposure
- Night work operations that create substantial traffic safety risks for workers and road users
- Existing traffic conditions and/or crash histories that indicate a potential for substantial safety and congestion impacts related to the work zone activity, and that may be mitigated by improved driver alertness and/or behavior through the work zone
- Work zone operations that require brief stoppage of all traffic in one or both directions
- High-speed highways where unexpected or sudden traffic queuing is anticipated, especially if the queue forms a considerable distance in advance of the work zone or immediately adjacent to the work space

The following Table provides guidelines for the use of law enforcement officers and flagpersons (**SECTION 914**).

Quick Reference Guidelines[1]
Use of Traffic Control Personnel in Work Zones (if needed[2])

Facility Type	Speed Limit[3]	No. of Travel Lanes Per Direction	Traffic Restriction in Work Zone	Typically, Most Appropriate Traffic Control Personnel	Marked Cruiser[4]	Example Uses	
						Personnel Location	Personnel Function
Highway Ramps	Any	2 or more	Lane Closure/Shoulder Closure/Land Shift	Law Enforcement Officers	Yes	In Advance of Work Area Work Vehicle Access/Egress Point	Presence and/or Speed Enforcement Control Traffic to Allow Access/Egress
		1	Lane Closure/Shoulder Closure/Land Shift	Flagpersons	No	Work Vehicle Access/Egress Point	Control Traffic to Allow Access/Egress
Highway Mainline Segments	Greater than 35	Any	Lane Closure	Law Enforcement Officers	Yes	In Advance of Work Area	Presence and/or Speed Enforcement
		2 or more	Lane Shift/ Shoulder Closure	Law Enforcement Officers	Yes	Work Vehicle Access/Egress Point	Control Traffic to Allow Access/Egress
		1	Land Shift/ Shoulder Closure/Lane Shift	Flagpersons	No	Work Vehicle Access/Egress Point	Control Traffic to Allow Access/Egress
	35 or Less[5]	Any	Lane Closure/Shoulder Closure/Lane Shift	Flagpersons	No	In Advance of Work Area	Control Alternating One-Way Traffic
						Work Vehicle Access/Egress Point	Control Traffic to Allow Access/Egress
Signalized Intersections	Greater than 35	Any	Lane Closure/Shoulder Closure/Lane Shift	Law Enforcement Officers	Yes	Intersection	Direct and/or Control Traffic
	35 or Less[6]	Any	Lane Closure/Shoulder Closure/Lane Shift	Law Enforcement Officers	No	Intersection	Direct and/or Control Traffic
Unsignalized Intersections	Any	Any	Lane Closure/Shoulder Closure/Lane Shift	Flagpersons	No	Intersection	Direct and/or Control Traffic

1 See Policy language for detailed guidelines.

2 In most cases, Law Enforcement Officers/Flagpersons should be used only if the Engineer deems that they are needed to direct, control, and/or alert road users.

3 Posted or statutory speed limit on one or more approaches to the facility type.

4 With emergency lights activated.

5 On all approaches to the facility type.

913.04 METHOD OF MEASUREMENT.

Services of law enforcement officers will be measured for payment by the number of hours for each person rendering services according to directions of the Engineer. This only includes, however, law enforcement officers that are employed within either the limits of the construction right-of-way for the Project, upon detours stipulated in the Contract, or upon detours ordered by the Engineer. Law enforcement officers furnished by the Contractor for continued use of a detour, bypass, or temporary traffic control beyond the period for which the Engineer deems that law enforcement officers are necessary to the proper completion of the Project, or at locations where traffic is unnecessarily restricted by the Contractor's method of operation, will not be measured for payment.

913.05 BASIS OF PAYMENT.

Although services of uniformed law enforcement officers (with/without cruisers) will be measured for payment by the number of hours for each person rendering services, there is no bid item for this work.

Uniformed law enforcement officers (with/without cruisers) will be paid based on actual cost as submitted by a bill of lading from the local community or communities involved or from the State for State Troopers and approved by the Engineer. The payment for this work will be made directly by the Department through a separate Purchase Order submitted by the local community or communities or the State agency. Payment for the law enforcement officers (with/without cruisers) required by the Contractor's operations beyond the period for which the Engineer deems necessary shall be the Contractor's responsibility.

SECTION 914 — FLAGPERSONS

914.01 DESCRIPTION.

This work includes providing flagpersons as required in the Contract or as directed by the Engineer to assist in controlling traffic through the construction site.

914.02 QUALIFICATIONS.

Provide flagpersons who are trained in safe traffic control practices and public contact techniques who are knowledgeable with the most recent publication of the "Flagging Handbook," published by the Federal Highway Administration, and who possess a certificate of satisfactory completion from a training course approved by the Department.

Flagpersons who are unqualified or unable to meet the above requirements or who are unable to provide proper and effective traffic control may be removed at the discretion of the Engineer. In this case, provide qualified replacement flagpersons, and maintain the required traffic control measures for the work site at all times.

914.03 CONSTRUCTION METHODS.

See the Table in **Subsection 913.03** for guidance on the use of flagpersons in work zones.

914.04 METHOD OF MEASUREMENT.

Services of flagpersons will be measured for payment by the number of hours for each person rendering services according to directions from the Engineer. This only includes, however, flagpersons that are employed within either the limits of the construction right-of-way for the Project, upon detours stipulated in the Contract, or upon detours ordered by the Engineer. Flagpersons furnished by the Contractor for its convenience will not be measured for payment. Examples include:

- Providing flaggers for the continued use of a detour, bypass, or temporary traffic control beyond the period for which the Engineer deems that flagpersons are necessary for the proper completion of the Project
- At locations where traffic is unnecessarily restricted by the Contractor's method of operation (e.g., laydown areas, site access/security)

914.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Flagpersons	HR

The current minimum acceptable bid for regular and overtime hours are provided on Page P-1 of the Proposal.

The unit bid price per manhour will constitute compensation for the flagpersons' services, including fringe benefits, and for associated protective clothing, hand signaling devices, communications equipment, and other applicable equipment and incidentals deemed necessary by the Engineer. Overtime will be compensated for separately and according to the union contract.

Payment for temporary work is included under **SECTION 937**.

SECTION 915 — RHODE ISLAND HIGHWAY BOUNDS

915.01 DESCRIPTION.

This work includes providing granite, reinforced concrete, or bronze highway bounds at the required locations and providing as-built and certification of the locations to the Department in the format stipulated.

915.02 MATERIALS.

Use materials that conform to **Subsection M10.07**. Use bronze rods that are 1¼ in. in diameter and are split a distance of 2 in. from the bottom.

915.03 CONSTRUCTION METHODS.

Install bounds at the required locations. Before installing the bounds, request the applicable Plats from the Construction Manager. Proposed bound locations are typically shown on final certified Plats along with Contract documents. When located in lawns, sidewalks, or drives, set bounds with the top of the bound a ½-in. below the surface. Otherwise, set bounds that do not project above the surrounding ground by more than 6 in.

When the bound point location on a ledge and the use of a bronze rod is directed by the Engineer, drill a 1½-in. hole to a depth of 8 in., and place a bronze rod and bronze wedge in the drill hole. Drive the rod on the wedge until the rod is solidly wedged into the hole. Embed the rod either by filling the hole with a cement grout composed of equal parts of fine sand and cement or by packing with lead.

The Contractor's Professional Land Surveyor (PLS) shall supervise and certify the installation of Rhode Island Highway Bounds and prepare as-builts. Ensure that the certification includes the date of installation, type of RIHB monument installed, design station/offset, and the installed station/offset and installed coordinates. Provide this information to the Department as a markup on the State Highway Plat, and include the information in a report or spreadsheet properly stamped and certified by the Contractor's PLS.

915.04 METHOD OF MEASUREMENT.

Highway Bounds of the various types specified will be measured by the number of bounds furnished and set.

915.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Highway Bounds	EA

The accepted quantities of Highway Bounds of the various types specified will be paid for at their Contract unit prices per each. The price constitutes full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 916 — CRASH CUSHIONS

916.01 DESCRIPTION.

916.01.1 General.

This work consists of furnishing and installing crashworthy systems or modules that conform to the manufacturer's specifications, allowing a vehicle to safely decelerate. Ensure that the selected crash cushion, formerly referred to as crash cushions, is acceptable for use under the prevailing highway conditions (e. g., design speed and traffic and truck volumes) and meets current FHWA standards for crashworthiness. Ensure that the type of crash cushion selected has as small a footprint as possible while providing its intended function.

916.01.2 Permanent Narrow Condition Crash Cushion.

This item consists of furnishing and installing a redirective, non-gating crash cushion that conforms to the manufacturer's specifications. Narrow condition crash cushions are designed to protect hazards equal to or less than 2 ft in width.

916.01.3 Temporary Narrow Condition Crash Cushion.

This item consists of furnishing, installing, maintaining, relocating (if necessary), and removing a temporary redirective non-gating crash cushion that conforms to the manufacturer's specifications. Temporary Narrow Condition Crash Cushions are designed to protect hazards equal to or less than 2 ft in width. If using water filled barrier through the winter months, provide an approved antifreeze solution in the water.

916.01.4 Permanent Wide Condition Crash Cushion.

This item consists of furnishing and installing a redirective, non-gating crash cushion that conforms to the manufacturer's specifications. Wide Condition Crash Cushions are designed to protect hazards greater than 2 ft in width.

916.01.5 Temporary Wide Condition Crash Cushion.

This item consists of furnishing, installing, maintaining, relocating (if necessary), and removing a temporary redirective, non-gating crash cushion that conforms to the manufacturer's specifications. Temporary Wide Condition Crash Cushions are designed to protect hazards greater than 2 ft in width. If the crash cushion will be in place during the winter months, provide an approved antifreeze solution to the water filled barrier.

916.01.6 Permanent Shock Absorbing Barrier Modules.

This item consists of furnishing and installing a non-redirective, gating crash cushion in the form of sand filled, polyethylene modules arranged in an array that conforms to the manufacturer's specifications.

916.01.7 Temporary Shock Absorbing Barrier Modules.

This item consists of furnishing, installing, maintaining, replacing, relocating (if necessary), and removing a non-redirective, gating crash cushion in the form of sand filled, polyethylene modules arranged in an array that conforms to the manufacturer's specifications.

916.01.8 Remove, Relocate, and Reset Temporary Crash Cushion; Remove, Relocate, and Reset Shock Absorbing Barrier Modules.

This work consists of removing previously installed crash cushions from one location and subsequently installing the crash cushions at a new location. This is generally used to accommodate the various stages of construction.

916.01.9 Concrete Leveling Pad.

This work consists of performing all operations necessary to furnish and install all components for the placement of level surfaces under crash cushions or shock absorbing barrier modules in the form of concrete leveling pads. Perform all work according to the manufacturer's specifications. The location and orientation of the concrete pad will be as shown in the Contract or as determined by the Engineer. As part of the installation of the concrete leveling pad, remove the existing surface and prepare the new surface.

916.02 MATERIALS.

Use materials that meet the requirements of the manufacturer's recommendations and have been accepted by the Federal Highway Administration for use in the location intended. Ensure that the crash cushion and shock absorbing barrier modules are designed for Test Level 3 (TL-3) when the design speed is greater than 45 mph and Test Level 2 (TL-3) when the design speed is 45 mph or less.

Provide a concrete leveling pad that is Portland cement concrete and has a minimum strength of 4000 psi. Use materials that conform to **PART M**. Use Portland cement concrete that conforms to **SECTION 601**. Ensure that the use of epoxy, rods, anchors, and steel reinforcements comply with the manufacturer's specifications.

916.03 CONSTRUCTION METHODS.

916.03.1 General.

Install all crash cushions according to the manufacturer's recommendations. Furnish a manufacturer's installation manual and submittal showing the proposed system setup (including the system length and width and proposed attachment/connection to existing barrier) or modules array to the Engineer before installing the unit. Ensure that the submittal demonstrates that the device meets the MASH TL-2 or TL-3 specifications as applicable.

Ensure that the crash cushion is compatible with the barrier or other device that the crash cushion is attached to or protecting. Any adjustment or realignment of any part of the unit for Contractor access or convenience will be performed at no additional cost to the Department.

916.03.2 Field Measurements.

Make all appropriate field measurements and evaluate special conditions for installation before the preparation of submittals.

916.03.3 Relocation.

Remove the temporary crash cushions from their initial locations and transport to new locations. Place the relocated crash cushion on the pavement/concrete and secure or attach (if necessary) according to the manufacturer's recommendations and as.

916.03.4 Replace and/or Repair Damaged Crash Cushions.

916.03.4.1 Permanent Installations.

For permanent crash cushions within the Limits of Disturbance (LOD) that are damaged by traffic after installation but before Final Acceptance of the Contract, repair or replace the damaged elements based on **Subsection 109.04(d)**.

Repair or replace an existing crash cushion that is damaged by traffic, and/or perform maintenance of the system if required as determined by the Engineer. This work includes 1) repairing components of an existing crash cushion system, or 2) replacing the existing crash cushion with a new system and removal of the existing components and/or system. Remove and dispose of all damaged material and debris and all associated snow removal up to a depth of 13 in. as measured by the Engineer.

Complete repairs required as a result of manufacturing defects, installation defects, or Contractor operations at no additional cost to the Department.

When required, furnish replacement parts and repair the unit as necessary within 72 hours after notification from the Engineer. Once the Contractor has begun repairs, ensure that the area remains protected and that the work continues until all repairs are complete. Ensure that the repaired system or modules conform to the manufacturer's specifications for a new system or a new modules array.

Notify the Engineer if the work cannot be completed within the required timeframe.

916.03.4.2 Temporary Installations.

Comply with **Subsections 104.08** and **107.08** and **SECTION 937** regarding the Contractor's responsibilities for repairing or replacing temporary crash cushions. Comply with the manufacturer's recommendations for crash cushion repair or replacement. Repair or replace temporary crash cushion at no additional cost to the Department.

916.03.4.3 Design-Build Contracts.

On Design-Build Contracts where crash cushions (permanent or temporary) are shown on the Base Technical Conceptual (BTC) plans for repairs, replacement, or as temporary traffic control, repair or replace the damaged crash cushion based on **Subsection 109.04(d)**.

On Design-Build Contracts where crash cushions are not shown on the BTC plans (i.e., the crash cushion installation had been designed by the DB Team) for either temporary or permanent conditions, repair or replace the damaged crash cushion at no additional cost to the Department.

916.03.5 Maintenance.

Perform maintenance according to **SECTION 937**.

916.03.6 Concrete Leveling Pad.

a. Geometry. Ensure that the concrete pad has a minimum thickness of 8 in. Ensure that the installed pad has a cross slope that does not exceed 8 percent and does not vary (twist) more than 2 percent in its length. Provide a light broom finish to the pad surface. If the manufacturer's specification states otherwise, use the more stringent specification.

b. Field Measurements. Make all appropriate field measurements and evaluate special conditions for installation before the preparation of Shop Drawings.

c. Shop Drawings. Submit Drawings according to **Subsection 105.02** showing the proposed concrete leveling pad setup including the length and width, any reinforcing, and proposed tie-in to existing concrete or existing ground surface. The Engineer will approve the Drawings before the start of construction.

d. Installation. When installing the concrete pad to space rebar, minimize interference with the anchor bolt holes that allow the system to be anchored to the concrete leveling pad.

916.04 METHOD OF MEASUREMENT.

Crash Cushion will be measured by the number of units installed.

Shock Absorbing Barrier Modules will be measured by the number of groups installed. A group is defined as including all modules necessary to complete a specific installation.

916.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Permanent Narrow Condition Crash Cushion	EA
Temporary Narrow Condition Crash Cushion	EA
Permanent Wide Condition Crash Cushion	EA
Temporary Wide Condition Crash Cushion	EA
Permanent Shock Absorbing Barrier Modules	GRP
Temporary Shock Absorbing Barrier Modules	GRP

The prices constitute full compensation for all labor, materials and equipment, surface preparation, loading, hauling, concrete leveling pad, and incidents required to finish the work, complete and accepted.

Payment for temporary work is included under **SECTION 937**.

SECTION 917 — REMOVE AND REPLACE RURAL MAILBOX POSTS AND MOUNTINGS

917.01 DESCRIPTION.

This work includes removing existing rural mailboxes, posts, and mountings; setting the existing boxes in temporary locations, if directed; providing new posts; and mounting the existing mailboxes on the new posts at the required locations.

917.02 MATERIALS.

Use materials for rural mailbox posts, mountings, and foundations that conform to the requirements in the Contract.

917.03 CONSTRUCTION METHODS.

917.03.1 Removing Existing Posts and Boxes.

Remove the existing mailboxes and their posts. Detach the mailboxes from the mountings and posts, and save for subsequent remounting on new posts. Fill and tamp the post holes with suitable materials. Replace any material damaged or lost due to the removing and dismantling. Replace the material with the type and kind that was damaged or lost.

917.03.2 Installation.

a. General. Notify and coordinate with the USPS and mailbox owner. Ensure that the mounting of new rural mailboxes on posts conforms to the RIDOT *Standard Details*.

b. Temporary Locations. If necessary, during the construction period, set the mailboxes in temporary locations as directed so that they are at all times satisfactorily accessible to the mail carrier and the owner.

c. Setting Posts. Tamp the bottoms of holes so that the posts will have a stable foundation. Set the posts plumb and true to line and grade, backfill the holes with approved granular material, and compact in layers to avoid displacing the posts.

917.04 METHOD OF MEASUREMENT.

Remove and Replace Rural Mailbox Posts and Mountings will be measured by the number of units installed.

917.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Remove and Replace Rural Mailbox Posts and Mountings	EA

The price constitutes full compensation for all labor, materials, and equipment, including all excavation, backfilling, disposing of surplus materials, removing and salvaging the existing installations, setting boxes in temporary locations, and all incidentals required to finish the work, complete and accepted.

SECTION 918 — RURAL MAILBOXES POSTMASTER APPROVED

918.01 DESCRIPTION.

This work includes replacing existing rural mailboxes with new two-door mailboxes when the existing mailboxes do not conform to the specifications of the US Postal Service and/or local requirements.

918.02 MATERIALS.

Provide new rural mailboxes that conform to the standards established by the US Postal Service for materials, coatings, and paint. Ensure that the doors of the new mailboxes are embossed with the following inscriptions: “U.S. MAIL,” and “APPROVED BY THE POSTMASTER GENERAL.” Provide identification in the form of a house, apartment, or box number, clearly visible to the mail carrier’s approach and consistent with USPS standards.

918.03 CONSTRUCTION METHODS.

Notify and coordinate with the USPS and mailbox owner. Ensure that the mounting of new rural mailboxes on posts conforms to the RIDOT *Standard Details*.

918.04 METHOD OF MEASUREMENT.

Rural Mailboxes will be measured by the number of boxes installed.

918.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Rural Mailboxes	EA

The price constitutes full compensation for all labor, materials, and equipment, including removal of existing rural mailboxes, hardware, and all incidentals required to finish the work, complete and accepted.

SECTION 919 — TEST PITS

919.01 DESCRIPTION.

This work includes excavating exploratory test pits used for locating existing utilities of every type, including water, sewer, storm drains, gas, power distribution, and communications and for determining water table elevations and soil conditions.

919.02 MATERIALS.

Materials associated with test pit excavations such as backfill, subbase, and base courses, asphalt pavements, and loam and seeding are specified in **PARTS 200**, **300**, **400**, and **L**.

919.03 CONSTRUCTION METHODS.

Test pit excavations may include any or all of the following items, the construction methods for which are specified in **PARTS 200** and **L**:

- Cutting pavement
- Breaking up and disposal of existing pavements
- Test pit excavation
- Backfill and compaction, where required
- Loam and seeding
- Replacement paving to match as nearly as possible the existing pavement in thickness

Submit the results of all test pits to the Department according to Design Policy Memo 480.01.

919.04 METHOD OF MEASUREMENT.

Test Pits will be measured by the number of individual pits excavated, regardless of whether utilities were located or water table elevations were determined.

919.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Test Pits	EA

The price constitutes full compensation for labor, materials, and equipment, including cutting and matching pavement, removal and proper disposal of existing pavements, excavation, pumping and bailing, backfilling, loaming and seeding, where required, electronic submission of the results, and all incidentals required to finish the work, complete and accepted.

The replacement of subbase and base courses, and the replacement paving and resurfacing, will be paid for separately under the appropriate work items.

SECTION 920 — RIPRAP

920.01 DESCRIPTION.

This work includes providing riprap on prepared surfaces of the sizes and layer thicknesses at the required locations. The work also includes placing stone bedding and filter fabric.

920.02 MATERIALS.

Use materials that conform to **Subsections M10.03**, **M10.03.1** and **M10.03.2**.

Use gravel borrow that conforms to **Subsection M01.02**.

Use filter fabric material that is suitable for erosion control applications and that complies with **SECTION M20** and/or is included on the Department's Approved Materials List.

Use stone bedding that conforms to **Subsection M10.03.1**.

920.03 CONSTRUCTION METHODS.

920.03.1 General.

Ensure that slopes to be protected by riprap are free of brush, trees, stumps, and other unsuitable material and are graded to a smooth surface. Remove all unsuitable material to the required depth and replace with gravel borrow. Compact fill as specified in **Subsection 202.03.3(a)** and **(b)**. If a toe trench is shown on the Plans, excavate the trench and maintain until the riprap is placed.

Provide protection for structure foundations as early as the foundation construction permits. Clean the area to be protected of waste materials and prepare the surfaces as required.

Place riprap in conjunction with the construction of the embankment, avoiding the mixing of embankment and riprap materials. Maintain the riprap protection until accepted, and replace any material displaced to the required lines and grades at no additional cost to the Department.

920.03.2 Filter Fabric.

Ensure that the installation of filter fabric conforms to the manufacturer's guidelines, as modified herein.

a. Finished Ground. Ensure that the finished ground is smooth and well compacted. Remove all rock, dirt clods, grass clumps, trash, and other obstructions that will prevent the mat from lying in direct contact with the soil surface and cause the fabric to puncture or tear.

b. Overlap. Provide a minimum overlap width of 2 ft.

c. Anchor Pins. Install anchor pins immediately after placement of each section to protect from wind uplift.

d. Placement. Ensure that the fabric is toed-in at the top and toed-in or toe-wrapped at the bottom.

920.03.3 Bedding For Riprap.

Place the bedding material on the prepared slope or area to the specified thickness of each layer. Proceed with the placement of stone bedding from the bottom up to the top of the slope. Do not dump the stone bedding onto the fabric from the top of the slope and then allow the stone to roll down the surface of the fabric. Place bedding in one operation, using methods that will preclude the segregation of particle sizes within the layer. Ensure that the surface of the finished layer is even and free from mounds or windows. Use additional layers of bedding material, when required, that preclude the mixing of materials in different layers.

920.03.4 Placed Riprap.

Place stone on the prepared slope or area to produce an evenly graded mass of stone with the minimum practical percentage of voids. Place the entire mass of stone to conform to the required lines, grades, and thicknesses. Place riprap to its full course thickness in one operation and avoid displacing the underlying material. Do not place riprap in layers, or dump into chutes, or use other methods likely to cause segregation.

Ensure that the larger stones are well distributed and that the entire mass of stone conforms to the specified gradation in **Subsection M10.03.2**. Place and distribute all materials comprising riprap protection to preclude large accumulations of either the larger or smaller sizes of stone.

Place stones for riprap on a prepared slope in a pattern that contains minimum voids. Ensure that the top surface of the riprap conforms to a true and even plane with a tolerance of ±4 in. Break joints as practical, and avoid joint openings to underlying soil by arranging stone sizes and chock the openings with smaller stones. Place larger stones near the base of the slope. Lay the stones to rest on the bank and not on adjacent stones by laying stones from the top of the bank downward to ensure independent support for each such stone.

Produce a compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required as necessary to secure the results specified.

When riprap and bedding material are dumped under water, increase the thickness of the layers as shown on the Plans. Use placement methods that will minimize segregation.

920.04 METHOD OF MEASUREMENT.

Riprap is measured by one of the following units, each as actually placed:

a. Cubic Yard. By the number of cubic yards as computed from surface area measurements parallel to the riprap surface and with the thickness measured normal to the riprap surface.

b. Ton. By the number of tons as measured by the actual scale weight, in tons, of the material actually placed.

c. Square Yard. By the number of square yards as computed from surface area measurements parallel to the riprap surface.

920.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Riprap	CY, TON, or SY

The price constitutes full for all labor, materials, and equipment, including excavation for riprap or bedding, preparation of subgrade, filter fabric, bedding material, trimming and fine grading, hauling and placing the material, and all incidentals required to finish the work, complete and accepted.

Riprap placed outside the specified limits will not be paid for, and the Contractor will be required to remove and dispose of the excess riprap at no additional cost to the Department.

SECTION 921 — SLOPE PAVERS

921.01 DESCRIPTION.

This work includes furnishing and placing precast concrete blocks on slopes at the required locations.

921.02 MATERIALS.

Use concrete blocks that have a nominal size of 16 in. × 8 in. × 4 in. Use Class A concrete that conforms to **SECTION 601**. Use mortar for joints that conforms to **Subsection M04.03.5**.

Use gravel borrow that conforms to **Subsection M01.02**.

921.03 CONSTRUCTION METHODS.

Lay the blocks on a compacted gravel base spaced to provide ⅜-in. joints. Stagger vertical joints to the center of each block. Ensure that the finished surface of the slope paving is smooth and true to the finished grades and sections. Pour mortar for all joints over the blocks and thoroughly brush into the ⅜-in. space to the full depth of the joint.

921.04 METHOD OF MEASUREMENT.

Slope Pavers will be measured by the number of square yards in the face area of the surface paved.

921.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Slope Pavers	SY

The price constitutes full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION 922 — TEMPORARY CONSTRUCTION SIGNS

922.01 DESCRIPTION.

This work includes providing temporary construction signs at the required locations. Ensure that all signs and sign drawings comply with the currently adopted edition of the *Manual on Uniform Traffic Control Devices*.

922.02 MATERIALS.

Use plywood or aluminum sheeting, reflective sheeting, wood posts, and other materials that conform to **SECTION M16**.

922.03 CONSTRUCTION METHODS.

922.03.1 Design and Fabrication.

Erect the signs and devices before the beginning of work as directed. Immediately remove the signs when the need no longer exists and replace without cost to the Department if any signs are damaged such that their usefulness has been compromised.

Ensure that all signs have been reflectorized according to **Subsection M16.02**, and ensure that the signs are legible and in new condition. Ensure that all signs are located to avoid obstructing the sidewalk.

Provide the number and type of construction warning and guide signs ordered by the Engineer. Reuse and relocate signs as required or directed by the Engineer at the various locations as the sequence of construction progresses. Perform the reuse and relocation of signs at no additional cost to the Department. If the Contractor provides additional signs for its convenience, no additional payment will be provided.

922.03.2 Modifications of Warning Sign Shapes within Narrow Medians or Adjacent to Retaining Walls.

In these cases, do not modify any diamond shaped warning sign panels to be used for temporary traffic control by cutting off the left or right points of the sign. Use the Plan location for proper installation without modification to the shape of the sign, and provide a distance plaque, if appropriate.

If relocating the sign is not an option due to physical constraints, use a rectangular sign panel and orient the sign so that the longest edge is installed vertically as described in the Plans.

922.03.3 Sign Mountings.

When construction operations are such that wood post mounting is impractical, mount temporary construction signs on portable support systems specifically designed for this use. The support system may be one of the products on the Department's Approved Materials List.

922.04 METHOD OF MEASUREMENT.

Temporary Construction Signs will be measured by the number of square feet of the signs actually provided.

922.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Temporary Construction Signs	SF

The price constitutes full compensation for all labor, materials, and equipment, including mountings, placing signs at their initial locations and removing signs from their final locations, and all incidentals required to finish the work, complete and accepted.

Payment for removing Temporary Construction Signs from their initial locations and for handling, maintaining, transporting, and relocating the signs to storage or to subsequent intermediate locations at which they are to be used for traffic control is not included in this Section but is included under **SECTION 937**.

Payment for temporary work is included under **SECTION 937**.

SECTION 923 — PORTABLE CHANNELIZING DEVICES AND BARRICADES

923.01 DESCRIPTION.

923.01.1 General.

This work includes providing portable barricades of various types and configurations at the required locations and conforming to the RIDOT *Standard Details* and the currently adopted edition of the MUTCD.

923.01.2 Types of Portable Channelizing Devices and Barricades.

The following types of portable barricades are currently in use by the Department:

- PVC Plastic Pipe Barricade (MUTCD, Type III)
- Plastic Pipe Barricade with Sandbag Base (MUTCD, Type III)
- Polyethylene Drum Barricade
- Fluorescent Traffic Cones

923.02 MATERIALS.

923.02.1 PVC Plastic Pipe.

Use plastic pipe that is white polyvinyl chloride that complies with the RIDOT *Standard Details*.

923.02.2 Polyethylene Plastic Pipe.

Use pipe that is white, rotationally molded polyethylene plastic conforming to ASTM D1248, Class II A3-E4 or Class II A4.

923.02.3 Polyethylene Drum.

Use a drum that has been manufactured from polyethylene plastic according to the details indicated on the Plans and conforming to the MUTCD.

923.02.4 Fluorescent Traffic Cones.

Use cones made of a plastic, fluorescent, commercially produced product. Ensure that the conical upper portion is 100 percent polyvinyl chloride having a highly pigmented, fluorescent red-orange color that complies with the RIDOT *Standard Details*. Ensure that the upper section is fused to a non-painted white base according to the manufacturer's recommendations.

923.03 CONSTRUCTION METHODS.

923.03.1 Design and Fabrication.

Ensure that barricades are sturdily constructed, freshly painted, and present a clean and neat, like-new appearance. Ensure that messages are clearly legible. Use barricades painted and reflectorized according to the requirements in other paragraphs of this Section.

923.03.2 Placement.

Erect barricades and devices before initiating construction work. Ensure that barricades remain in place until the Engineer determines that they are no longer needed at a given location. Reuse and relocate the barricades as shown on the Plans and at other locations as the sequence of construction progresses.

923.04 METHOD OF MEASUREMENT.

923.04.1 Plastic Pipe Barricades.

Plastic pipe barricades and plastic pipe barricades with sandbag bases will be measured by the number of units used on the Project site.

923.04.2 Drum Barricades.

Polyethylene drum barricades will be measured by the number of barrel-days the barricades are in place according to the Plans and/or as directed by the Engineer.

923.04.3 Fluorescent Traffic Cones.

Fluorescent traffic cones will be measured by the number of cones provided.

923.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Plastic Pipe Barricades	EA
Drum Barricades	BDAY
Fluorescent Traffic Cones	EA

923.05.1 Plastic Pipe Barricades.

The price constitutes full compensation for all labor, material, and equipment, including placing barricades and devices at their initial locations and for removing the barricades and devices from their final locations, and all incidentals necessary to finish the work, complete and accepted. Payment for temporary work is included under **SECTION 937**.

923.05.2 Drum Barricades.

The price constitutes full compensation for all labor, material, and equipment including fabrication, reflective sheeting, placing drum barricades at their initial locations and for removing the drum barricades from their final locations. Payment for temporary work is included under **SECTION 937**.

923.05.3 Fluorescent Traffic Cones.

The price constitutes full compensation for all labor, material, and equipment, including placing cones at their initial locations and for removing the cones from their final locations, and all incidentals necessary to finish the work, complete and accepted. Payment for temporary work is included under **SECTION 937**.

923.05.4 Maintaining and Moving.

Payment for removing barricades, pipe barricades, and traffic cones from their initial locations and for hauling, maintaining, transporting, and relocating barricades and traffic cones to storage or to subsequent intermediate locations at which they are to be used for traffic control is not included in this Section but is included under **SECTION 937**.

SECTION 924 — ADVANCE WARNING ARROW PANEL

924.01 DESCRIPTION.

This work includes providing, operating, and maintaining a portable trailer with a mounted flashing arrow unit at the required locations and complying with the currently adopted edition of the MUTCD.

924.02 MATERIALS.

924.02.1 Trailer.

Provide a trailer that is a portable, rubber-tired unit.

924.02.2 Power Supply.

Use a portable flashing arrow unit that is powered by diesel fuel. Equip the generator with battery powered backup. Provide a portable flashing unit with a hardwire capability.

924.03 CONSTRUCTION METHODS.

Ensure that the advance warning arrow panel is available for use throughout the duration of the Contract. Position and reposition the panel as shown on the Plans.

Perform all maintenance recommended by the manufacturer of the units as required to keep the unit operating properly, including the periodic cleaning of the units.

If there is a failure, malfunction, or damage to the unit for any reason, expedite the repair and furnish adequate flaggers or other approved means to provide a safe means for control of traffic until the units are back in service.

924.04 METHOD OF MEASUREMENT.

Advance warning arrow panels will be measured by the number of days the unit is deployed according to the Plans and/or as directed by the Engineer.

924.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Advance Warning Arrow Panels	DAY

The price constitutes full compensation for all labor, materials, and equipment, including the unit itself, first placement thereof, temporary storage, repositioning at different locations, diesel fuel, electric power, batteries, maintenance, and all incidentals necessary to finish the work, complete and accepted. Payment for temporary work is included under **SECTION 937**.

SECTION 925 — PORTABLE CHANGEABLE MESSAGE SIGN

925.01 DESCRIPTION.

This work includes providing, operating, and maintaining a portable trailer with a mounted changeable message sign at the required locations and complying with the currently adopted edition of the MUTCD.

925.02 MATERIALS.

925.02.1 Trailer.

Use a trailer that is a portable, rubber tired unit.

925.02.2 Message Sign.

Ensure that all equipment complies with Section 6F.60 of the currently adopted MUTCD and the FHWA *Portable Changeable Message Sign Handbook – PCMS*.

For the Disk Matrix Sign, ensure that the “create message” option is only accessible by use of a password to avoid unauthorized use of the controller.

Mount the controller cabinet with lockable door on the forward part of the trailer so the operator is viewing traffic while performing operations on the controller. Ensure that the cabinet has an interior light for night operation and programming.

Provide a power unit for operating the entire sign system that is a heavy-duty, diesel-powered generator with a battery backup system.

925.03 CONSTRUCTION METHODS.

Ensure that the changeable message sign is available for use throughout the duration of the Contract. Position and reposition the sign as shown on the Plans.

If there is a failure, malfunction, or damage to the unit, expedite the repair and furnish adequate flaggers or other approved means to provide a safe means for control of traffic until the units are back in service.

925.04 METHOD OF MEASUREMENT.

Portable Changeable Message Signs will be measured by the number of days the unit is employed according to the Plans and/or as directed by the Engineer.

925.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Portable Changeable Message Signs	DAY

The price constitutes full compensation for all labor, materials, and equipment, including the unit itself, first placement, temporary storage, repositioning at different locations, diesel fuel, electric power, batteries, maintenance, and all incidentals necessary to finish the work, complete and accepted.

Payment for temporary work is included under **SECTION 937**.

SECTION 926 — ANCHORED AND UNANCHORED BARRIER FOR TEMPORARY TRAFFIC CONTROL

926.01 DESCRIPTION.

This work includes providing anchored or unanchored barrier for temporary traffic control at the required locations. Use anchored and unanchored barrier for temporary traffic control that complies with the currently adopted edition of the AASHTO *Manual for Assessing Safety Hardware* (MASH).

926.02 MATERIALS.

926.02.1 Anchored and Unanchored Barrier Units.

Use Portland cement concrete and reinforcing that conforms to **Subsection 909.02.1**. Barrier units comprising other materials, such as steel, plastic, etc., may also be used. Ensure that the barrier units are installed to not inhibit roadway drainage.

926.02.2 Barrier Delineators.

Use barrier delineators that have a minimum of 9 sq in. of reflective surface area. Ensure that the unit can be mounted on the side of the barrier by use of an adhesive or other method approved by the manufacturer. The barrier delineators may be one of the products on the Department's Approved Materials List.

926.02.3 High Strength Non-Shrink Grout.

Use high-strength, non-shrink grout that conforms to **Subsection 819.02.2**.

926.02.4 Anchorage System.

Use anchors that conform to ASTM F3125 Grade A325, nuts that conform to ASTM A563, and washers that conform to ASTM F436. Use galvanized hardware according to ASTM A153. Use bolts, anchors, nuts, and washers that conform to **Subsection M05.05.4**.

For new or existing bridge decks, ensure that the anchorage system meets or exceeds the specific test level as specified on the Plans. Install anchors per the manufacturer's recommendations.

926.03 CONSTRUCTION METHODS.

926.03.1 Plant Requirements.

Ensure that plants conform to **Subsection 909.03.1**.

926.03.2 Barrier Delineators.

Install white delineators on the right side of the traveled way and amber delineators on the left side of the traveled way. Install the delineators at 50-ft intervals, located 3 in. from the top of the concrete barriers.

926.03.3 Placement.

During transporting, storing, hoisting, and handling of the units, prevent cracking or damage. Do not install damaged units or units that have markings painted on them from previous work sites.

During layout and placement, consider stormwater flows to avoid blocking any inlets, outlets, or accesses to the drainage system.

Remove unanchored barriers from their initial locations and transport to alternative locations as indicated on the Plans.

Install anchors per the manufacturer's recommendations. For new bridge decks and existing bridge decks to remain, use only adhesive, embedded, or expansion anchors. For existing bridge decks not to remain, through-bolts may be used in lieu of adhesive or expansion anchors.

Secure the anchored barrier units to the bridge deck surface. Firmly anchor the barrier in place before initiating any construction operations for which the barrier is intended to protect. Develop details for transitioning the selected temporary barrier system to any existing highway or bridge barrier systems and submit to RIDOT for approval.

Place anchors on the traffic side of the barrier and locate so that interference with the longitudinal deck reinforcement is minimized. Before barrier placement, locate and mark deck reinforcement using a pachometer. Adjust the position of the barrier to minimize interference between the anchors and deck reinforcement.

Place the barrier units so that exposed blunt ends are not within the clear zone stipulated in **Subsection 106.05(a)**.

926.03.4 Removal.

For anchored barrier, patch the remaining holes in the new deck with high strength, non-shrink grout. After removal, mechanically sweep both sides to remove built up sediment and construction debris.

926.03.5 Submittals.

For anchored and unanchored barrier on bridge decks, submit the selected temporary barrier system, including the rationale for the test level selection and any details for transitioned areas to any existing barrier systems, to the Engineer for approval.

926.04 METHOD OF MEASUREMENT.

Anchored and Unanchored Barrier for Temporary Traffic Control will be measured in the linear feet of continuous runs of the units placed. The measured length includes all 3-in. joints between the units.

926.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Anchored or Unanchored Barrier for Temporary Traffic Control	LF

The price constitutes full compensation for all labor, tools, materials, equipment, initial placement of the units, furnishing, hauling, handling, any new parts required to secure the units to the pavement or to adjacent units, relocation of the units if required, regularly moving units to gain access to and from the site, subsequent removal of the units, barrier delineators, and all incidentals required to finish the work, complete and accepted.

The Contractor will be paid 90 percent of the Contract unit price when the barrier units are in place. The remaining 10 percent of the Contract unit price will be paid when the barrier units have been removed from the Project.

Payment for temporary work is included under **SECTION 937**.

SECTION 927

This Section has been Reserved for Future Use.

SECTION 928— SHADOW OR ADVANCE WARNING VEHICLE WITH CRASH CUSHION AND FLASHING ARROW BOARD OR CHANGEABLE MESSAGE SIGN

928.01 DESCRIPTION.

This work includes furnishing, operating, moving, and maintaining a shadow or advance warning vehicle that includes a truck- or trailer-mounted energy-absorbing crash cushion (TMA) and either a truck- or trailer-mounted flashing arrow board (TMFAB) or trailer-mounted changeable message sign (TMCMS).

928.02 MATERIALS.

928.02.1 Shadow or Advance Warning Vehicle.

Use a vehicle that meets or exceeds the requirements and recommendations of the TMA manufacturer and that weighs a minimum of 10,000 lb. Ensure that the vehicle accommodates the mounting of the TMA and the TMFAB or TMCMS at the rear of the vehicle.

Ensure that each vehicle includes lighting and markings that conform to the latest Federal and Rhode Island General Laws (RIGL) requirements. Ensure that the appropriate number of first-aid kits and fire extinguishers are furnished with each vehicle conforming to Section 24-8-4.2 of the RIGL.

928.02.2 Truck- or Trailer-Mounted Attenuator (TMA).

Use a TMA that has been approved by FHWA as a crashworthy device acceptable for use on the National Highway System.

Ensure that each type of TMA furnished and used has been crashed-tested and found to conform to the AASHTO *Manual for Assessing Safety Hardware* (MASH) and/or NCHRP Report 350, whichever is applicable per the latest FHWA requirements, at the required test level condition listed below, which varies based on the speed limit of the roadway where the TMA will be used.

Posted or Statutory Speed Limit (Miles Per Hour)	Required Successful Crash-Testing to Test Level (TL) Condition[1]
40 or less	TL-2 or TL-3
45 or greater	TL-3

[1] *As stipulated by the AASHTO Manual for Assessing Safety Hardware or NCHRP Report 350, whichever is applicable per latest FHWA requirements.*

Furnish and install the TMA on the shadow/advance warning vehicle according to the TMA manufacturer's recommendations. Use a TMA that includes lighting and markings that conform to the latest Federal and RIGL requirements. Ensure that the entire end panel of the TMA that faces oncoming traffic includes chevron pattern markings with alternating non-reflective black and retro-reflective yellow stripes, each stripe a minimum of 4-in. wide and slanted at 45 degrees from vertical, in an inverted "V" form with the inverted "V" located at the center of the TMA end panel.

Use a combination of the TMA and the shadow/advance warning vehicle that has been selected and furnished as a system conforming to the TMA manufacturer's requirements, and ensure conformance with prior FHWA crashworthiness approval. If necessary, supply the TMA manufacturer with the proposed shadow/advance warning vehicle specifications to confirm that the furnished system complies with these Specifications.

928.02.3 Truck- or Trailer-Mounted Flashing Arrow Board (TMFAB).

Use a TMFAB that is a 4-ft high by 8-ft wide electronically illuminated arrow panel installed at the rear of the shadow/advance warning vehicle, with the bottom of the panel mounted a minimum of 7 ft above the roadway when in operating mode.

Ensure that the TMFAB display conforms to the latest MUTCD requirements for a Type C Arrow Board, contains at least 15 yellow-color lighted elements, and provides sufficient light output such that the TMFAB display is legible at a minimum distance of one mile. Provide a TMFAB panel that is finished with materials that are non-reflective black in color.

Ensure that the TMFAB can display a flashing arrow to the left, a flashing arrow to the right, a flashing arrow pointing to both the left and right simultaneously, a flashing "four corners" caution mode, and other displays if called for on the Plans. Ensure that the TMFAB is programmed to provide automatic dimming of the lighted elements during nighttime operation to eliminate glare to road users.

Ensure that the TMFAB is powered according to the manufacturer's requirements, typically via the shadow/advance warning vehicle's power system or via a dedicated battery system. Equip the TMFAB with a back-up battery system to provide continuous operation when failure of the primary power source occurs.

928.02.4 Truck- or Trailer-Mounted Changeable Message Sign (TMCMS).

Provide a TMCMS that is a 4-ft high by 8-ft wide electronically illuminated changeable sign panel installed at the rear of the vehicle, with the bottom of the panel mounted a minimum of 7 ft above the roadway when in operating mode.

Ensure that the TMCMS display:

- Conforms to the latest MUTCD requirements for a portable changeable message sign
- Consists of either a lamp matrix or full-matrix LED array capable of displaying a variety of user-programmed messages
- Provides sufficient light output such that the TMCMS display is visible at a minimum distance of ½ mile and legible at a minimum distance of 850 ft
- Automatically adjusts to maintain message legibility and to eliminate glare to road users during nighttime operation

Ensure that the TMCMS can display three lines of text with eight characters per line, and each of the flashing arrow and flashing caution modes illustrated in the latest MUTCD for a Type C Arrow

Board. Ensure that each text character displayed by the TMCMS is a minimum of 12 in. high and that multiple lines of text are equally spaced vertically.

Provide a TMCMS that is controlled by a solid-state unit housed in a weatherproof enclosure that is lighted for night operation. Provide a keyboard entry system to allow the operator to generate unique messages on the TMCMS. Ensure that the control unit includes a display screen upon which the operator can review messages before they are displayed on the TMCMS. Ensure that the display screen allows the operator to see the message that is actively displayed on the TMCMS, and allows the operator to save a minimum of five user-programmed messages in the control unit. Ensure that the system saves the messages in internal memory even when power is turned off or unavailable.

Power the TMCMS according to the manufacturer's requirements, typically via the shadow/advance warning vehicle's power system or via a dedicated battery system. Equip the TMCMS with a back-up battery system to provide continuous operation when failure of the primary power source occurs.

928.03 CONSTRUCTION METHODS.

928.03.1 General.

Ensure that the shadow/advance warning vehicle with TMA and TMFAB or TMCMS is available for use throughout the duration of the Project.

Comply with Section 24-8-4.2 of the Rhode Island General Laws.

Maintain the shadow/advance warning vehicle with TMA and TMFAB or TMCMS throughout the Contract period according to the recommendations of the equipment manufacturers.

Immediately remove malfunctioning, damaged, or failed equipment from the Project site. No payment will be made for the duration in which the Contractor attempts to use damaged, malfunctioning, or failed equipment on site.

928.03.2 Shadow or Advance Warning Vehicle.

Turn on the high-intensity, rotating, flashing, oscillating, or strobe lights on the shadow/advance warning vehicle. Ensure that the lights remain operational at all times when the vehicle is actively engaged in controlling or warning road users in a work zone.

Position each shadow vehicle to account for roll-ahead distance in the event of an impact, based on the TMA and/or shadow vehicle manufacturer's recommendations. This distance should ensure that the shadow vehicle will not roll into the work space or hazard when hit by an errant vehicle. If roll-ahead distance recommendations are not available from the TMA and/or shadow vehicle manufacturer, the example guidelines included in the AASHTO *Roadside Design Guide* may be used.

When a shadow vehicle is positioned to protect exposed workers and/or to shield a temporary hazard in the roadway, unless otherwise recommended by the TMA or shadow vehicle manufacturer, set the vehicle's parking brake and place the transmission in neutral gear.

928.03.3 Truck- or Trailer-Mounted Flashing Arrow Board (TMFAB).

Ensure that the minimum on-time of the TMFAB lighting elements is 50 percent during flashing mode operation and that the flashing rate is not less than 25 or more than 40 flashes per minute.

928.03.4 Truck- or Trailer-Mounted Changeable Message Sign (TMCMS).

The Engineer must approve in advance any TMCMS display messages differing from those called for in the Contract. Do not use any display message requiring more than two phases at any time. Display each phase of the message for at least three seconds, and adjust the display rate per phase so that the entire message can be read at least twice by passing motorists traveling at the posted or statutory speed limit. Do not allow text messages to scroll or travel horizontally or vertically across the face of the TMCMS.

928.04 METHOD OF MEASUREMENT.

Shadow or Advance Warning Vehicle with Crash Cushion and Flashing Arrow Board and Shadow or Advance Warning Vehicle with Crash Cushion and Changeable Message Sign will be measured by the number of hours each assembly is deployed in the work in accordance with the Contract TCP or as directed by the Engineer.

928.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Shadow or Advance Warning Vehicle with Crash Cushion and Flashing Arrow Board	HR
Shadow or Advance Warning Vehicle with Crash Cushion and Changeable Message Sign	HR

The prices constitute full compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Payment for temporary work is included under **SECTION 937**.

SECTION 929 — FIELD OFFICES

929.01 DESCRIPTION.

This work includes providing and maintaining an adequate weatherproof and ADA compliant field office for the exclusive use of the Engineer and his/her staff during both the Contract period and approximately 180 days thereafter.

929.02 GENERAL REQUIREMENTS.

929.02.1 Location.

Locate the field office on a site that is both satisfactory to the Engineer and convenient to the Project site with dedicated parking facilities.

929.02.2 Minimum Spatial Requirements.

Provide a field office or materials laboratory that contains a minimum of 550 sq ft of floor area, at least three rooms, and a 7-ft minimum of headroom for Small Sized Projects (Contract value < $10,000,000). For Projects with a Contract value ≥ $10,000,000, provide a field office or materials laboratory that contains a minimum of 1000 sq ft of floor area, at least five rooms, 7 ft minimum of headroom, and a sufficient number of windows to provide at least 27 sq ft of natural light.

929.02.3 Other Requirements.

a. Permits and Inspections. Arrange and comply with all necessary local and State regulatory permits and inspections, including all costs associated therewith.

b. Occupancy. Provide a field office that is fully equipped, operational, and ready for occupancy at least two weeks before the start of actual construction operations.

c. Field Office. Protect the field office against fire, flooding, and theft throughout the 24 hours of every day the unit is in service. The Contractor shall be responsible for the loss of any property belonging to the Department that is housed therein due to theft, fire, or natural causes.

d. Insurance. At the time the field office is made available to the Department, furnish evidence to the Engineer that adequate insurance has been obtained that protects the Department against loss of property from theft, fire, or natural causes.

   In the event of fire, theft, or equipment breakdown, repair or replace all equipment involved as soon as possible. If the field office is destroyed or rendered untenable for any reason, replace the office within two weeks or as directed.

929.02.4 ADA Considerations.

Ensure that the accommodations comply with Federal Law under Title I of the Americans with Disabilities Act (ADA).

929.03 SPECIFIC REQUIREMENTS.

929.03.1 Outside Utilities.

a. Electrical Power. Arrange for electrical service for the field office and provide the necessary meter connections, fuse box, and switches as required by the power company, all according to State and local building codes. Ensure that the power supply is 115-volt, 60-cycle current of sufficient amperage to provide for heat, interior and exterior lighting, operating office equipment, and air conditioning.

b. Sanitary Sewer Outfall. Provide an adequate temporary outfall into either the municipal sanitary sewer system or an individual sewage disposal system that has been approved by the RI Department of Environmental Management. Ensure that the disposal of sanitary wastes conform to the applicable requirements of both the RI Department of Environmental Management and municipal regulations.

c. Security. Enclose all office trailer units within a 6-ft chain link fence with adequate gates and locks. Provide outside area floodlighting, together with appropriate timers, on all four sides of trailers.

929.03.2 Interior Utility Services.

a. Lighting. Ensure that lighting fixtures provide a minimum illumination of 70 ft-candles in all areas.

b. Electrical Receptacles. Provide duplex electrical receptacles as required in the State Building Code and as directed by the Engineer. Ensure that at least ⅓ of these receptacles have a 20-amp capacity.

c. Heating and Air Conditioning. Ensure that heating and cooling equipment can maintain a year-round temperature between 68°F and 78°F.

d. Sanitary Facilities. Provide a water closet, lavatory, slop sink, vent fan, and a hot water heater with a minimum 5-gal capacity.

e. Network Internet Service. Provide and install a secure high-speed internet service capable of interconnecting and networking a combination of eight computers, printers, copiers, and scanners, compatible with the equipment specified in **Subsection 929.03.5(c)**. Ensure that the provided high speed internet service has a minimum upload and download speed of 50 Mbps.

929.03.3 Doors and Windows.

Provide doors that are stock sizes and have a key-in-knob lock of an approved manufacturer. Ensure that all doors are keyed alike. Ensure that all windows:

- Are operative except for picture windows
- Are either double hung or casement type equipped with adequate locks
- Are provided with either shades or venetian blinds

- Have openings that are adequately screened
- For windows in sanitary areas, have frosted glass

929.03.4 Furnishings and Equipment.

For both the field office and materials laboratory, provide the following and ensure that all are new or approved by the Engineer when received by the Department.

a. Furnishings.

- One worktable, 30 in. high, with a minimum of 24 sq ft of work area
- One drafting stool
- Two folding-type chairs
- One fire resistant, drawer-type safe, legal size, with combination or key lock
- One four-drawer, legal size metal filing cabinet equipped with lock
- Two two-drawer (14½ in. × 16 in.) metal filing cabinets
- Two round wastebaskets
- One plan rack of an approved design to be equipped with 10 rods

b. Equipment.

- A 5-lb CO_2 fire extinguisher from an approved manufacturer for each 200 sq ft of floor area
- A 115-volt, 60-cycle rotating fan
- One first-aid kit
- One electric sanitary water cooler with refrigerated storage compartment; supply with paper cups
- Toilet paper holders, paper towel dispensers, and soap dispensers in the toilet rooms

929.03.5 Special Requirements for Field Office.

Provide a field office with the following, which are new or approved by the Engineer when received by the Department:

a. Furnishings.

- Three office type desks, minimum top dimensions of 32 in. × 60 in., with two or more drawers on each side
- Three swivel desk chairs
- Ten folding-type chairs with cushioned seating area
- One conference/meetings table, minimum top dimensions 42 in. × 96 in.

b. Equipment.

- Two fully automatic electronic calculators with tape
- One business grade, multi-function (copy, print, scan, fax) high volume stand- alone color/black printer with a print quality of 1200 by 1200 dpi minimum resolution for black and white printing and 1200 × 1200 optimized dpi for color printing, capable of printing 35 ppm (black and white) and 35 ppm (color) and capable of scanning 20 ppm in PDF format @ 600 dpi, stapling and three-hole punching. Provide a printer with wireless capability and that can generate a maximum size printed document of 11 in. × 17 in. Provide a printer that is Apple AirPrint compatible.
- One pencil sharpener

c. Computer Equipment. The items of computer equipment and software to be furnished, installed, tested, made operational and maintained as follows.

Tier I: Small Sized Projects (Contract value < $10,000,000)

- Three Microsoft Surface Docks with a minimum of the following — 1 Gigabit Ethernet port, 4 USS 3.0 ports, 2 Mini Display Ports, and external power supply. Each dock will include a wireless 101 key enhanced keyboards, a wireless optical mouse with scroll wheel, 8x External USB DVD ±RW/CD-RW Drive, two 2-in. (minimum) wide screen flat panel LED Monitor with 1920 × 1080 (minimum) resolution (including any required adapters) and a dual monitor stand. Provide all necessary power cords, internet cables, electrical wires, and surge protectors at the direction of the Engineer.
- The computer equipment, software, and licenses will become the property of the Department at Contract completion. Provide proper maintenance of computers and all office equipment for the life of the Project, which includes but is not limited to network support, computer support, and peripheral support. Provide supplies for the Project for both new and existing equipment that includes but is not limited to flash drives, DVDs, toner, binders, folders, paper, dry erase boards, etc. Provide all supplies with the delivery and set-up of the office equipment and as required by the Engineer. On delivery of computer equipment to a field office, the Engineer must contact the (DoIT) service desk to arrange for Department inventorying. The Engineer must provide the detailed spec of the computer equipment, location of the field office, and the completion date of the Project. The Engineer must also contact the service desk at the end of the Project to take the computer equipment into the DOT State inventory, or the computer equipment must be moved from one location to another.

Tier II: Large Sized Projects (Contract Value ≥ $10,000,000) (in addition to Tier I)

- Four Microsoft Surface Docks with a minimum of the following — 1 Gigabit Ethernet port, 4 USS 3.0 ports, 2 Mini Display Ports, and External power supply. Each dock will include a wireless 101 key enhanced keyboards, a wireless optical mouse with scroll wheel, 8x External USB DVD ±RW/CD-RW Drive, two 24-in. (minimum) wide screen flat panel LED Monitor with 1920 × 1080 (minimum) resolution (including any required adapters) and a dual monitor stand. Provide all necessary power cords, internet cables, electrical wires, and surge protectors at the direction of the Engineer.

- The computer equipment, software, and licenses will become the property of the Department at Contract completion. Provide proper maintenance of computers and all office equipment for the life of the Project, which includes but is not limited to network support, computer support, and peripheral support. Provide supplies for the Project for both new and existing equipment that includes but is not limited to flash drives, DVDs, toner, binders, folders, paper, dry erase boards, etc. Provide all supplies with the delivery and set-up of the office equipment and as required by the Engineer.

- On delivery of computer equipment to a field office, the Engineer must contact the (DoIT) service desk to arrange for Department inventorying. The Engineer must provide the detailed spec of the computer equipment, location of the field office, and the completion date of the Project. The Engineer must also contact the service desk at the end of the Project to take the computer equipment into the DOT State inventory, or the computer equipment must be moved from one location to another. One 50-in. (minimum) conference room monitor with 3840 × 2160 (minimum) resolution with video conferencing camera (minimum 1080P resolution).

Failure to furnish, install, make operational, and maintain the field office equipment and peripheral equipment/accessories specified in this Subsection, will result in delay to the processing of progress payments.

929.03.6 Maintenance and Custodial Service.

Provide the following maintenance and custodial services.

a. Maintenance. Make all necessary repairs of damaged, defective, or vandalized parts of the field office and their associated furnishings and equipment and maintenance operations that continue as long as the field office is occupied by the Engineer

b. Custodial.

- Weekly trash removal
- Bi-weekly floor cleaning
- Bi-monthly window cleaning
- Snow plowing, sanding, and removal of snow at parking areas and walks
- Replacement of supplies as required to maintain office equipment and sanitary facilities

929.03.7 Project Sign.

Equip the field office with a sign as detailed in the RIDOT *Standard Details*.

929.04 METHOD OF MEASUREMENT.

Field Office will be measured by the number of calendar months the facilities are used under the Contract.

The Computer Equipment as noted in **Subsection 929.03.5(c)** will not be measured separately for payment.

929.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Field Office	MONTH

The price constitutes full compensation for furnishing, maintaining, and subsequently removing the field office, together with all associated costs of equipment and peripherals and supplies, including all costs associated with electrical utility, heating, lighting, air conditioning, water, sewer and telecommunication connections, permits, identification sign, maintenance, custodial services and supplies, and all incidentals required to provide this service, complete and accepted.

The Department will give the Contractor 90 days advance notice before it intends to terminate the occupancy of the field office.

The Computer Equipment in **Subsection 929.03.5(c)** will not be paid for separately but will be considered a subsidiary obligation of the Contractor. The timely provision of field offices and/or computer equipment for use by the Department is required before initial payment to the Contractor for any work performed.

SECTION 930 — PLANT FIELD LABORATORY

930.01 DESCRIPTION.

This work includes furnishing a building at the site of the production plant for the Department's exclusive use for testing.

930.02 GENERAL PLANT FIELD LABORATORY REQUIREMENTS.

930.02.1 Location.

Locate the laboratory within its own building or, if the Engineer permits, it may be part of an existing building. In this case, ensure that the laboratory portions of the building are entirely partitioned off from the remaining unrelated areas and meet all other laboratory requirements. The Department does not permit the use of a trailer, utility control room such as electric, telephone, water, sewage, etc., as a Department designated laboratory and/or office. Ensure that the laboratory is within sight distance of the plant and sampling rack (asphalt only) and maintains an unobstructed line-of-sight at all times.

930.02.2 Construction.

Provide a laboratory building that:

- Has a room at least 200 sq ft with a ceiling height at least 7½ ft
- Provides a sturdy and level floor (note that some equipment requires mounting to a concrete foundation)
- Is watertight
- Has at least two standard windows equipped with shades and screens and two doors equipped with adequate locks
- Has at least one door and window that opens to the outside external environment when the laboratory is located on an external wall

930.02.3 Other Requirements.

a. Equipment. In case of theft or breakdown, repair or replace all equipment involved within 48 hours. Discontinue the production of any material until the equipment is repaired or replaced. If buildings are destroyed or rendered untenable for any reason, replace them within two weeks. In the interim, provide temporary facilities for laboratory operations.

b. Utilities. Furnish all water, fuel, and electrical power required to conduct the various tests. Additional laboratory equipment not listed herein may be required to properly facilitate an AASHTO or ASTM test procedure (e.g., water bath thermometers, water bath heater/circulator, timers/stopwatches) and are considered incidental to this item.

c. Concrete. When both asphalt and cement concrete mixing plants are located in the same compound and when the Contractor provides one laboratory building for both asphalt and cement concrete testing facilities, duplication of laboratory equipment will not be required

with the exception of the chairs, calculator, and the computer equipment specified in **Subsection 930.03.4.**

930.02.4 ADA Considerations.

Ensure that the accommodations comply with Federal Law under Title I of the Americans with Disabilities Act (ADA).

930.03 SPECIFIC PLANT FIELD LABORATORY REQUIREMENTS.

930.03.1 Interior Utilities.

a. Power. Ensure that the electrical power supply is adequate to simultaneously operate all laboratory and office equipment, heating and air conditioning units, lighting, and all other utilities.

b. Heating and Air Conditioning. Provide heating and cooling systems that can maintain the laboratory at a year-round temperature between 68°F and 78°F, with controls in the laboratory.

c. Sanitary Facilities. Provide restroom facilities that include a toilet, lavatory sink, slop sink, vent fan, and running hot and cold water, with a minimum 5-gal capacity water heater tank. Ensure that the restroom is fully equipped and located within the laboratory or existing building and is accessible at all times during production.

d. Lighting. Provide adequate and satisfactory lighting inside the laboratory (10 ft-candles minimum per OSHA Standard 1926.56).

e. Telephone. Provide one handset with an answering machine.

930.03.2 Outside Facilities.

a. Parking Area. Provide a parking area (adequate for two vehicles) adjacent to the building so that safe and easy access to the laboratory building is ensured. Provide parking areas that are paved or well-compacted crushed gravel with maintained surface characteristics.

b. Lighting. Provide adequate outside lighting (5 ft-candles minimum per OSHA Standard 1926.56) for bins, stockpiles, sampling racks, laboratory access, and parking area for all night and early morning work.

c. Security. Ensure that the laboratory building has locking doors and windows.

d. Equipment. Ensure that bins for coarse and fine aggregates are safe and accessible for sampling.

930.03.3 Furnishings, Equipment, and Supplies.

For all of the following, provide new or used items in a condition acceptable to the Engineer (minimum quantities shown):

- One office desk, 30 in. high with minimum 32 in. × 60 in. top dimensions and with two or more drawers on each side
- One worktable or bench
- Two swivel desk chairs
- One fireproof filing cabinet with lock
- A cabinet or closet with lock
- One wastebasket
- A cooling fan
- A hood with an exhaust fan or dust eater for ventilation near the scales
- A copy machine with paper and toner
- A minimum 4.0 cu ft refrigerator
- A microwave oven
- One water cooler and fresh drinking water or a supply of bottled drinking water (to be restocked as necessary)
- Clock
- Calculator
- Electric pencil sharpener
- One first-aid kit, fully stocked
- One fire extinguisher
- Cleaning supplies for lab and lavatory, to be restocked as necessary
- Shop vacuum
- Toilet paper holders, paper towel dispensers, and soap dispensers in the lavatory
- Rugs with non-slip backing for all doors (2 ft × 3 ft minimum size or interior door mats)

930.03.4 Computer Equipment.

Provide the items of computer equipment and software according to **Subsection 929.03.5(c)**, and ensure that the equipment meets the following minimum specifications:

- One computer running activated Windows Professional (latest version) 64-bit
- Intel i3 or AMD Ryzen 3 CPU (minimum)
- 8GB RAM (minimum)
- 240GB SSD (minimum)
- Gigabit Ethernet (minimum)
- Minimum of six USB 2.0 (or faster) ports, two front mounted in case
- Permanent dust shield

- Microsoft Access (latest version) 64 bit installed with full license
- USB Standard 101 key keyboard with dust shield
- USB Optical Mouse with mouse pad
- 22″ (minimum) 16:9 widescreen monitor, port compatible with computer, full HD (1920×1080) resolution
- 600 VA (minimum) UPS backup power supply
- Surge protector rated at 1000 Joules (minimum, separate from UPS)
- Color laser printer with full set of cartridges, USB cable and letter-size paper
- Broadband Internet access (10Mb/sec minimum nominal connection speed)

930.03.5 Maintenance and Custodial Service.

Provide the following maintenance and custodial services:

a. Maintenance. Properly maintain equipment and keep in working condition for all production. Replace supplies as needed to maintain the office, office equipment, and lavatory.

b. Custodial Services. Provide the following:

- Weekly trash removal
- Weekly restroom cleaning
- Bi-weekly floor cleaning
- Bi-monthly window cleaning

Although the laboratory is for the exclusive use of the Department during all production, other Quality Control testing may be performed at the facility on a temporary or intermittent basis. Ensure that the laboratory and equipment remain clean and functional if such testing occurs before commencing production for the Department.

930.03.6 Special Plant Field Laboratory Requirements for Asphalt Concrete Mixing Plants.

In addition to the requirements of **Subsections 930.02** and **930.03.1** through **930.03.5** above, provide the following at the asphalt mixing plant:

a. Access. Provide access to the laboratory at least one hour before production begins.

b. Equipment and Supplies. The minimum quantities are:

- One automatic Marshall asphalt compactor complete with hammer assembly; 4 in., 10-lb drop hammer and counter, with automatic shutoff
- Four Marshall asphalt compaction molds complete with mold body, base plate, and collar (4 in. inside diameter)

- One Superpave Gyratory Compactor conforming to AASHTO T 312, complete with two molds and capable of recording and printing height measurements
- One Material Handling Chute to properly charge gyratory molds
- One assembly to perform theoretical maximum specific gravity tests according to AASHTO T 209. Provide a metal pycnometer, mechanical agitator and electronic digital vacuum gauge
- One sample splitter with ½-in. chute width and with 16 chutes
- One sample splitter with 2½-in. chute width and with 8 chutes
- One asphalt ignition oven capable of automatically determining the corrected asphalt content of a 3000-gram sample. Provide an oven that has an integral weighing system and printer capable of providing a hard copy of test results. Provide a suitable work area and adequate ventilation for the oven's exhaust. Provide two pairs of high-temperature resistant heavy-duty gloves, two sample trays, and a face shield that meets OSHA requirements as applicable. Provide an internal scale that conforms to **Subsection 930.03.4**. Perform all maintenance of the oven at intervals recommended by the manufacturer.
- One motor driven 12-in. sieve shaker, complete with belt driven mechanism to produce combination rocking and tapping action on each sieve, capacity for 6 full-height 12-in. sieves plus pan and cover; all parts mounted on a sturdy base (commonly known as a Mary Ann type shaker)
- One gravity drying oven of rugged construction with ⅜ in. thick insulated walls, minimum inside dimensions 18 in. wide, 14 in. deep, and 19 in. high, equipped with two expanded metal shelves, automatic thermostat and other controls, a glass thermometer reading 0° to 300°C by 1° divisions
- One set of US Standard 12-in. round intermediate height testing sieves, including sizes of 1″, ¾″, ½″, ⅜″, Nos. 4, 8, 16, 30, 50, 100, and two-200s with No. 14 mesh backing, with square openings, two pans and one cover
- One 12-in. round No. 200 wet wash sieve with 4-in. minimum depth
- One large utility sink complete with spray hose to perform wet washes according to AASHTO T 30. Ensure that the sink is separate from the restroom facilities
- Six drying pans approximately 10 in. ×14 in. × 2½ in. for use in the oven
- One digital scale 12,000 grams ±0.1 grams
- Two brass wire briquette brushes
- Two sieve or sash brushes
- Two approved dial type thermometers 50°F to 500°F

- One approved two-burner electric hot plate, UL approved
- Two metal mixing bowls, 14 in. or greater diameter
- Sample splitting tool
- Two putty knives
- Five metal sampling buckets
- Dust masks
- Two pairs of suede work gloves
- Four approximately 20 in. × 40 in. towels
- An approved cleaning solvent for the equipment
- Two pairs of safety goggles and two pairs of gloves for high heat applications
- One Marshall core specific gravity apparatus. To include a 30-gal tank, overflow and drain valves, stainless steel core hanger, water heater and thermometer (0°F to +160°F) accurate to 0.1°F
- One density tank for Marshall core specific gravity
- Two sampling spoons
- Two spatulas
- One long handle spade shovel
- A sampling rack with minimum dimensions of 4 ft × 4 ft located within sight distance of the plant laboratory to allow sampling of asphalt material from truck haulers

930.03.7 Special Plant Field Laboratory Requirements for Cement Concrete Mixing Plants.

In addition to the requirements above, provide the following at the concrete mixing plant:

a. Access. Access to the laboratory at least two hours before production begins

b. Equipment and Supplies. (Minimum quantities shown):

- One digital platform beam scale, capacity 45 kg (100 lb), sensitivity 5 grams (0.01 lb)
- One approved two burner electric hot plate, UL approved
- One gravity drying oven of rugged construction with ⅜ in. thick insulated walls, minimum inside dimensions to be 18 in. wide, 14 in. deep and 19 in. high, equipped

with two expanded metal shelves, automatic thermostat and other controls, a glass thermometer reading 0° to 300° C by 1° divisions

- One sieve shaker (samples less than 1 cu ft) with built-in timer or equivalent, consisting of eight changeable screens secured by a hydraulic clamping system; screens to be within US Standard tolerances and have openings as follows: 1″, ¾″, ½″, ⅜″, No. 4, No. 8, No. 16, and pan. Ensure that the unit is secured on a 1-ft concrete pad, enclosed, and covered and adequate ventilation is provided
- One motor driven portable sieve shaker for operation on 110 volt, 60-cycle single phase current, complete with a belt driven mechanism to produce combination rocking and tapping action, capacity for six full-height sieves plus pan and cover, all parts mounted on a sturdy base
- One set of brass frame US Standard testing sieves, all to be full height, 8 in. in diameter and matched for nesting; one each of the following: ¾″, ½″, ⅜″, Nos. 4, 8, 16, 30, 50, two No. 100s, and one No. 200 with No. 14 mesh backing, two pans and one cover
- Two fine, 2-in. sieve or sash brushes and two brass wire briquette brushes
- One set of 8 steel pans for drying soils, approximately 10 in. × 14 in. × 2 in.
- One complete air meter test outfit, ¼ cu ft (Ref. AASHTO T152 and ASTM C231)
- One complete slump test outfit (Ref. AASHTO T23 and T119) to include a steel pan with reinforced rims 24 in. × 24 in. × 3 in.
- One sample splitter with ½-in. chute width -16 chute
- One sample splitter with 2½-in. chute width - 8 chutes
- One digital scale 2000 grams ±0.1 gram
- One small concrete scoop (#1)
- Two dial thermometers (0°F to +160°F)
- Four plastic buckets, approximately 2.5-gal capacity
- One long handle spade shovel
- One steel brush, long handle
- Two putty knives
- Two pairs of suede work gloves
- One square steel trowel (6-in. length center handle)
- One plastic storage tote (10-gal capacity, 24 in. × 16 in. × 8.75 in. minimum) or acceptable equivalent

- One large concrete scoop (#2)
- One square shovel
- Table or bench to run air test and fabricate cylinders

If the Contractor fails to provide any of the supplies or equipment described above, the Engineer may not accept any mixes or products dispatched from the subject site.

930.03.8 Scales.

Calibrate all laboratory scales for asphalt and cement concrete mixing plant testing equipment every six months.

930.04 METHOD OF MEASUREMENT.

Not applicable.

930.05 BASIS OF PAYMENT.

Provision of Plant Field Laboratory will not be paid for separately but will be considered a subsidiary obligation of the Contractor, with the costs distributed among the Contract unit prices for items of work related to the field laboratory.

SECTION 931 — CONTRACT COMPLIANCE MANAGEMENT SYSTEM (CCMS)

931.01 DESCRIPTION.

The Department) is using a computerized web-based Contract Compliance Management System (CCMS) that enables RIDOT to more effectively and efficiently monitor compliance of prompt payments to all Subcontractors and/or civil rights requirements including, but not limited to, conformity with Rhode Island and Federal affirmative action, Disadvantaged Business Enterprise (DBE), and Minority Business Enterprise (MBE) laws and regulations.

The current CCMS is known as “Prism” and enables Contractors, consultants, Subcontractors, and subconsultants to more easily and accurately demonstrate compliance with prompt payments, DBE and MBE participation and utilization, On-The-Job Training (OJT), wage determinations, employment utilization and other Contract compliance requirements. The program supports Executive Order 11246, FHWA 1273 Training Special Provision (TSP), and Special Provisions for Disadvantaged Business Enterprise (DBE) contained within the Contract. The Department reserves the right to designate which CCMS will be used at any time.

At a minimum, the Department requires the input of payroll files for both the Prime Contractor/Consultant and all approved Subcontractors/Subconsultants with Contracts in excess of $10,000. CCMS also requires Invoices that include the work item numbers (that are on the Engineer’s Estimate), which must be entered into the comments section of the CCMS and/or Prism Invoice. The RIDOT CCMS Coordinator provides the Contractor/Consultant and Subcontractor/Subconsultant with assistance, as needed, during the term of the Contract. For more information, contact the RIDOT CCMS Coordinator as identified in the Post Qualification Letter.

931.02 EQUIPMENT.

Because this is a web-based system, virtually all systems should be compatible with the CCMS if there is access to the internet. Users must have at a minimum Microsoft Office 2003. For any issues, contact the RIDOT CCMS Coordinator.

931.03 METHODS.

After award of Contract the CCMS Coordinator sets up the Prime Contractor/Consultant (Prime) and any Subcontractors/Subconsultants (Subs) that are assigned to the Project. If there are any Subs that have not previously used CCMS, the CCMS Coordinator requests the necessary information so that the Sub can be set up in CCMS. The CCMS Coordinator then contacts the Sub with the necessary log-in information. For the duration of the Contract, keep CCMS updated with their weekly certified payrolls and to make sure that their Subs enter their Invoices as necessary. Also, the Primes must show that payments against the Subs’ Invoices, and the Sub must approve the payments in Prism. This requirement does not preclude the Contractor/Consultant from the obligation to maintain records as a backup to this program.

The Contractor/Consultant will be subject to a review of back-up records by the Department and/or the Office of Civil Rights units (e.g., the DBE Program unit, when applicable), as deemed necessary by that Office. The Contractor/Consultant must notify the RIDOT CCMS Coordinator of any errors or “bugs” that are discovered in the use of the CCMS. The Prime’s must include

these requirements in all Subcontract/Subconsultant agreements and ensure that their Subs are entering the necessary information into the CCMS.

Failure to comply with the above will lead to a notice of non-compliance and may result in delay of progress payments and/or any other sanctions deemed appropriate by RIDOT. Continued violations will lead to RIDOT determining whether to take additional actions including, but not limited to, initiating debarment or suspension proceedings.

931.04 METHOD OF MEASUREMENT.

This item does not require a measurement for payment.

931.05 BASIS OF PAYMENT.

Contractors/consultants are responsible for all expenses associated with the use of the Prism System including, but not limited to, computer equipment, training, maintenance fees, updating the database, submitting the appropriate reports to the Department, and maintaining records as a backup.

SECTION 932 — CUTTING AND MATCHING PAVEMENT

932.01 DESCRIPTION.

This work includes cutting back and matching cuts in both Portland cement and asphalt concrete pavements to the required depths of the specified course or courses at the required locations. The work also includes providing a temporary HMA bond breaker.

This work also includes the installation of cold joints, if these joints occur during paving operations, and the installation of temporary steel plates to protect a roadway excavation.

932.02 MATERIALS.

Not applicable.

932.03 CONSTRUCTION METHODS.

The Engineer will approve the method of cutting before the commencement of construction operations. Cut the sections of existing pavement, surface course, base course, or combination thereof to be removed along the neat lines. Make a vertical cut of at least 2½ in. deep along the designated lines. Chip and remove the pavement to be removed. Clean the edge of the cut joint by sweeping and blowing with compressed air. Protect the clean edge by adequate measures until the new pavement is placed and matched thereto.

Repair or replace any existing pavement, surface course, base course, or combination thereof beyond the neat lines that is damaged or destroyed by the Contractor's operations at no additional cost to the Department.

932.03.1 Cold Joints.

If, as a result of paving operations, a cold joint occurs, install the joints as directed by the Engineer.

932.04 METHOD OF MEASUREMENT.

Cutting and Matching Pavement will be measured by the length in linear feet of cuts made on designated courses of pavement.

932.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Cutting and Matching Pavement	LF

The price constitutes full compensation for all labor, materials, equipment and incidentals required to finish the work, complete and accepted.

No additional payment will be made for the installation of cold joints if the joints are caused by the Contractor’s sequence of paving operations.

SECTION 933

This Section has been Reserved for Future Use.

SECTION 934 — FIELD CONTROL AND CONSTRUCTION LAYOUT

934.01 DESCRIPTION.

This work includes verifying existing survey control points provided in the Contract documents and establishing additional survey field control, computations, construction layout, worksheets, plans, as-builts, and certifications to fulfill Contract requirements. Complete all work according to RIDOT policy requirements and State Procedural and Technical Standards for the practice of Professional Land Surveying in the State of Rhode Island. Perform the surveying in a timely manner and to reflect the ongoing nature of construction and inspection activities. This work will generally require frequent, separate site visits by the Contractor's survey crew to the Project site to accommodate the various stages of construction and inspection activities that will occur.

934.02 CONSTRUCTION LAYOUT.

934.02.1 Department's Responsibility.

The Engineer will provide the necessary horizontal and vertical control points distributed throughout the Project to support development of a field survey control network and subsequent construction layout for the design. The control points provided will be shown on a plan or report certified to the appropriate measurement specification by the designer's Professional Land Surveyor and deemed adequate for the construction layout.

934.02.2 Contractor's Responsibilities.

The Contractor shall be responsible, at a minimum, for the following:

a. Professional Land Surveyor. Retain a Professional Land Surveyor (PLS) registered in the State of Rhode Island to be responsible for all survey work performed on the Project. Perform all survey work according to the Department's policies and procedures. Ensure that all survey work conforms to the current "Procedural and Technical Standards for the Practice of Land Surveying in the State of Rhode Island," at the Rhode Island Department of Business Regulation website, (https://rules.sos.ri.gov/regulations/part/435-00-00-1). Submit to the Engineer for approval the Company, Professional Land Surveyor, and current Certificate of Authorization (COA) to practice Professional Land Surveying in the State of Rhode Island. The Engineer will review the information and respond in writing to the Contractor within five days on the acceptance of the candidate. Notify the Engineer before any changes to the COA or PLS in responsible charge.

b. Pre-Construction Surveys. Submit a Pre-Construction Survey to the Department, performed five working days before any significant disturbance of existing conditions at the site. Perform the necessary horizontal and vertical locations, calculations, and adjustments to verify the existing survey control points provided for construction of the Project. Verify significant existing features and elevations identified in the Contract Documents. Provide the data to the Engineer in an AutoCAD drawing file and report with the appropriate survey backup data. Ensure that the backup data includes a point listing and analysis of survey control points being used to construct the Project. The Professional Land Surveyor shall certify the preconstruction survey and shall deem the data appropriate

for the verification of significant features and elevations and the verification of adequate survey control points.

Notify the Engineer in writing of any significant discrepancies or concerns between the information provided in the Contract Documents and their preconstruction surveys. Do not disturb the areas in question until the Engineer responds to the notification.

c. Establish and Protect Survey Control. After existing survey control points have been verified, additional control points may be set and maintained as part of the survey control network for construction of the Project. Properly tie off all survey control points so that they can be conveniently re-established if disturbed or destroyed, including all reference points, boundary monuments, horizontal and vertical control monuments, stakes, and marks that have been established by the Department or their representatives. Set adequate survey control off locus to re-establish the survey control network as necessary. If the Contractor or its surveyor fails to preserve these items and if they must be re-established, perform this work at no additional cost to the Department.

d. General Construction Layout. Set the construction stakes or other appropriate monuments for all construction activities. In addition, install stakes as needed for the use of any utility crews that are staking or accomplishing utility relocations or construction associated with the Contract. Furnish, set, and reference all stakes or replacements thereof that may be required for construction operations. Clearly label construction stakes, and perform restaking as needed due to the progressive change in operation.

e. Structures and Bridge Construction Layout. Structures and bridge staking may include setting and re-establishing working points and reference points by XYZ coordinates provided in the Contract Documents. This information will be used to calculate and provide line and grade during all stages of work and at all substructures and segments of bridge or structure construction, as shown below:

- Establish working points or reference points, approved by the Engineer, on the ground as shown in the Contract Documents.
- Transfer the required points from the ground to the top of footing after the completion of concrete footing construction. If the structure is a curved wall or bridge edge of slab, curb, coping, median, or railing, mark a curved line on the footings, forms, or deck slab to the proper degree of curvature within ⅛ in. in 10 ft, as needed for construction and inspection activities.
- Transfer the required points to the top of all finished structures.
- Transfer the required points to the superstructure deck forming.
- Measurements and marks for plumbness are also required.

f. Quantity Measurements. Certify any surveying or measurements necessary for the computing of pay quantities. Notify the Engineer at least five working days before disturbing any areas where survey will be used to calculate pay quantities. Additionally, provide the Department five working days for verification, upon receipt, of cross sections or other survey data certified and stamped by the PLS. Where the Department deems it

necessary and appropriate to check the Contractor's quantity-related field survey data, do not perform any operations during the five-day period that may render the Department's efforts to check the Contractor's survey ineffective.

g. Field Records. Maintain and organize the records of all surveying work in Department approved field books, worksheets, raw data files, coordinate point files, and other formats approved by the Engineer. Submit copies of all survey documents upon request to the Engineer in a form acceptable to the Department on a daily basis to clearly identify survey services performed. Upon completion of the Contract, submit all field books, worksheets, raw data files, AutoCAD drawing files, coordinate point files, or other survey records to the Department. Submit the copies in both hard copy and approved standard electronic formats used by the Department.

h. Miscellaneous.

- Notify the Engineer 24 hours before any survey work will be performed in the field. Survey work will be monitored by the Engineer for conformance to standard survey practices and procedures.

- The Engineer's acceptance of all or any part of the Contractor's survey services shall not relieve the Contractor of responsibility to secure proper documentation and as-built dimensions for the completed work.

- When required, the Engineer will, in writing, direct the Contractor to make the necessary minor surveying and staking adjustments to suit actual field conditions. In addition, some Plan details may be dependent upon actual field conditions at the time of construction. It may be necessary to perform some field survey and/or office computations to stake these components.

- At the discretion of the Engineer, verifications or backup information may be requested from the Contractor for any survey services performed throughout the Contract. If the Engineer determines that the work is not being performed to ensure proper controls and accuracy, the Engineer will direct the Contractor to redo such work to the standards specified in the Contract at no additional cost to the Department. Also, if the Department sustains costs checking and/or correcting Contractor surveys and the resultant product contains survey errors and/or omissions, the Engineer will deduct the related costs incurred by the Department from any payments owed the Contractor.

934.03 METHOD OF MEASUREMENT.

The Professional Land Surveying services, including field control, construction layout, as-built and associated calculations, plans, worksheets, reports, and certifications, are deemed incidental to the Contract and will not be measured for payment.

934.04 BASIS OF PAYMENT.

The field control and construction layout work will not be paid for separately but will be included in the bid for the items of work to which the layout is incidental.

When the Engineer determines that extra construction surveying beyond the scope of the original Contract is required, the work will be paid for on a Force Account basis as set forth in **Subsection 109.04**.

SECTION 935 — REMOVING ASPHALT PAVEMENT BY MICRO-MILLING

935.01 DESCRIPTION.

This work includes the removal of asphalt material using micro-milling to the specified depth. See **SECTION 401** for additional, applicable information.

935.02 MATERIALS.

Not applicable.

935.03 CONSTRUCTION METHODS.

935.03.1 Equipment.

Ensure that the milling equipment for removing the asphalt pavement is designed specifically for grinding asphalt surfaces to close tolerances and is operated at a rate that will avoid tearing and gouging of the pavement surface. Ensure that the equipment can accurately establish profile grades and cross slopes and has a positive means for preventing any dust resulting from the operation from escaping into the air. Use an averaging ski not less than 25 ft in length on each side of the pavement removal equipment on all limited-access highways and on other types of highways when indicated in the Contract Documents.

935.03.2 Control Strip.

On the first day of milling, grind a control strip at least 500 ft long with uniformly textured surface and cross section. Ensure that the milled pavement surface has a transverse pattern 0.3 in. or less between the centers of each strike area and that the macrotexture is 1/16 in. or less as measured using ASTM E965.

935.03.3 Pavement Grinding.

Upon the approval of the control strip by the Engineer, grind all areas designated for micro-milling using the identical procedures, settings, and speed, and ensure that the work conforms to the requirements for the control strip.

When micro-milling impacts areas that include bridge joints that will remain in place, mill the pavement leading up to and away from the joints with the micro-milling machine. Mill any small areas that remain with a trimmer designed to come close to structures. Do not use a skid steer with attachment for this operation. Construct temporary ramps using Class 4.75 or Class 9.5 HMA and rosin paper or equivalent for debonding.

Do not allow any asphalt cuttings to remain on the Project at the end of the workday.

935.04 METHOD OF MEASUREMENT.

Removing Asphalt Pavement by Micro-Milling will be measured by the number of square yards of pavement removed.

935.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Removing Asphalt Pavement by Micro-Milling	SY

The price constitutes full compensation for all labor, materials, equipment, disposal, cleaning and sweeping pavement, asphalt emulsion tack coat, cutting and matching asphalt, and incidentals required to finish the work, complete and accepted.

Additional passes for micro-milling are incidental to the item and will not be reimbursed.

SECTION 936 — MOBILIZATION

936.01 DESCRIPTION.

936.01.1 Mobilization.

Mobilization includes the preparatory work and operations performed including, but not limited to, those necessary for:

- The movement of the Contractor's personnel and equipment to the Project site
- The establishment of all Contractor field offices, buildings, and other facilities required for the performance of the Contract
- Premium on Contract bonds
- Insurance for the Contract
- Other work and operations that shall be performed or costs incurred before the actual commencement of work

Mobilization is only to be used for these reasonably-anticipated expenses and is not used to be used to either front-load a bid in order to receive payment earlier, or to unbalance a bid.

936.01.2 Demobilization.

Demobilization includes removal of all materials, equipment, temporary structures, and other facilities of a temporary nature from the Project site at the conclusion of the Project and restoration of the Project site, including those areas used for storage of equipment, materials, or the placement of temporary facilities. The work also includes submission of all forms, certifications, and documentation required to close out the Project and issue a certificate of completion.

936.02 MATERIALS.

Not applicable.

936.03 CONSTRUCTION METHODS.

Not applicable.

936.04 METHOD OF MEASUREMENT.

This work will be measured for payment as follows:

a. First Payment. The first payment of 50 percent of the lump sum price for Mobilization or 5 percent of the total Contract amount minus the bid amount for Mobilization, whichever is less, will be made on the first progress payment following notice to proceed and the complete, approved set up of the Project field office.

b. Second Payment. The second payment of 35 percent of the lump sum price for Mobilization or 3.5 percent of the total Contract amount minus the bid amount for

Mobilization, whichever is less, will be made when the progress payment estimate of the amount earned, not including that amount earned for Mobilization, is 5 percent of the total Contract amount minus the bid amount for Mobilization.

c. Third Payment. The third payment of 15 percent of the lump sum price for Mobilization or 1.5 percent of the total Contract amount minus the bid amount for Mobilization, whichever is less, will be made when the progress payment estimate of the amount earned, not including that amount earned for Mobilization, is 10 percent of the total Contract amount minus the bid amount for Mobilization.

d. Final Payment. Upon completion of all work, including the completion of all Punch List items according to **Subsection 105.18** and demobilization of the Project site according to **Subsection 936.01.2** above, payment of the remaining balance of the lump sum price for Mobilization will be paid.

936.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Mobilization	LS

The price constitutes full compensation for all labor, materials, equipment and incidentals required to establish the Contractor's facilities at the site and, at the conclusion of the Contract, for the complete removal thereof.

No lump sum breakdown will be required for this item of work.

SECTION 937— FURNISH, INSTALL, MAINTAIN, AND MOVE TEMPORARY TRAFFIC PROTECTION

937.01 DESCRIPTION.

This work includes furnishing, installing, maintaining, and moving all traffic protective devices and associated personnel. Also encompassed in storing, covering and uncovering, relocating, re-erecting, replacement (in the event of unacceptable damage), and removing as necessary all existing and/or temporary traffic control devices (TTCDs). This work includes associated personnel, sign mountings, portable barricades, traffic cones, barrels, delineators, temporary construction signs, temporary barrier, temporary attenuators, truck mounted attenuators, other traffic warning devices, arrow boards, message boards, and any job specific devices for compliance with the MUTCD and the traffic-related work restrictions included in the Transportation Management Plan (TMP). All maintenance and movement work on these devices occurs after the initial installation on the Project and before the final removal.

Comply with **Subsection 104.09**.

937.02 MATERIALS.

937.02.1 Submittals.

Submit a Shop Drawing for any alteration to the approved TMP and/or TTCDs. Ensure that the Shop Drawing provides a detailed Temporary Traffic Control Plans for review and approval before starting work. Ensure that the Shop Drawing submission adheres to **Subsection 105.02** and the following requirements:

- Provide for the safe and efficient movement of traffic.
- Prepare a plan that meets or exceeds all standards in the *Manual on Uniform Traffic Control Devices* (MUTCD), the Contract Documents, and the Department's Standard Specifications.
- Address expected delay to vehicular traffic through the work zone.
- Address any delays to the Project's substantial completion date.
- Provide for the safe and efficient movement of pedestrians and bicycles.
- Meet all requirements of the Americans with Disabilities Act (ADA).
- Provide barrier and crash cushions to provide protection as required for hazard mitigation for workers and to shield all hazards to motorists within the appropriate AASHTO clear zone including bridge parapets, barrier blunt ends, poles, and large equipment. See **Subsection 106.05(a)**.
- Provide pavement marking removal.
- Incorporate traffic signal phasing, timing, and detection plans.
- Provide all necessary traffic counts that are required as backup.
- Signed and sealed by a registered Professional Engineer licensed in the State of Rhode Island.

- Include at least the following information necessary to successfully complete the Plan:
  - Description of each phase of work, including all elements of work to be accomplished in each phase
  - Contains Plans showing each traffic control phase that is planned for the duration of the Project
  - Documents expected duration of each traffic control configuration
  - Use CAD for the basis of any drawings.
  - Uses the same or greater level of detail as in the MUTCD and RIDOT *Standard Specifications*.
  - Shows taper lengths and lane shift widths, TTCD spacing, and sign locations for temporary and existing signs.
  - Documents removal or masking of items such as existing traffic signs, traffic signals, and markings.
  - Documents worker parking, work vehicles access, and equipment access.

937.02.2 Temporary Traffic Control Implementation Manager.

Employ a Temporary Traffic Control Implementation Manager (TTCIM) responsible for maintaining the portion of the Project being used by the public traffic in a safe condition, adequately accommodates traffic, and is according to the approved Plans and TMP. Ensure that the TTCIM has successfully completed the Traffic Control Supervisor training course provided by the American Traffic Safety Services Association (ATSSA) and is trained according to **Subsection 104.08(d)**. Submit the documentation to certify the TTCIM's compliance to the Department. The TTCIM shall perform the following responsibilities and duties:

- Oversee all traffic control operations.
- Have direct supervision of the installation, maintenance, and removal of all TTCDs.
- Include a template for a daily report verifying the inspection and installation of any required TTCDs.
- Begin corrective action on any deficiencies immediately upon notification from the Engineer.
- Inspect and document the traffic control setup for conformance with the approved Plans and TMP on a daily basis. Submit a daily report to the Department upon request documenting the inspection using the Inspection template supplied by the Department.
- If the TTCIM is not available for any portion of the Project, notify the Engineer in writing and provide an interim TTCIM that meets the training course requirements.

937.03 CONSTRUCTION.

937.03.1 Normal Operations.

Maintain all signs, barricades, and other TTCDs in a sturdy, clean, and legible condition. In this regard, maintenance involves the following: repairing, adjusting, washing, repainting, and the reapplication of reflective sheeting.

Locate the various TTCDs in their proper positions so that they reflect existing traffic conditions. As conditions change, remove or cover conflicting or unnecessary signs and TTCDs so that the respective messages are not visible to approaching traffic. Where changed conditions warrant, provide new TTCDs. When construction operations are not in progress, remove or cover all unnecessary signs. This item of work also includes covering and uncovering any existing permanent signage that may conflict with the temporary construction signage.

Ensure that weeds, shrubbery, and construction materials, equipment, and spoils do not obscure the view of any sign, light, barricade, or other temporary traffic control device. Remove obstructions at no additional cost to the Department.

Do not install any defective and/or damaged devices. Repair or remove and replace any TTCDs showing defects or damages as a result of the Contractor's operations or negligence at no additional cost to the Department. When the Engineer determines that a sign or TTCD has been severely damaged by causes other than the Contractor's operations, replace these signs and TTCDs, which will be paid for according to **Subsection 104.05.**

The Engineer must approve any modifications made to Contract Documents (i.e., Plans, Shop Drawings, TMP) and the applicable references for this Section (e.g., MUTCD).

937.03.2 Emergencies.

At the preconstruction conference, provide the Department with both the home telephone and cell phone numbers of at least three personnel who are available on a 24-hour basis for the duration of the Contract in the event of an emergency. These persons shall constitute the contacts in the event of an emergency, to be assigned as such in the PMP.

Upon notification by the Engineer, respond to the site of an emergency within 90 minutes and immediately take steps to commence repair operations.

937.04 METHOD OF MEASUREMENT.

Provide, Install, Maintain, and Move Traffic Protection will not be measured for payment.

937.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Furnish, Install, Maintain, and Move Temporary Traffic Protection	LS

937.05.1 Payment for Full Compliance.

The price constitutes full compensation for all labor, materials, and equipment; furnishing and installing all TTCDs, including maintaining, moving, and removing the TTCDs from their initial installation locations; handling, maintaining, transporting and relocating all TTCDs to storage or to subsequent intermediate locations where they will be used for traffic control; and all incidentals required to finish the work, complete and accepted.

Monthly progress payments under this item will be made at a rate determined by dividing the Contract lump sum price by the number of months allocated for completion of the Project. The number of months shall be equal to the difference between the Contract completion date and the date of the Notice to Proceed.

At the discretion of the Engineer, payment for authorized Contract time extensions will be made at the rate as defined above or on a Force Account basis according to **Subsection 109.04**.

If the Engineer orders maintenance of traffic not included within the original Contract or subsequent change order(s) that nets additional costs to the Contractor, then the Contractor will be paid for the maintenance and movement of traffic protective devices according to **Subsection 104.05**.

No payment will be made for unauthorized Contract time extensions, punch list work, or corrective activities.

Submit an itemized cost breakdown of the lump sum price provided for all work per the Basis of Payment associated with each of the following Specifications:

914 – FLAGPERSONS

916 – CRASH CUSHIONS

922 – TEMPORARY CONSTRUCTION SIGNS

923 – PORTABLE CHANNELIZING DEVICES AND BARRICADES

924 – ADVANCE WARNING ARROW PANEL

925 – PORTABLE CHANGEABLE MESSAGE SIGN

926 – ANCHORED AND UNACHORED BARRIER FOR TEMPORARY TRAFFIC CONTROL

928 – SHADOW OR ADVANCE WARNING VEHICLE WITH CRASH CUSHION AND FLASHING ARROW BOARD OR CHANGEABLE MESSAGE SIGN

No payment will be made for unauthorized Contract time extensions, “punch list” work or corrective activities.

937.05.2 Failure to Comply.

a. Maintenance. If, in the judgment of the Engineer, the Contractor fails to adequately install and/or safely maintain TTCDs along any portion of the Project, the appropriate charge(s) in the Table of Fines in **SECTION 110** will be deducted from monies due to the Contractor.

b. Movement. If, in the judgement of the Engineer, the Contractor fails to remove and/or relocate TTCDs for compliance with the traffic-related work restrictions included in the approved TMP or to otherwise meet changes in traffic conditions, construction operations, or other conditions affecting the safety and/or mobility of the traveling public, the appropriate charge(s) in the Table of Fines in **SECTION 110** will be deducted from monies due to the Contractor.

937.05.3 Emergencies.

If emergency repair work has not been initiated within the 90-minute time frame specified above, the charge set forth in the Table of Fines in **SECTION 110** will be deducted from monies then due the Contractor until the repair work is completed.

SECTION 938 — PRICE ADJUSTMENTS

938.01 DESCRIPTION.

This provision ensures adequate and fair compensation for unpredictable and fluctuating costs that, from time to time, occur in the prices of liquid asphalt, diesel fuel, and steel, as described below.

938.02 DEFINITIONS.

938.02.1 Base Price of Liquid Asphalt and Diesel Fuel.

The base price is the unit price of the material (FOB Terminal) as determined by the Department. The base prices for liquid asphalt and diesel fuel will be determined just before the first date that the NOTICE TO CONTRACTORS is advertised in the public press.

938.02.2 Period Price of Liquid Asphalt and Diesel Fuel.

The period prices for liquid asphalt and diesel fuel (FOB Terminal) will be determined for any one-month period following the NOTICE TO PROCEED during which the price varies from the base price.

938.02.3 Base Price (BP) for Steel.

The base price for steel will be determined by the Department just before the first date that the NOTICE TO CONTRACTORS is advertised in the public press.

938.02.4 Period Price Index (PPI) for Steel.

For all steel items, the PPI will be defined as the Bureau of Labor Statistics (BLS) Producer Price Index (PPI) for “Steel Mill Products,” Series ID WPU 1017-02 (not seasonally adjusted). The latest version of the index will be used, including any corrections or rebasing of the index. PPI will be defined as the BLS PPI at the time the material is purchased from the mill, as specified by the Invoice date.

938.02.5 Base Price Index (BPI) for Steel.

For all steel items, the Base Price Index (BPI) will be defined as the BLS PPI just before the first date that the NOTICE TO CONTRACTORS is advertised in the public press.

938.02.6 Period Price (PP) for Steel.

The period price for steel will be calculated as follows: PP = (BP × (PPI/BPI)).

938.03 PRICE ADJUSTMENT.

Price adjustments for liquid asphalt and diesel fuel will be determined by the difference between the period price and the base price. Price adjustments for liquid asphalt and diesel fuel will be made at the end of each month during which a) work was accomplished on the Project, and b) prices varied.

Price adjustments for steel will be calculated every month that steel is purchased, but only applied when steel price indices vary by more than 5.0 percent.

Price adjustments for work performed after the Contract completion date, including approved time extension(s), will be as follows:

Credit due the Contractor will be the lesser amount calculated from the following two algorithms (a and b), whereas credit due the Department will be the greater of the two calculations:

a. Actual Monthly Period Prices. The price adjustment calculated using the actual monthly period prices in effect at the time of the construction.

b. Monthly Period Prices in Effect. The price adjustment calculated using the monthly period prices in effect during a period determined by setting the last day of relevant work to the Contract completion date as may have been modified by approved time extension(s).

Price adjustments due the Contractor will be made according to an approved Contract Addendum. Credit due the Department will be processed by deducting monies from progress payments or by other means if there are insufficient progress payments remaining.

938.03.1 Asphalt Binder.

The asphalt content will be the optimum amount used in every ton of asphalt concrete mixture, as determined by the Department's Materials Engineer, using the method for determination of optimum binder content as set forth in **SECTION M03**.

The price adjustment will be determined by multiplying the total weight of asphalt binder, in tons, by the difference between the base price and period price.

The base price of asphalt binder is set forth in **Special Provision Code 938.1000**.

938.03.2 Diesel Fuel.

The fuel for operating the plant and the fuel for hauling and placing asphalt concrete will equal the total number of tons of asphalt concrete placed during the month in question times a fuel adjustment factor of 2.5 gal of fuel per ton of asphalt concrete. Tonnage of asphalt concrete placed during the month in question will equal the sum of the weights indicated on the Daily Automated Recordation printout slips provided at the plant.

The price adjustment will be determined by multiplying the total volume of fuel, in gallons, by the difference between the base price and the period price.

The base price of diesel fuel is set forth in **Special Provision Code 938.1000**.

938.03.3 Steel.

Steel price adjustments will apply only when specified in the Contract and only to unfabricated structural steel material, consisting of rolled shapes, plate steel, sheet piling, pipe piles, steel castings, steel forgings, and unfabricated reinforcing steel bars. Payments will only be made for fluctuations in the cost of the steel material used in the items specified. Steel price adjustments will not be made to steel purchased before the time of bid opening for conventional contracting methods (design/bid/build) or submittal of price proposals for all other contracting methods.

Steel price adjustments will not include the costs of Shop Drawing preparation, handling, fabrication, welding, erection, surface preparation, coatings, transportation, storage, staging, installation, profit, overhead, fuel costs, fuel surcharges, or other charges not related to the cost of the unfabricated structural steel and unfabricated reinforcing steel.

The weight of steel subject to a price adjustment will be calculated based on approved Shop Drawings and incorporated into the final Work.

For all steel items specified above, the price adjustment will be determined according to thresholds as follows:

- If the absolute value of [(PP-BP)/BP] is less than or equal to a threshold of 0.050, then no price adjustment is made.
- If the absolute value of [(PP-BP)/BP] is greater than 0.050, then a price adjustment is made and will apply to the full variance between the base price and the period price.
- If the threshold is exceeded and the PP is higher than the BP, the price adjustment owed to the Contractor is calculated as follows:

  [PP – BP] × Weight of steel

- If the threshold is exceeded and the PP is lower than the BP, the price adjustment owed to the Department is calculated as follows:

  [BP – PP] × Weight of steel

The base price of steel is set forth in **Special Provision Code 938.1000.**

938.04 METHOD OF MEASUREMENT.

Pay adjustments will be measured using the Method of Measurement for the applicable Item to be adjusted.

938.05 BASIS OF PAYMENT.

Pay adjustments will be paid per each unit for the applicable Item to be adjusted.

SECTION 939 — STONE WALLS IN HISTORIC, SCENIC, OR RURAL AREAS

939.01 DESCRIPTION.

This work includes the resetting and construction of stone walls in historic, scenic, or rural areas at the required locations.

939.02 MATERIALS.

939.02.1 Stones.

Stones for walls to be reset include stones in the existing wall, with additional stones as required to complete the wall construction. Ensure that additional stones conform to the stones in the existing wall relative to shape, color, texture, and geological composition. Ensure that stones for new walls conform to stones found in nearby walls relative to the aforementioned characteristics.

Stones used below grade, for the core, or for the back of a retaining wall need not meet these criteria. However, use stones that conform to **SECTION M14** and that are appropriately sized and shaped to permit proper interlocking with the existing stones.

Retain any special features such as lintels, gate posts, copings, markers, etc., for resetting.

939.02.2 Mortar.

Use mortar that conforms to **Subsection M04.03.5**.

939.03 CONSTRUCTION METHODS.

939.03.1 General Requirements.

Ensure that the laying of stones conforms to **Subsections 911.03** and **912.03**.

For the construction of walls in historic areas, use stone masons with demonstrated proficiency in historic stone masonry construction/restoration practices. Submit documentation to the Engineer of professional certifications and the locations of at least three successfully completed stone walls similar in type to the work to be performed no less than 30 days before the start of work. This documentation must be approved by the Engineer in consultation with the RIDOT Historic Preservation Specialist for the masonry contractor to be allowed to perform the work. Ensure that the approved mason(s) complete the entire work item for which the approval was given.

939.03.2 Documentation.

Before dismantling historically significant walls, measure and record their width and height at 25-ft intervals and at locations where characteristics of the wall change. Take a minimum of six digital color photographs of each wall to be dismantled in locations that are representative of the walls original type. If no representative wall sections exist, the Engineer in consultation with the RIDOT Historic Preservation Specialist will determine the finished appearance/dimensions. Submit two copies of the measurements and two sets of photographs to the Engineer. This documentation must be reviewed and approved by the Engineer in consultation with the RIDOT Historic

Preservation Specialist for accuracy before the walls are dismantled. Once approved, this record of the walls will be referenced during the reconstruction of the walls and will remain the property of the Department.

939.03.3 Dismantling.

Carefully dismantle historically significant walls to be removed and reset to avoid fracturing and chipping the stones. Stockpile the stones in the area where the wall will be rebuilt. If the stones must be temporarily moved to a different location, keep the stones separate from any other stones. Do not use a dump truck to transport stone from historically significant walls. The Contractor will be responsible for protecting all stockpiled stones from damage, theft, and vandalism.

939.03.4 Resetting.

Ensure that exposed face(s) consist of stones from the extant walls. During resetting, keep weathered stone faces exposed. Blend additional stones required to complete the walls with the existing stone to reduce any incompatibility in the appearance of the walls. Duplicate the original wall and any special features such as lintels, gateposts, openings, copings, markers, etc.

939.03.5 New Walls.

When new stone walls are required in the vicinity of historic properties and districts, construct a 5-ft long sample section of wall. The Engineer in consultation with the RIDOT Historic Preservation Specialist will approve the stone, joint construction, and overall character of installation of the sample section. The approved sample section may be part of the finished work. Demolish and rebuild any rejected sample section.

939.03.6 Weep Holes.

Use weep holes constructed of solid, gray PVC pipe that includes the resetting and construction of stone walls in historic, scenic, or rural areas. These walls require special treatment as indicated herein.

939.03.7 Cleaning.

Remove all excess material and leave the site in a presentable condition. If surplus stones exist, the Engineer will determine whether to transport the surplus stones to an offsite, permanent stockpile area or to dispose of the material.

939.04 METHOD OF MEASUREMENT.

Stone Walls in Historic, Scenic, or Rural Areas will be measured by the number of cubic yards of masonry placed.

939.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Stone Walls in Historic, Scenic, or Rural Areas	CY

The price constitutes full compensation for all labor, materials, and equipment, including documenting and dismantling of the existing wall, stockpiling of stone, removal of stones from the stockpile, all necessary cutting/dressing of stones, reconstruction of special features, construction of weep holes, cleaning, and all incidentals required to finish the work, complete and accepted.

Special site preparation such as clearing and grubbing or gravel base courses will be paid for under other appropriate items of the Contract.

Removal and stockpiling of surplus stone at an offsite, permanent stockpile location will be paid for under an appropriate item in the Contract.

Stones required to construct new walls or to supplement quantities of stones in existing walls will be paid for under separate item(s) in the Contract.

SECTION 940 — AS-BUILT PLANS AND AS-BUILT SURVEY PLANS

940.01 DESCRIPTION.

This work includes providing As-Built Plans, As-Built Survey Plans, and other related documents to the Department before acceptance. In the As-Built Plans, document any changes made to a highway asset during construction.

Changes are defined as any relocation, addition, deletion, revision, or modification of the assets listed below. It also constitutes any asset that is not built in conformity with the construction Contract.

940.02 METHODS.

On the As-Built Plans, document any asset that the Engineer has determined is not built substantially in conformity with the lines, grades, cross sections, dimensions, and material requirements as required by the Contract.

On the As-Built Survey Plans, document the surveyed location and elevation of any asset that has been identified as “not built in substantial conformity” on the As-Built Plan sheets and the specific surveyed locations and elevations required to be as-built as identified in the Contract documents.

For the As-Built Survey Plans, include the following information:

- A note to reference the current Contract Plans, Plats, Shop Drawings, or other documents that affect the location or elevation of any as-built asset shown
- A note to reference specific dates of as-built survey field work and the as-built task performed
- A note to clearly identify the original survey control points provided for the Project and the remaining and new survey control points established for the As-Built Survey
- A note to identify the horizontal and vertical datums and any significant discrepancies discovered regarding survey control
- The Northing, Easting, Elevation, and Description of any survey control point used for locating assets
- The surveyed location and elevation of any asset that has been identified as “not built in substantial conformity” on the As-Built Plans sheets
- The specific surveyed locations and elevations required to be as-built as identified in the Contract documents
- The base plan underlay for the As-Built Survey Plans should include the current approved Contract Plans showing the design location of features appropriate for the as-built assets being shown

Document any changes made to the following assets.

940.02.1 Bridge Assets.

Any bridge asset that is changed such that the component of the bridge is not within tolerances of either measurement or properties or is otherwise constructed inconsistent with the awarded Plans.

940.02.2 Drainage Assets.

- Structural control units
- Inlets
- Manholes
- Box culverts
- End walls
- Ditches

940.02.3 Facility Assets.

- Site (sidewalks, signs, building locations, etc.)
- Security (cameras, fences, gates, locks)
- Stormwater (culverts, outlets, storm mains, storm structures)
- Communications (cabinets, lines, towers)
- Electrical (cabinet, line, pole, light, transformer)
- Gas (mains, structures, valves)
- Sanitary (lift stations, fittings, mains, structures, tanks)
- Water (hydrants, fittings, mains, structures, valves)

940.02.4 Geotechnical.

- Earth retaining structures
- Slopes
- Subgrade (ground improvement)
- Special drainage
- Instrumentation system

940.02.5 Lighting Assets.

- Electrical lines/conduits
- Light poles
- Handholes
- Light foundations

940.02.6 Pavement/Highway Assets.

- Horizontal and vertical alignments
- Intersection and crossover details
- Sidewalk, curb and gutter, shoulder gutter
- Driveways

- Fencing, gate location
- Pavement markings
- Benchmarks (BM) and their descriptions

940.02.7 Survey.

- Remaining survey control points
- Benchmarks
- Rhode Island Highway Bounds installed
- Encroachments
- Boundary lines and easements
- Current Project baselines

940.02.8 Sign Assets.

- Sign foundations
- Sign support structures
- Sign panel

940.02.9 ITS and Traffic Management Assets.

- Conduits (fiber power communication)
- Fiber splice enclosures
- Manholes
- Handholes
- ITS cabinets
- Pull and splice boxes
- Utility meters/disconnects
- Utility poles
- Foundations
- Camera poles
- DMS signs
- DMS structures
- RVDS location and direction
- Cameras and their orientation
- WWD systems (passive active)

940.02.10 Traffic Signal Assets.

- Conduits
- Conduit duct banks
- Manholes
- Handholes
- Foundations
- Mast arms
- Pedestrian poles

- Controller cabinets
- Pull and splice boxes
- Hubs
- Support structures
- Meters
- Power services
- Loops and detectors
- Signal heads

940.03 DELIVERABLES.

Submit the As-Built Plans and the As-Built Survey Plans as Shop Drawings.

940.03.1 As-Built Plans.

Submit As-Built Plans that document all changes made during construction. The As-Built Plans shall be signed and sealed by the Contractor's Professional Engineer (PE) registered in the State of Rhode Island. Include the Professional Engineer's printed name, signature, and date of approval on each sheet.

If all assets have been built in substantial conformity with the As-Bid Plan sheet, include a statement on the As-Built Plan sheet to clearly identify the conformity.

Provide As-Built Plans that are red-lined PDF files in the same scale and content as the As-Bid Plans and formatted on 11-in. × 17-in. sheets. If, as determined by the Engineer, the changes cannot be clearly delineated on the existing drawings, clearly delineate all changes on 11-in. × 17-in. detail sheets, enlarged 200 percent from the reproductions.

940.03.2 As-Built Survey Plans.

Submit final paper and electronic (pdf) copies of certified As-Built Survey Plans and final AutoCAD drawing files with neatly organized layers and features that conform to current RIDOT CAD Standards. In the AutoCAD drawing file, include the point objects for all as-built assets and all survey control points used.

The Contractor's Professional Land Surveyor approved for the Project must sign and seal each individual sheet of the As-Built Survey Plan. The PLS must be registered in the State of Rhode Island. Ensure that all work conforms to the Procedural and Technical Standards for the Practice of Professional Land Surveying in the State of Rhode Island.

940.04 METHOD OF MEASUREMENT.

As-Built Plans and Documents will not be measured for Payment.

940.05 BASIS OF PAYMENT.

This Item of work will not be paid for separately. Thirty percent of the Contract retainage value will be withheld until the As-Built Plans and the As-Built Survey Plans have been submitted, reviewed, and accepted by the Department.

SECTION 941

This Section has been Reserved for Future Use.

SECTION 942

This Section has been Reserved for Future Use.

SECTION 943 — ON-THE-JOB TRAINING

943.01 INTRODUCTION.

SECTION 943 conforms to the requirements of 23 USC 140(a). Training and upgrading of minorities, women, and disadvantaged individuals toward journey worker status is a primary objective of this Section.

943.01.1 Minority Groups (23 CFR 230.305(2)(d)).

An employee may be included in the minority group to which he or she appears to belong or is regarded in the community as belonging. As defined by U.S. Federal agencies for employment purposes, minority group persons in the U.S. are identified as Blacks (not of Hispanic origin), Hispanics, Asian or Pacific Islanders, and American Indians or Alaskan Natives.

943.01.2 Racial/Ethnic Identification.

For the purpose of this regulation and any accompanying report requirements, an employee may be included in the group to which he or she appears to belong, identifies with, or is regarded in the community as belonging. However, no person should be counted in more than one racial/ethnic category. The following group categories will be used:

1. Black or African American (not Hispanic or Latino). A person having origins in any of the black racial groups of Africa.

2. Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

3. American Indian/Alaskan Native (not Hispanic or Latino). A person having origins in any of the original peoples of North America and South America (including Central America), and who maintains tribal affiliation or community attachment.

4. Asian (not Hispanic or Latino). A person having origins in any of the original peoples of the Far East, Southeast Asian, or the Indian subcontinent including for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

5. White (not Hispanic or Latino). A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

6. Native Hawaiian or Other Pacific Islander (not Hispanic or Latino). A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

7. Two or More Races. A person who primarily identifies with two or more of the above race/ethnicity categories.

943.01.3 Disadvantaged Individuals.

Refer to veterans and/or individuals currently participating of any government assistance program, for low-income individuals, administered by the RI Department of Human Services.

As part of the contractor's equal employment opportunity and affirmative action programs, training shall be provided as follows:

- The contractor shall provide on-the-job training aimed at developing full journey worker status in the type of trade or job classification involved.
- The number of training hours assigned to this contract per this TSP will be xxx hours. The number of trainees to be trained under this TSP will be trainees.
- In the event that a contractor subcontracts a portion of the contract work, he/she shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided, however, that the contractor shall retain the primary responsibility for meeting the training requirements of this TSP. The contractor shall also ensure that this TSP is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training.
- The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journey workers in the various classifications within a reasonable area of recruitment. Prior to commencing construction, at the preconstruction meeting, the contractor shall submit to RIDOT for approval a Contractor Training Proposal (TR1 form) stating the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the contractor shall specify the anticipated starting time for training in each of the classifications. The contractor will be credited for each trainee employed by him/her on the contract work that is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter. All trainees, participating in the On-the-Job-Training (OJT) program, must be registered (TR2 form) with the Office of Civil Rights (OCR) and approved prior to starting work onsite. Unregistered trainees will not be eligible for training credit and/or training reimbursement.

943.02 GOOD FAITH EFFORTS.

Make every effort to enroll minority, women, and disadvantaged trainees (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority, women and disadvantaged trainees) to the extent that such persons are available within a reasonable area of recruitment. Furnish evidence of his/her systematic and direct recruitment efforts to the satisfaction of RIDOT prior to a determination as to whether a contractor is in compliance with the contract’s TSP. These efforts are required regardless of whether the contractor is union or non-union. A contractor is not considered to have met this OJT requirement if he/she selects job classifications in the unskilled or semi-skilled positions (e.g., flaggers, laborers). This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not. Nonetheless, provide to the Office of Civil Rights all documented Good Faith Efforts (GFEs) prior to hiring outside the OJT program’s primary objective.

No employee shall be employed as a trainee in any classification in which he/she has successfully completed a training course leading to journey worker status, or in which he/she has been employed as a journey worker. The contractor may satisfy this requirement by including appropriate questions in the employee application, or by other suitable means. Regardless of the method used, the contractor's records shall document the findings in each case.

943.03 ACCEPTABLE TRAINING.

The minimum length and type of training for each classification shall be as established in the training program selected by the contractor and approved by RIDOT and the Federal Highway Administration. RIDOT and the Federal Highway Administration will approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the contractor and to qualify the trainee(s) for journey worker status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with the Rhode Island apprenticeship agency recognized by the Bureau, and training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, and Bureau of Apprenticeship are acceptable for the purposes of this TSP.

Training will be considered acceptable provided it is being administered in a manner consistent with the equal employment obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from RIDOT prior to commencing work on the classification covered by the program. It is the intention of this TSP that training is to be provided in the construction crafts rather than clerk-typists or secretarial-type positions. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and is approved by the division office of the FHWA. Training at other RIDOT Projects is permissible as long as the training is an integral part of an approved training program. Submit the training verification (TR3 form) from all RIDOT Projects to OCR once a month with corresponding Monthly OJT Training reports (TR5 form). Forms listed below.

943.04 OJT TRAINING REPORTING REQUIREMENTS.

NOTE: RIDOT reserves the right to revise and/or rename the reporting process and forms that it requires contractors to submit to enable RIDOT to monitor OJT compliance. Contractors agree to follow the process and use the forms that RIDOT requires.

(TR0 Form) On-the-Job-Training (OJT) Acknowledgment and Statement of Intent Compliance

(TR1 Form) Contractor Training Proposal

(TR2 Form) New Trainee Registration (TR3 Form) Trainee Weekly Verification

(TR5 Form) Monthly OJT Hours Report (TR6 Form) Trainee Status Change

(TR7 Form) Certificate of Training

(TR9 Form) Training Goal Reconsideration Request

Forms available to print at http://www.dot.ri.gov/about/who/civil_rights.php.

943.05 TRAINEES.

RIDOT's On-the-Job-Training program is a hybrid of both Project-Specific and Contractor-Based FHWA programs.

943.05.1 Project-Specific.

OJT goals are assigned to specific federal-aid contracts. Goals are to be met by the project's substantial completion date. Ensure that trainees are enrolled under the specific project to meet its contract's TSP requirement. All training hours attained by the trainee will be applied toward the project's OJT goal.

943.05.2 Contractor-Based.

Registered and approved OJT trainees are permitted to work among multiple RIDOT projects when necessary. However, all worked training hours will be applied toward meeting the specific project's OJT goal in which the trainee was enrolled.

943.06 REIMBURSEMENT.

Except as otherwise noted below, the contractor will be reimbursed at a rate of $6.00 per hour of onsite training provided to each trainee in accordance with an approved training program. This reimbursement will be made even if the contractor receives additional training program funds from other sources, provided such other does not specifically prohibit the contractor from receiving other reimbursement. Therefore, it is contractors' responsibility to determine if it is permissible to accept training reimbursement concurrently from other sources.

Reimbursement for offsite training will not be made to the Contractor.

No reimbursement under this TSP will be made to the contractor if the failure to provide the required training, is caused by the contractor and evidences a lack of good faith on the part of the contractor in meeting the requirements of this TSP. Training Invoices must be submitted to the Resident Engineer (RE) along with proof of OJT compliance (e.g., copy of the Certificate of OJT Goal Attainment (COA1), approved TR5s etc.). Contractors that failed to comply with the contract's TSP requirements will be required to contact OCR to request an OJT Good Faith Efforts Assessment (TR12 form) in order to obtain an OJT compliance determination. Contractors with a satisfactory compliance determination will be eligible for training reimbursement. Contractors with an unsatisfactory compliance determination will not be eligible for training reimbursement and may be subject to sanctions (please refer to the noncompliance procedures and sanctions section below for details).

It is normally expected that a trainee will begin training on the project as soon as feasible after start of work, utilizing the skill(s) involved, and remain on the project as long as training opportunities exist in the work classification or until the trainee has completed the training program. It is not required that all trainees be employed as such for the entire length of the contract. A contractor will have fulfilled his/her responsibilities under this TSP if he/she has provided acceptable training and number of training hours to the number of trainees specified therein. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Trainees will be paid the appropriate rates approved by the Departments of Labor or Transportation.

Trainees will be paid at least 60 percent of the appropriate minimum journeyman's rate specified in the contract for the first half of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period, unless apprentices or trainees from an approved existing program (e.g., unions' apprenticeship programs) are enrolled as trainees on this project. In that case, the appropriate rates approved by the Departments of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification covered by this TSP.

The contractor shall furnish the trainee a copy of the program he/she will follow in providing the training. The contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed.

The contractor will provide for the maintenance of records and furnish periodic reports documenting his/her performance under this TSP.

943.07 TRAINING GOAL RECONSIDERATION REQUEST.

Contractors that have evidence of implemented Good Faith Efforts (GFE), exerted to comply with the contract's TSP requirements, and that are having difficulty meeting the contract's OJT goal may submit a Training Goal Reconsideration Request (TR9 Form) requesting OCR to reassess the contract's OJT goal considering the provided GFE. The form must be submitted at least 30 days before the project's substantial completion date but not after the project's employment peak season. Documented GFE must accompany the TR9 form including a letter justifying the request.

Contractors who fail to submit an OJT Goal Reconsideration Request and who fail to meet the OJT goal by the project's substantial completion date will be given an opportunity to submit a Corrective Action Plan (CAP) to reallocate the unmet OJT goal hours onto another RIDOT project; however, such training will not be eligible for reimbursement. Contractors that fail to comply with the CAP will be deemed non-compliant.

943.08 NON-COMPLIANCE PROCEDURES AND SANCTIONS.

943.08.1 Non-Compliance with Contract's Training Special Provisions (TSP).

Flagrant disregard in meeting the contract's TSP requirements and/or fulfilling the approved Corrective Action Plan (CAP) and/or making a GFE may result in an unsatisfactory performance claim being submitted to the department in charge of RIDOT's bidding process and contract awards.

943.08.2 Non-compliance with EEO Provisions.

The RIDOT will impose contract sanctions and initiate appropriate legal proceedings under applicable State and Federal law, if necessary, to achieve Equal Employment Opportunity on all Federal- aid highway projects.

In the event of a contractor's noncompliance with the nondiscrimination provisions stated in the contract (TSP requirements and/or EEO regulations) and after allowing a reasonable time (15 days) for corrective action to be taken, the RIDOT may, at its own discretion, impose contract sanctions including, but not limited to, the following:

- Withholding of payments to the contractor under the contract until the contractor complies
- Cancellation, termination, or suspension of the contract, in whole or in part
- The denial of bidding privileges and the initiation of debarment proceedings in accordance with State Procedures
- The implementation of such sanctions shall not prevent the State of Rhode Island from entering into litigation to protect its interests and rights under the following applicable laws: Civil Right Act of 1964 as amended, Federal-aid Highway Act of 1968, 1970; Americans with Disabilities Act of 1990

943.09 CONTRACTOR PROCEDURES.

943.09.1 Pre-Award.

- Before contract award of any federal aid project, the contractor must have his/her Affirmative Action Plan (AAP) in place and on file with the Department of Administration/EEO Office. Contractor must also submit its AAP directly to RIDOT, if RIDOT requests.
- Prior to any award, the Lowest Bidder/Contractor must submit a completed and signed On-the- Job-Training (OJT) Acknowledgment and Statement of Intent Compliance (TR0 form) to RIDOT's Office of Procurement during post-qualification for review by the OJT Compliance Officer of the Civil Rights (OCR).and
- The contractor must either use a US or RI DOL approved program or an approved training program of a recognized labor organization or trades council.

943.09.2 Post-Award.

Proposed On-the-Job trainees are to be listed on the Trainee Registration enrollment form for each trainee to be employed and submitted to OCR's OJT Compliance Officer for approval. Trainees' hours may not be reimbursed until the Contractor Training Proposal (TR1 form) and the New Trainee Registration (TR2 form) are reviewed and approved by RIDOT.

The contractor orients the training foreman, superintendent and the On-the-Job Training trainee(s) to their respective responsibilities in the program and provides copies of the training guidelines for the training job classification being used.

The contractor shall provide a certified payroll weekly to the Resident Engineer. This payroll should distinguish clearly the trainee's training hours from regular hours worked for each On-the-Job trainee. Certified payrolls are required to be uploaded to PRISM also.

The contractor will monitor and submit monthly reports (TR5 & TR3 forms) for all trainees in the program, for progress, any problems or training issues to the OJT Compliance Officer.

The contractor must notify the Resident Engineer and the OJT Compliance Officer in writing within 5 working days of any trainee status change such as: terminations, layoffs, resignations, etc. The contractor must also submit the status change form/documentation (TR6 form) to the OJT Compliance Officer within 10 working days after the event. Subsequent to any trainee's termination or resignation, the OJT Compliance Officer will make a good faith effort determination (regarding the contractor's best efforts to replace the trainee as to whether this training position needs to be filled).

Contractors who assign training position(s) to subcontractors must ensure the subcontractor submits a Contractor Training Proposal (TR1 form) to the OCR. The Prime Contractor shall retain the responsibility for full compliance with OJT training requirements of the project.

The contractor shall furnish the trainee a copy of the program he/she will follow in providing the training. The contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed (TR7 form).

Once a trainee has been registered and approved by the Office of Civil Rights, the contractor, in advance, will email the Resident Engineer notifying that a specific trainee will be on the project. As part of the weekly verification of trainee hours, the contractor will be responsible to complete and submit with their certified payrolls the Trainee Weekly Verification (TR3 form) for each Trainee. The Resident Engineer will review the form, against the submitted certified payrolls and the training provided onsite and reply to the contractors' trainee officer with the signed form. On a monthly basis, the contractor must submit to the Office of Civil Rights the Monthly OJT Hours Report (TR5 form) accompanied with the completed and signed Trainee Weekly Verification forms. The OCR's OJT Compliance Officer will review the submission and document compliance. All approved documentation received from the OCR will be necessary to receive the corresponding training reimbursement.

Contractors will be responsible for invoicing RIDOT for the OJT training provided, and invoices must be submitted in accordance with 109.06 along with proof of OJT compliance (e.g., copy of the Certificate of OJT Goal Attainment (COA1), approved TR5s etc.). Contractors that failed to comply with the contract's TSP requirements will be required to contact OCR to request an OJT Good Faith Efforts Assessment (TR12 form) in order to obtain an OJT compliance determination. Contractors with a satisfactory compliance determination will be eligible for training reimbursement. Contractors with an unsatisfactory compliance determination will not be eligible for training reimbursement and may be subject to sanctions (please refer to the noncompliance procedures and sanctions section above for details).

SECTION 944 — LIGHTING FOR NIGHT WORK OPERATIONS

944.01 DESCRIPTION.

This work includes illuminating work zone and lane drop areas and all other areas with channelization devices placed along the roadway to direct or restrict traffic, as required for night work operations. Illumination of these areas will be provided by both floodlighting and equipment-mounted lighting. Refer to Section 6F82 of the currently adopted MUTCD.

944.02 MATERIALS.

944.02.1 Floodlights.

For all floodlights for both the lane drop areas and the equipment mounted lighting, use cut-off type light distribution that has a die-cast aluminum housing with integrally-case heavy-duty hinges. Close the fixture housing door with two or more captive screws. Ensure that the door has positive gasketing to ensure water tightness and dust tightness. Do not provide weep holes to the housing. Use a reflector that has high purity anodized aluminum with a secondary internal reflector element to reflect high angle rays back into the beam to achieve high beam utilization.

944.03 CONSTRUCTION METHODS.

944.03.1 Plan of Operation.

Before proceeding with any night work, submit a plan for night work operations, including the placement of illumination devices, to the Engineer for review and approval. Ensure that the Plan includes permanent lighting at the applicable locations (e.g., shifts, splits, other area designated by the Engineer).

944.03.2 Illumination Standards.

Maintain the following standards at all times during night operations.

For lane drops, illuminate the traveled way within the lane drop areas and all cones, barrels, or other physical barriers placed on the roadway for the purpose of channelizing or restricting vehicular traffic to a minimum average of 2 ft candles measured on both the horizontal and vertical planes 6 in. above the surface in question. Locate all portable lighting off the traveled way opposite the channelizing devices (i.e., when closing the left or high-speed lanes, all lighting should be placed on the right side of roadway). Aim all lighting to avoid shadows on the traveled way and prevent excessive glare to the motorist. Accomplish the illumination of the lane drop areas using 250-watt, 400-watt, 1000-watt metal halide floodlights. Mount floodlights on portable or fixed poles, tripods or staging in a location off the traveled way. Rope off the lighting staging area to all personnel except the lighting technicians.

944.03.3 Power Sources.

Provide portable generators of the type, size, and wattage output required to adequately energize the lighting equipment specified. Ensure that the generator placement and wiring comply with all applicable electrical codes and pertinent OSHA safety standards. Ensure that the lighting fixture and generator electrical rating are compatible.

944.03.4 Inspection.

Monitor the illumination on the Project at random intervals for conformance to the specifications. Substandard illumination in any area (traveled way, work area or equipment lighting) may be sufficient reason for the Engineer to direct stoppage of all work until the substandard situation is corrected.

If there are sufficient noncompliance incidents relating to the illumination of the work area and the lane drops or if the finished roadway surface is unsatisfactory in any way, or if safety considerations dictate, the Engineer may revoke the night-time paving operation for the Contract.

Furnish the Engineer, for the duration of the Project and at no additional compensation, a hand-held digital light meter, complete with instructions, capable of measuring 1 to 100 ft-candles. The light meter will be returned to the Contractor upon completion of the Project.

944.04 METHOD OF MEASUREMENT.

Lighting for Night Work Operations will not be measured separately for payment.

944.05 BASIS OF PAYMENT.

Lighting for Night Work Operations will not be paid for separately but is a subsidiary obligation, with the cost distributed among the Contract unit prices for those items of work that will be performed during night-time operations. These unit prices include full compensation for furnishing and operating all equipment, labor, and materials necessary to illuminate the roadway surface (lane drop and work zone area), including the necessary lighting on the equipment and all incidentals necessary to finish the work to the satisfaction of the Engineer.

SECTION 945 — REMOVAL OF TRAFFIC SIGNAL EQUIPMENT

945.01 DESCRIPTION.

This work includes removing and either disposal of or salvaging of existing traffic signal equipment. Traffic signal equipment to be removed may include traffic signal wire and cable; mast arm, span, and pedestal poles with or without foundations; traffic signal cabinets with or without foundations; traffic detectors and pedestrian pushbuttons; controllers, relays, and associated equipment housed inside traffic signal cabinets; and traffic signal heads.

945.02 MATERIALS.

Not applicable.

945.03 CONSTRUCTION METHODS.

945.03.1 General.

Where traffic signal equipment will be removed from an intersection that will remain open to traffic and will be controlled by a new or improved traffic signal, minimize the amount of time that a traffic signal is not operational and actively controlling traffic at the intersection. Ensure that the schedule provides for the new or improved traffic signal to be operational before the end of the same working day when the existing traffic signal is turned off. Use an appropriate number of law enforcement officers and other temporary traffic control devices, as approved by the Engineer, to safely control traffic at the intersections when the traffic signal is not operational.

When a gap or opening remains on an existing-to-remain pole after the removal of traffic signal equipment, cover the openings using a knockout seal or other appropriate material to provide a secure closure of the opening with the approval of the Engineer. Perform this work at no additional cost to the Department.

Provide a plan callout to remove and dispose of the foundation for a traffic signal pole or cabinet, which will require the removal of the foundation, including all reinforcement, ground rods, and conduit/wiring within to a minimum depth of 24 in. below the finished grade surrounding the foundation, with the remaining portion of the foundation to remain buried in place. Backfill the resulting excavated areas with suitable material, compacted and finished so that the patched areas will match the existing conditions.

945.03.2 Removal and Salvaging of Traffic Signal Equipment.

Tag all pieces of equipment to be salvaged with each tag identifying the Contract number, the intersection or location from which the equipment was removed, the date that the equipment was removed, and a description of the name and/or type/function of the equipment. Call the contact person to coordinate the delivery of the salvaged equipment. Do not schedule delivery before confirming an acceptable date/time with the contact person. Deliver all salvaged traffic signal equipment to the address noted on the CS pages. Obtain a written receipt(s) for all equipment that has been received at the delivery address, and submit these to the Engineer to allow for processing of payment(s).

945.04 METHOD OF MEASUREMENT.

Remove and Dispose Traffic Signal Equipment and Remove and Salvage Traffic Signal Equipment will be measured by each traffic signal system removed and disposed of.

The removal of existing handholes, manholes, conduit, and risers associated with a traffic signal will be paid for under the appropriate pay item.

945.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows:

Pay Item	Pay Unit
Remove and Dispose Traffic Signal Equipment	EA
Remove and Salvage Traffic Signal Equipment	EA

The prices constitute full compensation for all labor, materials, and equipment, including all incidentals required to finish the work, complete and accepted.

Part L
LANDSCAPING

SECTION L01 — LOAM, PLANTABLE SOIL, OR HIGH ORGANIC SOIL

L01.01 DESCRIPTION.

L01.01.1 Loam.

This work includes placing loam to the required lines, grades, limits, and depths.

L01.01.2 Plantable Soil.

This work includes furnishing and placing plantable soil to a 4-in. depth on designated areas.

L01.01.3 High Organic Soil.

This work includes furnishing and placing high organic soil to the lines, grades, and depths in detention ponds, wetland replacement, and/or wetlands restoration/reclamation areas.

L01.02 MATERIALS.

Provide loam, plantable soil, and high organic soil that is clean and free of any undesirable material and conforms to **SECTION M18**.

L01.03 CONSTRUCTION METHODS.

Place all materials on surfaces that are true to the required lines, grades, and cross sections. Place and spread the materials to the required depth and minimum thickness.

L01.03.1 Loam.

Provide the loam from sources outside the Project limits. Submit a sample for testing before the placement of loam. The Engineer will approve the sample before placement. Loam that does not meet the requirements in **SECTION M18** will be rejected.

Before placement, prepare the surface to receive the loam. Remove and dispose of all roots, sod, weeds, cobbles, or stone with any dimension greater than 1 in.

Grade the loamed surface and, in addition to the removal and disposal before placement, remove and dispose of all roots, sods, weeds, cobbles, or stones with any dimension greater than 1 in. After shaping and grading, do not allow any trucks or other equipment that is not required to perform seeding, mulching, or mowing operations on the loamed areas

Perform this work only with permission from the Engineer. The Engineer may suspend work when it is determined that soil or weather conditions are unsuitable for spreading and/or grading loam. Resume work with the approval of the Engineer.

Seed all loamed areas within two weeks after spreading the loam. Refer to **SECTION L02** for dates and other requirements. Maintain the loamed areas free from erosion until Project acceptance.

L01.03.2 Plantable Soil.

Furnish plantable soil either from sources outside the Project limits (Plantable Soil Furnished and Spread) or from material removed and stockpiled under the excavation items (Plantable Soil Rehandled and Spread). Place plantable soil according to **Subsection L01.03.1**.

L01.03.3 High Organic Soil.

Furnish high organic soil either from sources outside the Project limits (High Organic Soil Furnished and Spread) or remove and stockpile the material under the excavation items (High Organic Soil Rehandled and Spread). Submit a sample for testing before the placement of high organic soil. The Engineer will approve the sample before placement. High organic soil that does not meet the requirements specified in **SECTION M18** will be rejected.

Use a dozer to track all slopes. Ensure that the resulting tracks are perpendicular to the flow of water. Remove and dispose of all roots, sods, weeds, cobbles, or stones with any dimension greater than 4 in. from the soil surface. Do not rake the soil.

After spreading and tracking the high organic soil, apply a wetland seed mix on the same day. Refer to **SECTION L02** for dates and other requirements.

L01.04 METHOD OF MEASUREMENT.

All materials furnished and spread or rehandled and shaped will be measured by the number of square yards for the surface area on which the loam is placed.

L01.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Loam 4-in. Deep	SY
Plantable Soil 4-in. Deep	SY
High Organic Soil 4-in. Deep (Slopes)	SY
High Organic Soil 6-in. Deep (Bottom)	SY

Payment at the Contract unit price is full compensation for all resources, labor, materials; removal and disposal of all roots, sod, weeds, cobbles, or stone with any dimension greater than allowed; trimming and fine grading; seeding as detailed in **SECTION L02**; and equipment and incidentals required to finish the work, complete and accepted.

SECTION L02 — SEEDING

L02.01 DESCRIPTION.

This work includes the preparation of the seed bed, furnishing and placing materials, and establishing the grassed areas. Work includes the following types:

- Type 1. Plantable Soil areas, which are either flats, to be seeded with a General Highway Seed, or slopes, to be seeded with a Slope Seed Mix
- Type 2. Loamed areas adjacent to lawns or sidewalks, seeded with a Residential Seed Mix
- Type 3. Temporary seeding using a Temporary Seed Mix on sloped and flat areas of embankments or excavation sites to provide temporary vegetative cover for erodible soils
- Type 4. Plantable soil areas, either flats or slopes, seeded with a Native Seed Mix
- Type 5. Wetland areas and high organic soil, seeded with a Wetland Seed Mix
- Type 6. Plantable soil areas, either flats or slopes seeded with a Wildflower Seed Mix

Slope areas are defined as 3H:1V or steeper.

L02.02 MATERIALS.

Use lime, fertilizer, mulch, water, and seed mixtures that conform to **SECTION M18**.

L02.03 CONSTRUCTION METHODS.

All seeding is a specialty item.

L02.03.1 Seeding Dates.

Take advantage of time and weather conditions best suited for seeding. The normal dates for seeding shall be as follows:

Type	Spring Seeding	Fall Seeding
1, 2, 4	April 1 to May 31	August 15 to October 15
3	See*	
5	May 1 to June 15	August 15 to September 30
6	April 1 to May 1	September 1 to September 30

* *Seeding may be performed at any time between March 15 and November 15 with approval of the Engineer. Do not use Type 3 seeding on frozen ground.*

Seeding at other than the above times will be allowed only with the written permission of the Engineer. The Engineer may suspend work when it is determined that soil or weather conditions

are unsuitable for raking and/or seeding. The Contractor may resume work when approved by the Engineer.

Notify the Engineer at least 48 hours in advance of initiating seeding. Where there is existing or new plant material, ensure that no lime, fertilizer, mulch, and/or seed mix contacts the plant material or their mulched areas.

L02.03.2 Preparation of Areas for Seeding.

a. Type 1 (General Highway Seeding). Rake Type 1 areas either by hand or mechanically (e.g., power rake) to produce a loose, friable seed bed. Use a dozer to track slopes 3H:1V and steeper. Ensure that the resulting track imprints are perpendicular to the flow of water.

   Remove and dispose of all sticks, litter, wire, weeds, cable, cobbles, or stones larger than 1 in. for any dimension.

   Where the seed bed has become compacted, scarify to a depth of 5 in. before raking. Do not use seeding of this type where the seed bed has not been properly prepared or where the soil is compacted.

b. Type 2 (Residential Seeding). Hand rake Type 2 areas to a finished grade. Remove and dispose of all sticks, litter, wire, weeds, cable, cobbles, and stones larger than ½-in. in any dimension. After hand raking, roll the entire area. Blend the finished grade of the proposed area into the adjacent lawns (where applicable).

   Where the seed bed has become compacted, scarify to a depth of 5 in. before fine raking. Do not use seeding where the seed bed has not been properly prepared or where the soil is compacted.

c. Type 3 (Temporary Seeding). Ensure that Type 3 areas to be seeded are free of depressions and unprotected channels where runoff may cause erosion.

d. Type 4 (Native Grass Seeding). Prepare Type 4 areas according to Para. a.

e. Type 5 (Wetland Seeding). Do not rake Type 5. Remove and dispose of all sticks, litter, wire, weeds, cable, cobbles, or stones larger than 4 in. for any dimension without disturbing the finished grade.

f. Type 6 (Wildflower Seeding). Prepare Type 6 areas according to Para. A. except as designated below.

   For Type 6 areas previously seeded or containing existing vegetation, remove all sod from the site proposed for wildflower seeding. Apply plantable soil to raise the planting bed to final grade after sod removal. Rake the areas to produce a loose friable soil.

L02.03.3 Application of Lime.

Apply lime (ground or pelletized) dry and spread evenly over the entire surface to be seeded. Use an application rate of 1 ton per acre. Complete the raking after the lime and fertilizer have been applied. DO NOT APPLY LIME ON TYPE 3, TYPE 4, AND TYPE 5 AREAS.

L02.03.4 Application of Fertilizer.

After the application of lime, spread the fertilizer at the following rates:

- Types 1 and 2 — 850 lb per acre
- Type 3 — 650 lb per acre
- Type 4 — 500 lb per acre
- Type 5 — Do not apply fertilizer
- Type 6 — 150 lb per acre

Incorporate both the lime and fertilizer into the soil by raking according to **Subsection L02.03.2**.

L02.03.5 Sowing of Seed.

After the seed beds have been prepared as outlined in **Subsections L02.03.2** through L02.03.4, apply grass seed conforming to the applicable formula in **Subsection M18.10** according to the specified rates. Apply the fertilizer, grass seed, and cellulose fiber mulch for all Types in one operation.

a. Type 1 (General Highway Seeding). Seed Type 1 areas with General Highway Seed Mix on flats and with Slope Seed Mix on slopes. Both mechanical and hydroseeding methods may be used.

b. Type 2 (Residential Seeding). Seed Type 2 areas with a Residential Seed Mix. Use additional hand raking and rolling in lieu of mulch. The Engineer will not accept these areas until a generally weed-free, 3-in. stand of grass is established.

c. Type 3 (Temporary Seeding). Seed Type 3 areas with a Temporary Seed Mix on flats and slopes. Both mechanical and hydroseeding methods may be used.

d. Type 4 (Native Grass Seeding). Seed Type 4 areas with a Native Seed Mix. Both mechanical and hydroseeding methods may be used.

e. Type 5 (Wetland Seeding). Seed Type 5 areas with a Wetland Seed Mix. Where there is access for a hydroseeder, spread the Wetland Seed Mix using this method only. Where there is no access for a hydroseeder, spread the wetland seed mix by a hand-held spreader.

f. Type 6 (Wildflower Seeding). Seed Type 6 areas with a Wildflower Seed Mix. Seeds may be mechanically applied by overseeding the area with a slit seeder or broadcast with the use of a drop or broadcast spreader. A hydroseeder may be used. When a hydroseeding method is used, use the seed, fertilizer, and 10 percent of the mulch in the first application and the remaining 90 percent of mulch in a second application.

   If a slit seeder is used, disburse the seed 3 in. on center and ¼-in. deep. Make two passes, the second perpendicular to the first. Disburse small seeds separately from larger seeds.

   If a drop or broadcast seeding method is used, spread the large seed separately from small seeds. Disburse each seed type (large or small) in two passes, the second perpendicular to the first. Hand rake the area to provide a soil coverage of a ¼ in.

L02.03.6 Mulching.

Cover all seeded areas with a suitable mulch at the time of seed application. Use cellulose fiber mulch that conforms to **Subsection M18.08.1**.

Use cellulose fiber mulch separately or as part of a hydroseeding operation. If cellulose fiber mulch is applied separately, apply the mulch immediately after the seeding operation.

Remove cellulose fiber mulch that becomes adhered to signs, sign posts, lighting standards, new or existing plant materials, and/or walls.

L02.03.7 Care During Construction.

Reseed any areas that fail to show a uniform growth of grass until the areas are covered with a satisfactory growth of grass as approved by the Engineer.

For the seed, fertilizer, etc., used in reseeding operations, use the required application rates and required seeding dates as previously specified.

a. Watering. Water Type 1, Type 2, Type 4, and Type 6 seeded areas within 72 hours of the seeding operation. One additional watering may be required.

   Apply water at a controlled rate and ensure that the water reaches the root zone. Do not allow watering operations to flood adjacent areas, erode soil, or cause damage to the seeded areas.

b. Mowing. Accomplish the mowing for Type 1 seeded areas in two mowings per year on areas flatter than 3H:1V. Perform mowing on Type 2 seeded areas when the grass has obtained a height of 4 in. and then maintain at a 4-in. height until accepted.

   Only mow Type 1 and Type 2 seeded areas.

   Ensure that each cutting results in a stand of evenly mowed grass, 3 in. tall immediately following the cutting. Perform neat trimming around all poles, trees, ledges, delineators, curbs, piers, abutments, and other structures falling within the seeded areas, which will be conducted simultaneously with the mowing during each cutting operation. Trim and expose all curbs; ensure that all gutters are free of grass clippings.

c. Failure to Perform Care During Construction. If the Engineer determines that the care during construction tasks as specified in the Contract have not been performed, the daily charge set forth in **SECTION 110** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. The daily charge will continue each consecutive calendar day until the deficiencies have been corrected to the satisfaction of the Engineer.

L02.04 METHOD OF MEASUREMENT.

Seeding will be measured by the number of square yards seeded.

L02.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Seeding	SY

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the seeding work, complete and accepted.

SECTION L03 — SODDING

L03.01 DESCRIPTION.

This work includes the preparation of the sod bed and furnishing, placing, and caring for sod as required.

L03.02 MATERIALS.

Provide sod, lime, fertilizer, water, and wooden pegs that conform to **SECTION M18**.

L03.03 CONSTRUCTION METHODS.

L03.03.1 Sodding Dates.

The following dates for sodding apply:

- Spring Sodding: April 1 to June 30
- Fall Sodding: December 15 to November 15

Do not perform sodding on frozen ground. Do not place frozen sod.

Notify the Engineer at least 48 hours in advance of the time intended for commencement of sodding. Where there is existing or new plant material, ensure that no lime or fertilizer contacts the plant material or the mulched areas.

L03.03.2 Shipping, Handling, Storage, & Delivery.

Protect the sod from damage while in transit or in storage. Do not use sod that has been damaged or has deteriorated. Place sod within 36 hours of harvesting.

L03.03.3 Preparation of the Sod Bed.

Place sod on a minimum of 4 in. of loam or plantable soil. Ensure that the top surface of the sod meets the specified grades or is flush with the surrounding finished grades and/or structures.

Hand rake the sod bed to produce a loose, friable surface. Remove and properly dispose of all sticks, litter, wire, weeds, cable, cobbles or stones larger than ½ in. in any dimension. After hand raking, roll the entire area with a hand roller.

Where the sod bed has been compacted, scarify the sod to a minimum depth of 5 in. before fine raking. Do not place sodding where the sod bed has not been properly prepared or where the soil has become compacted.

L03.03.4 Application of Lime.

Apply lime (ground or pelletized) dry and spread evenly over the entire surface to be sodded. Use an application rate of 1 ton per acre. Complete the raking after fertilizer has been applied.

L03.03.5 Application of Fertilizer.

After the application of lime, spread the fertilizer at the rate of 500 lb per acre on both flats and slopes.

Incorporate both the lime and fertilizer into the soil by raking. Rake the sodded areas by hand only.

L03.03.6 Placing of Sod.

Ensure that the sod bed is moist. Ensure that a watering truck is on site at all times during the sodding operation. Lay sod to be placed in drainage ways and where continuous or solid sodding is stipulated with the longest dimension parallel to the contours. Ensure that the finished grades at junctions of drainage ways are properly constructed.

Lay the first row of sod in a straight line with subsequent rows placed parallel to and tightly against each other. Stagger lateral/vertical joints at a minimum of 12 in. to promote uniform growth and strength. Only use full-sized sod strips unless otherwise directed by the Engineer. Ensure that the sod is not stretched or overlapped and that all joints are butted tight.

Immediately after the sod is placed, press the sod firmly into contact with the sod bed by tamping, hand rolling, or other methods approved by the Engineer. Do not displace or deform the sod. Cut the sod to the required line or as directed by the Engineer.

L03.03.7 Pegging.

Hold the sod in place with pegs to prevent any movement in all drainage ways, on all slopes 2H:1V or steeper, and elsewhere as required.

L03.03.8 Watering.

Water and maintain new sodded areas until the sod is firmly rooted as determined by the Engineer. Use water that is free of contaminants and from a municipal, domestic, or other source suitable for irrigation.

Replace all dead, dying, and damaged sod as directed at no additional cost to the Department.

L03.03.9 Joint Dressing.

Examine the entire area for open joints or other signs of surface imperfection. Fill all open joints or other voids with loam or plantable soil.

L03.03.10 Care During Construction.

Maintain the sodded areas, including watering and mowing, until all newly sodded areas have been accepted. Before acceptance of the work, reshape, refertilize resod or repair any damaged areas according to the applicable Specifications and to the satisfaction of the Engineer at no additional cost to the Department.

- Mowing. Maintain the grass between 3-in. minimum and 4-in. maximum. Trim all areas at the same time as mowing to the same height. Remove all clippings from gutters.
- Failure to Perform Care During Construction. If the Engineer determines that the care during construction tasks as specified in the Contract have not been performed, the daily charge in **SECTION 110** will be deducted from monies due the Contractor. The daily charge will continue each consecutive calendar day until the deficiencies noted have been corrected to the satisfaction of the Engineer.

L03.04 METHOD OF MEASUREMENT.

Sodding will be measured by the number of square yards installed.

L03.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Sodding	SY

The price constitutes full compensation for the preparation of sod beds, for furnishing and applying all lime, fertilizer, pegs, sod, raking, mowing, watering, care during construction, and for all labor, materials and equipment and incidentals required to finish the work, complete and accepted.

SECTION L04 — REFERTILIZATION OF SEEDED, SODDED, AND GRASSED AREAS

L04.01 DESCRIPTION.

This work includes a second application of fertilizer to newly seeded and newly sodded areas and/or the application of fertilizer to existing grassed areas.

L04.02 MATERIALS.

Use fertilizer that conforms to **SECTION M18.**

L04.03 CONSTRUCTION METHODS.

Allow one growing season between the first application of fertilizer to newly seeded areas as required under **SECTION L02** and newly sodded areas as required under **SECTION L03**. The second application is described below.

L04.03.1 Seeded Areas.

Spread the refertilization for seeded areas at the following rates:

- Types 1 and 2 — (850 lb per acre)
- Type 3 — No refertilization is required
- Type 4 — 250 lb per acre
- Type 5 — No refertilization is required
- Type 6 — 75 lb per acre

L04.03.2 Sodded Areas.

Spread the refertilization of sodded areas at the rate of 500 lb per acre.

L04.03.3 Existing Grassed Areas.

Spread the application of fertilizer to existing grassed areas at the rate of 500 lb per acre.

L04.04 METHOD OF MEASUREMENT.

Refertilization of Seeded, Sodded, and Grassed Areas will be measured by the number of acres fertilized.

L04.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Refertilization of Seeded, Sodded, and Grassed Areas	ACRE

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION L05 — SEED STABILIZERS

L05.01 DESCRIPTION.

This work includes furnishing and placing seed stabilizers over seeded areas at the required locations.

L05.02 MATERIALS.

Seed stabilizers include jute mesh, excelsior matting, erosion control blankets, adhesive mulch stabilizer, and straw mulch. Use materials that conform to **SECTION M18.**

L05.03 CONSTRUCTION METHODS.

L05.03.1 Jute Mesh.

a. General. Apply jute mesh immediately after seeding. Loosely install the mesh but smoothly to fit the contour of the finished grade, parallel to and in the same direction as the surface flow of storm water.

b. Anchor Slots and Junction Slots. Bury the up-slope end of each separate strip or piece of jute mesh in a 6-in. minimum vertical anchor slot or junction slot with the soil tamped firmly against the mesh. The Engineer may require that any edge likely to be exposed to greater than normal flow be similarly buried.

c. Check Slots. Space the check slots so that at least one check slot, junction slot, or anchor slot of the jute mesh occurs in each 75 ft on gradients of less than 4 percent and in each 50 ft on gradients of more than 4 percent. On slope drains, provide a check slot or an end every 25 ft.

   Form check slots by folding 1 ft of the jute into a 6-in. vertical slot at right angles to the flow of water. Staple the jute into place, and tamp the surrounding soil at each check slot.

d. Overlap. Where more than one width of material is required, overlap edges a minimum of 4 in.; overlap the ends at junction slots a minimum of 12 in., and ensure that the upslope section of mesh is on top.

e. Terminal Folds. Fold the downhill ends of the jute mesh under approximately 4 in. and staple in place.

f. Stapling. Insert the staples through the mesh along edges and overlaps and in the center of all jute mesh strips at intervals not greater than 3 ft. Ensure that all anchor slots, junction slots, check slots, and terminal folds have five staples spaced not more than 9 in. on center across their widths.

g. Over-Seeding. After the jute mesh has been secured in place and immediately before rolling, over-seed all areas disturbed by installation of the jute mesh using the appropriate seed mixture.

h. Maintenance and Repair. Maintain the areas of jute mesh until all work on the Project is completed and accepted. Before acceptance of the work, if staples have become

loosened or raised or if jute mesh has become loose, torn or undermined, then reshape, refertilize and reseed the damaged areas. Repair or replace the jute mesh according to the above Specifications at no additional cost to the Department.

L05.03.2 Excelsior Matting.

a. General. Elevate the areas to receive excelsior matting to the lines and grades indicated, with a smooth surface free of depressions and eroded areas that will allow water to collect or flow under the matting. Apply the matting immediately after seeding and evenly without stretching. Ensure that the matting lies smoothly to fit the contour of the finished grade, parallel to and in the same direction as the surface flow of storm water.

b. Abutting Ends. Butt the adjoining ends and, where more than one width of material is required, ensure that the ends are laid parallel to one another with the edges butted snugly.

c. Stapling. Secure the matting in place with staples driven vertically into the soil. Space the staples not more than 2 ft in three rows for each strip, with one row along each edge and one row spaced 12 in. apart across their width.

d. Maintenance and Repair. Maintain the excelsior matted areas until all work on the Project has been completed and accepted. Maintenance includes the repair of areas damaged by erosion, wind, fire, or other causes. Repair damaged areas to re-establish the condition and grade of the soil before application of the matting, and then reshape, refertilize, and reseed. Repair or replace the excelsior matting according to the above Specifications at no additional cost to the Department.

L05.03.3 Erosion Control Blankets.

Place erosion control blankets according to Subsection L05.03.2.

L05.03.4 Adhesive Mulch Stabilizer.

a. Preparation. Mix the adhesive mulch stabilizer in the proportion of 1 gal of stabilizer to 5½ gal of water. Apply a resulting mix of 130 gal of adhesive mulch stabilizer to 715 gal of water per acre or according to the manufacturer's recommendations.

b. Application. Apply the slurry at the above specified rate in a uniform and even coat.

L05.03.5 Straw Mulch.

Apply straw to seeded areas by hand or blower at the rate of 0.62 to 0.82 lb/sq yd (1½ to 2 tons/acre). Do not distribute straw onto new or existing plant material, pavement surfaces (driveways, roads, or sidewalks) or other areas not designated to receive straw.

L05.04 METHOD OF MEASUREMENT.

Jute Mesh, Excelsior Matting, and Erosion Control Blanket will be measured by the number of square yards installed.

Adhesive Mulch Stabilizer and Straw Mulch will be measured by the number of acres installed.

L05.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Jute Mesh	SY
Excelsior Matting	SY
Erosion Control Blanket	SY
Adhesive Mulch Stabilizer	ACRE
Straw Mulch	ACRE

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to complete the work according to the Contract.

SECTION L06 — PLANTING

L06.01 DESCRIPTION.

This work includes furnishing, planting, watering, mulching, staking and guying trees, shrubs, vines, perennials, ornamental grasses, ground covers, and bulbs of the required type and size.

L06.02 MATERIALS.

Use plant materials, antidesiccant, loam, fertilizer, bone meal, mulch, water, stakes, guy webbing fabric, and herbicide that conform to **SECTION M18**.

L06.03 CONSTRUCTION METHODS.

L06.03.1 General.

Perform all work under the supervision of the Engineer. No payment will be made for work performed when the Engineer is not present.

Ensure that all individuals performing planting or pruning operations possess a current Rhode Island Arborist License or is directly supervised by an individual who does. Ensure that herbicides are applied only by individuals who possess a current Rhode Island Commercial Applicators License.

L06.03.2 Planting Dates.

Plant all plant material during the Spring or Fall planting season as indicated below. Do not plant any material in frozen ground or when snow covers the ground. Resume work when directed by the Engineer:

- Balled and burlapped and container material deciduous:
  - Spring: March 1 to June 30
  - Fall: September 1 to December 15
- Balled and burlapped and container material evergreen (broadleaf and needled):
  - Spring: April 1 to May 15
  - Fall: December 15 to October 15

Planting at other than the above time will be allowed only with the written permission of the Engineer. Resume work when directed by the Engineer in writing.

L06.03.3 Selection, Tagging, Shipment, and Storage.

The Engineer will inspect and tag at the nursery all plants proposed for a specific Project. Provide seven days' notice to the Engineer before any tagging operations. Ensure that all plant material meets the American Association of Nurseryman Standards for Nursery Stock, currently adopted edition, and its amendments. The Department will only accept plants that are hardy for Zone 6 or lower, as determined by the USDA.

Ensure that a certificate of inspection accompanies each package, bale, box, or carload lot shipped or otherwise delivered. When more than one variety of a species, or more than one species of a genus is required for a Project, ensure that each plant or bundle of plants is tagged as to variety and/or species before delivery to the job site. Provide a certificate of compliance for all plant materials at the time of delivery to the job site.

L06.03.4 Substitution.

Do not make any substitutes in type and size of plant materials without the written consent of the Engineer.

L06.03.5 Layout and Excavation of Plant Holes.

Stake plant material locations and bed outlines on the Project site before any planting holes or beds are excavated. Notify the Engineer, in writing, at least 24 hours in advance, excluding weekends and holidays, before the start date of layout operations. All staked locations will be approved by the Engineer before excavating planting holes.

L06.03.6 Planting and Backfilling.

Complete all watering of plant material during the backfilling process regardless of weather conditions. At all times during the planting operation, ensure that a watering truck is on site and prepared for watering activities.

Apply water at a controlled rate to ensure that the water reaches the root zone (saucer) of the plant or plant bed and does not run off to or flood adjacent areas.

L06.03.7 Mulching.

Apply mulch after the first watering and no later than one week after planting.

Before placing mulch, apply a pre-emergent weed control around all individual trees, shrubs, and shrub beds, and around all plant material to be mulched. A Rhode Island Licensed Commercial Applicator shall apply pre-emergent weed control at a rate according to the manufacturer's instructions and as approved by the Engineer. Furnish mulch material and place over all saucer areas of individual trees and shrubs and over the entire area of planting beds as required.

L06.03.8 Pruning.

Perform pruning of all plants under the supervision of a Rhode Island Licensed Arborist skilled in this work and according to currently accepted horticultural practice.

L06.03.9 Antidesiccant Application.

a. Spring Applications. Apply antidesiccant on all evergreen and deciduous plant material (trees, shrubs, and vines) planted during the Spring season on exposed and/or windy sites within ten days after the planting operation. Do not apply antidesiccant when the temperature is 90°F or hotter.

b. Fall Applications. Apply antidesiccant on all evergreen plant material (trees, shrubs, and vines), regardless of time of planting or planted location, between November 15 and December 15.

Use antidesiccant applications that meet the manufacturer's instructions for mixture and temperature range. Do not apply antidesiccant in the rain. Ensure that antidesiccant applications cover all sides of the leaf or needle.

L06.03.10 One-Year Establishment Period.

All plant material shall receive a one-year establishment (Guarantee) period. During this time, employ currently accepted horticultural practices to keep all plant material installed in a living, healthy condition up to the date of final acceptance, which shall be one calendar year following the satisfactory completion of the planting activities as confirmed, in writing, by the Engineer.

During this period, water, weed, cultivate, prune, mulch and repair, replace, or readjust guy webbing and stakes as required or as directed by the Engineer. Reshape plant saucers, repair wash outs and gullies, replace lost mulch, keep all planting sites free from weeds, and perform other work necessary to maintain the plant material in a healthy, growing condition.

Promptly remove all dead, dying, or rejected plant material, as determined by the Engineer, from the Project during the period of establishment. Replace in kind, quantity, and size as originally specified with live, healthy specimens selected and planted. All replacement plant material shall, from the time of installation, receive a one-year establishment period, according to this Subsection.

If the Engineer determines that the one-year establishment period tasks in the Contract have not been performed as specified, the daily charge in **SECTION 110** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. The stated daily charge will continue each consecutive calendar day thereafter until the deficiencies noted have been corrected to the satisfaction of the Engineer.

L06.04 METHOD OF MEASUREMENT.

Planting will be measured by the number of trees, shrubs, vines, perennials, ornamental grasses, groundcover, or bulbs of the specified types and sizes installed.

L06.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Plantings	EA

The accepted quantities of Planting of the various types will be paid for at the Contract unit price per each type.

SECTION L07 — EXTENDED ESTABLISHMENT PERIOD

L07.01 DESCRIPTION.

This work includes performing currently accepted horticultural practices to ensure that all plant material installed remains in a living, healthy condition up until the date of final acceptance. That date is three calendar years following the satisfactory completion of the planting activities as confirmed in writing by the Engineer.

L07.02 MATERIALS.

Use water, fertilizer, pre-emergent herbicide, mulch, antidesiccants, stakes, guy webbing, and plant material that conforms to **SECTION M18.**

L07.03 CONSTRUCTION METHODS.

L07.03.1 General.

This work includes the establishment of previously planted trees, shrubs, vines, perennials, ornamental grasses, ground covers, bulbs, and wildflowers. Perform the establishment tasks of watering, weeding, mulching, fertilization, pruning, mowing, and replacement of dead, dying, or rejected plant material.

a. Submittal. Submit to the Engineer at the start of each year a schedule of work for establishment activities for that year.

b. Landscape Establishment Crew. Employ one or more Landscape Establishment Crews during the Contract period. Ensure that the crews are under the supervision of a licensed Rhode Island Arborist. Ensure that each crew member has been trained in current horticultural practices.

   Ensure that the Landscape Establishment Crews perform all establishment tasks.

L07.03.2 Watering.

Perform watering of all plant material once every two weeks for a total of 13 times during each Contract year from June 1 through October 31. Water wildflower areas once a month during each Contract year from June 1 through October 31 for a total of five waterings. At each watering, saturate the soil around each plant. The Engineer may require additional watering as needed based on the weather conditions.

Apply water at a controlled rate and so as to ensure that the water reaches to root zone (saucer) of the plant or plant bed and does not run off to nor flood adjacent areas. Ensure that watering does not dislodge plants, erode soil or mulch, or cause damage to the saucer berm. Saturate each saucer or planting bed before moving on to the next site. Do not use the overhead hydroseeder spray nozzles as a watering device. The hydroseeder can be used to transport and store water for watering operations and when a hose and nozzle are properly attached and approved by the Engineer, and the hydroseeder can be used for watering operations.

Complete all watering regardless of weather conditions.

L07.03.3 Mulching.

Place mulch during the second year of the establishment period on all individual plants and plant beds or as directed by the Engineer. Before placement, remove all weeds, stones, and other extraneous material. Apply pre-emergent weed control around all individual plants and plant beds to be mulched. Pre-emergent weed control shall be applied by a Licensed Rhode Island Commercial Applicator and at a rate according to the manufacturer's instructions.

Ensure that the amount of new mulch results in a finished depth of 2 in. of mulch (old and new) or as directed by the Engineer. Do not mulch wildflower areas.

L07.03.4 Fertilization.

Perform soil tests before fertilizing and ensure that the results comply with the recommendations from the licensed Rhode Island Arborist. Apply fertilizer during the first and third year of the establishment period on all individual plants and plant beds or as directed by the Engineer. Fertilize between April 1 and June 15 only.

Broadcast fertilizer over all individual plants and plant beds at a rate of 1 oz/sq ft. Do not fertilize wildflower areas.

L07.03.5 Weed Control.

The Landscape Establishment Crew shall manually remove all weed growth, including grass and litter from individual plants and planting beds. Remove woody growth, vines, and other undesirable volunteers and properly dispose of. Remove all woody growth, vines, and litter from wildflower areas. Perform weed control activities so as to not disturb or destroy plant material or mulched areas.

L07.03.6 Pruning.

Perform pruning of all plants according to **Subsection L06.03.8**.

L07.03.7 Insect and Disease Control.

Periodic inspection of all plantings by trained personnel is necessary to detect problems during the early stages of insect infestations or disease infections. Apply all chemicals including insecticides and fungicides according to applicable Rhode Island State laws and only by individuals with a current Rhode Island Pesticide Applicators License as approved by the Engineer before application.

L07.03.8 Stake and Guy Inspection and Removal.

During the first year, replace and repair any broken stakes and/or guy webbing.

After the first year, remove all stakes and guy webbing. The Engineer will identify the individual plants for which the stakes and guy webbing will remain beyond the first year. Remove these stakes and guy webbing only at the direction of the Engineer.

L07.03.9 Inspection, Removal, and Replacement of Dead or Damaged Plant Material.

Remove all dead or damaged plant material. Replace the removed material in kind, quantity, and size as originally specified with live, healthy specimens selected and planted according to **SECTION L06**. Ensure that all replaced plant material complies with **SECTION L07** up to and until the end of this activity.

L07.03.10 Failure to Perform Extended Establishment Period.

If the Engineer decides that the extended establishment period tasks in the Contract have not been adequately performed as specified, the daily charge in **SECTION 110** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. The stated daily charge will continue each consecutive calendar day thereafter until the deficiencies have been corrected to the satisfaction of the Engineer.

L07.04 METHOD OF MEASUREMENT.

The Extended Establishment Period will be measured for payment per month for eight months during the work season.

L07.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Extended Establishment Period	PMO

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION L08 — TREE AND SHRUB TRIMMING

L08.01 DESCRIPTION.

L08.01.1 Tree and Shrub Trimming.

This work includes removing and disposing of all dead wood, stubs, broken or damaged branches and stems, undesirable branches, and stems from existing trees and shrubs.

L08.01.2 Trimming for Utilities.

This work includes removing and disposing of all dead wood, stubs, broken or damaged branches and stems, and undesirable branches and stems from existing trees for the required utility relocation.

L08.02 MATERIALS.

Use materials that conform to **SECTION M18**.

L08.03 CONSTRUCTION METHODS.

Ensure that all tree and shrub trimming is performed by or under the supervision of a Rhode Island Licensed Arborist.

Remove and dispose of all branches interfering with or hindering the healthy growth of the tree or shrubs. For any branches that are partially dead yet have a healthy lateral branch at least one-third the diameter of the parent branch, remove only beyond the healthy branch. Remove all branches that interfere with the overhead clearance (i.e., 14 ft above the roadway surface) or are within sight lines for overhead signs, at intersections, or around horizontal curves.

Make all cuts parallel to and as close to the branch or stem collar as practical. Make all cuts using a three-point cut with limited damage to the branch collar. Do not allow pruning to deform or destroy the typical shape or symmetry of the tree or shrub. Make all cuts with disinfected, sharp tools that will be approved by the Engineer.

Do not use tree paint on any cuts. Do not use climbing irons or other equipment injurious to trees.

L08.04 METHOD OF MEASUREMENT.

L08.04.1 Tree and Shrub Trimming.

Tree and Shrub Trimming will be measured by the number of hours employed in trimming.

L08.04.2 Tree Trimming for Utilities.

Tree Trimming for Utilities will be measured by the number of crew-hours employed in trimming.

L08.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Tree and Shrub Trimming	HR
Tree Trimming for Utilities	CHRS

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION L09 — SELECTIVE CLEARING

L09.01 DESCRIPTION.

This work includes the removal and disposal of trees, shrubs, vines, and stumps.

L09.02 MATERIALS.

Use herbicides that conform to **SECTION M18**.

L09.03 CONSTRUCTION METHODS.

Mark all trees, shrubs, vines, and other plant materials designated to remain in the field as approved by the Engineer. Cut off the remaining trees, shrubs, vines, and stumps flush with the ground.

Stack trunks and branches over 8 in. in caliber as cordwood in 4-ft lengths or dispose of according to **Subsection 201.03.1**. Remove and dispose of small branches, leaves, and other refuse.

Use a foliar spray of a non-destructive herbicide on all poison ivy, bull briar, or other noxious weeds remaining in these areas. Use a Licensed Rhode Island Commercial Applicator to apply non-selective herbicides according to the manufacturer's instructions and as approved by the Engineer.

Remove all dead trees from the area. Perform all work so as to enhance the area. Do not disturb the remaining natural growth.

L09.04 METHOD OF MEASUREMENT.

Selective Clearing will be measured by the number of acres cleared and cleaned up, which will be established by flagging or as otherwise determined by the Engineer.

Any area designated as a Clearing and Grubbing area will not be included in the measurement.

L09.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Selective Clearing	ACRE

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION L10 — TREE AND SHRUB ROOT PRUNING

L10.01 DESCRIPTION.

This work includes both the mechanical and manual pruning of existing tree and shrub roots to allow for the installation of a new roadway and roadway features without causing extensive damage to the root systems of nearby plant materials.

L10.02 MATERIALS.

Use materials that conform to **SECTION M18**.

L10.03 CONSTRUCTION METHODS.

Notify the Engineer 48 hours before commencement of this work. Ensure that all work is performed under the direct supervision of a licensed Rhode Island Arborist. Ensure that all work occurs in the presence of the Engineer.

L10.03.1 Pruning Dates.

Perform mechanical and manual pruning of tree and shrub roots between December 15 and June 15 of the following year.

L10.03.2 Mechanical Root Pruning.

Initiate this work before any excavation work within the Project limits. Roots found during excavation, outside the designated mechanical root pruning area, may require hand pruning at the direction of the Engineer. Do not use trencher or excavator equipment. Use hand equipment that has been disinfected, sharpened, and approved by the Engineer. Use air or hydro excavation only to expose root cuts for evaluation when required.

Perform mechanical root pruning 6 in. to 12 in. from the edge of any proposed excavation. The Contractor and Engineer will field locate the areas to be pruned before commencement of this work.

Provide a cut 2 in. to 4 in. wide and 15 in. to 18 in. deep. Do not use paint on wounds caused by pruning.

L10.03.3 Manual Root Pruning.

Proceed with this work before any excavation work within the Project limits. The Engineer will delineate manual root pruning in the field before commencement. However, manual root pruning limits may be extended by the Engineer to other areas.

Perform manual root pruning with hand equipment that is disinfected and sharp.

Hand dig the soil from the delineated area so as to not rip or otherwise damage the roots during the excavation process. Once located, totally expose the root(s) by hand, and cleanly cut the root(s) using hand pruning equipment.

Perform pruning immediately following the exposure of root(s). After pruning, cover the exposed root(s) with existing soil and lightly tamp to remove air pockets. Do not expose any roots for more than one hour.

L10.04 METHOD OF MEASUREMENT.

Mechanical Tree and Shrub Root Pruning and Manual Tree and Shrub Root Pruning will be measured by the number of linear feet of each item pruned. Exposing root cuts for evaluation by the Engineer is not measured for payment.

L10.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Mechanical Tree and Shrub Root Pruning	LF
Manual Tree and Shrub Root Pruning	LF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to complete the work according to the Contract.

No payment will be made for work performed when the Engineer and the Arborist are not present.

If hydro excavation equipment is not on site and needs to be brought in, this will be paid for as Extra Work.

SECTION L11 — TREE AND SHRUB PROTECTION DEVICE

L11.01 DESCRIPTION.

L11.01.1 Tree Protection Device.

This work includes applying wood framing around the trunk or trunks of the tree from the ground level to a height of 6 ft.

L11.01.2 Shrub Protection Device.

This work includes applying standardized snow fencing around shrubs in a circumferential manner.

L11.01.3 Drip-Line Tree Protection Device.

This work includes applying standardized snow fencing around the drip-line of trees in a circumferential manner.

L11.02 MATERIALS.

L11.02.1 Tree Protection Device.

Wood framing includes nominal lumber 6 ft in length; the width and thickness varies from 2 in. × 2 in. to 2 in. × 6 in., depending on trunk diameter. Binding material includes single strand, 9-gauge wire or ½-in. strapping.

L11.02.2 Shrub Protection Device.

Fencing includes standardized snow fencing. Use standard steel posts to maintain the position of the fencing. Use steel posts that are a minimum of 6 ft in length.

L11.02.3 Drip-Line Tree Protection Device.

Use materials that conform to **Subsection L11.02.2** for shrub protection devices.

L11.03 CONSTRUCTION METHODS.

L11.03.1 Tree Protection Device.

Place the wood framing around the trunk in sufficient quantity to protect the trunk from mechanical damage. Do not space wood framing members greater than 4 in. apart. Ensure that the binding material is tight to prevent the wood from moving. Do not allow the binding material to contact any portion of the tree. Do not allow nails or any other fasteners to enter the tree. Remove and dispose of the wood framing when all mechanical work within the surrounding area has been completed.

L11.03.2 Shrub Protection Device.

Place the snow fencing around the shrub in a circumferential manner ensuring a 1-ft clearance between the face of the fence and outer face of the shrub. If a 1-ft clearance is not practical, locate the fence as close to the shrub as needed without touching the shrub. Do not secure the fence to the shrub. Use standard steel posts to support the snow fence. Do not secure restraining lines to the shrub or to the surrounding vegetative growth. Remove the fencing when all mechanical work within the surrounding areas has been completed.

L11.03.3 Drip-Line Tree Protection Device.

Place the snow fencing around the drip-line of the tree the same as indicated in **Subsection L11.03.2**.

L11.04 METHOD OF MEASUREMENT.

L11.04.1 Tree Protection Device.

Tree Protection Device will be measured by the number of each unit installed.

L11.04.2 Shrub Protection Device.

Shrub Protection Device will be measured by the number of linear feet actually installed.

L11.04.3 Drip-Line Tree Protection Device.

Drip-Line Tree Protection Device will be measured by the number of linear feet installed.

L11.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Tree Protection Device	EA
Shrub Protection Device	LF
Drip-Line Tree Protection Device	LF

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

SECTION L12

This Section has been Reserved for Future Use.

SECTION L13

This Section has been Reserved for Future Use.

SECTION L14 — HERBICIDE

L14.01 DESCRIPTION.

L14.01.1 Pre-Emergent Herbicide Application in Mulch Areas.

This work includes the application of a pre-emergent herbicide on areas to be mulched as part of new planting operations or previously mulched areas to prevent new weed growth.

L14.01.2 Nonselective and Pre-Emergent Herbicide Application.

This work includes the application of either a nonselective herbicide or a pre-emergent herbicide or both herbicides where weeds will be killed within the limits of the Project.

L14.02 MATERIALS.

Use non-selective and pre-emergent herbicides applied that conform to **Subsection M18.14**.

L14.03 CONSTRUCTION METHODS.

L14.03.1 Pre-Emergent Herbicide Application in Mulch Areas.

After the completion of mulching operations, apply a pre-emergent herbicide on all mulch areas as required.

Use a rate of application according to the manufacturer's guidelines and approved by the Engineer. Ensure that all work under this item is performed by or under the direct supervision of a Rhode Island Licensed Commercial Applicator.

L14.03.2 Nonselective and Pre-Emergent Herbicide Application.

Apply these two herbicides where weeds must be killed within the Project limits.

Apply the chemicals either by separate applications or in one combined application. Use a rate of application for each chemical according to the manufacturer's directions and approved by the Engineer.

Ensure that all work under this item is performed by or under the direct supervision of a Rhode Island Licensed Commercial Applicator.

L14.04 METHOD OF MEASUREMENT.

L14.04.1 Pre-Emergent Herbicide Application in Mulch Areas.

Pre-Emergent Herbicide Application in Mulch Areas for previously mulched areas will be measured by the number of square yards applied.

For new planting operations, pre-emergent herbicide applications in mulched areas will not be measured separately but will be included in the measurement for the individual plant material.

L14.04.2 Nonselective and Pre-Emergent Herbicide Application.

Nonselective and Pre-Emergent Herbicide Application will be measured by the number of square yards applied.

L14.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities as follows.

Pay Item	Pay Unit
Pre-Emergent Herbicide Application in Mulch Areas	SY
Non-Selective and Pre-Emergent Herbicide Application	SY

Payment at the Contract unit price is full compensation for all resources, labor, materials, equipment, and incidentals required to finish the work, complete and accepted.

Part M
MATERIALS

SECTION M01 — BORROW AND AGGREGATES

M01.01 COMMON BORROW.

Use common borrow that is gravelly in nature and conforms to the minimum test data as specified below.

a. Boulders. Include boulders (retained on a 3-in. sieve) up to 9 in. in diameter and not exceeding three-fourths of the thickness of horizontal layers placed after compaction, as specified in **Subsection 202.03.2(c)**. However, these sizes are not included in the analysis for gradation.

b. Material. Use material that contains no more than 17 percent by weight passing the No. 200 sieve.

Use common borrow that conforms to all applicable specification requirements before its final placement on the Project. Do not cull deleterious or out of specification material after placement and/or grading in-place.

M01.02 GRAVEL BORROW.

Use gravel borrow that consists of bank run sand and gravel or plant processed and crushed or uncrushed gravel with fine aggregate added as filler. Alternatively, gravel borrow may consist of selected materials that have been reclaimed from within the Project limits and that are proportioned and processed to produce granular material for reuse as gravel borrow within the source Project limits. Use gravel borrow, whether consisting of bank run or plant processed sand and gravel, or reclaimed and processed granular material, that consists of sound, durable particles free from loam, clay, organic soil, vegetative matter, and soft and elongated particles.

M01.02.1 Bank Run or Plant Processed Sand and Gravel.

Use bank run or plant-processed sand and gravel for gravel borrow that is well graded and meets the gradation requirements specified in Column I(a) of the Table in **Subsection M01.09**. In addition, ensure that the maximum particle size does not exceed 9 in. or three-fourths of the loose lift thickness, whichever is smaller.

M01.02.2 Reclaimed and Processed Granular Material.

Gravel borrow may be produced by reclamation of selected materials available within the Project limits, or other sources as approved by the Engineer, that are suitably proportioned and processed to produce a mixture of granular particles meeting the gradation requirements specified herein. Suitable materials may include natural granular soils, boulders, or rock; roadway subbase, base, and asphalt or concrete pavement; and other concrete, stone, brick, or cinder block, recovered from existing foundations, buildings, or selected utilities.

Do not use the following materials for reclamation:

- Rubber, plastic, glass, wood, reinforcing steel, or other metallic materials
- Building materials that may be sources of lead or asbestos
- Components of septic, leaching bed, and sanitary sewer systems including soils, pipes, and structural concrete
- Soils or other materials contaminated by synthetic organic or inorganic compounds, metals, or petroleum hydrocarbon products

Crush or pulverize and break down asphaltic concrete conglomerations so that only asphalt coatings remain on aggregates. Break down all materials suitable for reuse so that the processed mixture meets the gradation requirements specified in Column 1b of the Table in **Subsection M01.09**.

M01.03 PERVIOUS FILL.

Use pervious fill that is clean, naturally occurring granular, bank run, or plant processed soil materials. Ensure that pervious fill meets the gradation requirements of Column IV of the Table in **Subsection M01.09**. Ensure that the minimum permeability coefficient (k) of pervious fill is 1×10^{-4} cps as determined by a constant head permeometer (AASHTO T215).

M01.04 BEDDING MATERIAL.

Ensure that bedding material consists of gravel borrow, crushed stone, or crushed or screened gravel.

Use gravel borrow bedding material that conforms to the gradation requirements of Column I of the Table in **Subsection M01.09** and that has 100 percent by weight passing the 1½-in. sieve.

Use crushed stone and crushed or screened gravel bedding that has 100 percent passing the 1½-in. sieve and 0 to 5 percent passing the #4 sieve.

M01.05 COARSE AGGREGATE FOR ASPHALT CONCRETE AND PORTLAND CEMENT CONCRETE.

M01.05.1 General Requirements.

Use aggregates that comply with AASHTO M43, M80, except were amended or noted herein.

Ensure that crushed quarry rock and processed (crushed and/or screened) gravel aggregates are durable, are not weathered such that they degrade with handling and working, and remain free of deleterious or organic matter.

Use coarse aggregates that meet the Los Angeles Abrasion and Crushing criteria specified in the Table in **Subsection M01.10** for use in asphalt or Portland cement concrete and that meets the criteria for soundness in **Subsection M01.11** as measured by sodium sulfate loss. Ensure that aggregates are resistant to degradation by freeze and thaw and resistant to acid attack.

If lithology or physical character indicates that aggregates may be susceptible to degradation by freeze-thaw or acid attack, or potentially adversely reactive with Portland cement, the Department may require that additional, appropriate laboratory testing be performed to demonstrate that the aggregate is suitable for the intended use.

Ensure that all producers provide single source aggregate samples at least once a year for testing by the Department.

M01.05.2 Single-Source Requirements and Blending Policy.

Ensure that each aggregate supply used in asphalt or Portland cement concrete mixes has been produced from either quarry rock or natural gravel, obtained from one distinct quarry source or natural gravel source with defined location and boundaries.

Do not use blends of gravel aggregates from more than one source, blends of crushed quarry rock from more than one source, or blends of gravel with crushed rock that are produced by mixing these materials at the crusher feed.

The Department will allow controlled blending of approved aggregates at the asphalt or concrete production plants of different aggregate types and/or aggregates from different sources, if each aggregate type from each separate source is stockpiled in a separate bin at the production plant and if the Los Angeles abrasion and soundness values of each aggregate type from each source meet the criteria established for that type and for the intended asphalt pavement application or concrete use. Submit a separate mix design for each proposed coarse aggregate blend for review and approval.

M01.05.3 Definitions of Quarry Rock and Gravel Sources.

a. Quarry Rock Source. A quarry rock source is a distinct, stated location at which extensive, intact, consolidated bedrock of igneous, metamorphic, or sedimentary type is or may be exposed by clearing and removal of overlying soil and boulder cover material, and from which exposed bedrock is then extracted by blasting or other mechanical means from a working face, bench, or floor level, and reduced in size for final crushing and processing for the production of crushed quarry rock aggregates.

b. Gravel Source. A gravel source is a distinct, stated location at which clay to boulder-sized materials, which may occur as mixed-size or stratified natural deposits, are or may be exposed by clearing, stripping, and removal of vegetation, topsoil, and organic soils, and are then excavated using conventional mechanical excavating equipment for the production of crushed and/or screened gravel aggregates.

M01.05.4 Definitions of Aggregate Types.

Coarse aggregate is classified as crushed quarry rock or processed gravel as defined below:

a. Crushed Quarry Rock. Crushed quarry rock is coarse aggregate consisting of 100 percent crushed bedrock that is produced by crushing bedrock extracted from a single-source quarry location. Use crushed quarry rock aggregate that is processed separately from

overburden soil deposits and that does not contain crushed or uncrushed gravel and is free of deleterious material or soft, friable particles.

b. Processed Gravel. Processed gravel is coarse aggregate produced by crushing and/or screening naturally occurring boulder, cobble, and gravel-sized materials extracted from a single source location. Ensure that processed gravel is free of deleterious material or soft, friable particles.

M01.06 KEYSTONE.

Use keystone or chip stone used for keying bases and pavements and cover stone for seal coats that consists of crushed quarry rock or crushed gravel and that conforms to the gradation requirements of either Column III or VI of the Table in **Subsection M01.09**. Ensure that the abrasion and soundness conforms to **Subsections M01.10** and **M01.11**. Use keystone that consists of at least 90 percent crushed particles. Use cover stone that consists of 100 percent crushed particles.

M01.07 FILTER STONE.

Use filter stone for underdrains that conforms to the gradation requirements of Column V of the Table in **Subsection M01.09**. Ensure that soundness conforms to the applicable requirements of **Subsection M01.11.**

M01.08 FINE AGGREGATE.

Use fine aggregate in asphalt or Portland cement concrete that meets the general requirements of **Subsections M02.02** and **M03.02.2** and that conforms to the requirements for single-source origin, production, and blending in **Subsection M01.05.2**. Use fine aggregate in asphalt that also complies with AASHTO M323.

Use fine aggregate for filler or seal coat cover that consists of clean, hard, durable particles that meet AASHTO M6.

M01.09 GRADATION OF AGGREGATES.

Use aggregates in base and subbase courses and other applications that conform to the gradation requirements in the first Table on the next page.

M01.10 ABRASION AND CRUSHING REQUIREMENTS FOR COARSE AGGREGATES.

Coarse aggregate for use in asphalt or Portland cement concrete may be either crushed quarry rock or processed gravel meeting the abrasion and crushed particle/fracture face criteria in the second Table on the next page. Determine the abrasion resistance by the Los Angeles Abrasion Test, AASHTO T96. Use coarse aggregate in asphalt that meets the abrasion requirements in the following table and all aggregate requirements in AASHTO M323.

Gradation – Percent Passing

Sieve Size	I		II	III	IV	V	VI
	Gravel Borrow						
	Ia Bank Run Processed Sand/Gravel	IIb Reclaimed Processed Material	Crushed Stone or Crushed Gravel	Keystone	Pervious Fill	Filter Stone	Cover Stone
3″	60 - 100	100			100		
2¼″							
2″			100				
1½″		70 - 100	90 - 100				
1¼″							
1″			30 - 55	100		100	
¾″		50 - 85	0 - 25	90 - 100		70 - 85	100
½″	50 - 85		0 - 10	20 - 55		10 - 40	90 -100
⅜″	45 - 80			0 - 20		0 - 20	30 - 60
#4	40 - 75	30 - 55		0 - 5	30 - 100	0 - 5	0 - 15
#8							0 - 5
#40	0 - 45						
#50		8 - 25					
#100			0 - 1				
#200	0 - 10	2 - 10			0 - 8		

Los Angeles Abrasion Criteria

Portland Cement Concrete Applications:	
Crushed Quarry Rock & Processed Gravel (Crushing not required)	45% maximum loss

Aggregate Type	Asphalt Base/ Binder Courses	Asphalt Surface & Friction Course	Seal Coats: Keystone & Cover Stones
Asphalt Applications:			
Quarry Rock and Processed Gravel (Notes 1, 2, 3)	50% maximum loss	40% maximum loss	30% maximum loss

Notes: Crushing requirements for processed gravel for asphalt:

1. *Base and binder courses: 75 percent by weight particles with one or more fracture faces.*
2. *Surface and friction courses: 95 percent by weight particles with at least one fracture face, and 75 percent by weight particles with at least two fracture faces.*
3. *Keystone: 90 percent crushed particles; Cover stone: 100 percent crushed particles.*

M01.11 SOUNDNESS, SODIUM SULFATE.

Use aggregate materials for Portland cement concrete that have a maximum percentage loss of 12 percent as determined by the Sodium Sulfate Test, AASHTO T104.

M01.12 SPECIAL GRADED AGGREGATE FOR SHAPING AND TRIMMING DRIVEWAYS AND SHOULDERS.

Use coarse aggregate (plus No. 4) that consists of clean, hard, durable particles of crushed rock fragments or crushed gravel. Use crushed gravel that consists of 95 percent by weight particles with at least one fractured face. Ensure that coarse aggregates have a percentage of wear by the Los Angeles Abrasion Test (AASHTO T96) of not more than 50 percent, and a Sodium Sulfate Soundness (AASHT0 T104) of not more than 12 percent.

Use a fine aggregate that consists of particles produced during the crushing of coarse aggregate at the approved source and that are free of organic deleterious matter.

Ensure that the composite coarse and fine aggregate mix conforms to the following gradation requirements:

Square Mesh Sieve Size	Percentage by Weight Passing Indicated Square Mesh Sieve
1 in.	100
1 in.	85 – 100
½ in.	50 – 85
No. 4	40 – 75
No. 40	8 – 35
No. 200	2 – 10

Select coarse and fine aggregates for use as Special Graded Aggregate for driveway or shoulder surfaces to provide a stable, compactable, functional, and presentable surface that is similar in color and texture, as approved by the Engineer, to match existing surfaces.

SECTION M02 — PORTLAND CEMENT CONCRETE

M02.01 HYDRAULIC CEMENT.

M02.01.1 Portland Cement.

Use Portland cement that conforms to the chemical and physical requirements of AASHTO M85.

M02.01.2 Blended Hydraulic Cements.

Use blended hydraulic cements that conform to the chemical and physical requirements of AASHTO M240.

M02.01.3 Masonry Cement.

Use masonry cement that conforms to ASTM C91.

M02.02 FINE AGGREGATE FOR CONCRETE.

Use fine aggregate for concrete that conforms to AASHTO M6 and consists of natural sand, manufactured sand produced from larger aggregate, or a combination thereof. Ensure that manufactured sand is graded with a minimum percentage of flat elongated particles. Ensure that all fine sand consists of hard, strong, durable particles that are free from coatings or any injurious materials or injurious amount of clay, loam, or other deleterious substances. In addition, do not use fine aggregate that contains substances that, when mixed in Portland cement concrete, produces an unacceptable level of chloride ions in the final product. Substances that produce chloride ions are deleterious material. Any fine aggregate may be rejected if the Engineer determines that the aggregate contains an unacceptable amount of unsound or deleterious material.

Use fine aggregate for mortar that conforms to AASHTO M45.

M02.03 COARSE AGGREGATE FOR CONCRETE.

Use coarse aggregate for concrete that consists of screened gravel, crushed gravel, or crushed quarry rock and conforms to AASHTO M80, with the exception that grading shall conform to the requirements in AASHTO M 43.

M02.04 CURING MATERIALS.

Use curing materials that conform to the following requirements.

M02.04.1 Burlap Cloth.

Use burlap cloth made from jute or Kenaf that conforms to AASHTO M182 Class 3 or 4. Ensure that the burlap is clean and free from cuts, tears, uneven weaving, and contaminants.

M02.04.2 Sheet Materials for Curing Concrete.

Do not use waterproof paper as a curing medium for Portland cement concrete.

a. Polyethylene Film. Use polyethylene film clear or white opaque that conforms to ASTM C171.

b. Plastic Coated Fiber Blankets. Use white plastic-coated fiber blankets or white plastic coated absorbent synthetic fabric blankets that conform to ASTM C 171 for white-burlap polyethylene sheets for moisture loss and reflectance.

M02.04.3 Liquid Membrane Curing Compounds.

Use liquid membrane curing compounds that are non-pigmented-chlorinated, rubber base-clear and conform to ASTM C 309. Use curing compounds from the Department's Approved Materials List.

M02.05 CHEMICAL ADMIXTURES.

Do not use calcium chloride in Portland cement concrete.

Do not use chemical admixtures unless approved by the Engineer.

Use chemical admixtures that are listed on the Department's Approved Materials List and that conform to the requirements below:

- Chemical Admixtures — AASHTO M194
- Air-entraining Admixtures — AASHTO M154

M02.06 MINERAL ADDITIVES.

M02.06.1 Fly Ash.

Use fly ash for the replacement of Portland cement that conforms to the chemical and physical requirements of AASHTO M295, Class C or F.

M02.06.2 Silica Fume.

Use silica fume that conforms to the chemical and physical requirements of AASHTO M307.

M02.06.3 Ground Granulated Blast Furnace Slag.

Use ground granulated blast furnace slag that conforms to the chemical and physical requirements of AASHTO M 302, Grade 100 or 120.

M02.07 WATER.

The Engineer will approve the water used in mixing and curing of concrete. Ensure that the water is clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substance injurious to the

finished Project. Test the water according to ASTM C 1602. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, enclose the intake to exclude silt, mud, grass, or other foreign materials.

When comparative compressive tests are made that conform to AASHTO T106, reject water with any indication of unsoundness, marked change in time of setting, or a reduction of more than 10 percent in mortar strength.

In all concrete work, except for prestressed and post-tensioned concrete, ensure that the water does not contain more than 1000 ppm of chlorides as chlorine nor more than 1300 ppm of sulfates as SO_4.

In prestressed concrete work, ensure that the water does not contain more than 650 ppm of chlorides nor more than 1300 ppm of sulfates as SO_4.

Ensure that the water does not contain an amount of impurities that will cause a change in the setting of Portland cement.

In addition to the preceding requirements, ensure that the water does not contain coloring agents or more than 300 ppm of alkalides ($Na_2O + 0.65K_2O$) as determined on the filtrate. Ensure that the specific gravity of the water mixture does not exceed 1.034 and does not vary more than ±0.010 during any day's operations.

M02.08 CONCRETE PAVEMENT JOINTS.

M02.08.1 Transverse and Longitudinal Joints.

Use joints that include load transfer devices, poured joint seal, and expansion joint filler, which shall be preformed joint filler.

Use tie bars that are deformed that conform to AASHTO M31 or M42, except do not use rail steel for bars that will be bent and re-straightened during construction. Use dowel bars that are plain round bars that conform to AASHTO M254 and M255 and are free from burring or other deformation restricting slippage in the concrete. Treat one-half the length of each bar with a bond-breaker material.

Use sleeves for dowel bars that are metal and of an approved design to cover 2 in. ±¼ in. of the dowel with a closed end and with a suitable stop to hold the end of the sleeve at least 1 in. from the end of the dowel bar.

M02.09 JOINT MATERIALS FOR CONCRETE PAVEMENTS.

M02.09.1 Preformed Joint Filler.

Use preformed joint filler that conforms to AASHTO M153 Type II, Expanded Rubber Specification ASTM D1056, Type 2C2, or AASHTO M33 and M213.

M02.09.2 Poured Joint Sealer.

Use a poured joint sealer that is a rubber compound of the hot poured type conforming to AASHTO M173.

M02.09.3 Preformed Neoprene Compression Seals and Lubricant Adhesive.

a. Neoprene Seals. Use seals that meet all physical requirements of ASTM D2628, Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements. Ensure that the seal is free of curling, pin holes, and uncured areas and is uniform in all dimensions. Ensure that the accepted width and height of the seal is not less than the dimensions designated by the seal manufacturer and are known as the nominal width and nominal height. Ensure that the actual width of the seal does not exceed the nominal width by more than 0.0625 in. for seals up to 1.50 in. and 0.1875 in. for seals 1.50 to 2.50 in. In addition, ensure that the actual height of a seal does not exceed the nominal height by more than 0.125 in. for seals 2.5 in. or less and 0.250 in. for larger seals.

   Ensure that the preformed compression seal has an adequate design and strength to prevent the intrusion of debris into a sealed joint through repeated cycles of expansion and contraction. Ensure that the seal functions properly at all temperatures between -0°F and 140°F and collapses downward symmetrically along the vertical center plane of the seal design. When the seal is in a compressed condition, ensure that the misalignment of the walls does not exceed 0.125 in. for seals of nominal width 2 in. or less and 0.250 in. for seals of nominal width greater than 2 in.

   Determine the compression deflection characteristics of the fabricated seal using ASTM D575 Method A. Use test specimens that are 4 in. in length for seals 1.25 in. or less in nominal width and 6 in. for seals of nominal width greater than 1.25 in. Ensure that seals are conditioned through six complete cycles of compression and that all readings are taken on the seventh cycle. At 20 percent compression of the nominal width, ensure that seals 1.25 in. or less exert a stress of not less than 1.5 pounds per linear inch per inch of height of seal and have a safe compressibility of 40 percent or less of the nominal width.

   Ensure that seals of nominal width greater than 1.25 in. exert a stress of not less than 2 pounds per linear inch per inch of height of seal at 20 percent compression and have a safe compressibility of 50 percent or less of the nominal width. The maximum safe compressibility is that point in compression where the air voids are closed and the elastometer itself is in compression. Ensure that the maximum safe compressibility does not exceed 100 pounds per linear inch per inch of height of seal at the above stated safe compressibility levels.

   Use the compression-deflection characteristic of the seal to classify the seal according to movements of 0.05 in., 1.0 in., 1.5 in., and 2.0 in. No tolerance on movement classification shall be permitted. Ensure that the movement of the seal as determined above does not exceed or be equal to its classification.

   Each seal will be qualified for only one movement and will not be used for other movements.

b. Lubricant Adhesive. The Engineer will approve the lubricant adhesive to aid in seal installation. Use a lubricant adhesive that has a single component neoprene polymer with only the necessary antioxidants and acid acceptors and is in a hydrocarbon solvent. Ensure that the lubricant remains fluid at temperatures between 5°F and 120°F and contains not less than 22 percent total solids by weight as determined by ASTM D2369. Ensure that the peel strength of the lubricant adhesive, as determined by ASTM D903, is not more than 1500 psi. Ensure that the lubricant adhesive is compatible with the preformed compression seals, concrete, asphalt, and sealing compounds and is not affected by moisture. Use a lubricant that has a minimum shelf life of nine months.

M02.09.4 Silicone Highway Joint Sealant.

Use a silicone joint sealant that is a one-part silicone material that readily extrudes over a wide temperature range and cures to produce a durable, flexible, low modulus silicone rubber joint seal. Use a sealant that has an extension recovery of 100 percent and a compression recovery of 50 percent of the original joint width.

Use a silicone sealant that meets the requirements of Federal Specifications TT-S-01543 A Class A (one-part silicone sealants) and TT-S-00230 C Class A (one component sealants).

Silicone sealant is not intended for continuous water immersion. Do not apply in confined spaces where the sealant is not exposed to atmospheric moisture. Do not apply the sealant to wet or damp surfaces nor should it be installed during inclement weather. Apply in a thickness not more than ½ in. and not thinner than ¼ in. with an approximate width to depth ratio of 2:1.

M02.10 JOINT MATERIALS FOR BRIDGE STRUCTURES.

M02.10.1 Preformed Expansion Joint Filler.

a. Asphalt Type. Ensure that this type of joint filler consists of preformed strips of a composition that conforms to AASHTO M33.

b. Non-Extruding and Resilient Type. Use cork joint material that conforms to AASHTO M153, Type II or III.

Use expanded rubber joint filler that is preformed with strips in the required thickness. Use a filler of durable elastic expanded rubber, gray in color, and containing no reclaimed rubber or factice. Use an expanded rubber joint filler that conforms to ASTM D1056, Type 2C2.

c. Preformed Polyethylene Foam Joint Filler. Use preformed polyethylene joint filler that conforms to ASTM D7174. Ensure that the filler is chemically resistant and capable of being used in conjunction with cold applied polymer sealants such as silicones, polyurethanes, and polysulfides. Ensure that the material is waterproof and remains flexible in cold weather.

M02.10.2 Joint Seal (Poured and Caulked Types).

Ensure that the grooves for joint seals are formed when the concrete is placed, is wire brushed clean, has all dust blown free with compressed air, and is surface dry, primed, and filled with a poured or caulked joint seal. Use a joint sealer that is an approved poured or caulk type placed according to the manufacturer's recommendations.

The requirements for silicone joint sealant for bridges is identical to that set forth for highways in **Subsection M02.10.4**.

M02.10.3 Poured Neoprene Sealant – Type G.

Use a poured neoprene sealant that is a two-compound, cold-applied, self-leveling, neoprene sealant.

M02.10.4 Polyurethane Joint Sealant.

Use a polyurethane joint sealant that is a one-component, moisture-cured, high-performance, premium-grade, non-sag elastomeric sealant. Ensure that the sealant is designed for an extension and compression recovery of 25 percent maximum. Use a polyurethane joint sealant that meets Federal Specifications TT-S-00230C, Type II Class A.

Use a color of the polyurethane joint sealant of limestone, aluminum gray, or precast at the discretion of the Engineer.

M02.10.5 Polyurethane Elastomeric Joint Sealant.

Use a polyurethane elastomeric joint sealant that is a two-component, chemically-cured, high-performance, premium-grade, non-sag elastomeric sealant. Ensure that the sealant is designed for an extension and compression recovery of 50 percent maximum. Use a polyurethane elastomeric joint sealant that meets Federal Specifications TT-S-00227E.

Use a color of the polyurethane elastomeric joint sealant of limestone, aluminum gray, or precast at the discretion of the Engineer.

SECTION M03 — ASPHALT PAVEMENTS

M03.01 ASPHALT CONCRETE PAVEMENT.

Ensure that coarse and fine aggregates, mineral filler, and asphalt cement are combined to produce asphalt concrete pavements.

M03.02 MATERIALS.

M03.02.1 Performance-Graded Asphalt Binder.

a. Scope. This Specification covers performance graded asphalt binder for use in pavement construction.

b. Manufacture. Use an asphalt binder that has been prepared from crude petroleum by suitable methods. The supplier shall conform to the requirements of AASHTO R26; "Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders," and shall submit annually a quality control plan conforming to R26.

Approved temperature-viscosity charts and test data shall be provided by the supplier.

c. Requirements. Use an asphalt binder that is homogeneous, free from water, and is not foam when heated to 175°C (347°F).

Ensure that the asphalt binder has been sampled and tested according to and meet all the requirements of AASHTO M 320 for PG 64-28 binder. Do not use a direct tension test.

M03.02.2 Aggregate for Asphalt Pavements.

a. Coarse Aggregate. Use a coarse aggregate (retained on the No. 8 sieve) that has been crushed stone, or crushed gravel, and, unless otherwise stipulated, and that conforms to the respective requirements of **Subsections M01.05**, **M01.10**, and **M01.11**.

b. Fine Aggregate. Use a fine aggregate that consists of sand, stone screenings or a mixture of sand and stone screenings. Ensure that stone screenings and sands are free from dirt, clay, organic matter, excess fines, or other deleterious materials. Ensure that fine aggregates conform to the quality requirements of AASHTO M29.

Use a fine aggregate with a gradation that, when proportionally combined with other required aggregate fractions, the resultant mixture meets the gradation required under the composition of mixture for the specified class.

M03.03 ASPHALT MATERIAL.

M03.03.1 Asphalt Binder.

Use an asphalt binder that conforms to **Subsection M03.02.1**.

Do not use cutback asphalt for any application.

M03.03.2 Emulsified Asphalt.

Use an emulsified asphalt that conforms to AASHTO M140.

M03.04 HIGH PERFORMANCE COLD PATCHING MATERIAL.

M03.04.1 General Requirements.

Ensure that this material is a plant mixed, high performance cold patching material composed of mineral aggregates, a modified asphalt material, and capable of storage in a stockpile for a minimum of one year. Ensure that the material can be placed in all conditions, including wet snow conditions, with no pothole preparation and a minimum of labor including the shoveling of the material into the pothole and compacting with a truck tire.

M03.04.2 Aggregates.

Obtain aggregates from a source approved by the Department and that satisfy all requirements of the manufacturer of the asphalt material.

a. Coarse Aggregate. Use coarse aggregate that has been either crushed ledge, crushed granite, or crushed gravel and that meets **SECTION M01** for surface course aggregates.

b. Fine Aggregate. Use a fine aggregate that is natural sand, stone screening, or a blend of the two.

M03.04.3 Asphalt Material.

Use an asphalt material that is on the Department's Approved Materials List for high performance cold patch. Produce the cold patch according to the manufacturer's recommendations.

a. Manufacture. Produce the mix in an approved plant and according to the applicable provisions of **PART 400** and according to the manufacturer's recommendations.

b. Stockpiling. Stockpile the material so that there is no injury to the mixture or its performance as a patching material. Maintain the stockpile free from all contamination. Stockpile according to the manufacturer's recommendations with the exception of ensuring that the material can be stockpiled either indoors or outdoors under naturally prevailing weather conditions.

SECTION M04 — DRAINAGE AND STORMWATER

M04.01 CONCRETE AND PLASTIC PIPE.

M04.01.1 Non-Reinforced Concrete Pipe.

Use pipe that conforms to AASHTO M86 and **SECTION 601** for the specified diameters and strength classes.

M04.01.2 Reinforced Concrete Pipe.

Use pipe that conforms to AASHTO M170 and **SECTION 601** for the specified diameters and strength classes. Use elliptical pipe that conforms to AASHTO M207. The pipe wall design and the use of elliptical reinforcement in circular pipe are optional. Use precast reinforced concrete end sections that conform to the applicable Specifications.

M04.01.3 Perforated Concrete Pipe.

Use pipe that conforms to AASHTO M175 and **SECTION 601** for the specified diameters and strength classes.

M04.01.4 Plastic Sewer Pipe.

For plastic sewer pipe that will be used as pipe culvert, use pipe that conforms to the following stipulations.

a. Pipe Sizes and Dimensions.

- Use pipe in the following diameters:

Size	Nominal O.D.	Maximum Wall	Nominal Wall
12 in.	12.50 in.	0.500 in.	0.250 in.

- Use standard length of plastic sewer pipe of 10 ft.
- Use pipe sections with a plastic sleeve coupling that may be solvent welded to one end of the pipe section.

b. Physical and Chemical Properties.

- Crushing Strength. Ensure that the crushing strength of the finished pipe is a minimum of 1200 pounds per linear ft as determined by ASTM C301 (Sand Bearing Method Section 8).
- Straightness. Ensure that the maximum ordinate as measured from the concave side of the pipe does not exceed ¼ in. per ft of pipe length.
- Quality and Appearance. Ensure that the pipe is free from defects, bubbles, and other imperfections according to accepted commercial practice.

- Joint Tightness. Use solvent welded connections that can tolerate an internal pressure of 10 psi for a period of 24 hours without leakage.

M04.01.5 Perforated Corrugated Polyethylene Drainage Pipe.

For this classification of pipe, comply with AASHTO M252 and M294.

M04.01.6 Perforated and Unperforated Polyvinyl Chloride Pipe.

For this classification of pipe, comply with AASHTO M278.

M04.01.7 Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe.

Provide pipe, couplings, and fittings for polyethylene pipe that conform to AASHTO M294 and ASTM F2306. Provide pipe, couplings, and fittings for polypropylene pipe that conform to AASHTO M330 and ASTM F2881. The following provisions also apply:

- Provide pipe that is Type S and meets the requirements of the AASHTO NTPEP Quality Audit Program for High Density Polyethylene Pipe and polypropylene pipe.
- Ensure that the basic materials are virgin resin, recycled resin, or cleaned, reworked polyethylene or polypropylene compounds.
- Ensure that all joints are watertight according to ASTM D3212 and that the joints are sealed with elastomeric gaskets that conform to ASTM F477.

M04.01.8 Impermeable High-Density Polyethylene (HDPE) Liner.

Use HDPE liner that conforms to the following:

Minimum Property Unit	Unit	Test Method	Requirements
Thickness	mils	ASTM D5199	30
Break Strength	lb/in	ASTM D6693	114
Break Elongation	%	ASTM D6693	800
Tear Resistance	lb	ASTM D1004	16
Puncture Resistance	lb	ASTM D4833	42
Sear Shear Strength	lb/in	ASTM D6392	45
UV Resistance	%	ASTM D5885	35

M04.02 METAL PIPE.

M04.02.1 Ductile Iron Pipe.

For all ductile iron pipe, joints, fittings, and appurtenances, use Class 52 and meet the requirements of the latest revisions and addenda of the following standard specifications.

a. American National Standards Institute, ANSI (parentheses designations are American Water Works Association designations for the standard)

- A21.51 (C151) Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids
- A21.11 (C111) Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
- A21.53 (C153) Ductile Iron Compact Fittings

b. ASTM A716 – Ductile Iron Culvert Pipe

M04.02.2 Corrugated Steel Pipe and Pipe Arches.

For these conduits and the coupling bands, comply with AASHTO M36 for the specified sectional dimensions and gauges. Furnish shop-formed elliptical pipe and shop-strutted pipe where specified.

For special sections, such as elbows and flared end sections for these conduits, use the same gauge as the conduit to which they are joined, and conform to AASHTO M36.

M04.02.3 Asphalt Coated Corrugated Metal Pipe and Pipe Arches.

Use conduits and the coupling bands that conform to AASHTO M190 for the specified sectional dimensions, gauges, and type of asphalt coating. Ensure that coupling bands are fully coated with asphalt material.

For special sections, such as elbows and flared end sections for these conduits, use the same gauge as the conduit to which they are joined and that conform to AASHTO M190.

M04.02.4 Perforated Corrugated Steel Pipe for Underdrains.

Use pipe that conforms to AASHTO M36 Type III for the specified diameters. Any one of four types may be furnished.

M04.02.5 Asphalt Coated Perforated Corrugated Metal Pipe for Underdrains.

Use pipe that conforms to AASHTO M190 and is coated with a Type A coating installed on AASHTO M36 Type III pipe. Fully cover coupling bands.

M04.02.6 Corrugated Aluminum Pipe.

Use pipe that conforms to AASHTO M196 and M197.

For special sections, such as elbows and flared end sections for these conduits, use the same gauge as the conduit to which they are joined and that conforms to AASHTO M196 and M197.

M04.02.7 Perforated Corrugated Aluminum Alloy Pipe for Underdrains.

Use pipe that conforms to AASHTO M196 and M197.

For special sections, such as elbows and flared end sections for these conduits, use the same gauge as the conduit to which they are joined and that conforms to AASHTO M196 and M197.

M04.02.8 Smooth-Lined Corrugated Metal Pipe.

Ensure that smooth-lined corrugated metal pipe is manufactured with a smooth metal interior liner and a corrugated exterior core helically wound and lock-seamed to form a strong, integrated mechanical bond. Liner and culvert are fabricated from aluminum or galvanized steel and may be asphalt coated or uncoated. Ensure that the gauge of the outer core conforms to AASHTO M36 for galvanized metal pipe and AASTHO M196 for aluminum alloy pipe.

For special sections, such as elbows and flared end sections for these conduits, use the same gauge as the conduit to which they are joined and that conforms to AASHTO M36 and M196.

M04.02.9 Cast Iron Soil Pipe.

Use cast iron soil pipe that conforms to ASTM A74.

M04.02.10 Pipe Joints.

a. Joint Mortar. Use pipe joint mortar that conforms to **Subsection M04.03.5**.

b. Rubber Gaskets. Use ring gaskets that conform to ASTM C443.

c. Oakum. Use oakum for joints that is made of hemp line, thoroughly corded, and finished and free from lumps and dirt.

d. Asphalt Joint Materials. Use asphalt joint materials that conform to **Subsection M03.02.1**.

M04.03 CATCH BASINS, MANHOLES, DROP INLETS, PAVED WATERWAYS, AND MISCELLANEOUS SMALL STRUCTURES.

Use materials for the construction of catch basins, manholes, drop inlets, and paved waterways that conform to the following requirements.

M04.03.1 Clay Brick.

Use brick that conforms to one of the following:

- Sewer Brick: ASTM C 32, Grade SS or SM
- Building Brick: ASTM 62, Grade SW

M04.03.2 Asphalt Concrete for Paved Waterways.

Use material that conforms to the mix requirements for HMA Class 9.5 pavement in **Subsection M03.02**.

M04.03.3 Concrete Masonry Blocks.

Concrete masonry blocks may be rectangular or segmented. Ensure that the blocks have ends shaped to provide interlock at vertical joints. Use blocks that conform to ASTM C139.

M04.03.4 Hydrated Lime.

Use hydrated lime that conforms to ASTM C207, Type N.

M04.03.5 Mortar.

Use a bagged Type S mortar mix and submit to the Engineer for approval before use. Use mortar that conforms to ASTM C270 and ASTM C1329. Use mortar within the time limit recommended by the manufacturer. If there is no guidance from the manufacturer, discard the mortar no more than 45 minutes after its preparation.

M04.03.6 Frames, Grates and Covers, and Ladder Rungs.

Use metal units that conform to the plan dimensions and to the following Specification requirements:

- Use gray iron castings that conform to AASHTO M105. The strength class is optional unless otherwise designated.
- Use carbon-steel castings that conform to AASHTO M103. Grade is optional unless otherwise designated.
- Use structural steel that conforms to ASTM A283, Grade B or better.
- Use galvanizing that conforms to AASHTO M111.
- Use malleable iron castings that conform to ASTM A47. Grade selection is optional unless otherwise designated.

M04.03.7 Concrete and Steel Reinforcing.

Use materials that conform to **SECTION M02** and **SECTION M05**.

SECTION M05 — METALS

M05.01 MILL TEST REPORTS.

Furnish certified copies in quadruplicate of mill test reports of metals used in the work. Mark and identify the finished metal products for easy correlation with the mill test reports. Ensure that the chemical and physical properties of each heat of steel used conforms to the relevant AASHTO or ASTM Specifications.

M05.02 BAR REINFORCEMENT.

Use reinforcing bars that are deformed, fabricated from new billet steel, and conform to AASHTO M31 (ASTM A615) or ASTM A706. Use Grade 60.

M05.03 WIRE REINFORCEMENT.

M05.03.1 Wire Fabric.

Use steel wire fabric that conforms to either AASHTO M55 (ASTM A185) or AASHTO M221 (ASTM A497) for plain and deformed wire fabric.

M05.03.2 Spiral Wire.

Use spiral wire reinforcement that conforms to AASHTO M 336 (ASTM A1064).

M05.04 PRESTRESSING STEEL.

Use prestressing steel that is high-strength steel wire, high-strength seven-wire strand, or high-strength alloy bars of the required grade and type.

M05.04.1 Products.

- Use wire that is high-strength, stress relieved, uncoated steel wire conforming to AASHTO M204 (ASTM A421).
- Use strand that is high-strength, seven-wire, low relaxation, uncoated strand conforming to AASHTO M203 (ASTM A416).
- Use bars that are high-strength, uncoated, alloy bars conforming to AASHTO M275 (ASTM A722).

M05.05 STRUCTURAL STEEL.

For all steels used in main load carrying member components subject to tensile stress, use bars that conform to the applicable Charpy V-Notch Impact Test requirements of AASHTO M270 (ASTM A709).

M05.05.1 Products.

- Use carbon steel and foundation pilings that conform to AASHTO M270 (ASTM A709), Grade 36.
- Use high-strength, low-alloy steel that conforms to AASHTO M270 (ASTM A709), Grade 50 or Grade 50W.
- Use high-strength, low-alloy structural steel plate quenched and tempered that conforms to AASHTO M270 (ASTM A709), Grade 70W.
- Use high-yield strength, quenched and tempered, low-alloy steel plate that conforms to AASHTO M270 (ASTM A709), Grades 100 or 100W.

M05.05.2 Steels for Pins, Rollers, and Expansion Rockers.

a. Steel Bars, Carbon Cold Finished Standard Quality. Use steel bars, carbon cold finished standard quality that conforms to AASHTO M169 (ASTM A108), Grades 1016 to 1030 inclusive for sizes 4 in. in diameter or less.

b. Steel Forgings, Carbon, and Alloy for General Industrial Use. Use steel forgings, carbon, and alloy for general industrial use that conforms to AASHTO M102 (ASTM A668), Class F for sizes to 10 in. in diameter and Classes C, D, and G for sizes to 20 in. in diameter.

M05.05.3 Structural Tubing.

Use structural tubing that is either cold formed welded or seamless tubing conforming to ASTM A500, Grade B or hot-formed welded or seamless tubing conforming to ASTM A501.

M05.05.4 Fasteners – Bolts.

Note: Where AASHTO M164 bolts are specified in the RIDOT Standard Details, the Bridge Standard Details, or elsewhere, take the reference to mean ASTM F3125, respectively. Where AASHTO M293 washers are specified in the Standard Details, the Bridge Standard Details, or elsewhere, take the reference to mean ASTM F436.

a. Carbon-Steel Bolts. Use carbon steel bolts that conform to ASTM A307.

b. High Strength Bolts. Use high strength bolts for structural steel joints that conform to either ASTM F3125, Grade A325 (or Grade A490). When high strength bolts are used with unpainted weathering grades of steel, use Type 3 bolts.

Provide a lot number appearing on the shipping package and a certification noting when and where all testing was done, including rotational capacity tests and zinc thickness when galvanized bolts and nuts are used.

Ensure that the maximum hardness for ASTM F3125 Grade A325 bolts 1 in. or less in diameter is 33 HRC.

- Proof Load Tests. Conduct proof load tests (ASTM F606 Method 1) for the bolts. Use wedge tests of full-size bolts according to Section 8.3 of ASTM F3125 Grade A325.

Ensure that galvanized bolts are wedge tested after galvanizing. Conduct proof load tests (ASTM A563) for the nuts. Perform the proof load tests for nuts to be used with galvanized bolts after galvanizing, over-tapping, and lubricating.

Except as noted below, use nuts for ASTM F3125 A325 bolts that conform to ASTM A563, Grades DH, DH3, C, C3, and D or AASHTO M292 (ASTM A194), Grades 2 and 2H. Use nuts for ASTM F3125 Grade A490 bolts that conform to ASTM A563, Grades DH and DH3 or AASHTO M292 (ASTM A194) Grade 2H.

Ensure that nuts to be galvanized (hot-dip or mechanically galvanized) are heat treated, Grade 2H, DH, or DH3.

Ensure that plain (ungalvanized) nuts have a minimum hardness of 89 HRB.

Use nuts with ASTM F3125 Grade A325 Type 3 bolts that are Grade C3 or DH3. Use nuts with ASTM F3125 Grade A490 bolts that are Grade DH3.

Lubricate all galvanized nuts with a lubricant containing a visible dye. Ensure that black bolts are oily to the touch when delivered and installed.

Use washers that are hardened steel washers conforming to ASTM F436.

- Identifying Marks. ASTM F3125 Grade and AASHTO M164 (ASTM A325) for bolts and the specifications referenced for nuts require that bolts and nuts manufactured to the specification be identified by specific markings on the top of the bolt head and on one face of the nut. Ensure that head markings identify the grade by the symbol A 325, the manufacturer, and the type if Type 2 or 3. Ensure that nut markings identify the grade, the manufacturer and, if Type 3, the type. Ensure that markings on direct tension indicators identify the manufacturer and Type 325. Ensure that other washer markings identify the manufacturer and, if Type 3, the type.

  ASTM F3125 Grade A490 for bolts and the specifications referenced for nuts require that bolts and nuts manufactured to the specifications be identified by specific markings on the top of the bolt head and on one face of the nut. Ensure that head markings identify the grade by the symbol A 490, the manufacturer, and the type, if Type 2 or 3. Ensure that nut markings identify the grade, the manufacturer and, if Type 3, the type. Ensure that markings on direct tension indicators identify the manufacturer and Type 490. Ensure that other washer markings identify the manufacturer and, if Type 3, the type.

- Dimensions. Use bolt and nut dimensions that conform to the Heavy Hexagon Structural Bolts and for Heavy Semi-Finished Hexagon Nuts given in ANSI Standard B18.2.1 and B18.2.2.

c. Galvanized High-Strength Fasteners. When galvanized, use fasteners that are hot-dip galvanized according to AASHTO M 232 (ASTM A153) Class C or that are mechanically galvanized according to AASHTO M298 (ASTM B695) Class 50. Use galvanized bolts that are either ASTM F3125 Grade A325 Type 1 or Type 2, except that Type 2 bolts shall only be mechanically galvanized. Use galvanized bolts that have been tension tested after galvanizing. Galvanize washers, nuts, and bolts of any assembly by the same

process. Ensure that the nuts have been over-tapped to the minimum amount required for the fastener assembly and lubricated with a lubricant containing a visible dye so that a visual check can be made for the lubricant at the time of field installation. Do not galvanize ASTM F3125 Grade A490 bolts.

d. Alternative Fasteners. Other fasteners or fastener assemblies may be used that:

- Meet the materials, manufacturing, and chemical composition requirements of ASTM F3125 Grade A325 or Grade A490
- Meet the mechanical property requirements of the same specification in full-size tests
- Have body diameter and bearing areas under the head and nut, or their equivalent, not less than those provided by a bolt and nut of the same nominal dimensions prescribed in **Subsection M05.05.4(b)(3)** subject to the approval of the Engineer. These alternative fasteners may differ in other dimensions from those of the specified bolts and nuts.
- Subject to the approval of the Engineer, high-strength steel lock-pin and collar fasteners may be used as an alternative for high strength bolts. Ensure that the shank and head of high-strength steel lock-pin and collar fasteners meet **Subsection M05.05.4(b)(3)**.
- Ensure that each fastener has a solid shank body of sufficient diameter to provide tensile and shear strength equivalent to or greater than that of the bolt specified, and have a cold forged head on one end, of type and dimensions as approved by the Engineer, a shank length suitable for material thickness fastened, locking grooves, breakneck groove and pull grooves (all annular grooves) on the opposite end. Ensure that each fastener has a steel locking collar of proper size for the shank diameter used that, by means of suitable installation tools, is cold swaged into the locking grooves forming a head for the grooved end of the fastener after the pull groove section has been removed. Use a steel locking collar that is a standard product of an established manufacturer of lockpin and collar fasteners, as approved by the Engineer.

M05.05.5 Weld Metal.

Use weld metal that conforms to ANSI/AASHTO/AWS D1.5 *Bridge Welding Code*.

M05.05.6 Shear Connectors.

Use shear connector studs that conform to the Specification for Cold Finished Carbon Steel Bars and Shafting, AASHTO M169 (ASTM A108) cold-drawn bar, Grade 1018 or Grade 1020, either semi-or fully-killed. If flux-retaining caps are used, use steel for the caps that is a low carbon grade suitable for welding and that complies with Cold-Rolled Carbon Steel Strip, ASTM A109.

Determine tensile properties by tests of bar stock after drawing or of finished studs that conform to the following requirements:

- Tensile Strength (min.) — 60,000 psi
- Yield Strength*(min.) — 50,000 psi
- Elongation (min.) — 20 percent in 2 in.
- Reduction of area (min.) — 50 percent

**As determined by a 0.2 percent offset method*.

Determine tensile properties according to the applicable sections of ASTM A370, Mechanical Testing of Steel Products. Conduct tensile tests of finished studs on studs welded to test plates using a test fixture similar to that shown in Figure 7.2 of ANSI/AASHTO/AWS D1.5 *Bridge Welding Code*. If fracture occurs outside of the middle half of the gauge length, repeat the test.

Ensure that finished studs have a uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other defects. Ensure that the finish is as produced by cold drawing, cold rolling, or machining.

a. Certification. Certify that the studs, as delivered, are according to the material requirements of this Section. Furnish certified copies of in-plant quality control test reports to the Engineer upon request.

b. Acceptance Samples. The Engineer may select studs of each type and size used under the Contract as necessary for checking the requirements of this Section.

M05.05.7 Low Alloy Nickel Copper Steel Pipe (Corrosion Resistant).

Ensure that the pipe is manufactured subject to the requirements of ASTM A53 Welded and Seamless Steel Pipe with the following modifications:

- Carbon — 0.20 percent maximum
- Manganese — 1.06 percent maximum
- Phosphorous — 0.08 percent maximum
- Sulphur — 0.05 percent maximum
- Copper — 0.75 to 1.25 percent
- Nickel — 1.60 to 2.20 percent

M05.05.8 Steel Forging and Steel Shafting.

a. Steel Forgings. Use steel forgings that conform to the specification for steel forgings, carbon, and alloy, for general use, AASHTO M102 (ASTM A668, Class C, D, F, or G).

b. Cold Finished Carbon Steel Shafting. Use cold finished carbon steel shafting that conforms to AASHTO M169 (ASTM A108) Grade 10160-10300 inclusive.

M05.05.9 Steel Castings and Iron Castings.

a. Steel Castings. Use steel castings for use in highway bridge components that conform to AASHTO M192 (ASTM A486). Use carbon-steel castings for general applications that conform to AASHTO M103 (ASTM A27), Class 70 or Grade 70-36 steel.

b. Chromium Alloy-Steel Castings. Use chromium alloy-steel castings that conform to the specification for corrosion-resistant iron chromium, iron-chromium-nickel, and nickel-based alloy castings for general applications, AASHTO M163 (ASTM A743) Grade CA 15.

c. Gray-Iron Castings. Use gray-iron castings that conform to the specification for gray-iron castings, AASHTO M105 Class No. 30.

d. Ductile Iron Castings. Use ductile iron castings for scupper grates that conform to ASTM A536.

e. Malleable Iron Castings. Use malleable iron castings that conform to ASTM A47. Provide a grade of Number 32510.

f. Iron Castings. Ensure that iron castings are true to pattern in form and dimensions and free from pouring faults, sponginess, cracks, blow holes, and other defects in position affecting their strength and value for the service intended. Use castings that are boldly filleted at angles and with arises that are sharp and perfect.

g. Castings. Ensure that all castings are blast-cleaned or otherwise effectively cleaned of scale and sand to present a smooth, clean, and uniform surface.

M05.05.10 Bronze or Copper-Alloy.

a. Bronze Castings. Use bronze castings that conform to ASTM B22.

b. Copper-Alloys 913 or 911 or Copper-Alloy Plates. Use copper-alloys 913 or 911 or copper-alloy plates that conform to ASTM B100.

M05.05.11 Aluminum Materials.

Use aluminum materials for structures, signs, sign and signal supports, lighting, hardware, and welding materials that conform to the following:

a. Sheet and Plate Aluminum. Use sheet and plate aluminum that conform to ASTM B209, Alloy 5456-M116 for thicknesses from 0.188 in. to 1.25 in.

b. Plate Aluminum. Use plate aluminum that conforms to ASTM B209 Alloy 5086-M116 for thicknesses from 0.250 in. to 2.000 in.

c. Extruded Aluminum Bars, Rods, Shapes, and Tubes. Use extruded aluminum bars, rods, shapes, and tubes for all thicknesses that conform to ASTM B221.

d. Aluminum Bars, Rods, and Wire for Pines, Rollers, and Expansion Rockers. When aluminum is used for pins, rollers, or expansion rockers, ensure that they conform to ASTM B211 Alloy 6061-T6.

e. Fasteners, Rivets and Bolts. Fasteners for aluminum connectors may be coated carbon steel bolts, ASTM A307; power driven aluminum rivets ASTM B316 Alloy 6061-T6 conforming to MIL-R-1150F; coated high strength steel bolts ASTM F3125 325; or stainless-steel bolts ASTM F593 Group 1, 2, or 3.

f. Weld Metal. Use weld metal that conforms to the American Welding Society's AWS D 1.2 Structural Welding Code - Aluminum.

g. Aluminum Castings. Use aluminum permanent mold castings that conform to ASTM B108 Alloy A 4440-T4. Use sand castings that conform to ASTM B26.

h. Aluminum Forgings. Use aluminum forgings and forging stock that conform to ASTM B247 Alloy 6061-T6.

i. Seamless Pipe and Seamless Extruded Tube. Use seamless pipe and seamless extruded tube that conform to ASTM B241.

j. Aluminum for Standard Structural Shapes. Use aluminum for standard structural shapes that conform to ASTM B308

k. Extruded Structural Pipe and Tubing. Use extruded structural pipe and tubing that conform to ASTM B429.

M05.05.12 Structural Materials for Corrugated Metal Structures.

Use materials that conform to the following:

a. Corrugated Metal Pipe and Pipe Arches. Use corrugated metal pipe and pipe arches that conform to AASHTO M36 (ASTM A760), AASHTO M245 (ASTM A762), or AASHTO M190 for steel and AASHTO M196 (ASTM B745) for aluminum.

b. Spiral Rib Metal Pipe. Use spiral rib metal pipe that conforms to the same requirements as corrugated metal pipe.

c. Structural Plate Pipe. Use structural plate pipe, pipe arches, and arch structures or culverts that conform to AASHTO M167 (ASTM A761) for steel and AASHTO M219 (ASTM B746) for aluminum.

M05.05.13 Hardware for Timber Construction.

The term hardware includes all metal fastenings required for timber connections or for connecting timber to concrete or steel work. The following items are considered hardware:

- Bolts, tie rods, turnbuckles, washers, nuts, drift bolts, steel dowels, nails, spikes, and lag screws for timber connections
- Steel plates used as washers
- Metal timber connectors of various designs
- Metal shear developers for composite timber and concrete structures
- Anchor plates or clips for plank floors and sidewalks

a. Steel Components. Use rods, plates, eye bars, and shapes that conform to AASHTO M270, Structural Steel for Bridges, Grade 36.

b. Hardware. Bolts, nuts, drift bolts, dowels, and washers may be fabricated with mild carbon steel. Washers may be cast as iron or malleable iron castings.

c. Timber Connectors. Fabricate split rings as manufactured in 2½-in. and 4-in. diameters of hot-rolled carbon steel that conforms to the requirements of the Society of Automotive Engineers Specification SAE-1010.

Fabricate shear plates of hot-rolled carbon steel that conforms to SAE-1010 for 2-in. diameter plates. Fabricate shear plates of malleable cast iron, Grade 32510, according to ASTM A47 for 4-in. diameter plates.

Fabricate spike grid connectors of malleable cast iron, Grade 32510, according to ASTM A47.

d. Miscellaneous Requirements. Ensure that bolts have either standard square, hexagonal, dome heads, or economy type (washer) heads. Use bolts that conform to ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi tensile. Use bolts that have coarse threads, Class 2 tolerance and that conform to the ANSI Standard Specifications.

Use nails that are cut or round wire of standard forms. Use spikes that are cut or wire spikes or boat spikes.

e. Galvanizing. Use hardware and steel components that are galvanized. Use hardware that is galvanized according to AASHTO M232, Zinc Coating (Hot-Dip) on Iron and Steel Hardware. For other steel components, use galvanization that complies with AASHTO M111, Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.

M05.06 GALVANIZING FOR BAR REINFORCEMENT.

Use bar reinforcement that is either:

- Class 1 galvanized after bar fabrication according to ASTM A767, Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement, including Supplemental Requirements S1 and S3

Or:

- ASTM A1094, Continuous Hot-Dip Galvanized Steel Bars for Concrete Reinforcement, which shall be bent after galvanizing

Do not use chromating for either type of galvanizing.

Before galvanizing, remove all grease, dirt, mortar, mill scale, injurious rust, or any other foreign substance from the material.

For these specifications, interpret the term “injurious rust” to mean rust that is not firmly bonded to the steel. Rust that is difficult to remove, even by vigorous scrubbing with a wire brush, is considered firmly bonded to the steel.

Tap oversize the galvanized threads of nuts and mechanical connectors used for assembly with galvanized bolts and reinforcement before coating and need not be retapped afterwards. For the minimum additional diameter for Class-2A threads galvanized to Class C, use the following:

Class-2A Thread Diameter (in.)	Additional Diameter (in.)*
7/16 in. and smaller	0.016 in.
Over 7/16 in. to 1 in.	0.021 in.
Over 1 in.	0.031 in.

* *Applies to both pitch and minor (root) diameters, minimum and maximum limits*.

Ensure that material galvanized according to these specifications is free from any buildup of unadhered wet storage stains (white rust). Remove the corrosion deposits, if present, to the satisfaction of the Engineer before incorporating the material into the work. After removal of the deposits, ensure that the coating has a uniform appearance free from unusual discolorations and/or surface defects, including uncoated spots, lumps, blisters, gritty areas, acid flux, and black spots. Materials with these defects, or not meeting the finish and adherence of coating requirements as defined in the relevant ASTM specification, will be rejected. Remove these materials immediately from the work site. Use acceptable material to replace the rejected material at no additional cost to the Department.

a. Zinc-Rich Paint. Use zinc-rich paint for the field applications and repair of galvanized coatings that meet the following requirements:

   - Ensure that one application of the material provides a dry coating thickness of at least 2.0 mils.
   - Ensure that the applied coating provides barrier protection and is anodic to steel.
   - Ensure that the application of the coating material is possible under shop or field conditions.
   - Ensure that the dried film has a minimum zinc dust content equal to 94 percent (by weight).
   - Use a brand of material that has been approved by the galvanizer and is compatible with the galvanizing and is inert in concrete.

b. Miscellaneous Hardware. Use hairs, tie wires, nuts, bolts, washers, other devices, and miscellaneous hardware that is used to support, position, or fasten the reinforcement that are made of, or coated with, a non-conducting material or galvanized. The Engineer will approve the hardware proposed for use. If the hardware is galvanized, prepare and galvanize the hardware according to both AASHTO M232 (ASTM A153) and this specification. Ensure that the deflection of the hardware used to support the reinforcing bar mat does not exceed 10 percent of the specified concrete clear cover.

c. Mechanical Couplers. Use mechanical couplers that are on the RIDOT Approved Products List or submitted to the Engineer for approval a minimum of 15 working days before their use. Size the mechanical couplers to fit the reinforcing bar to be spliced and

designed so that the splice connection meets or exceeds 125 percent of the specified yield strength of the rebar.

M05.07 GALVANIZING.

Use structural steel that has been galvanized according to the specifications for Zinc (Hot-dip-Galvanized) Coatings on iron and steel products, AASHTO M111 (ASTM A123). Use fasteners and hardware items that have been galvanized according to the specifications for Zinc Coating (Hot-dip) on Iron and Steel Hardware, AASHTO M232 (ASTM A153), except do not use high strength fasteners that are galvanized if hydrogen embrittlement can occur. Provide corrosion protection for these fasteners that complies with **Subsection 825.03.3(c)**.

M05.08 METALIZING.

Metalize structural steel according to C2.2, Recommended Practices for Metalizing with Aluminum and Zinc for protection of Iron and Steel, of the American Welding Society.

M05.08.1 Materials.

Ensure that all coatings meet current VOC emission requirements of the EPA Clean Air Act of 1977.

M05.08.2 Blast Abrasive.

Ensure that materials are fresh, dry, and sharp. Ensure that the grain size provides a surface profile as defined in **Subsection 827.03.1(b)**. Do not use round, soft sand. Submit samples of the abrasive to the Engineer for approval before initiating any work.

Verify that abrasive cleaning materials meet the requirements of SSPC AB2, Cleanliness of Recycled Ferrous Metallic Abrasives, or SSPC AB 3, Newly Manufactured or Remanufactured Steel Abrasive. Ensure that the condition and cleanliness of the recycled abrasives complies with the fabricators approved quality control program as per SSPC QP3 and/or AISC Special Paint Endorsement.

M05.08.3 Wire.

Ensure that the wire used for spraying is pure zinc or an alloy consisting of 85 percent zinc and15 percent aluminum by weight drawn to the manufacturer's recommendations for compatibility with the equipment being used. Ensure that the chemical composition complies with ASTM B833.

SECTION M06 — PAINT

M06.01 GENERAL.

Obtain certification from the coating manufacturer that all paint materials satisfy composition and testing requirements, conform with the approved qualified products or other applicable requirements, and will not exceed the manufacturer's specified shelf life before use.

Materials will be rejected if the material arrives at the application site in containers other than original, unopened containers; if a container has a break in the lid seal or a puncture; or if the coating materials have started to polymerize, solidify, gel, or deteriorate in any manner.

Ensure that there is no noticeable difference in color between batches of finish paint used on an individual structure, defined as follows. Ensure that the tri-stimulus color value is no greater than a ΔE (color difference) of 2. Ensure that the volatile organic content (VOC) complies with prevailing Federal and State regulations.

M06.01.1 Material Certification.

The coating manufacturer or an approved laboratory shall test a sample from each production batch and forward the results to the Engineer. Provide the following test data for each of the coating material components (primer, intermediate, and topcoats):

- Infrared spectra (2.5 μm to 15 μm (2.5 to 15 microns))
- Certificate of Compliance for compliance with US EPA VOC limits for the State of Rhode Island.

M06.01.2 Product Literature.

Provide product data sheets with each of the products and include the following information:

a. Basic Description. Generic type, recommended service environment/use, recommended substrates, recommended surface preparation, recommended compatible coatings, and recommended thinners.

b. Physical Characteristics and Performance. Solids by volume of the mixed components, recommended thickness per coat, weathering ability, minimum and maximum recoat interval, and cure requirements, per the applicable ASTM standards.

c. Application Instructions. Mixing instructions, pot life for catalyzed materials, temperature and humidity application limitations, instructions for application by spray including equipment recommendations, cleanup recommendations, and storage conditions.

d. Solvent Identification Sheets. Solvent Identification Sheets that provide a listing of the volatile portions of vehicle and categorized solvents by type and photochemical reactivity.

e. Product Certification. Certificates of Compliance for materials used to meet RIDOT Specifications.

f. Safety Data Sheets. Safety Data Sheets (SDS) to the Contractor and Engineer for accompanying shipped materials so that the recipient of the material is aware of storage requirements and of the hazards presented by the products. Provide additional copies of the SDS upon request.

M06.01.3 Shipping and Delivery.

Deliver all paint to the shop or jobsite in their original containers, unopened, and with labels intact.

Provide all coating layers in the paint system from the same manufacturer.

Ensure that sufficient quantities of paint are ordered. Supply all topcoat material from the same lot or batch number.

Deliver all paint furnished in metal containers that are US Standard 5-gal size or the similar metric equivalent. One-gallon containers may be used for small quantities only for touch-up or spot maintenance work.

Label all containers according to ANSI Z129.1-2000 Hazardous Industrial Chemicals-Precautionary Labeling.

List the following information in clear, legible type on the label of each container for each product:

- Manufacturer's name and complete address
- Product name including component type, if applicable
- Color name or number of the particular product or component
- The lot and/or batch number of the product and components
- The date of manufacture of the product and components
- Identification of any toxic substances contained in the product

M06.02 PAINT SYSTEMS.

Select the paint from either the NEPCOAT Qualified Products List or as otherwise described in this specification.

M06.02.1 New or 100 Percent Bare Existing Structural Steel and/or Hardware.

Use paint systems on the NEPCOAT Qualified Products List for new or 100 percent bare structural steel and any related hardware. Prepare the surface per the recommended (not minimum) method from the manufacturer. For steel that is galvanized or metalized, omit the specified zinc rich primer. Use the intermediate and finish coats of NEPCOAT systems to overcoat galvanizing or metalizing. If the galvanizing or metalizing is damaged, apply the approved organic zinc-rich primer from the NEPCOAT Qualified Products List for the system before applying the intermediate and topcoat.

M06.02.2 Existing Steel Structures and/or Hardware.

This applies when the surface has been previously coated and/or has rusted, when minimal surface preparation has been specified by the Engineer, or requested by the Contractor and approved by the Engineer. Use the coating system on the NEPCOAT Qualified Products List, except replace the zinc rich primer by a surface tolerant product from the same manufacturer and compatible with the coating to be applied over it. Submit the coating system for approval before the start of any work. Prepare the surface per the manufacturer-recommended (not minimum) method.

M06.03 CAULKING AND SEALANTS.

Supply caulking and sealants that are compatible with the coating system specified for the Project. Provide written confirmation from the coating and caulking/sealant manufacturers that the caulking and sealant products are compatible. Ensure that the color of the caulking or sealants is the same as the finish coat color or clear.

SECTION M07 — SHEET PILING AND PILES

M07.01 UNTREATED TIMBER SHEET PILING.

Use timber sheeting that is sound spruce, Douglas fir, white or yellow Lodgepole or Ponderosa pine, or western hemlock plank, planed on one side and either tongue and grooved or splined. Ensure that the timber sheeting is not less than nominal 4 in. thick. Use timber sheeting that conforms to AASHTO M168, Structural Timber, Lumber, and Piling.

M07.02 TREATED TIMBER SHEET PILING.

M07.02.1 General.

Use treated timber sheet piling that conforms to **Subsection M07.01**. In addition, use treated sheet piling that conforms to AASHTO M133 and the current American Wood Protection Association (AWPA) Standards U1 and T1 regarding acceptable wood species, approved preservatives, and treatment processing. Also, ensure that the selected wood preservative is approved for the end use by the USEPA, registered for use in the State where the treated wood is produced, and acceptable by current RIDEM regulations.

M07.02.2 Wetlands, Marine, and Freshwater Waterbodies.

In these locations, the following is required:

- Coat any chemically or pressure treated piles (CCA, ACQ, etc.) with an impact-resistant, biologically inert substance. Coat the piles at the point of manufacture, not on site.
- Completely remove and do not reuse existing creosote piles that are affected by Project activities. Do not install any new creosote piles.

M07.03 PRECAST CONCRETE SHEET PILING.

Use concrete sheet piling that conforms to **SECTIONS 601** and **809**.

M07.04 STEEL SHEET PILING.

Ensure that steel sheet piling is rolled steel sections that conform to AASHTO M270, Grade 36.

M07.05 UNTREATED TIMBER PILES.

M07.05.1 General.

Use timber piles that conform to AASHTO M168 and are cut from sound and live trees, preferably during the winter season. Ensure that piles are free from any defects that will impair their strength or usefulness for the intended use.

Ensure that untreated timber piles have the bark unpeeled. Use treated timber piles that are clean-peeled, removing all of the outer bark and at least 80 percent of the inner bark and is well distributed over the outer surface of the pile. Remove any strips of inner bark that are wider than ½-in.

Cut all piles above the ground swell. Ensure that piles have a uniform taper from butt to tip end and are free from short kinks. Trim off knots or blemishes close and even with the body of the pile. Ensure that a line from the center of the butt to the center of the tip lies entirely within the body of the pile.

M07.05.2 Inspection.

All piles will be subject to inspection before or after shipment to the site, or both, at the option of the Engineer.

M07.05.3 Specific Requirements.

Use untreated piles that are new spruce, oak, Douglas fir, yellow pine, or any other species, subject to the approval of the Engineer that will withstand the specified driving without damage.

Use the following table for butt and tip dimensions for various lengths of piles:

Length	Minimum Dimension 3 ft from Butt	Minimum Tip Dimension
Up to 40 ft	12 in.	8 in.
40 ft and up to 50 ft	12 in.	7 in.
50 ft and over	13 in.	6 in.

For all piles, ensure that the maximum dimension is 20 in., measured 3 ft from the butt. Take measurements under the bark in all cases. Where the piles will support a concrete cap, ensure that the maximum butt dimensions are 6 in. less than the designated width of the concrete cap.

Where piles will be in line in a bent, ensure that all piles in the bent have a uniform size to permit the proper fastening of the bracing. Do not cut piles to accommodate the bracing.

M07.06 TREATED TIMBER PILES.

Use treated timber piles that conform to **Subsections M07.05.1** and **M07.05.2**.

M07.06.1 Specific Requirements.

Use preservative treatment that conforms to AASHTO M133 and the current American Wood Protection Association Standards U1 and T1 regarding acceptable wood species, approved preservatives, and treatment processing. Also, use a wood preservative selected that has been approved for the end use by the USEPA, registered for use in the State where the treated wood is produced, and acceptable by current RIDEM regulations.

M07.07 PRECAST-PRESTRESSED CONCRETE PILES.

For precast-prestressed concrete piles, use standard 14-in. square piles designed and manufactured according to the Joint AASHTO and PCI Committee recommendations. Use precast-prestressed concrete piles that conform to **SECTIONS 601** and **809**.

M07.08 CONCRETE-FILLED SHELL PILES.

This Subsection applies to steel shell type piles where the shell is not considered as a permanent load carrying member.

M07.08.1 Steel Shells.

Ensure that steel shells have sufficient strength and rigidity to permit driving and to prevent distortion caused by soil pressures or the driving of adjacent piles, until filled with concrete. Ensure that the shells are sufficiently watertight to exclude water during the placing of concrete.

Use steel shells that have a uniform taper, a combination of uniform sections of increasing diameter, a combination of uniform sections of equal length that increase progressively not more than twice the thickness of the shell at each change in diameter, or a uniform section throughout. Only use one type for the Contract. Use tips that are of steel fully welded to tightly close the bottom of the pile to make a watertight closure. Avoid the use of more than one short section at the butt end when necessary to extend the pile length.

If steel shells consisting of a succession of cylindrical sections of increasing diameter are used, ensure that all sections have an equal length and increase in diameter by not more than 1 in. between adjoining sections from the section at the tip to the section at the butt of the pile.

Ensure that the minimum tip diameter is 8 in. Ensure that the minimum butt diameter at the point of cut-off is 12 in. when the specified loading is 40 tons or less, and is 14 in. when the specified loading is over 40 tons and less than 50 tons.

M07.08.2 Concrete.

Use Class HP concrete for concrete-filled shell piles that otherwise conform to **SECTION 601**.

Use reinforcement that conforms to **Subsection M05.02**.

M07.09 STEEL H-PILES.

Use steel H-piles that are rolled structural shapes conforming to AASHTO M270, Grade 36.

M07.10 STEEL PIPE PILES.

This Subsection applies to steel piles where the casing is considered a permanent load-carrying member.

M07.10.1 Steel Pipe.

Use steel for pipe piles that conforms to the Standard Specifications for Welded and Seamless Steel Pipe Piles, ASTM A 252, Grade 2.

M07.10.2 Concrete.

Use Class A concrete for steel pipe piles that conforms to **SECTION 601**.

M07.11 PILE POINTS AND DRIVE SHOES.

Use pile points and drive shoes that are carbon-steel castings that conform to AASHTO M103 (ASTM A27), Class 70 or Grade 70-36.

M07.12 CLOSURE PLATES AND CAPS.

Use closure plates and caps that are mild carbon steel that conforms to AASHTO M270 (ASTM A709), Grade 36.

SECTION M08 — FENCE AND GUARDRAIL

M08.01 BARBED WIRE.

Use barbed wire that conforms to ASTM A121.

M08.02 CHAIN LINK FENCE.

Use chain link fence and required fittings and hardware that conforms to AASHTO M181 for the type of metal, coating, sizes of wire, and mesh specified.

Use right-of-way wire fencing that conforms to AASHTO M279, Class 3, Grade 60.

M08.03 METAL BEAM RAIL.

Use rail elements that are corrugated sheet steel beams conforming to AASHTO M180 Class A, Type II.

M08.04 TIMBER RAIL.

Ensure that the timber rail is cut from the specified grade for dry, well-seasoned, and dressed Southern Yellow Pine, spruce, or fir that complies with AASHTO M168.

Where preservative treatment is specified, use a product that conforms to AASHTO M133 and the current American Wood Protection Association (AWPA) Standards U1 and T1 regarding acceptable wood species, approved preservatives, and treatment processing. Also, select wood preservative that is approved for the end use by the USEPA, registered for use in the State where the treated wood is produced, and acceptable by current RIDEM regulations.

M08.05 WIRE CABLE.

Use wire cable for guardrail that conforms to AASHTO M 30 for the specified diameter and strength class.

Use flexible rail elements composed of multiple wires in any arrangement other than cable form that conforms to the strength requirements on the specifications for the item.

M08.06 FENCE POSTS.

Ensure that all wood posts are peeled and with ends cut square. Use posts that conform to AASHTO M168. Ensure that the posts are straight and that all knots are trimmed flush with the surface. Where treated posts are designated, use a type of treatment that conforms to AASHTO M133 and the current American Wood Protection Association (AWPA) Standards U1 and T1 regarding acceptable wood species, approved preservatives, and treatment processing. Also, select a wood preservative that has been approved for the end use by the USEPA, registered for use in the State where the treated wood is produced, and acceptable by current RIDEM regulations.

Ensure that all dimension timber and lumber required for fences or gates are sound, straight, free from knots, splits, and shakes, and conforms to AASHTO M168. Use a species referenced in AASHTO M133 or AWPA U1 Standards and grades and that is dressed and finished on four sides.

Use steel posts that are galvanized according to AASHTO M 111. Use fittings, hardware, and other appurtenances that are standard commercial grade and comply with current standard practice.

M08.07 GUARDRAIL POSTS.

Use railing posts that are either wood, steel, or concrete that complies with AASHTO M 180.

M08.07.1 Wood Posts.

Use wood posts that are fabricated from an approved or specified timber species and have the quality, diameter or section, and length as specified in AASHTO M 181. When treated posts are specified, use posts that have been fabricated before treatment. Use timber preservatives and preservative treatments that conform to **Subsection M08.06**.

M08.07.2 Steel Posts.

Use steel posts that have the section and length specified. Use posts that are of copper bearing steel when so specified. Use steel that conforms to AASHTO M183 for the grade specified or, for new railroad rail posts, to ASTM A1 for the unit weight of rail specified.

Ensure that the posts are galvanized to conform to AASHTO M111.

M08.07.3 Precast Reinforced Concrete Posts.

Use precast reinforced concrete posts that have a section and length as specified. Use Class XX concrete that conforms to **SECTION 601**. Use bar reinforcement that conforms to **Subsection M05.02**.

M08.07.4 Concrete Deadmen.

Use concrete deadmen for end anchorages as specified. Use concrete that conforms to the manufacturer's specifications and **SECTION 601**. Use bar reinforcement that conforms to **Subsection M05.02**.

M08.08 GUARDRAIL HARDWARE.

Use offset brackets of the resilient and non-resilient types that meet the type and strength requirements specified.

Use splices and end connections that are the type and design specified and meet the strength necessary to develop the full design strength of the rail elements.

Use end spring assemblies that are positive and a type that meets the required design and strength of the railing structure.

Use end anchor rods and accessories, fittings, bolts, washers, and other accessories that comply with the size, strength, and galvanization required by AASHTO M 180. Ensure that all galvanizing is performed after fabrication.

Use steel beam guardrail reflectorized triangular delineators that are the type specified. The Department's Product Evaluation Committee will approve all triangular delineators, which shall be one of the products on the Department's Approved Materials List.

Use washers on the delineator that conform to ASTM B209 Alloy 5052-H32.

SECTION M09 — CURBING

M09.01 GRANITE CURB FOR ROADWAYS.

Use granite that conforms to ASTM C615.

M09.02 GRANITE SLOPE CURBING FOR ROADWAYS.

Use granite that conforms to ASTM C615.

M09.03 PRECAST CONCRETE CURBING.

M09.03.1 General.

Use concrete that conforms to **SECTION 601**.

With the slope faced curbing, ensure that the top, slope, and vertical faces are floated smooth and the edges rounded to remove the sharp corners while the curb is still soft.

Pour the slope faced curbing with white faced top and slope in two courses. Pour the second course immediately after pouring the first course so that a sufficient bond between the two courses is obtained.

M09.03.2 Reinforcement.

Use reinforcing materials that conform to **Subsection M05.02**.

M09.03.3 Joint Fillers.

Use preformed and poured joint fillers that conform to **Subsection M02.10**.

M09.04 ASPHALT CURBING.

Use asphalt concrete curbing that is made using Class 9.5 HMA.

M09.05 GRANITE CURB FOR BRIDGES.

Use granite that conforms to ASTM C615.

M09.05.1 General.

Use stone for bridge curb that is hard, durable granite of a uniform grayish white color and free from seams that impair its structural integrity. Natural color variations characteristic of granite at the source quarry will be permitted.

M09.05.2 Anchors.

Use anchors that are No. 6 reinforcing bars. Install at least three anchors in each stone.

M09.05.3 Mortar.

Use mortar for joints that is one part Portland cement to two parts clean sand with sufficient water to form a workable mixture. Use mortar within 45 minutes after its preparation.

SECTION M10 — DUST CONTROL, RIPRAP, STONE WALLS, COBBLESTONES, FLAGSTONES, HIGHWAY BOUNDS

M10.01 (Reserved).

M10.02 CALCIUM CHLORIDE.

Use calcium chloride that conforms to AASHTO M144.

M10.03 RIPRAP.

Use riprap that consists of broken stone produced from sound ledge or large boulders with at least three fractured faces on each particle and that are free from overburden, spoil, shale, or organic material. Use stone that has a minimum density of 160 lb/cu ft. Ensure that the stones are angular in shape with a minimum dimension not less than one third of the maximum dimension. Use stone for placed riprap that has one flat face and is roughly square or rectangular to facilitate laying up.

M10.03.1 Bedding for Riprap.

Use bedding stone that conforms to **Subsection M10.03** and conforms to one of the following designations:

Filter Stone

National Stone Association Modified NSA No.	Size (Inches) (square openings)		
	100% Passing	0 - 50% Passing	0 - 15% Passing
FS-1	½	No. 16	No. 50
FS-2	2	No. 4	No. 18
FS-3	6½	2.5	No. 4

M10.03.2 Stone for Riprap.

Use stone for riprap that complies with this **Subsection M10.03** and conforms to one of the designations in the following Table. In addition, ensure that the stone is well graded within the size specified.

M10.04 STONE WALLS.

Use stones for this work that are natural field stone and are roughly rectangular in shape with at least one fairly even face.

M10.05 COBBLESTONES.

Use stones that are hard durable cobbles not less than 4 in. nor more than 8 in. long by 6 in. wide and that have a uniform thickness of not less than 4 in.

Graded Riprap Stone

National Stone Association Modified NSA No.	Size (Inches) (square openings)		
	100% Passing	0 - 50% Passing	0 - 15% Passing
R-1	2	1	No. 4
R-2	4	2	1
R-3	8	4	2
R-4	14	7	4
R-5	20	10	6
R-6	26	13	8
R-7	34	18	14
R-8	50	24	18

M10.06 FLAGSTONES.

Use flagstone that is clean, even grain stone, and finished with a rock face top and chiseled edges. Ensure that the face edge of tread does not vary more than ¼ in. from a line throughout its length.

Use stone for walks that have a uniform thickness of not less than 3 in.

Use stone for treads that have a uniform thickness of not less than 1½ in.

M10.07 HIGHWAY BOUNDS.

M10.07.1 Granite Bounds.

Use granite bounds that conform to **Subsection M09.01**.

M10.07.2 Reinforced Concrete Bounds.

Use materials for reinforced concrete bounds that conform to **SECTION 601** and **Subsection M05.02**.

M10.07.3 Bronze Rods.

Use bronze for highway markers that conform to AASHTO M107.

SECTION M11 — TIMBER

M11.01 SAWN LUMBER.

Use timber for construction that is sawn lumber that meets both the classification and grading requirements for stress graded structural species and the following special requirements.

M11.01.1 Structural Grades.

Use structural grades that conforms to ASTM D245, Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber.

M11.01.2 Mechanical Properties.

Ensure that the mechanical properties conform to ASTM D2555, Method for Establishing Clear Wood Strength Values.

M11.01.3 Structural Lumber.

Use structural lumber that is American Standard Lumber manufactured and graded according to the latest edition of the ALS PS 20. Ensure that this lumber is grade-marked according to both the requirements of that standard and the applicable grading rules agency.

M11.01.4 Sawn Lumber and Timber.

Use sawn lumber and timber that conforms to AASHTO M168, Standard Specification for Wood Products.

M11.02 STRUCTURAL GLUED LAMINATED TIMBER.

Use structural glued laminated timber that conforms to the American National Standard Institute's publication ANSI/AITC A190.1, Wood Products – Structural Glued Laminated Timber.

M11.02.1 Working Stresses.

Determine working stresses according to ASTM D3737, Test Method for Establishing Stresses for Structural Glued Laminated Timber.

M11.02.2 Other Requirements.

Ensure that all other requirements of **Subsection M11.01** also apply.

M11.03 PRESERVATIVE TREATMENT.

Ensure that the preparation, process, amount, and type of preservative treatments conform to Section 17 of the AASHTO *LRFD Bridge Construction Specifications*. These requirements apply to both the wood preservatives and the preservative treatments of dimensional lumber, timber, posts, beams, stringer, and laminated members.

SECTION M12 — WATERPROOFING, DAMPPROOFING AND SEALERS (CONCRETE PROTECTIVE SYSTEMS)

M12.01 WATERPROOFING.

Use products that are on the RIDOT Approved Products List or submitted for review and approval by the Engineer.

M12.01.1 Heat-Applied Prefabricated Membrane.

a. Primer. Use primer that allows the quick application of the prefabricated waterproofing sheet membrane as specified by the manufacturer of the membrane.

b. Sheet Membrane. Use membrane material that consists of a prefabricated reinforcement of synthetic nonwoven material, thoroughly impregnated and coated with styrene-butadiene-styrene (SBS) modified bitumen. Provide the membrane in rolled sheet form.

Use curb bitumen that is a SBS modified liquid bitumen that conforms to the manufacturer's recommendations.

M12.01.2 Cold Spray-Applied Liquid Membrane.

a. Primer. Use primer that is a 100 percent reactive, monomer or polymer-based, two-component resin.

b. Membrane. Use a coating system that is a spray applied, 100 percent solids, fast cure, high-build monomer or polymer system. Primer is required. Ensure that the membrane system passes ASTM C 836 Crack Bridging Test at 80 mils, or ensure that the thickness applied is at least equal to the thickness used by the manufacturer for the ASTM C 836 Crack Bridging Test. Include a manufacturer-approved tack coat for overlays on the waterproofing membrane. In addition, use a membrane that meets or exceeds the properties in the following Table, submitted with a Certificate of Compliance, on the laboratory prepared samples. Use broadcast aggregate, if required, that meets the manufacturer's recommendations.

M12.02 DAMPPROOFING.

Use products on the RIDOT Approved Products List or submitted for review and approval by the Engineer.

M12.02.1 Primer.

Use primer as required by the Manufacturer.

M12.02.2 Mop Coats.

Use mop coats that conform to ASTM D449.

Test Method — Required Results

Test	Method	Required Result
Initial Cure Time	N/A	≤ 30 Minutes, 73°F, 50% - 85% RH
Water Vapor Transmission	ASTM E 96	0.026 gr/ft^2/hr (0.18 g/m^2/hr)
Adhesion to Concrete	ASTM D 4541	> 100 psi
Adhesion to Steel	ASTM D 4541	> 290 psi
Tensile Strength, Method A, Die C	ASTM D 638	> 435 psi
Elongation at Break, Method A, Die C	ASTM D 638	> 100%
Low Temperature	¼ in. (6.35mm) Mandrel @ -13°F (-25°C)	Pass
Crack Bridging	ASTM C 836	Pass @ 10 cycles, 0.0625 in., -15°F (1.6mm, -26°C)

M12.03 CONCRETE PROTECTIVE SEALERS.

Ensure that the sealer has been tested by the manufacturer according to these specifications and submitted to the Engineer for approval before the start of application. Use material that conforms to the following requirements:

- Meets all current Federal and State environmental regulations.
- Does not contain oxidizing ingredients such as marine oils, stearates, and vegetable oils.
- Reduces the chloride intrusion into concrete by 90 percent when tested according to AASHTO T259, Resistance of Concrete to Chloride Ion Penetration or by 55 percent when tested according to RIDOT Materials Laboratory Test, Chloride Penetration Resistance of Concrete Sealers as described in the research report FHWA-RI-RD-90-1, Laboratory Evaluation of Concrete Sealers for Vertical Highway Structures.
- Reduces the net moisture weight gain of concrete after drying to 30 percent or less as tested according to RIDOT Materials Laboratory Test, Water Absorption and Water Vapor Transmission of Concrete Sealers, as described in the RIDOT research report FHWA-RI-RD-90-1, Laboratory Evaluation of Concrete Sealers for Vertical Highway Structures.
- Provides effective freeze-thaw protection to the underlying concrete as tested according to ASTM C666, Resistance of Concrete to Rapid Freezing and Thawing, as modified by RIDOT for coated specimens, as described in the RIDOT research report FHWA-RI-RD-90-1, Laboratory Evaluation of Concrete Sealers for Vertical Highway Structures.
- Is applied in a minimum of two coats or as recommended by the manufacturer.
- Is used as supplied by the manufacturer. Do not dilute or alter.

- At least two weeks before the start of application, the manufacturer shall submit a one-gallon sample of the product and all pertinent information, including the manufacturer's protective coating test results, to the Engineer.

M12.03.1 Film Forming Sealers.

Use film forming sealers that form a durable, impermeable surface coat over the concrete substrate and that conforms to the following.

- Is a formulation that, when set, is weatherproof, waterproof, resistant to most chemicals, inhibits the intrusion of chloride salts, and has exceptionally strong adhesive qualities.
- For two-component coatings, is shipped in new containers identified Part A and Part B, and is proportioned in each container to provide the manufacturer's specified mixing ratio.

M12.03.2 Penetrant Class Sealers.

Use penetrant class sealers that penetrate the surface of the concrete substrate and leave no visible trace of its presence.

SECTION M13 — BRIDGE BEARINGS

M13.01 ELASTOMERIC BEARINGS.

M13.01.1 Elastomer.

Use raw elastomer that is virgin neoprene (polychloroprene). Use an elastomer compound that is classified as a low temperature Grade 0, 2, 3, 4, or 5 as defined in Section 18 of the *AASHTO LRFD Bridge Construction Specifications*.

M13.01.2 Steel Laminates.

Use steel laminates for reinforcement that has been fabricated from rolled mild steel conforming to ASTM A36 or A570. Ensure that the steel laminates have a minimum nominal thickness of 16 gauges. Do not allow holes in plates for manufacturing purposes unless they have been accounted for in design and indicated as such on the Plans.

M13.01.3 Bond.

Use a vulcanized bond between fabric and reinforcement that has a minimum peel strength of 30 lb/in. Ensure that the steel laminated bearings develop a minimum peel strength of 40 lb/in. Perform peel strength tests by ASTM D429 Method B.

M13.02 POT AND DISC BEARINGS.

Use new and unused materials in the manufacture of pot and disc bearings. Ensure that all required pot and disc bearings required are fabricated by a single manufacturer.

Use an elastomeric rotational element, sealant, sealing rings, steel, stainless steel, and TFE sheet that conform to Section 18 of the AASHTO *LRFD Bridge Construction Specifications*.

M13.03 SLIDING BEARINGS.

M13.03.1 Carbon Steel.

Use sole, pivot, and masonry plates that conform to AASHTO M270, Grade 36.

M13.03.2 Stainless Steel.

Use stainless steel that conforms to ASTM A240, Type 304 or ASTM A167, Type 304.

M13.03.3 Polytetrafluoroethylene (TFE).

Use TFE resin that is virgin material (not reprocessed) conforming to ASTM D1457. Ensure that the specific gravity is between 2.13 and 2.19 and that the melting point is 623°F ±2°.

M13.03.4 Bedding of Masonry Plates.

a. Preformed Fabric Pads. Use preformed fabric pads as bedding that are composed of multiple layers of 8-oz cotton duck impregnated and bonded with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. Ensure that the number of plies used produce the specified thickness after compression and vulcanizing. Ensure that the finished pads can withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 lb/sq in. without detrimental reduction in thickness or extrusion.

b. Sheet Lead. Use sheet lead as bedding that is common, desilverized lead conforming to ASTM B29. Ensure that the sheets have a uniform thickness and are free from cracks, seams, slivers, scale, and other defects. Use lead sheets that are ⅛ in. in thickness with a permissible tolerance of ±0.03 in.

M13.03.5 Anchor Bolts.

Use anchor bolts, including nuts and washers, that are galvanized and conform to **Subsection M05.05.4**.

SECTION M14 — STONE FOR MASONRY

M14.01 STONES.

Use stone that is of the approved quality, sound and durable, resistant to weathering action, reasonably uniform in color, and free from seams, cracks, laminations, and minerals that by weathering would cause discoloration or deterioration. Use stone from a quarry, the product of which is known to be of satisfactory quality. Use stone that is properly seasoned and can be wrought to the lines and surfaces, whether curved or plane. Ensure that the stone remains free from dirt, oil, and any other injurious material that may prevent the proper adhesion of the mortar and concrete backing or detract from the appearance of the exposed surfaces. Submit samples of the stone to be used when requested by the Engineer. When seam faced stones or a variety of distributed sizes, colors, and textures is desired, obtain the stone from more than one source if necessary.

Use granite that conforms to ASTM C615.

M14.01.1 Sizes and Dimensions.

a. Cut Stone (Dressed or Tooled). Where the width of bed is not shown, ensure that the stone is not less than 1¼ times the rise with a minimum width of 10 in. Ensure that the length of headers is not less than the width of the bed of the widest adjacent stone plus 12 in. Use stretchers that have a length of not less than 2½ times their thickness nor less than 3 ft and not more than 3½ times their thickness. Before any stone is delivered, prepare course layout plans with sufficient detail of individual stones to permit cutting in the quarry.

   Cut the stone to lie on the natural beds with tops and bottoms parallel. Ensure that the contact area of the beds is free from large depressions and cuppings that might impair the stability of the work and is dressed for at least 4 in. back of the pitch line. Dress the vertical joints at right angles to the face for at least 2 in. back from the face, at which point they may fall away not more than 1 in. Dress the beds and joints for caps, copings, and special units a corresponding distance from all exposed faces.

b. Split-face. Stone facing may vary from 9 in. to 15 in. in thickness, with occasional deeper stones for headers. Avoid square units as possible. Use stone for capping that conforms to the section dimensions and reasonably conforms to the lengths shown by scale on the drawings.

c. Rubble. Use stones for this type of masonry that consist of irregular quarry stones without other preparation than the removal of very acute angles and excessive projections from the general surface. Stone removed from existing structures within Project limits, or stones from other approved sources may be used. Do not use any stone less than 9 in. in thickness.

M14.01.2 Surface Finish.

a. Cut Stone (Dressed or Tooled). The surface finishes of cut stone are defined as follows:

- Smooth-finished: Having a surface in which the variations from the pitch line do not exceed 1/16 in.
- Fine-finished: Having a surface in which the variations from the pitch line do not exceed ¼ in.
- Rough-finished: Having a surface in which the variations from the pitch line do not exceed ½ in.
- Scabbled: Having a surface in which the variations from the pitch line do not exceed ¾ in.
- Rock-faced: Having an irregular projecting face without indications of tool marks. Ensure that the projections beyond the pitch line do not exceed 3 in. and that no part of the face recedes back of the pitch line.

b. Split-face. Use stone in exposed surfaces that is split-faced and that the maximum projection is 1 in. at the base of walls and that tapers off to approximately ½ in. adjacent to concrete copings or caps. Avoid concave faces, and slightly crown the top surface of the capping to shed water.

c. Rubble. Use stones selected and laid to present faces that reasonably conform to the general plane of the wall surface, avoiding conspicuous projections extending 2 in. from the face line or depressions more than 1 in. deep.

SECTION M15 — TRAFFIC CONTROL AND HIGHWAY LIGHTING SYSTEMS

M15.01 GROUND RODS.

Use ground rods that have a ⅝-in. diameter by 10-ft long rod of copper-clad steel and that is equipped with a clamp of sufficient size to receive the ground wire.

M15.02 WIRE AND CABLE.

M15.02.1 Wire for Highway Lighting.

a. General. Use wire and cables that are single conductor. Use conductors of sizes No. 10 AWG and larger that are stranded. Use wires of sizes smaller than 10 AWG that are solid.

   Ensure that the conductors are factory identified by printing the size and type of insulation. Ensure that each conductor is colored according to the National Electric Code. Use a constant insulation color throughout the length of the conductor that does not otherwise need to be taped or tagged for identification. Use white for the color of the insulation of the neutral conductor. Do not use white for the remaining conductors. Use dissimilar colors for identification. Ensure that the grounding conductor is insulated to 600 volts and that the grounding conductor insulation is green in color.

b. Conductors. Use wire conductors that are annealed copper conforming to the following specifications as applicable:

   - American Society for Testing Materials:
     - ASTM B3 — specification for annealed copper wire
     - ASTM B8 — specification for concentric-lay-standard, copper conductor, hard, medium hard or soft
     - ASTM B33 — specification for tinned soft or annealed copper wire for electrical purposes

c. Insulation. Ensure that insulation is indicated and conforms to the following specifications as applicable.

   - American Society for Testing Materials:
     - ASTM D1351 — (THW and THWN) specification for polyethylene insulated wire and cable
     - ASTM D2655 — XLPE (XHHW-2) specification for crosslink, thermosetting polyethylene insulation for wire and cable 0 to 600 volts

   For all wire below finished grade, use XLPE (XHHW-2). THW or THWN may be used between the handhole and fixture if the percent of wire above ground is greater than the percent below ground.

d. Cable Jacket. Ensure that the insulation is jacketed and has an outer covering as specified in the National Electric Code, Table 310-13, Conductor Applications and Insulations. When specified by the National Electric Code, use a neoprene jacket that conforms to ASTM D752.

e. Insulation and Jacket Thickness. Ensure that the minimum thickness of insulation and jacket thickness is as follows:

Conductor Size	Insulation Thickness in 64ths	Jacket Thickness in Inches
14 thru 10 AWG	3	0.015
8 thru 2 AWG	4	0.030
1 thru 4/0 AWG	5	0.045
250 thru 500 MCM	6	0.065
600 thru 1000 MCM	7	0.065

M15.02.2 Ground Wire.

Use ground wire that is seven strand, No. 2 AWG or No. 6 AWG, soft drawn copper and that conforms to **Subsection M15.02.1(b)**.

M15.02.3 Service Conductors.

Use service conductors that are type THHN or TWH and comply with Paras. a through e of **Subsection M15.02.1**.

M15.02.4 Traffic Signal Cable.

Use a traffic signal cable or wire that conforms to IMSA Specification 19-1 or 20-1.

M15.02.5 Loop Detector Wire.

Use wire for inductance loop detectors that are No. 14 AWG, complying with IMSA Specification 51-5.

Use a roadway loop embedding sealer to encapsulate traffic signal loop wires embedded in highway materials. Apply the sealer cold, which may be a one- or two-component system, with a viscosity that is sufficient to allow the material to be either poured or placed under pressure and fully encapsulate the loop wires. Ensure that the sealer is curable at temperatures of 40°F and above and, when bonded to common paving materials, has sufficient strength and resiliency to withstand stresses due to vibrations and differences in expansion and contraction as a result of temperature changes or traffic conditions. Use a sealer that is compatible with the sheathing and covering of loop inductance wire and that is resistant to most chemicals and solvents including salts, acids, hydrocarbons, etc.

M15.02.6 Loop Detector Lead-In Cable.

Use a loop detector lead-in cable that conforms to IMSA Specification 50-2.

M15.02.7 In-Line Disconnect Device.

Use an unfused disconnecting device that consists of a copper pin and a copper receptacle of at least 90 percent conductivity to be crimped to the cable. Ensure that the receptacle establishes contact pressure with the pin through the use of a copper beryllium sleeve spring, is equipped with a disposable mounting pin, and is fully annealed. Ensure that both the copper pin and receptacle have a centrally located recessed locking area adaptor to be completely filled and retained by the rubber housing. Use a fused disconnecting device that consists of a spring-loaded 90 percent minimum conductivity contact suitable for gripping the specified cartridge fuse.

Ensure that the contacts are fully annealed, adapted to be crimped to the cable, and are adapted to be retained securely in the proper position within the rubber housing. Use a disconnect device housing that consists of water resisting synthetic rubber that can be buried in the ground. Ensure that each housing provides a section to form a water seal around the cable, has an interior pin or fuse contacts, and has a section to provide a water seal between the two housings at the point of disconnection. Ensure that each housing is permanently marked “load side” or “line side.” Use a fuse for the disconnecting devices that is rated 600 volts and 100,000 ampere interrupting capacity and is 13/32 in. in diameter.

M15.02.8 Splice Kits.

Use material for this item that consists of a splice made of fabricated 6061-T aluminum and is insulated with EPDM rubber compound rated 600 volts to accept copper conductors. Use splices approved for submersible installations.

Use splices that consist of four terminals with a rubber boot suitable for accepting the recommended conductor sizes. Ensure that the unused boot remains intact to keep the watertight integrity of the splice. Use splices that are manufactured by HOMAC, RAB 350 Series or approved equal.

M15.03 HANDHOLES AND PULL BOXES.

M15.03.1 Precast Handholes and Pull Boxes.

Ensure that Precast Type A Handholes, Precast Type B Heavy Duty Handholes, and Precast Type H Heavy Duty Handholes are designed and manufactured according to ASTM C478, Precast Concrete Manhole Sections, with the additional stipulation that the concrete mix design will be Class XX as set forth in **SECTION 601**.

Use cast iron frames and covers that conform to **Subsection M04.03.6** or as indicated on the drawings. Use covers on traffic signal handholes that have the word “Signal” cast into them. Use covers on telephone handholes that have the word “Comm” cast into them. Use covers for electric pull boxes that have the word “Electric” cast into them. Provide frames and covers with ground connectors as shown in the RIDOT *Standard Drawings* for bonding purposes.

Use steel reinforcing that conforms to **Subsection M05.02**.

Provide support grips for each cable, including ground wire, in each handhole or pull box. Use supporting grips that are of the closed mesh type for permanent support of the cable. Ensure that the ends are made of stainless steel and can support 600 lb complete with supporting hook.

M15.03.2 Metal Pull Boxes.

a. Type V Pull Box (Within Structure). Use Type V pull boxes that are galvanized steel. Furnish boxes complete with tapped hubs, galvanized checkered plate covers, and neoprene gaskets. Ensure that the cover is fastened flush to the frame using stainless steel bolts with hex heads. Provide a grounding lug.

   Use pull boxes that are listed by Underwriters Laboratories and are tested for submersible application.

b. Type W Pull Box (Surface Mounted). Furnish boxes complete with tapped hubs, galvanized checkered plate covers, and neoprene gaskets. Ensure that the cover is fastened using stainless steel screws. The box can be secured by using mounting lugs (optional) or using stainless steel bolts through back or bottom. Alternative methods of securing this box can be made using Unistrut.

   Use pull boxes that are listed by Underwriters Laboratories and are tested for submersible application.

M15.04 CONDUIT AND FITTINGS.

M15.04.1 Rigid Steel Conduit and Fittings.

Use a conduit that conforms to Federal Specification WW-C-581 and the latest revision of the Underwriters' Laboratories, Inc., publication, UL-6-Standard for Rigid Metallic Conduit. Use exterior surface conduit including fittings that is zinc-coated, and use interior conduit and fittings that are coated with zinc, enamel, or other corrosion resisting coating. Use a conduit that is metalized galvanized, hot-dip galvanized, or electro-galvanized.

Use threads and couplings that conform to Appendix III of ASTM A53, Basic Threading Data for Pipe.

M15.04.2 PVC Plastic Conduit.

Use plastic conduit and elbows that conform to the NEMA Standards Publication TC 2. Use plastic fittings that conform to NEMA Standards Publication TC 3. Use conduits, elbows, and fittings that are UL listed.

M15.04.3 Fiberglass Conduit.

Use fiberglass conduit that is filament-wound reinforced epoxy resin. Ensure that all conduit is manufactured according to NEMA TC 2 and UL 1684 and that fittings are manufactured using the same materials and process as the conduit.

Ensure that joints are watertight and have a minimum pullout strength of 2000 lb. Watertight joints may be formed by the use of a gasket or epoxy adhesive.

Do not use adhesive anchors to support the conduit hanger system.

M15.04.4 Expansion Couplings.

Ensure that the fittings are designed to compensate for expansion in a horizontal line of conduit at expansion joints in a structure.

Provide expansion fittings for a maximum of a 4-in. longitudinal conduit movement, 2 in. in either direction. Provide expansion fittings for transverse conduit movement where required by structural conditions.

Use expansion fittings that are bonded with heavy duty, two-bolt, ground fittings. Do not use strap type clamps.

M15.05 LUMINAIRES.

M15.05.1 Luminaires with Integral Driver and 7-Pin Receptacle.

Use luminaires that are multiple cutoff LED type. Construct each luminaire with a two-piece aluminum die-cast housing. Ensure that the latching assembly is a double action, snap safety type. Ensure that the hinge pin and hinge plate are stainless steel with complete sealed and tilted optical system. Ensure that the projected surface area of each luminaire does not exceed 2.25 sq ft, excluding the 7-pin control.

Use a slip fitter that is an adjustable type accommodating a 1¼-in. to 2-in. diameter pipe with four stud mounting bolts with two U brackets locking a full 7½ in. desirable, 5½ in. minimum of bracket.

Use a housing for the luminaries that is die-cast aluminum with standard grey polyester powder coat finish. Ensure that the optical assembly includes a specular Alzak aluminum reflector, removable without tools. Ensure that a flat lens heat resistant glass is factory installed. Use luminaries that are the horizontal type for IES Type III medium cutoff optics.

Use LED luminaires on 30-ft standards that meet the following specifications:

- Efficacy: 128 lumens/watt minimum
- Lumens: 17,367 minimum
- Wattage: 135 maximum
- Input Voltage: 240V
- Color Temp: 4000K
- Distribution: Type II medium
- BUG Rating: B = 3; U = 0; G = 2 (maximum)
- Warranty: 10 years minimum; full replacement
- Control: 7-pin receptacle
- Options: 0-10V Dimmable (10 percent)
- Weight: 21 lb
- EPA: 0.3 sq ft
- Rated Life: L70.60,000 hrs @ 25C
- Surge Protection: 10kA

Use LED luminaires on 40-ft standards that meet the following specifications:

- Efficacy: 108 lumens/watt minimum
- Lumens: 28,089 minimum
- Wattage: 260 maximum
- Voltage: 240V
- Color Temp: 4000K
- Distribution: Type II medium
- BUG Rating: B = 3; U = 0; G = 2 (maximum)
- Warranty: 10 years minimum; full replacement
- Control: 7-pin receptacle
- Options: 0-10V dimmable (10 percent)
- Weight: 30 lb
- EPA: 0.75 sq ft
- Rated Life: L70.60,000 hr @ 25C
- Surge Protection: 10kA

Provide luminaires with 7-pin receptacles for individual control. Ensure that receptacles are molded hard rubber and are installed with neoprene gasket and retaining ring.

If circuits are energized via a photocell-controlled contactor at the service pedestal, supply photo-control shorting caps for each luminaire.

M15.05.2 LED Drivers.

Use a luminaire that contains a high-power-factor reactor type Light Emitting Diode (LED) Driver, multi-tap connected for 240 volts ±10 percent starting voltage. Ensure that Light Emitting Diode (LED) Drivers are suitable for operation at minus 20°F.

M15.05.3 Photo-Electric Controls.

Use controls that are a tubeless type suitable for 240-volt operation with the multiple high-pressure sodium luminaires specified above. Ensure that the photo-electric controls are rated 105 to 285 volts, 50/60 cycles, alternating current, 1800 volt-amperes, for high pressure sodium loads with peak currents not greater than 120 amperes, and are rated with an inrush current of 60 amperes complete with a single-pole, double-throw 1000-watt relay. Use controls that have an adjustable turn-on at 1.0 to 2.5 ft-candles. Ensure that the turn-off value is 10 ft-candles maximum and that the operating level is between 0.5 and 10 ft-candles.

Ensure that the temperature operating range is between minus 50°F and plus 150°F.

Use photo-electric controls that consist of a dependable, simple, tubeless circuit, including a hermetically sealed, broad area cadmium sulfide photo-cell capable of controlling a relay without intermediate amplification. Ensure that the relay is de-energized during the night with normally closed contacts in the closed position and that the luminaire is energized. During the day, ensure that the relay is energized with contacts open and the luminaire is de-energized. Ensure that there are fail-safe features for the lighting load to remain turned on in the event of failure of the

electric circuit. Incorporate directional design features and a time delay in the photo-electric controls to prevent false turn-offs to headlights and other transient light sources.

Mount the individual components of each photo-electric control on a Bakelite chassis, which is protected by a weatherproof acrylic housing. Mount the photo-electric controls directly on the high-pressure sodium luminaires, and ensure that the controls conform to the EEI-NEMA standards for locking, sealing, and base dimensions.

M15.05.4 Protective Screen for Understructure Luminaire.

Use angle iron that is 1½″ × 1¼″ × 2.34 lb/ft. Use angles that are galvanized after welding corners and drilling. Ensure that angles are galvanized after welding corners and drilling. Ensure that the wire mesh is galvanized chain link type, #6 gauge, with approximately 1-in. square openings.

M15.06 LIGHT STANDARDS AND FOUNDATIONS.

M15.06.1 Light Standards.

Use poles, non-rounded luminaires and high-level lighting structures that are designed according to the currently adopted version of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Use breakaway support couplings that meet the requirements of the currently adopted version of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Ensure that the design and fabrication of aluminum lighting standards for the support of high pressure sodium luminaires are similar and compatible in design and appearance with the lighting standards installed on various sections of Interstate highways in the State of Rhode Island. Use a nominal luminaire mounting height of 30 ft and 40 ft.

Ensure that each shaft is tempered by a cold working process from a seamless extruded tube of 6063-T6 or 6005-T5 wrought-aluminum alloy. Ensure that the davit arm tapers from 6 in. at the base to 4 in. at the tip.

Provide a 2-in. diameter slip fitter, 9 in. long, at the end of each davit arm.

Ensure that all arms are curved on an approved radius through an angle within 3 degrees of the horizontal. Provide twin davit lighting standards with approved type field joints. Coat the bottom of the bases with asphalt paint after assembly.

Use a base that is a 356-T4 permanent mold cast aluminum alloy that is approximately 12 in. square at the bottom with a height of 3½ in. Perform the welding by the inert gas shielding arc method, and ensure that welds are free from cracks and porosity. Ensure that the base has slotted anchor bolt holes to allow mounting on 11-in. or 12-in. bolt circles. Provide bases with cast aluminum bolt covers.

Use aluminum that, after fabrication, has a minimum yield limit of 25,000 lb/sq in. Ensure that the shaft can withstand a 1500-lb horizontal load 18 in. down from the top without fracture or apparent

permanent deformation after the load has been released. Ensure that the base can withstand the maximum allowable bending moment of the shaft, but not less than 18,500 ft-lb.

When the arm is welded to the shaft, ensure that the arm can withstand a vertical load of 100 lb and a horizontal load of 50 lb applied at the end of the arm without fracture or permanent deformation after the load has been removed.

M15.06.2 Light Standard Foundation.

a. Concrete. Light standard foundations may be cast in place or precast units. Use Class A cement concrete masonry for cast-in-place units. For precast units, use Class XX cement concrete masonry.

   Use cement concrete masonry that conforms to **SECTION 601**.

b. Steel Reinforcement. Use steel reinforcement that conforms to **Subsection M05.02.**

c. Anchor Bolts. Use anchor bolts that are high strength steel with a minimum yield of 55,000 psi, a 1-in. diameter by 66 in. long, and a 4-in. L bend on the unthreaded end. Ensure that each anchor bolt has a cut or rolled thread 6 in. long and are1 in. 8 National Coarse Class 2 fit. Use hexagon nut and leveling washers with each bolt. Ensure that the anchor bolt, washers, and hexagon nut are hot dipped galvanized conforming to ASTM A153.

   Provide and set anchor bolts for roadway lighting according to templates furnished by the manufacturer.

   Provide anchor bolts for bridge lighting as detailed on the Shop Drawings.

d. Steel Conduit. Use steel conduit, elbows, and fittings that conform to **Subsection M15.04**.

e. Breakaway Support Couplings. Ensure that the breakaway support couplings are those manufactured by Manitoba Safe-T-Base of Winnipeg, Canada, or an approved equal.

M15.07 SERVICE PEDESTAL.

Ensure that service is at 120/240, or 240/480 volt, single phase, three-wire.

M15.07.1 Enclosure.

Provide exterior mounted, weatherproof, NEMA 3R, Type 304 stainless steel two-door service enclosure with body stiffeners and mounting on a concrete pad that conforms to the general arrangement and dimensions indicated. Ensure that the enclosure walls and top are cast solid with one opening on the north wall, which is covered with a lexan, watertight window approximately 5½ in. by 9 in. long. Provide a 10-gauge steel back panel with white baked enamel finish for mounting the panelboard, photo control, relay, and contactor. Drill and tap the back panel as required to mount the equipment. Provide an enclosure with stainless steel, hinged bolted gasketed doors, combination flush access handles, hasp and brass padlock, directory frame and two sets of keys. Anchor the enclosure to the concrete base using two ½-in. thunderstuds stainless steel anchor bolts on each side embedded into the concrete. Provide a service pedestal

with a ¼ in. thick by 2 in. wide neoprene gasket continuous around the perimeter of the enclosure base. Vulcanize joints or splices in gaskets to ensure that the entire installation is watertight.

Ensure that the enclosure includes space for all materials listed.

Provide an enclosure with a watertight air vent in the roof, a 20-amp GFI receptacle, a keyless light with a 15-amp single pole switch, and a 500-watt electric utility heater with controlling thermostat mounted inside at the base.

M15.07.2 Panelboards and Miscellaneous Equipment.

a. 240/480 Volt, Single-Phase, Three-Wire Service. Use panelboards and other equipment that are of a dead front safety type with breaker sizes and with all conductors enclosed in conduit or other approved enclosed wireways.

   Ensure that the circuit breaker mechanisms are quick-make, quick-break on manual and automatic and are trip-free from the handle so that the contacts cannot be held closed against circuit faults or abnormal overloads.

   For the main circuit breaker, use a two-pole 200-amp, rated 600 volts in a NEMA 1 enclosure. Use a main breaker that has a 200-amp trip setting and a minimum interrupting rating of 22,000 amps at 480 volts. Ensure that the breaker has dual lug capabilities on the load side, or provide an auxiliary distribution power block.

   Use a controlled lighting panelboard that is a 225-amp, single-phase, 3-wire with 32 circuit positions. Ensure that all lighting branch circuit breakers are single-pole, rated 277 volts, in the required sizes. Ensure that single pole breakers have an interrupting rating of not less than 14,000 amps at 277 volts.

   Provide a 3.0 Kva dry-type step-down transformer rated 240/480 volts primary to 120/240 volts secondary to supply power to the miscellaneous loads distribution panelboard.

   Use a miscellaneous load panelboard that is rated 100 amps, 120/240 volts, single-phase, three-wire with a 60-amp main breaker and minimum of 12 single-pole positions. Use single-pole breakers that are rated for a 120-volt application with an interrupting rating of not less than 10,000 amps at 120 volts.

   Equip the mounting panel with circuit breakers, busses, and bolts for making copper connections with lock washers to prevent loosening. Do not use riveter bus connections. Securely fasten the busses to insulating bases and use copper for the busses based on 1000 amperes per square in. copper density. Drill and tap busses to permit future circuit changes without the necessity for additional machining. Design and assemble panelboards so that any individual breaker may be removed without disturbing adjacent breakers or necessitating the removal or loosening of required insulation. Use terminal lugs that are copper, bronze, or brass.

b. 120/240 240/480 Volt, Single-Phase, Three-Wire Service. Use panelboards and other equipment that are a dead front safety type with the required breaker sizes and with all conductors enclosed in conduit or other approved enclosed wireways.

Use circuit breaker mechanisms that are quick-make, quick-break on manual and automatic and are trip-free from the handle so that the contacts cannot be held closed against circuit faults or abnormal overloads.

Use a main circuit breaker that is a two-pole, 200-amp, rated 240 volts in a NEMA 1 enclosure and that has a 200-amp trip setting and a minimum interrupting rating of 22,000 amps at 240 volts.

Note: For installations where service is at 120/240 volts from a three-phase system, use a minimum interrupting rating of 65,000 amps at 240 volts.

Use a breaker that has dual lug capabilities on the load side, or provide an auxiliary distribution power block.

Use a controlled lighting panelboard that is 225-amp, single-phase, three-wire, with 32 circuit positions for 120/240 volt operation. Ensure that all lighting branch circuit breakers are single-pole and rated 240 volts. Use single-pole breakers that have an interrupting rating of not less than 10,000 amps at 120 volts. Equip the mounting panel with circuit breakers, busses, and bolts for making copper connections with lock washers to prevent loosening. Do not use riveter bus connections. Securely fasten the busses to insulating bases that have copper based on 1000 amperes/sq in. copper density. Drill and tap busses to permit future circuit changes without the necessity for additional machining. Design and assemble panelboards so that any individual breaker may be removed without disturbing adjacent breakers or necessitating the removal or loosening of required insulation. Use terminal lugs that are copper, bronze, or brass.

Use a miscellaneous load panelboard that is rated 100 amps, 120/240 volts, single-phase, three-wire with a 60-amp main breaker and minimum of 12 single-pole positions.

M15.07.3 Service Pedestal Concrete Mat.

Construct the service cabinet concrete mat with Class A concrete according to **SECTION 601**.

M15.07.4 Photo-Electric Control.

Use photo-electric controls that conform to **Subsection M15.05.3**, and mount the controls inside the service pedestal.

M15.07.5 Contactors.

Use contactors that are rated for H.I.D. lighting inductive loads, 600 volts, 2-pole, continuous duty ampere as indicated and are mechanically held. Use contacts that are silver tungsten. Provide a separate 120-volt circuit for coil operation with a hand-off automatic selector switch. Use a contactor that is ASCO 920 or approved equal.

M15.07.6 Poles.

Use poles for temporary work that conform to USASI Class 5. Use poles that are southern yellow pine treated according to **Subsection M11.03**.

M15.08 SERVICE UNITS.

a. Disconnect Switch. Use a disconnect switch that is the fusible type, heavy duty, 250-volt A.C., NEMA 3R rain-tight and conforms to Federal Specification W-S-865.

b. Fuses. Use fuses that are dual-element and can carry 500 percent of the indicated rating for a minimum of 10 seconds, have an interrupting rating of 100,000 RMS amperes, and have standard National Electrical Code dimensions.

c. Disconnect Switches – Lighting Pedestals. For 240/480 volt and 120/240 volt services, install a safety disconnect switch ahead of the meter socket for cold-sequence operation. Use a disconnect switch that is rated 2-pole, 3-wire, 600-volt enclosed in a NEMA 3R enclosure. Ensure that the switch can be locked with customer or utility padlocks for safety installation and removal of the utility meter.

M15.09 METER SOCKETS.

Provide meter sockets at all service pedestals, traffic signal controllers, intersection control beacons, and counter stations. For all of the above applications, use meter sockets that are 5-terminal duncan type and meet all requirements of the local utility company. Use meter sockets for traffic signal controllers and service pedestals that include a manual bypass.

Encase the line side of the service conductors in a watertight PVC conduit within the service enclosure or signal cabinet.

M15.10 POLE LINE HARDWARE.

Ensure that all miscellaneous pole line hardware required to complete the Project as planned is standard material manufactured for pole line construction. Ensure that all metal parts are hot-dipped galvanized.

When secondary racks are required, use those that are classified Heavy Service Secondary Rack by the EEI-NEMA and have a minimum spacing of 12 in. between the insulators. Secure each rack to the pole by not less than one through bolt and one lag bolt.

Ensure that all pole hardware, bolts, plate rods, hangers, clips, wire guards, and pole bands are hot-dipped galvanized conforming to ASTM A153.

M15.11 METALS.

Use metals for light standards, poles, bases, and hardware that conform to the same specifications as set forth in **Subsection M16.04.3**, except that design stresses may conform to CE Paper 3341 for 6061-T6 aluminum as modified by subsequent AASHTO publications.

M15.12 MESSENGER CABLE, FITTINGS.

Use messenger cable that is wire steel strand messenger cable conforming to ASTM A475, extra-high-strength grade, Class A galvanized.

M15.13 TRAFFIC SIGNAL CONTROLLER UNITS AND CONTROLLER CABINETS.

Refer to **Subsection T12.02**.

M15.14 DETECTOR RELAYS – LOOP.

Rack mount all detector units and ensure that units meet the provisions of Subsection 6.5, Inductive Loop Detectors of the NEMA Standard Publication No. TS-2, Traffic Controller Assemblies. Set all delay and extension settings in the controller.

M15.15 VEHICULAR SIGNAL HEADS.

Use signal heads that conform to the Equipment Standard of the Institute of Transportation Engineers, currently adopted edition. For all vehicular signal heads, use Light Emitting Diode (L.E.D.) Traffic Signal Modules that are 12 in. (300 mm) in diameter.

Use a L.E.D. signal module that conforms to the Purchase Specifications of the Institute of Transportation Engineers, currently adopted edition, for Light Emitting Diode (L.E.D.) Traffic Signal Modules.

An independent laboratory shall certify that the L.E.D. signal module complies with Section 6, Quality Assurance, of the above referenced ITE L.E.D. Purchase Specification.

Use a UV stabilized clear lens on all LED lamps.

Warrant all L.E.D. signal modules against material defects, workmanship, and loss of luminous intensity for a period of 60 months from the time the units are placed in service.

Ensure that lamps have a minimum of 144 L.E.D.s (light emitting diodes). Wire the lamps with parallel circuits so that one burned out L.E.D. will not affect more than 5 percent of the total circuit.

Provide a filtered power supply engineered to electrically protect the L.E.D.s and maintain a safe and reliable operation. Provide in-line fusing with a maximum rating of 2 amps in the power lead to minimize the effect and repair cost of an extreme over voltage situation or other failure mode. Ensure that all signals can flash operate with no restrictions or degradation of performance.

Provide lamps with 40-in. pigtails. Terminate wires with a crimp style female quick slide ¼-in. spade lug (16-14 wire size). Provide lamps with color coded 16 AWG wires for identification of heads as follows:

- Red L.E.D. – Red with White neutral
- Yellow L.E.D. – Yellow with White neutral
- Green L.E.D. – Green with White neutral

Ensure that all modules supplied to be retrofit into existing signal heads include a new gasket.

Use a L.E.D. signal module that is a single, self-contained device, not requiring on-site assembly for installation into a signal housing. Use a module that has a permanent UP ARROW for correctly orienting the module in the signal housing. Permanently mark the manufacturer's name, trademark, serial number, and any other necessary identification on the backside of the module.

Ensure that the maximum wattage for a 12-in. (300 mm) ball is 25 watts and, for a 12-in. (300 mm) arrow, is 14 watts.

Use red and green arrows and green/yellow dual indication arrows that consist of two rows of L.E.D.s. Ensure that the lamps are in parallel circuits so that one burned-out L.E.D. will not affect more than 5 percent of the total circuit.

M15.16 PEDESTRIAN SIGNAL HEADS.

Refer to **Subsections T14.02** and **T14.03**.

M15.17 PEDESTRIAN PUSHBUTTON DETECTORS.

a. General. Use pedestrian pushbutton detector housings that consist of a cast aluminum enclosure that is free of voids, pits, dents, excessive foundry grinding marks, and other exterior blemishes and is water-tight and rated for outdoor use. Furnish the housing with a hole in the bottom and back that are tapped to accept a ½-in. NPT thread plug. Supply the bottom hole with a threaded plug. Supply the back hole with a non-threaded plastic plug or equivalent.

   Ensure that pedestrian pushbuttons comply with the US Access Board's ADA Accessibility Guidelines (ADAAG) that are approved by the USDOT and are pressure-activated requiring no more than 3 lb of force to activate. Ensure that pushbuttons and solid state switches are rated to 20 million actuations minimum.

   Ensure that pedestrian pushbutton detector assemblies include a sign with an arrow indicating the direction of the crossing associated with the pushbutton. Ensure that the sign explains the meaning of each of the pedestrian signal indications that may be visible to a pedestrian standing at the button and conforms to the specific design included in the currently adopted MUTCD. Ensure that all pedestrian detectors furnished and installed under one Contract are identical models of current production. Untried or prototype units will not be accepted.

b. Accessible Pedestrian Detector – Pushbutton w/ Sign (APD). Ensure that APDs include features that provide audible, vibrotactile, and other visual information to pedestrians. Use APDs that meet or exceed the requirements for Accessible Pedestrian Signals and Detectors included in the currently adopted MUTCD.

   Use APDs that include a raised vibrotactile arrow incorporated into the pushbutton to clearly indicate the direction of crossing. Ensure that the raised vibrotactile arrow has high visual contrast (light on dark or dark on light) and is aligned parallel to the direction of pedestrian travel on the crosswalk associated with the pushbutton. Ensure that the vibrotactile arrow vibrates when the WALK signal is on for the crosswalk associated with the pushbutton and is motionless at all other times.

   Use APDs that include an audible pushbutton locator tone to allow visually disabled pedestrians to locate the pushbutton. Ensure that the locator tone is deactivated or silent when the WALK signal is on for the crosswalk associated with the pushbutton, when the traffic signal is operating in a flashing mode, and when a passive pedestrian detection

system is in place that activates the locator tone only at times when a pedestrian is present near the APD. At all other times, ensure that the locator tone, having a duration of 0.15 seconds or less and repeating at one second intervals, emanates from the APD. Ensure that the volume of the locator tone automatically adjusts in response to ambient sound level, up to a maximum volume of 100 dBA. Initially program the volume-intensity-responsive locator tone to emanate at a minimum of ambient sound and a maximum of 5 dBA louder than ambient sound. Ensure that the locator tone is audible a distance of 6 to 12 ft away from the pushbutton or to the nearest edge of the building closest to the pushbutton, whichever is less.

Use APDs that emanate an audible indication of the WALK signal upon activation of the WALK signal for the crosswalk associated with the pushbutton. Ensure that the audible walk indications have the same duration as the pedestrian WALK signal, except when the pedestrian signal rests in WALK. In the latter case, ensure that the duration of the audible indication of the WALK signal is no more than seven seconds. Ensure that the APD-emanated indication of the WALK signal is audible from the entrance to the crosswalk associated with the pushbutton that is closest to the APD.

Use APDs that can provide either a percussive tone or a verbal speech message for the audible indication of the WALK signal. Where at least 10 ft separate the APD from another APD, ensure that the audible WALK indication is a rapid-tick percussive tone, repeating at eight to ten ticks per second and consisting of multiple frequencies with a dominant component at 880 Hz. Where less than 10 ft separate the APD from another APD, for concurrent pedestrian crossings (when some vehicles have a green signal during the pedestrian interval), ensure that the audible WALK indication is a verbal speech message that is patterned after the model, “Smith Street. Walk sign is on to cross Smith Street.” For exclusive pedestrian crossings (when all vehicles have a red signal during the pedestrian interval), ensure that the audible WALK indication is a rapid-tick percussive tone as described above.

Record verbal speech messages in a clear, moderately pitched voice, with excellent diction and moderate pacing. Ensure that the volume of the audible WALK indication is automatically adjusted in response to ambient sound level, up to a maximum volume of 100 dBA. Initially program the volume-intensity-responsive audible WALK indication to emanate at a minimum of ambient sound and a maximum of 5 dBA louder than ambient sound.

Use APDs that include a pushbutton confirmation light that is illuminated upon pushbutton activation. Once illuminated, ensure that the confirmation light remains on until the WALK signal turns on for the crosswalk associated with the pushbutton, when the confirmation light turns off. Ensure that each actuation of the confirmation light at times when the WALK signal is not on is accompanied by the audible verbal speech message “Wait.” Where both (a) less than 10 ft separate the APD from another APD, and (b) the APD is associated with a concurrent pedestrian crossing (when some vehicles have a green signal during the pedestrian interval), ensure that this audible verbal speech message “Wait” is followed by an audible verbal speech information message patterned after the model “Wait to cross Smith Street at First Avenue.” Ensure that all verbal speech messages comply with the same recording, volume adjustment, and initial programming requirements stipulated above for audible WALK indication verbal speech messages.

Ensure that all sounds emanate from the APD via a weather and waterproof speaker that is protected by a vandal-resistant screen. Ensure that minimum and maximum volumes for each different sound can be programmed independently.

Ensure that all audible, vibrotactile, and visual features of the APD are non-operational when the traffic signal is in flash mode.

Ensure that each APD can be customized with speech messages that vary from those described above.

Install an individual control unit for each APD in the pedestrian signal head associated with each APD. Ensure that all programmable settings of the APD control unit can be wirelessly reconfigured by a technician standing next to the APD and using either (a) the manufacturer's APD programming application installed on an external device (laptop, tablet, or smart phone) or (b) a configuration device designed by the APD manufacturer specifically for such purpose. Ensure that each APD allows for a wired cable connection to be used for reprogramming (via cable with standard USB connections between the APD and an external device) as an alternative to the wireless connection, if the latter fails for any reason. Regardless of the number of individual APDs that are included in the Contract, provide two copies of the (a) manufacturer's APD programming application or configuration device and (b) cable with USB connections to the Department's Traffic Maintenance Section before the APD field testing required by **Subsection T13.03.3**.

M15.18 PAINT COLORS.

Use Federal Yellow that conforms to the color standards approved and contained in the *Manual for Signs and Pavement Marking of the National System of Interstate and Defense Highways*, standard Interstate colors.

M15.19 ITEMS REQUIRING A MATERIALS CERTIFICATE AND A CERTIFICATE OF COMPLIANCE.

For the following items, provide a Materials Certificate and a Certificate of Compliance confirming their conformance to the applicable requirements:

- Electrical conduit
- Stainless steel bolts and nuts
- Lamps and luminaires
- Light Emitting Diode (LED) Drivers (both multiple and series)
- Conductors

SECTION M16 — SIGNS AND SIGN SUPPORTS

M16.01 SIGN PANELS.

M16.01.1 Extruded Aluminum.

Use panels that have been fabricated of extruded aluminum channels ASTM B221, alloy 6063-T6 and that are 0.125 in. thick, 12 in. wide, and of bolted joint design. Do not use partial channel sections except where sign dimensions warrant and then only one such reduced section of 6 in. may be used per sign panel.

Design the locking tab fastenings engaging the sign stringers and connected to the sign sheets with a factor of safety of not less than 1.61 against the minimum yield stress of the material and that have been fabricated of 6061-T6 aluminum alloy material.

Use stud material that is aluminum alloy 1100-H16, electrically welded to the sign sheets by the capacitor discharge method.

Use hardware required to fasten panels together or to attach signs to posts that are aluminum or stainless steel. Use stainless hardware that conforms to ASTM A320. Use nuts that are the self-locking type.

M16.01.2 Aluminum Sheets.

Use aluminum sheets for signs that conform to ASTM B209, alloy 6061-T6.

M16.01.3 Temporary Construction Sign Panels.

Use plywood that is the exterior type and conforms to the requirements in Department of Commerce product Standard PSI-66.

Use face, core, and cross veneers that are Grade B or better, and ensure that the entire area of contacting veneer surface is bonded with a waterproof adhesive that meets the test requirements for exterior type.

Use an overlay that is the high-density type. During plywood manufacture and subsequent handling, prevent any press caul lubricants, release agents, or other contaminants from contacting the overlay surface.

Cut sign blanks to shape using a saw blade that does not tear plywood grain. Ensure that holes are clean cut and uniform.

The Contractor may use aluminum sheets for temporary construction signs that meet **Subsection M16.01.2**.

The Contractor may also use vinyl rollup signs that meet the requirements for Type II Engineering Grade reflective sheeting.

M16.02 REFLECTIVE SHEETING.

M16.02.1 General.

Provide reflective sheeting that is a retroreflective system with a smooth outer surface. When an adhesive backing is used, ensure that the sheeting has a precoated adhesive on the back protected by an easily removable liner.

- Type IIIA and Type IIIB are high performance grade encapsulated lens sheetings with designations A for glass bead and B for prismatic sheeting.
- Type IV is a reflectorized, reboundable flexible sheeting designed for channeling devices with markings that meets or exceeds the retroreflection requirements, color conformance, and all tests according to ASTM D4956.
- Type V is durable fluorescent orange retroreflective sheeting for certain work zone signs.
- Type VI is a prismatic retroreflective sheeting used for certain outside work zone signs.

AASHTO M268 Type I retroreflective sheeting, Type II engineering grade and Type IIA super engineering grade are not included in these Specifications.

M16.02.2 Applications.

a. Type IIIA or Type IIIB Sheeting. Use Type IIIA or Type IIIB sheeting on any sign for which Type V or Type VI sheeting is not specified.

b. Type IV Sheeting. Use Type IV sheeting on channeling devices with markings, including fluorescent traffic cones, drum barricades, and plastic pipe-type barricades.

c. Type V. Use Type V sheeting on:

- All W20-1 and W21-4 signs
- All W3-1a, W3-2a, W4-1, W4-2, W10-1, E5-1, and E5-1a signs within work zones with orange background sheeting choice
- All G20 Series

d. Type VI. Use Type VI sheeting on all R1-1, R1-2, R4-7, R5-1, R5-1a, W3-1a, W3-2a, W4-1, W4-2, W10-1 signs, Hazard Markers Type 1, 3, and Typical End-of-Road Markers, E5-1, and E5-1a series.

M16.02.3 Material Requirements, Type IIIA, IIIB, and Type IV Sheeting.

a. Color Requirements. Use colors that conform to AASHTO M268 except as modified as follows:

- Silver is an acceptable color designation for white.

The Department may accept colors by certification or may require the Contractor to provide copies of laboratory test reports to substantiate compliance with the Contract color requirements.

When testing is required, use a test instrument that is one of the following or an approved equal:

- GARDNER Model AC-2a Color Difference Meter or Model XL 30 Color Difference Meter
- HUNTERLAB D25 Color Difference Meter

Mount test panels according to the manufacturer's recommendations.

b. Specific Intensity Per Unit Area (SIA). Ensure that the reflective sheeting meets the minimum SIA requirements as shown in Tables 1 and 2 for the Type(s) of sheeting specified. SIA is expressed in candelas per foot candle per square foot (candelas per lux per square meter). Conduct measurements of SIA according to the applicable requirements. Mount test panels according to the manufacturer's recommendations.

c. Specular Gloss. Ensure that the reflective sheeting has an 85-degree specular gloss of not less than 50 for Types IIIA, IIIB, and IV when tested according to ASTM D523.

d. Color Processing. Ensure that color processing complies with AASHTO M268.

e. Shrinkage. Ensure that shrinkage complies with AASHTO M268, except that the shrinkage of Type III reboundable sheeting is not more than 0.10-in. in 24 hours in any dimension.

f. Flexibility. Use Types III and IV sheeting, with the liner removed and conditioned for 24 hours at 72°F and 50 percent relative humidity that is sufficiently flexible to show no cracking when slowly bent around a ⅛-in. mandrel with adhesive contacting the mandrel. For ease of testing, spread talcum powder on adhesive to prevent sticking to mandrel. Ensure that the test specimen is 2¾-in. × 11 in.

Ensure that non-adhesive sheetings show no signs of cracking or crazing when flexed repeatedly over a 1/16-in. mandrel to an angle of 180° at 72°F.

Ensure that Type III reboundable sheeting is conditioned and tested at 32°F.

g. Adhesive. When an adhesive is used, ensure that the reflective sheeting has either a pressure sensitive adhesive backing (Class 1) or a heat activated adhesive backing (Class 2) that allows application of the sheeting without the necessity of additional adhesive coats on either the reflective sheeting or application surface.

Use a Class 1 adhesive that is a pressure sensitive adhesive of the aggressive tack type requiring no heat, solvent, or other preparation for adhesion to smooth clean surfaces. Use a Class 2 adhesive that is adhesive activated by applying heat in excess of 175°F to the material as in the heat-vacuum process of sign fabrication.

Table 1

Minimum Specific Intensity Per Unit Area (SIA)
(candelas per footcandle per square foot)

Type III Sheeting

A -- Glass Bead Reflective Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45	100	170	45	20.0
0.2	+30	150	25	60	100	25	11.0
0.5	-4	95	15	30	62	15	7.5
0.5	+30	65	10	25	45	10	5.0

B -- Prismatic Reflective Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45	100	170	45.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	65	10.0	25	45	10.0	5.0

Table 2

Minimum Specific Intensity per Unit Area (SIA)
(candelas per lux per square meter)

Type IV Sheeting

Observation Angle (°)	Entrance Angle (°)	White	Fluorescent Orange
0.2	-4	550	180
0.2	+30	330	100

Remove the protective liner attached to the adhesive by peeling without soaking in water or other solvents without breaking, tearing, or removing any adhesive from the backing. Ensure that the protective liner can be easily removed following accelerated storage for four hours at 160°F under a weight of 2.5 lb/sq in.

Ensure that the adhesive backing of the reflective sheeting produces a bond to support a 1¾-lb weight for five minutes, without the bond peeling for a distance of more than 2 in. (1 in. for Type III reboundable sheeting) when applied to a smooth aluminum surface and tested as specified.

h. Impact Resistance. Ensure that the impact resistance of Types III and IV reflective sheeting conforms to AASHTO M268 with the following exception: For Type III reboundable and Type IV sheeting, use a 100 in-lb setting on the test instrument. Further condition the Type III reboundable sheeting and test at 32°F.

i. Accelerated Weathering. When applied according to recommended procedures, use reflective sheeting that is weather resistant and, following cleaning according to the manufacturer's recommendations, shows no appreciable discoloration, cracking, blistering, or dimensional change. Following exposure, wash the panels with a 5 percent hydrochloric acid solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft, clean cloth, brought to equilibrium at standard conditions, and tested. Ensure that it has not less than the percent of the minimum SIA specified in Table 3 when subjected to accelerated weathering according to ASTM G23, Type E or EH Weatherometer with humidifier off.

Table 3

Accelerated Weathering Testing Requirements

Type III & IV Sheeting

Type of Material	Hours Tested	Minimum Specific Intensity Per Unit Area
III	2200*	80% of Table 1
IV	250	50% of Table 2

* *For orange material having glass bead retroreflective elements and for Type III reboundable sheeting, the hours tested shall be 500.*

M16.02.4 Material Requirements – Type V Sheeting.

a. Photometric – Coefficient of Retroreflection R_A. When the sheeting applied on aluminum test panels is measured according to ASTM E810, ensure that the sheeting has a minimum coefficient of retroreflection values as shown in Table 4. Ensure that the rotation angle is 90°, the observation angles are 0.2° and 0.5°, the entrance angles (component B1) are -4° and +30°, and the entrance angle component B2 is 0°.

Table 4

Minimum Coefficient of Retroreflection R_A (candelas per footcandle per square foot) (90° Rotation Angle)

Type V Sheeting

Observation Angle (°)	Entrance Angle (°)	Orange
0.2	-4	200
0.2	+300	90
0.5	-4	80
0.5	+30	50

b. Daytime Color. Use a color that conforms to Table 5. Determine daytime color and maximum spectral radiance factor (peak reflectance) of sheeting mounted on aluminum test panels instrumentally according to ASTM E991. Determine the values on a Hunter Lab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument with circumferential viewing (illumination)]. Perform computations according to ASTM E308 for the 2° observer.

Table 5

Color Specification Limits* (Daytime)

Type V Sheeting

Color	1		2		3		4		Reflectance Limit Y (%)	
	x	y	x	y	x	y	x	y	min.	max.
Orange (new)	0.583	0.416	0.523	0.397	0.560	0.360	0.631	0.369	30	–
Orange (weathered)	0.583	0.416	0.523	0.397	0.560	0.360	0.631	0.369	20	45
*Maximum spectral radiance factor, new: 110 percent, min. weathered: 60 percent										

c. Nighttime Color. Determine nighttime color of the sheeting applied to aluminum test panels instrumentally according to ASTM E811 and calculated in the u′, v′ coordinate system according to ASTM E308. Measure sheeting at 0.33° observation and -4° entrance at 90° rotation. Use a color that conforms to Table 6.

Table 6

Color Specification Limits* (Nighttime)

Type V Sheeting

Color	1		2		3		4	
	u′	v′	u′	v′	u′	v′	u′	v′
Orange (new and weathered)	0.400	0.540	0.475	0.529	0.448	0.522	0.372	0.534

* *The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.*

d. Resistance to Accelerated Weathering. Ensure that the retroreflective surface of the sheeting is weather resistant and shows no appreciable cracking, blistering, crazing, or dimensional change after one year of unprotected outdoor exposure in south Florida,

south-facing, and inclined 45° from the vertical, or after 1500 hours of exposure in a xenon arc weatherometer according to ASTM G26, Type B, Method A. Following exposure, wash the panels in a 5 percent HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft, clean cloth, and brought to equilibrium at standard conditions. After cleaning, check to ensure that the coefficient of retroreflection is not less than 100 when measured as indicated in the second bullet below and that the color is expected to conform to the requirements of Tables 5 and 6 for weathered sheeting. Ensure that the sample:

- Shows no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting, or curling or more than 1/32-in. shrinkage or expansion.

- Is measured only at angles of 0.2° observation, -4° entrance, and 90° rotation. Where more than one panel of a color is measured, check to ensure that the coefficient of retroreflection is the average of all determinations.

e. Impact Resistance. Ensure that the retroreflective sheeting, applied according to the sheeting manufacturer's recommendations to a test panel of alloy 6061-T6, 0.040 in. × 3 in. × 5 in. and conditioned for 24 hours, does not demonstrate cracking outside the impact area when the face of the panel is subjected to an impact of 100 in-lb, using a weight with a ⅝-in. diameter rounded tip dropped from a height necessary to generate an impact of 100 in-lb, at test temperatures of both 32°F and 72°F.

f. Resistance to Heat. Measure the retroreflective sheeting, applied to a test panel as in Para. e above, and conditioned for 24 hours, according to Para. a at 0.2° observation and -4° entrance angles at 90° rotation and exposed to 170 ±5°F for 24 hours in an air circulating oven. After heat exposure, ensure that the sheeting retains a minimum of 70 percent of the original coefficient of retroreflection.

g. Field Performance. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions.

M16.02.5 Material Requirements – Type VI Sheeting.

a. Coefficient of Retroreflection, R_A. Ensure that the coefficients of retroreflection are not less than the minimum values specified in Table 7. Perform testing according to ASTM D4956.

Coefficients of retroreflection R_A are specified in units of candelas per footcandle per square foot.

Ensure that the observation angles comply with ASTM D4956.

Table 7

Minimum Coefficient of Retroreflection R_A (candelas per lux per square meter)

Type VI Sheeting - ASTM D4956, Latest Edition

Observation Angle (°)	Entrance Angle (°)	Rotation Angle (°)	White	Yellow	Blue	Green
0.2	-4	0	430	350	20	45
0.2	+30	0	235	190	11	24
0.33	-4	0	300	250	15	33
0.33	+30	0	150	130	7	18
0.5	-4	0	250	200	10	25
0.5	+30	0	170	140	7	19
1.0	-4	0	28	22	2.4	5.0
1.0	+30	0	15	12	1.0	2.7

For colored, transparent overlay films and for screen printed transparent color areas on white sheeting, ensure that the ratios of the R_A for the white to the R_A for the color, when measured at 0.2° observation, -4° entrance, and 0° rotation, are between 5:1 and 15:1 for red, not less than 5:1 for blue, and not less than 5:1 for green when processed according to the sheeting manufacturer's recommendations.

b. Color Requirements. Determine conformance to color requirements of Table 8 by instrumental method according to ASTM E1164 on sheeting applied to aluminum test panels. Determine the values on a Hunter Lab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument with circumferential viewing (illumination)]. Perform computations according to ASTM E308 for the 2° observer.

Table 8

Color Specification Limits* (Daytime)

Type VI Sheeting

Color	1		2		3		4		Reflectance Limit Y (%)	
	x	y	x	y	x	y	x	y	min.	max.
White	0.305	0.305	0.355	0.355	0.335	0.375	0.285	0.325	40	—
Yellow	0.487	0.423	0.545	0.454	0.465	0.534	0.427	0.483	24	45
Blue	0.078	0.171	0.150	0.220	0.210	0.160	0.137	0.038	1	10
Green	0.030	0.398	0.166	0.364	0.286	0.446	0.201	0.794	3	9

* *The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.*

c. Gloss. Use retroreflective sheeting that has an 85° specular gloss of not less than 50 when tested according to ASTM D523.

d. Color Processing. Ensure that the retroreflective sheeting permits cutting and color processing with compatible transparent and opaque process colors according to the sheeting manufacturer's recommendations at temperatures of 59°F to 100°F and relative humidities of 20 percent to 80 percent. Ensure that the sheeting is heat resistant and permits force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.

e. Flexibility. Provide retroreflective sheeting with the liner removed and conditioned at standard conditions that is sufficiently flexible to show no cracking when slowly bent, in one second's time, around a ⅛-in. mandrel, with the adhesive contacting the mandrel, at test conditions. Spread talcum powder on the adhesive to prevent sticking to the mandrel.

f. Adhesive. Remove the protective liner attached to the adhesive by peeling without soaking in water or other solutions and without breaking, tearing, or removing any adhesive from the backing. Ensure that the protective liner can be easily removed following accelerated storage for four hours at 158°F under a weight of 2.5 lb/sq in. Ensure that the adhesive backing of the retroreflective sheeting produces a bond to support a 1.75-lb weight for five minutes without the bond peeling for a distance of more than 2 in. when applied to a test panel. Apply 4 in. of a 1 in. × 6 in. specimen to a test panel. Condition and then position the panel face down horizontally, suspend the weight from the free end of the sample, and allow it to hang free at an angle of 90° to the panel surface for five minutes.

g. Impact Resistance. Ensure that the retroreflective sheeting, applied according to the sheeting manufacturer's recommendations to a test panel of alloy 6061-T6, 0.040 in. × 3 in. × 5 in. and conditioned at standard conditions, does not demonstrate any cracking outside the impact area when the face of the panel is subjected to an impact of 50 in-lb using a weight with a ⅝-in. diameter rounded tip dropped from a height necessary to generate an impact of 4.17 ft-lb, at test temperatures of 32°F and 72°F.

h. Resistance to Accelerated Outdoor Weathering. Provide a retroreflective surface of the sheeting that is weather resistant and shows no appreciable cracking, blistering, crazing, or dimensional change after two years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, wash the panels in a 5 percent HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft, clean cloth, and brought to equilibrium at standard conditions. After cleaning, ensure that the coefficient of retroreflection is not less than the values in Table 9 when measured at 0° rotation and that the colors conform to Table 8. Ensure that the sample:

- Shows no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting, or curling or more than 1/32 in. shrinkage or expansion.

- Is measured only at angles of 0.2° observation, -4° entrance, and 0° rotation, and 1.0° observation, -4° entrance, and 0° rotation. Where more than one panel of a color is measured, check to ensure that the coefficient of retroreflection is the average of all determinations.

Table 9

Minimum Coefficient of Retroreflection R_A after Accelerated Outdoor Weathering (candelas per lux per square meter)

Type VI Sheeting

Observation Angle (°)	Entrance Angle (°)	Rotation Angle (°)	White	Yellow	Blue	Green
0.2	-4	0	250	200	11	25
1.0	-4	0	45	35	1.3	3

i. Resistance to Heat. Measure the retroreflective sheeting, applied to a test panel and conditioned at standard conditions, for retroreflectance at 0.2° observation and -4° entrance angles and 0° rotation and exposed to 170°F ±3°F for 24 hours in an air circulating oven. Ensure that, after heat exposure, the sheeting retains a minimum of 70 percent of the original coefficient of retroreflection when measured at room temperature.

j. Resistance to Corrosion. Ensure that the retroreflective sheeting, applied to a test panel and conditioned at standard conditions, demonstrates no loss of adhesion, appreciable discoloration or corrosion and, after cleaning, retains a minimum of 80 percent of the original coefficient of retroreflection when measured at 0.2° observation, -4° entrance and 0° rotation angles after 1000 hours exposure to a 5 percent concentration of salt spray at 95°F when tested according to ASTM B117.

k. General Characteristics and Packaging. Supply retroreflective sheeting that has good appearance and is free from ragged edges, cracks, and extraneous materials, and is furnished in either rolls or sheets. When furnished in continuous rolls, ensure that the average number of splices are not more than 3 per 54.7 yd of material with a maximum of four pieces in any 45.7-yd length. Butt or overlap splices and ensure that splices are suitable for continuous application as furnished. When furnished as cut sheets or sign faces, ensure that the sheeting is packaged flat according to commercially accepted standards. Provide sheeting that is packed snugly in corrugated fiberboard cartons, according to commercially accepted standards. Ensure that each carton clearly stipulates the brand, quantity, size, lot or run number, and color. Stored under normal conditions, ensure that the retroreflective sheeting as furnished is suitable for use for a minimum period of one year.

l. Performance Requirements and Obligations.

- Certification. The sheeting manufacturer shall, upon request, supply with each lot or shipment a certification that states that the material supplied will meet all of the requirements listed herein.

- Field Performance Requirements. After 10 years in service, ensure that the coefficient of retroreflection is not less than the values in Table 10.

Table 10

Minimum Coefficient of Retroreflection R_A after Ten Years (candelas per lux per square meter)

Type VI Sheeting

Observation Angle (°)	Entrance Angle (°)	White	Yellow	Blue	Green
0.2	-4	250	200	10	23
1.0	-4	45	35	2	5

Make all measurements after sign cleaning according to the sheeting manufacturer's recommendations.

Natural causes include effects of exposure to weather. Natural causes exclude (without limitation) damage from exposure to chemicals, abrasion, and other mechanical damage from fasteners used to mount the sign, collisions, or mishandling.

For screen printed transparent colored areas on white sheeting, provide new sheeting for which the coefficients of retroreflection will maintain the ratios required.

- Process Inks. The manufacturer of the sheeting shall furnish the process inks, clears, and thinners recommended for the sheeting to meet the performance requirements of this Specification and shall further be responsible for technical assistance in the use of these inks according to this Specification.

- Slip Sheet. Furnish slip sheet paper, if recommended by the sheeting manufacturer for sheeting surface protection or for use in packaging, storage, or shipping finished signs, in rolls by the manufacturer at no additional charge, in at least equal dimension (square yards) and in the same sizes as the sheeting supplied.

- Washers. Washers, if recommended by the sheeting manufacturer to protect the sign surface from damage by bolts or other fasteners, shall be furnished by the manufacturer at no additional charge.

m. Fabrication Date. The sign fabricator shall date all signs at the time of fabrication with the fabrication date so that the start of the warranty period can be determined.

M16.02.6 Testing Procedures.

a. Testing Conditions. Unless otherwise specified herein, condition all applied and unapplied test samples and specimens at the standard conditions of 73°F ± 3°F and 50 ±5 percent relative humidity for 24 hours before testing.

b. Testing Panels. Unless otherwise specified herein, when tests will be performed using test panels, apply the specimens of retroreflective material to smooth aluminum cut from ASTM B209 Alloy 5052-H36, 5052-H38, 5154-H38 or 6061-T6 sheets in 0.020 in., 0.040

in., or 0.063 in. thickness. Ensure that the aluminum is degreased and lightly acid etched before the specimens are applied. Apply the specimens to the panels according to the recommendations of the retroreflective sheeting manufacturer.

c. Specific Intensity Per Unit Area (SIA). Take measurements according to Instrumental Photometric Measurements of Retroreflective Materials and Retroreflective Devices, Federal Test Method Standard 370. Perform the test at 50 ft with a 1-in. source and 1-in. receiver on a 12-in. square test specimen. Ensure that the observation and entrance angles are in the same plane.

Rotate the specimen to orientation angles recommended by the manufacturer. The presentation angle is zero.

Ensure that the SIA of the sheeting when 100 percent wet is not less than 90 percent of the dry values in Tables 1, 2, 4, and 7. Take wet performance measurements on new sheeting according to the standard rainfall test specified in Section 7.10.1 of AASHTO M268.

d. Adhesion Test. Perform adhesion tests according to AASHTO M268.

e. Colorfastness. Perform the colorfastness test according to AASHTO M268, except ensure that the specimens are prepared and subjected to accelerated weathering as specified above.

f. Fungus Resistance. For use in areas where fungus growth may be a problem and if specified by the Engineer, determine fungus resistance as specified herein.

After inoculation with the test organism, Aspergillus niger, and incubation for 14 days, ensure that the reflective material demonstrates no appreciable formation of fungus growth. Ensure that any formation of fungus growth is non-injurious to the reflective material and is removable by wiping with a soft cloth. After completion of the incubation and after being wiped clean, check to ensure that the reflective material retains the full SIA values as specified in Tables 1, 2, 4, and 7.

- Test Organism. Use Aspergillus Niger, ATCC No. 6275 for the test organism in this test. This organism may be obtained upon request from the American Type Culture Collection (ATCC), 12301 Parklawn Drive, Rockville, Maryland 20852, or Mycology Laboratory, PRL, US Army Natick Laboratories, Natick, Massachusetts 01760. Maintain cultures of the organism on a potato-dextrose agar medium and promptly renew if there is evidence of contamination. The stock cultures may be kept for not more than four months in a refrigerator at a temperature from 37.4°F to 50°F. Use subcultures incubated at 82.4°F to 86°F for 10 to 14 days in preparing the inoculum.

- Culture Medium. Use a culture medium that has the following composition:

  $NaNO_3$ – 3.0 grams
  K_2HPO_4 – 1.0 grams
  $MgSO_47H_2O$ – 0.5 grams
  KCl – 0.25 grams

Agar – 15.0 grams
Distilled water to make 1000 ml

Ensure that the pH is between 5.5 and 6.5. If otherwise, adjust to that range with HCL or NaOH. After mixing, sterilize the ingredients by autoclaving for 15 minutes at 15 psi at 248°F.

Under sterile conditions, pour the medium into six, 150 mm × 20 mm petri dishes, approximately 65 ml per dish, and allow to harden.

- Inoculum. Add approximately 10 ml of sterile, distilled water containing about 0.005 percent of nontoxic wetting agent to a subculture (10 to 14 days old) of the test organism in a ripe, fruiting condition. Force the spores into suspension with a sterile camel's hairbrush (or other suitable means) and dilute to 100 ml with sterile, distilled water. in

- Preparation of Specimens. Cut three, 3 in. × 3 in. specimens from the sample, and apply to test panels with the reflective surface up. Completely immerse the test specimens in a leaching tank of continuously flowing water for 24 hours and then remove and dry. Use a leaching tank that is large enough to hold an amount of water weighing not less than 50 times the weight of the specimens. Ensure that the water entering the tank does not fall directly on the specimens and flows at a rate of 5 to 10 liters per hour. Check to ensure that the pH of the water is in the range of 6.0 to 8.0.

g. Inoculation. Under aseptic conditions, dip each specimen in 70 percent ethanol for a few seconds, rinse in distilled water, and place firmly on the surface of the solidified agar medium contained in the petri dishes. Place specimens with the reflective surface facing up, one specimen to each dish. With a sterile pipette, distribute 1.0 ml to 1.5 ml of inoculum over the surface of each specimen and the surrounding medium.

- Incubation Period. Use an incubation period of 14 days at a temperature of 84.2°F to 89.6°F and 85 to 90 percent relative humidity.

- Control. Test three control specimens of untreated, porous grade filter paper with the specimens of the reflective material to check the viability of the inoculum. At the end of the incubation period, the controls should be covered with fungus growth.

- Test Results. Upon completion of the incubation period, examine the specimens visually for fungus growth. Wipe the specimens with a soft cloth wet with a 70-percent ethanol solution. Condition the specimens at standard conditions for 48 hours. Test the specimens according to Para. c of this Subsection and, when finished, attempt to remove the specimen from the test panel.

M16.03 CUTOUT LETTERS, SYMBOLS, AND ACCESSORIES.

M16.03.1 Description.

Provide cutout letters, digits, and alphabet accessories that have been fabricated in either of the following manners:

a. Embossed aluminum frames in which prismatic reflectors are installed to be an integral part of the character or otherwise securely affixed to prevent their displacement in handling or service. Letters in which reflectors are assembled by means of tape are unacceptable.

b. Adhesive coated reflective sheeting that is permanently adhered to flat aluminum backing. Use reflective sheeting that conforms to Type IIIA silver sheeting as specified in **Subsection M16.02**.

M16.03.2 Detailed Specifications.

a. Design and Fabrication of Frames Using Prismatic Reflectors. Use a letter design that complies with the Federal Standard Alphabet Series D and E modified to accommodate the required reflectors.

Ensure that all items have been fabricated from 0.040-in. sheet aluminum.

Provide mounting holes within the frames to permit the use of screws, rivets, or other common fasteners.

Ensure that the size and spacing of reflector holes affords maximum night legibility and visibility to the finished cutout figure.

b. Finishing of Frames. After metal fabrication has been completed, ensure that the aluminum frames are degreased, etched, neutralized, and chemically treated before being finished in an approved baking white enamel.

c. Prismatic Reflectors. Provide reflectors that consist of a transparent acrylic plastic face, herein referred to as the lens, and an opaque back fused to the lens under heat and pressure around the entire perimeter to form a unit permanently sealed against dust, water, and water vapor. Provide reflector lens that are colorless, yellow, red, or green.

Use lens that consist of a smooth front surface free from projection or indentations other than for identification and a rear surface bearing a prismatic configuration such that it will produce the total internal reflection of light. Ensure that the manufacturer's trademark is molded legibly into the face of the lens.

Provide a reflector lens that is methyl methacrylate that complies with Federal Specification L-M-500a, Type I, Class 3.

d. Design and Fabrication of Characters Reflectorized with Encapsulated Lens Reflective Sheeting. Ensure that the letter design conforms to the Bureau of Public Roads standards for use on the National System of Interstate and Defense Highways.

Ensure that the characters are a minimum of 0.032-in. thick aluminum sheets of 3003 H14 alloy. Use aluminum that has been properly treated according to the sheeting manufacturer.

M16.04 SIGN SUPPORTS AND STRUCTURES.

M16.04.1 General.

Provide signs, sign panel supporting frames, and overhead sign support structures, including anchor bolts and foundations that conform to the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Provide steel poles, posts, channel posts, U-channels, or other required shapes that are galvanized and conform to the Contract Documents.

Use anchor bolts that are hot-rolled steel conforming to ASTM F3125 Grade A325 or a substitute approved in advance by the Engineer. Ensure that anchor bolts have the proper size and length to develop proper bond in transferring loads to concrete foundations and that possess a minimum yield strength of 50,000 psi.

M16.04.2 Design of Overhead Sign Structures.

Before fabrication, furnish in triplicate computations containing the design stresses and allowable stresses for each complete structure. Ensure that all plans and computations bear the seal of a Rhode Island Registered Professional Engineer.

Provide cantilever sign supports that have dual arms with a minimum 0.14 in. per ft taper on the arms. Columns may either be tapered on non-tapered members.

Ensure that all overhead span sign structures have a single horizontal steel member supported by steel columns at either side. The columns and horizontal members may be either tapered or non-tapered.

When the clearance between the bottom of the leveling nuts and the top of the concrete is equal to or greater than one bolt diameter, consider the bending stresses in the anchor bolts in design.

Do not use grout under base plates, unless approved by the Engineer. If specific conditions warrant its use, assume that the grout is a non-load bearing. Assume that the loads are directly supported by the anchor bolts.

Include the following notes on all Plans and/or Shop Drawings in reference to anchor bolts:

- *Pretension all anchor nuts by tightening to 1/6th turn beyond the snug-tight position.*
- *Ensure that the maximum clearance between the bottom of the leveling nuts and the top of the concrete does not exceed the amount specified on the Drawings.*

Do not use vibration mitigation devices.

M16.04.3 Overhead Sign Structures – Steel.

Provide pipes for end support columns, cantilever arms, and horizontal span members that conform to ASTM A53, Grade B.

Use stainless steel plates that conform to ASTM A240, Type 304.

Use base plates and attached stiffener plates that conform to ASTM A588.

For all other elements except bolts and nuts, provide materials that conform to ASTM A36.

After complete fabrication, ensure that each of the fabricated steel sections of all sign supports are hot-dip galvanized according to ASTM A123.

Use high strength bolts, nuts, and washers that conform to ASTM A325 and that are hot-dip galvanized according to ASTM A153, Class C.

Use headed cast-in-place anchor bolts in lieu of hooked anchor bolts.

For all nuts for high strength bolted connections including nuts for anchor bolts, use prevailing torque-reusable type locking nuts.

Provide U-bolts that conform to ASTM A36 and that are hot-dip galvanized according to ASTM A153.

Provide stainless steel bolts that conform to ASTM A193, Grade B8 and that conform to ASTM A194, Grade 8. Use stainless steel lock washers that conform to ASTM A167, Type 302.

M16.04.4 Ground Mounted – Breakaway.

Use materials for foundations, sign supports, hardware, and attachments that conform to the breakaway design indicated on the Plans. Construct foundations with Class A concrete and reinforcing steel that conform to **Subsection M05.02**.

M16.04.5 Directional, Regulatory, and Warning Sign Mountings.

a. Wood Posts. Ensure that wood posts are cut from well-seasoned, straight, sound, southern yellow pine, Grade No. 2 or better, dressed on four sides and are treated with chromated copper arsenate Type C according to AASHTO M133-86, before the mounting of the sign to the post. Use mounting hardware that is of the theft resistant type as indicated on the Department's Approved Materials List.

b. Tubular Square Post. Use tubular steel posts that are 2-in. or 2½-in. square, 12-gauge tubing with bracing, anchorage, and breakaway supports as required.

c. U-Channel. Use U-channel posts for directional, regulatory, and warning signs that are 4 lb/ft. Provide U-channels that have been galvanized according to ASTM A123.

M16.04.6 Street Sign Posts and Brackets.

a. Tubular Steel Posts. Provide posts for supporting street signs that are tubular steel with an outside diameter of 2 in. with a wall thickness of 0.64-in. and a minimum weight of 1.64 lb/ft. Ensure that all steel posts have been galvanized according to ASTM A153 and are free of slivers, cracks, burrs, and other manufacturing imperfections.

b. Brackets and Hardware. Use street name sign brackets that consist of a post to sign (post top) bracket and a sign to sign (cross) bracket. Use brackets that are the appropriate design and size for mounting extruded aluminum street name sign blades with a 0.091 minimum gauge and with lengths up to 48 in. and 9 in. in height. Use brackets that have been die-cast of high strength aluminum alloy #380 with tensile strength of 49,000 psi. Ensure that the brackets are free of holes, pits, or flaws and are not larger than the inside diameter of the base of the post top bracket to ensure proper fit. Where two sign blades are used, ensure that the two slots of the cross brackets are 90 degrees to each other.

Use street name sign brackets to be mounted on traffic signal poles that consist of either one die-cast aluminum cantilever type L-bracket or one die-cast aluminum wing type bracket. Use a minimum of two stainless steel straps to hold each type of bracket. Ensure that all brackets are free of pits or flaws and other manufacturing imperfections.

For bolts for bolt through slots, conform to the manufacturer's recommendations.

M16.04.7 Parking Sign, Mile Marker, and Delineator Posts.

a. Parking Sign Posts. For posts for parking sign mountings, use a U-channel shape made from steel conforming to ASTM A499 and galvanized according to ASTM A123. Use posts that have a weight of 3 lb/ft and that include ⅜-in. diameter mounting holes spaced 1 in. on center for a minimum distance of 5 ft from the top of the post.

b. Mile Marker Post. Use posts for mile marker mountings that conform to Para. a. above, except ensure that the mounting holes extend a minimum distance of half the overall post length from the top of the post.

c. Delineator Posts. For posts for delineator mountings, use a U-channel shape made from steel conforming to ASTM A499 and galvanized according to ASTM A123. Ensure that each post has a minimum weight of 1.12 lb/ft and that the post includes ⅜-in. diameter mounting holes spaced at 1 in. on center for a minimum distance of half the overall post length from the top of the post.

M16.05 REVIEW AND APPROVAL OF MATERIALS USED IN TRAFFIC SIGN CONSTRUCTION.

M16.05.1 Requirements.

Submit, before award of the Contract, the source of all items intended to be supplied for this Contract. Obtain approval of each of these items, in writing, from the Engineer.

Where a specific manufacturer's product (proprietary item) is identified, this represents the standard required. However, a similar product of another manufacturer may be considered as a substitute and approved as an equal. If the Contractor desires to use a product that is considered equal to a proprietary item, submit a complete description of the item and seven copies of Shop Drawings, catalog cuts, and/or other descriptive literature that describe the items presented for formal approval. Provide a Certified Test Report and/or Materials Certificate and a Certificate of Compliance as required.

The requirements for a Certified Test Report and/or Materials Certificate and a Certificate of Compliance for each of the items in the Contract are contained below.

For those materials requiring a Certified Test Report and/or Materials Certificate, forward the documents to the Engineer. Obtain acceptance on these documents before the material is incorporated into the Project. Final acceptance will be granted upon submission of a Certificate of Compliance after installation of the material.

The method of processing for approval all items other than those described herein will be established by the Engineer.

M16.05.2 Certified Test Report.

A Certified Test Report is a document containing a list of the chemical, metallurgical, electrical, and/or physical results obtained from an actual test of the materials involved and documents that the Specifications are met. The following information will also be required:

- Name of organization to whom the material is consigned
- Quantity of material represented
- Means of identifying the consignment, such as label, marking, seal number, lot number, etc.
- Date and method of shipment

Ensure that the Certified Test Report has been signed by an authorized and responsible agent for the organization manufacturing the material and notarized.

M16.05.3 Materials Certificate.

A Materials Certificate is a document certifying that the materials, components, and equipment furnished, conform to all requirements of the Contract. Appurtenances, such as miscellaneous hardware, may be covered in total by a single entry. Provide the following information on the document:

- Project to which the material is consigned
- Name of Contractor to which material is supplied
- Kind of material
- Quantity of material represented by the Certificate
- Means of identifying the consignment, such as label, marking, seal, lot number, etc.
- Date and method of shipment

Ensure that the Materials Certificate has been signed by an authorized and responsible agent for the organization supplying the material and notarized.

M16.05.4 Certificate of Compliance.

A Certificate of Compliance is a document certifying that the materials, components and/or equipment covered by the previously submitted Certified Test Report and/or Materials Certificate

have been installed in the work and that they conform to all requirements of the Contract. Appurtenances, such as miscellaneous hardware, may be covered in total by a single entry. Provide the following information on the document:

- Project number
- Kind of material
- Quantity represented by the Certificate
- Manufacturer and model number and lot number

Ensure that the Certificate of Compliance has been signed by an authorized and responsible agent for the Prime Contractor and notarized.

M16.05.5 Items Requiring Certified Test Report and/or Materials Certificate and Certificate of Compliance.

For the following items, a Certified Test Report and a Certificate of Compliance will be required confirming their conformance to the requirements in the Contract. If the consignee noted on a Certified Test Report is other than the Prime Contractor, then identify the shipment for the Materials Certificates:

- Reflective sheeting
- Demountable copy
- Aluminum post and attachment hardware
- Aluminum flat sheets for sign panels
- Anchor bolts and nuts
- Overhead sign support (complete)
- Delineators (all)
- Delineator posts

SECTION M17 — PAVEMENT MARKINGS

M17.01 GLASS BEADS – DUAL GRADATION.

M17.01.1 Scope.

This Specification addresses the requirements for glass beads that will be dropped onto white and yellow pavement marking material to produce a highly weather and wear resistant reflectorized traffic marking.

M17.01.2 Detailed Requirements.

For reflective glass spheres for waterborne and epoxy markings, use glass spheres that meet AASHTO M247 Types 2 and 5. Only use AASHTO M247 Type 2 with waterborne paints.

M17.02 WATERBORNE PAVEMENT MARKINGS.

Ensure that the paint dries on a road surface to an adherent film that will provide proper anchorage and reflection for the finished glass beads when applied as specified. Ensure that the paint will be uniformly applicable with mechanical line-marking equipment. Use paint that is suitable for binding glass beads to produce a highly weather and wear resistant traffic line.

a. Composition. The manufacturer has the discretion to select the paint composition, if the finished product meets the following requirements:

   - The paint does not contain more than 0.06 percent lead (ASTM D3335).
   - Volatile organic compounds (VOC) do not exceed the limits as specified in Federal, State, and local regulations.
   - The closed cup flash point is not be less than 125°F (ASTM D3941).

b. Color. Ensure that the color after drying (for white) is a flat white, free from tint, furnishing good opacity and visibility under both daylight and artificial light, and matches Chip No. 37886 of Federal Standard 595. For yellow, ensure that the color closely matches Chip No. 33538 of the Federal Standard.

c. Dry Opacity. Ensure that the paint has a minimum contrast ratio of 0.92 when tested according to ASTM D2244 at a wet film thickness of 5 mils.

d. Bleeding. Ensure that the paint has a minimum bleeding ratio of 0.97 when tested according to ASTM D868.

e. Retroreflectivity. Ensure that the daylight directional reflectance is not less than 350 $mcd/m^2/lx$ for white and not less than 275 $mcd/m^2/lx$ for yellow when measured according to ASTM E1710.

f. Scrub Resistance. Ensure that the paint passes 300 cycles when tested according to ASTM D2486.

g. Freeze-Thaw Stability. Use paint that displays no change in consistency greater than 0 percent when tested according to ASTM D2243.

h. Dry Time. Allow the paint to dry to a no-tracking condition in not more than two minutes. Determine the no-tracking condition by actual application on the pavement at a wet film thickness of 15 mils. Apply the line for the test with equipment for the paint to be at the temperature of 120°F to 140°F at the spray gun. Ensure that the maximum drying time is not exceeded when the pavement temperature is 45°F to 120°F and under humidity conditions of 85 percent or less, provided that the pavement is dry.

M17.03 PREFORMED THERMOPLASTIC PAVEMENT MARKINGS.

M17.03.1 Physical Properties.

a. Pigments.

- White. Ensure that the material is manufactured with sufficient titanium dioxide pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected.

- Red, Blue, and Yellow. Ensure that the material is manufactured with sufficient pigment to meet FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected. Use yellow pigments that are organic and heavy-metal free.

- Black. Ensure that the material is manufactured without intermixed glass beads and without factory-applied surface beads.

- Other Colors. Use pigments that are heavy-metal free.

b. Heating Indicators. Ensure that the top surface of the material has regularly spaced indents. Ensure that the closing of these indents during application acts as a visual cue that the material has reached a molten state, allowing for satisfactory adhesion and proper embedment of the anti-skid/anti-slip elements and a post-application visual cue that proper application procedures have been followed.

c. Skid Resistance. Ensure that the surface of the retroreflective and skid resistant preformed thermoplastic material contains factory applied, anti-skid elements with a minimum hardness of 9 (Mohs scale). Upon application, use material that provides a minimum skid resistance value of 60 BPN when tested according to ASTM E 303.

d. Slip Resistance. Upon application, use material that provides a minimum static coefficient of friction of 0.6 when tested according to ASTM C 1028 (wet and dry) and a minimum static coefficient of friction of 0.6 when tested according to ASTM D 2047.

e. Thickness. Use material that is supplied at a minimum thickness of 125 mils (3.15 mm).

f. Retroreflectivity. Determine the photometric quality of the white preformed thermoplastic markings by evaluating the coefficient of retroreflected luminance (R_L), which is expressed as millicandelas per square meter per lux ($mcd/m^2/lx$). Evaluate the retroreflectivity with a retroreflectometer unit according to ASTM E1710. Ensure that all personnel performing

retroreflectivity testing are certified to perform the testing by ATSSA and/or the manufacturer of the retroreflectometer unit used during the evaluation. Ensure that the installed material has an initial minimum intensity reading of 350 mcd/m^2/lx for white when tested according to ASTM E 1710.

g. Environmental Resistance. Use material that is resistant to deterioration from exposure to sunlight, water, salt, or adverse weather conditions and is impervious to oil and gasoline.

h. Abrasives. Apply the abrasives and surface beads on the retroreflective and skid resistant material in an alternating arrangement across the surface of the material so that the surface is covered by a "checkerboard" pattern of glass beads and abrasive materials. Use an abrasive material that has a minimum hardness of 9 (Mohs scale).

i. Interconnected. Use material that consists of interconnected individual pieces of preformed thermoplastic pavement material that, through a variety of colors and patterns, makes up the desired design. Ensure that the individual pieces in each material segment, typically 2 ft. × 3 ft., are factory assembled with a compatible material and interconnected in a single layer so that it is not necessary to assemble the individual pieces within a material segment in the field.

j. Packaging. Place the preformed thermoplastic markings in protective plastic film with cardboard stiffeners where necessary to prevent damage in transit. Apply a protective film around the box to protect the material from rain or premature aging.

M17.04 EPOXY RESIN PAVEMENT MARKINGS.

M17.04.1 Physical Properties.

Formulate and design the two-component, 100 percent solids paint to provide a simple volumetric mixing ratio (e.g., two-part component A to one-part component B) specifically for service as a hot-spray applied binder for glass beads to produce maximum adhesion, refraction, and reflection. Use material that is composed of epoxy resins and pigments only and meets the following minimum requirements:

a. Color. For white, ensure that the color (after drying at the specified thickness) is a flat white, free from tint, furnishing good opacity and visibility under both daylight and artificial light and that matches Chip No. 17875 of Federal Standard 595. For yellow, ensure that the color (after drying at the specified thickness) matches Chip No. 13538 of Federal Standard 595.

Ensure that the paint is well mixed in the manufacturing process and is free from defects and imperfections that may adversely affect the serviceability of the finished product. Ensure that the paint does not liver, thicken, curdle, gel, settle excessively, or otherwise display any objectionable properties after storage. Individual components do not require mixing before use when stored for a maximum of 12 months.

b. Composition. The manufacturer has the discretion for the overall paint composition if the following requirements are met:

- White:
    - Titanium Dioxide — 20 ±2 percent, by weight
    - ASTM D476 Type II/III
    - Epoxy Resin — 80 ±2 percent, by weight
- Yellow (lead-free):
    - Titanium Dioxide —15 ±3 percent, by weight
    - ASTM D476 Type II/III
    - Epoxy Resin — 73 to 82 percent, by weight
    - Organic Yellow — 6 to 9 percent, by weight

c. Epoxy Content (Component A). Test the epoxy content of the epoxy resin according to ASTM D1652 and calculate as the weight per epoxide equivalent (WPE) for both white and yellow.

Determine the epoxy content on a pigment free basis. Ensure that the WPE meets a target value provided by the manufacturer within a tolerance of ±50.

d. Amine Value (Component B). Test the amine value according to ASTM D2074 to determine its total amine value. Ensure that the total amine value meets a target value provided by the manufacturer within a tolerance of ±50.

The manufacturer may specify an alternative test method for determining the amine value subject to the approval of the Engineer.

e. Toxicity. Upon heating to application temperature, ensure that the material does not exude fumes that are toxic or injurious to persons or property. Submit a certification to the Engineer attesting to this requirement.

f. Abrasion Resistance (ASTM D4060). When the abrasion resistance of the material is tested with a CS-17 wheel under a load of 1000 grams for 1000 cycles, ensure that the wear index is no greater than 82.

g. Hardness (ASTM D2240). Ensure that the Type D durometer hardness of the material is not less than 75 nor more than 100 after the material has been conditioned for not less than 72 hours nor more than 96 hours at 23° ±2°C.

h. Tensile Strength (ASTM D638). Ensure that the tensile strength of the material is not less than 6000 psi after 72 hours of conditioning at 23° ±2°C.

i. Compressive Strength (ASTM D695). Ensure that the compressive strength of the material is not less than 12,000 psi after 72 hours of conditioning at 23° ±2°C.

j. Infrared Spectrophotometer Analysis (ASTM D2621). Analyze samples of both Part A and Part B (and of that mixed to the proper ratio) by infrared spectrography. Ensure that the spectrum of each component and final product is a reasonable match to the spectrum of the original formulation submitted by the manufacturer.

k. Directional Reflectance (ASTM E1347). Ensure that the daylight directional reflectance (without glass spheres) is not less than 84 percent for white and not less than 50 percent for yellow (relative to magnesium oxide).

l. Dry Time – Laboratory (ASTM D711). Ensure that the epoxy resin compounds, when mixed in the proper ratio and applied to a uniform wet film thickness of 20 mils and immediately dressed with glass beads at the proper rate, exhibit a no-tracking drying condition in not more than 30 minutes at 72°F.

m. Dry Time – Field. Consider the no-tracking condition for the field as the condition where no visual displacement of the epoxy resin striping material is observed when a passenger car has passed over the stripe or handwork when viewed at a distance of 50 ft and has a maximum of 30 minutes at 70°F.

M17.04.2 Certification.

Provide a certified test report by an independent testing laboratory before the start of the work indicating that the material as specified has been tested according to the above procedures and that the results comply with the above requirements. A Material Safety Data Sheet is also required.

a. Samples. At least 30 days before use, submit samples of the components to the Engineer for use as a baseline test batch. Place the samples in sealed quart can containers that contain a minimum of 24 fluid ounces, include all relevant manufacturing information, identify the proposed Rhode Island Contract numbers, and include the infrared spectrophotometer information.

b. Certified Test Reports. Provide certified test reports for each batch delivered for application at the Project site. Ensure that the reports reference the batch number and physical characteristics outlined above. Do not initiate the application until the proposed epoxy materials are verified by submitting the Certificate to the Engineer.

M17.04.3 Packaging.

Ship the epoxy materials in appropriate, durable, and substantial containers. Mark the individual containers with the following information:

- Manufacturer’s name and address
- Name of product
- Lot and batch number
- Color
- Net weight and volume of contents
- Date of manufacture
- Date of expiration

- Statement of content (i.e., Part A contains pigment and epoxy resin, Part B contains catalyst)
- Mixing proportions, application temperatures, and instructions
- Safety information

M17.05 PREFORMED PAVEMENT MARKING TAPE.

Use preformed pavement marking tape that is removable, retroreflective, and can perform in all-weather conditions.

M17.05.1 Physical Properties.

When installed per the manufacturer's written instructions, ensure that the preformed tape can meet the performance requirements of these specifications for a minimum service period of six months in all weather.

Use preformed tape markings that are either white or yellow wet retroreflective film on a conformable backing.

M17.05.2 Composition.

Use removable, preformed, wet retroreflective pavement markings that are bonded to a thin, flexible, conformable backing that is precoated with a pressure sensitive adhesive.

Use preformed tape markings that are precoated with a pressure sensitive adhesive and can adhere to asphalt concrete or Portland cement concrete at temperatures of 50°F or higher and rising, according to the manufacturer's recommendations. Use a surface preparation adhesive for all applications to improve initial and long-term adhesion.

M17.05.3 Performance.

Ensure that preformed pavement marking tape remains in proper alignment and is distinctly visible when dry from a minimum distance of 300 ft in daylight conditions and from a minimum of 150 ft when illuminated by automobile low-beam headlights at night. Determine visibility distances when viewed from an automobile traveling on the roadway.

a. Reflectance. Use enclosed lens white and yellow films that have the following initial minimum reflectance values under dry and wet conditions as measured according to ASTM E1710. Ensure that values measured in the laboratory under dry conditions comply with the testing procedure in ASTM D 4061. Ensure that values measured under wet conditions comply with the testing procedure of ASTM E 2177 using a portable retroreflectometer capable of measuring at 30 meters geometry.

   Visually, ensure that the reflective performance meets the following minimums whether the material is dry or wet:

	White	Yellow
Retroreflected Luminance (R_L [mcd/m^2/lx])	500	300

b. Adhesion. Demonstrate that the properly applied pavement marking adheres to the roadway under climatic and traffic conditions normally encountered in the construction work zone. If the surface preparation adhesive is required to ensure a firm bond to the pavement surface due to temperature or climatic reasons, comply with the manufacturer's recommendations.

c. Removability. Use tape that can perform for the duration of a normal construction season. Ensure that the preformed tape is designed and constructed so that it can be readily removed when the markings are no longer applicable and can be removed intact or in large pieces at temperatures above 40°F without the use of heat, solvents, grinding, or blasting and without permanent scarring of the roadway surface. Ensure that the removal does not leave any evidence on the surface that the marking or adhesive was once applied at that location.

d. Skid Resistance. Ensure that the surface of the tape markings when new provide a minimum average skid resistance value of 50 BPN when tested according to ASTM E 303.

M17.05.4 Quality.

Provide a Certificate of Compliance for each color and lot of material delivered to the Project indicating acceptable values for all specified Quality Assurance tests.

M17.06 RAISED REFLECTIVE PAVEMENT MARKERS.

M17.06.1 Design.

Use raised reflective pavement markers (RRPMs) that conform to the currently adopted edition of the MUTCD. Ensure that the RRPMs are designed to be set into a pavement recess and for use in areas that experience regular snowplow activity.

M17.06.2 Physical Properties.

Use RRPMs that consist of a polycarbonate body or other suitable lightweight but durable material upon or within which is mounted one or two prismatic retroreflective elements. Ensure that the body is not made of ferrous materials. The Engineer will reject any off-color reflection from the prismatic retroreflective elements. Use retroreflective elements that adhere to the body in proper position at the manufacturer's factory.

a. RRPMs for Bi-Directional Control Devices. Use a body that is white, black, or another color approved by the Engineer and that contains two prismatic retroreflective elements to reflect incident light from approaching traffic in both directions. Use a color of the retroreflective elements that, when illuminated by an automobile headlight, will be white or red, depending on the direction of travel and for conformance with the MUTCD. White indicates the correct direction and red indicates the wrong direction.

b. RRPMs for Other Uses. Use RRPMs that contain either one or two prismatic retroreflective elements to reflect incident light from approaching traffic in one or both directions, whichever is called for by the Plans. Ensure that the color of the reflective elements when illuminated by an automobile headlight conform to the currently adopted MUTCD.

M17.06.3 Adhesive.

Ensure that the RRPMs are bonded to the pavement with an epoxy or other suitable adhesive capable of holding the devices in place under traffic loading, as recommended by the RRPM manufacturer.

M17.06.4 Approval.

Unless the RRPMs to be furnished and installed are already included in the Department's Approval Materials List, submit documentation for the RRPMs to the Engineer as a Shop Drawing for review and approval before the start of work. Ensure that the documentation includes certification by the manufacturer demonstrating that the devices and the adhesive comply with these specifications, the requirements of the Contract, and the currently adopted edition of the MUTCD.

SECTION M18 — LANDSCAPING MATERIALS

M18.01 LOAM.

Use material that consists of screened loose, friable, fine sandy loam or sandy loam, as defined by the USDA's Natural Resources Conservation Service in the 1993 *Soil Survey Manual*; that is free of subsoil, refuse, stumps, roots, rocks, cobbles, stones, brush, noxious weeds, litter, and other materials that are larger than ½ in. in any dimension; and that will prevent the formation of a suitable seed bed. Use organic matter that has not less than 5 percent nor more than 20 percent of the loam as determined by loss-on-ignition of oven dried samples that have been drawn by the Engineer. Ensure that the loam has an acidity range of 5.5 pH to 7.6 pH. Notify the Department of the intended source of loam at least two weeks before its use to allow time for sampling.

Use loam that conforms to all applicable specification requirements before its final placement on the Project. Do not cull deleterious or out of specification material after placement and/or perform grading in-place.

M18.02 PLANTABLE SOIL.

Use material that consists of loose, friable topsoil free of refuse, brush, stumps, roots, rocks, cobbles, stones, noxious weeds, litter, and other materials that are longer than 1 in. in any dimension and that will prevent the formation of a suitable seed bed. Use organic matter that is not less than 4 percent nor more than 20 percent of the plantable soil as determined by loss-on-ignition of oven dried samples that have been drawn by the Engineer. Ensure that the plantable soil has an acidity range of approximately 5.5 pH to 7.5 pH.

Acceptable plantable soil can also be attained by thoroughly mixing a suitable organic soil with a suitable subsoil. Ensure that the resulting mix is a homogeneous material free from hard lumps and other materials specified above and can support plant growth. Ensure that the soil mixture complies with the above specified requirements for organic matter content and pH. Notify the Department of the intended source of plantable soil at least two weeks before its use to allow for sampling.

Use plantable soil that conforms to all applicable specification requirements before its final placement on the Project. Do not cull deleterious or out of specification material after placement and/or perform grading in-place.

M18.03 COMPOST.

Use material that is a well decomposed, stable, weed free, organic matter source, derived from agricultural, food, and/or yard trimmings. Ensure that the product does not contain any substances toxic to plants and is reasonably free (less than 1 percent by dry weight) of man-made foreign matter. Ensure that the compost has no objectionable odors and does not resemble the raw material from which it was derived. Ensure that the compost has a pH between 5.5 pH and 8.0 pH and a moisture content between 35 percent and 55 percent. Ensure that the particle size passes through a 1-in. screen or smaller and that it is stable to highly stable, passes growth screening, and has a soluble salt concentration at 2.5 d s/m or less for soil blend. Use compost that meets USEPA Part 503 exceptional quality concentration limits for trace elements/heavy metal.

M18.04 HIGH ORGANIC SOIL.

Use material that is free of refuse, brush, stumps, roots, rocks, cobbles, stones, noxious weeds, litter, and other materials that are larger than 4 in. in the greatest dimension and that will prevent the formation of suitable seed bed. Use organic matter that has not less than 10 percent nor more than 25 percent of the high organic soil as determined by loss-on-ignition of oven dried samples that have been drawn by the Engineer.

M18.05 LIME.

M18.05.1 Ground Lime.

Use ground lime for all roadside horticultural applications that has a standard commercial product of ground dolomitic limestone intended for agricultural use. Ensure that the lime is fine ground dolomite so that, when burned by standard lime producing methods, the lime yields at least 30 percent calcium oxide and 5 percent to 20 percent magnesium oxide for a total of 50 percent yielded from calcium and magnesium oxide. Ensure that at least 40 percent but not more than 60 percent passes through a 100-mesh screen and that all passes a 20-mesh screen.

M18.05.2 Pelletized Lime.

Use pelletized lime for all roadside horticultural purposes that has a standard commercial product of pelletized dolomitic limestone. Ensure that the minimum calcium carbonate ($CaCO_3$) derived from magnesium sources is 48 percent.

Before pelletizing, ensure that 100 percent by weight passes through an 8-mesh screen, 90 percent through a 20-mesh screen, 65 percent through a 60-mesh screen, and 50 percent through a 100-mesh screen.

M18.06 FERTILIZER.

M18.06.1 Commercial Fertilizer.

a. General. Use commercial fertilizer that complies with all State and US fertilizer laws and regulations. Deliver to the site the original, unopened, standard size containers that show weight, analysis of the product, and name of the manufacturer and bear the manufacturer's Certificate of Compliance covering analysis.

b. Fertilizer for Seeding and Sodding. Use fertilizer that contains the following percentages by weight:

- 10 percent available Nitrogen (N)
- 10 percent available Phosphoric Acid (P)
- 10 percent available Potassium (K)

Ensure that significant quantities of trace elements such as iron, boron, etc., are contained in the fertilizer. Ensure that 75 percent of available nitrogen is in a slow-release form as found in certain urea-form products or natural organic forms or a combination of both. Ensure that the salt index of the fertilizer does not exceed 35.

Apply fertilizer that meets the following rates:

- Trees, shrubs, vines – 5 lb (of actual N) per 1000 sq ft
- Perennials, ornamental grass, ground covers – 2½ lb (of actual N) per 1000 sq ft
- Bulbs – ½ lb (of actual N) per 1000 sq ft

M18.07 BONE MEAL.

Use material that is fine ground, steam-cooked, packing house bone with a minimum analysis of 23 percent phosphoric acid and 4 percent nitrogen.

M18.08 MULCH.

M18.08.1 Cellulose Fiber.

Use cellulose fiber mulch that is derived from natural, clean, whole woodchips. Ensure that the fiber is not produced from recycled material such as sawdust, paper, or cardboard fiber and that the fiber is dyed green to contrast with the soil on which it is to be applied. Use fiber that has a water holding capacity of not less than 31.5 oz of water per 3.5 oz of fiber. Ensure that the rate of application for cellulose fiber mulch complies with the manufacturer's guidelines.

M18.08.2 Wood Chips.

Use wood chips for mulch that is ⅛ in. nominal thickness with 75 percent of the chips having an area of not less than 1 sq in. nor more than 6 sq in. Use chips that are free from leaves, twigs, shavings, bark, and other foreign materials that are injurious to healthy plant growth. Obtain wood chips only from green wood, which may be from either hardwood or softwood sources.

M18.08.3 Pine Bark Mulch.

Use pine bark mulch that is derived from evergreen tree bark aged a minimum of six months and no more than 18 months. Use bark that has been shredded so that the resulting pieces are no more than ¼ in. thick and no longer than 3 in. Use mulch that is free of stringy material and does not contain an excess of fine particles. Use mulch that is dark brown in color, free of leaves, twigs, sod, weeds, shavings, and other foreign materials that are injurious to healthy plant growth.

M18.08.4 Adhesive Mulch Stabilizer.

Use adhesive mulch stabilizer material that is a powder or liquid chemical that, when properly mixed, applied, and cured, will create a water insoluble bio-degradable mesh. Before application, submit the manufacturer's recommendations for approval.

Mix adhesive mulch stabilizer according to the manufacturer's directions.

M18.09 SEED STABILIZER MATERIALS.

M18.09.1 Straw.

Use straw for mulch that consists of mowings of acceptable herbaceous growth, reasonably free from noxious weeds or woody stems, and is reasonably dry. Do not use any salt hay, feed hay, and/or construction hay.

M18.09.2 Erosion Control Netting.

Use erosion control netting material that is new, clean, sound, and free of rips and tears and is furnished in lengths of not less than 50 ft.

a. Jute Mesh. Use jute mesh that is uniform, open, plain weave of undyed and unbleached, smolder resistant, and natural single jute yarn and is a minimum of 4 ft in width ±1 in. Ensure that there are 78 warp ends per width and 41 weft ends per yard. Ensure that the weight averages 1.22 lb per linear yard, ±5 percent.

b. Excelsior Matting. Use excelsior matting that is made of a uniform web interlocking wood excelsior fiber with a backing of mulchnet fabric on one side only. Ensure that the mulchnet is woven of either twisted paper cord or cotton cord with mesh sizes not exceeding 1½ in. by 3 in.

   Provide excelsior matting in rolled strips of not over 150-ft average length and that meet the following minimum requirements:

   - Width – minimum 36 in., ±1in.
   - Weight to average – 0.80 lb/sq yd, with a tolerance of ±5 percent

   Staples are made from 12-in. lengths of No. 11 gauge steel wire bent to form a U of 1.5 in. to 2 in. in width. Longer staples may be required for loose soils.

M18.09.3 Erosion Control Blanket.

Use a blanket that is a nonwoven, natural, biodegradable wood fiber formed into a blanket. Ensure that a photodegradable polypropylene netting is laminated to its surface. Ensure that the blanket does not contain growth inhibiting additives and is free of noxious weed seeds.

Use a width of 40 in. or 80 in., ±1 in.

Ensure that the weight averages 0.50 lb/sq yd, with a tolerance of ±10 percent.

M18.09.4 Staples for Seed Erosion Stabilizer Materials.

Use staples that are made from 11 gauge steel, are 6 in. long, and are used with jute mesh, excelsior matting, and erosion control blanket.

M18.10 SEED MIXTURES.

M18.10.1 General.

Ensure that all legume seed has been inoculated within 24 hours before mixing and planting with the appropriate inoculum for each variety. Ensure that all inocula is fresh and used within the date limit prescribed by the manufacturer. Use three times the normal amount of inoculant when the seed will be treated in an approved hydroseeder.

Deliver all seed to the job in containers labeled according to the provisions of the Rhode Island Seed Act of 1956 (Volume 8, Title 2, Chapter 6) and its amendments, as provided for agricultural seed offered for sale. Use only the current year's seed.

M18.10.2 General Highway Mix.

General Highway Mix Type	Percent By Weight	Percent by Volume (Pure Live Seed)
Creeping Red Fescue Improved varieties	70	78
Kentucky Bluegrass Improved varieties	15	68
Perennial Ryegrass Improved varieties	16	85

Note: Seeding rate: 150 lb per acre

M18.10.3 Slope Mix.

Slope Mix Type	Percent By Weight	Percent by Volume (Pure Live Seed)
Creeping Red Fescue Improved varieties	60	85
Perennial Ryegrass Improved varieties	15	90
Birdsfoot trefoil (Lotus corniculata)	15	78*

Note: Seeding rate: 150 lb per acre

* *Includes up to 20% hard seed.*

M18.10.4 Residential Seed Mix.

Residential Seed Mix Type	Percent By Weight	Percent by Volume (Pure Live Seed)
Chewing Fescue Improved varieties	30	85
Kentucky Bluegrass Improved varieties	30	90
Perennial Ryegrass Improved varieties	40	90

Note: Seeding rate: 150 lb per acre

M18.10.5 Temporary Seed Mix.

Temporary Seed Mix Type	Percent By Weight	Percent by Volume (Pure Live Seed)
Annual Ryegrass	40	85
Perennial Ryegrass	60	90

Note: Seeding rate: 75 lb per acre

M18.10.6 Native Seed Mix.

Native Seed Mix Type	Percent By Weight	Percent by Volume (Pure Live Seed)
Switch Grass (Panicum virgatum)	20	75
Little Blue Stem (Andropogon Scoparius)	25	75
Perennial Ryegrass	25	90
Hard Fescue	30	

Note: Seeding rate: 60 lb per acre

M18.10.7 Wetlands Mix.

The composition of a wetlands mix for a particular application will be set forth in the Contract by Special Provision Code.

M18.10.8 Wildflower Seed Mix.

Wildflower Seed Mix Type	Percent By Weight
Yarrow /(Achillea millefolium)	10
Oxeye Daisy/(Chrysanthemum laucanthemum)	22
Lance-Leaved Coreopsis/ (Coreopsis lanceolata)	58
Black-Eyed Susan/(Rodbeckia Lirta)	10

Note: Seeding rate: 8 lb per acre
Hard fescue rate: 20 lb per acre

M18.11 SOD.

Use sod that is live, fresh, and of suitable character for the intended use and for the soil on which it will be placed. Use sods that are at least 2 sq ft in area and thick enough to contain all natural roots without mutilation. Do not use sods less than ¾ in. or over 1 in. thick, unless express written permission of the Engineer is procured. Do not use sod that has been stored longer than 36 hours.

Use sod that has a minimum of the following:

- 70 percent Kentucky Bluegrass, improved variety
- 10 percent Red Fescue (Festuca rubra), improved variety

Upon delivery to the job site, provide a certificate of compliance from the supplier (sod producer) to the Engineer stating that the sod meets the required specifications before any work is performed. Ensure that the certificate identifies the date that the sod was harvested.

M18.11.1 Wooden Pegs.

Use pegs that are hard wood stakes that are approximately 1 in. × 2 in. × 6 in. in length. Ensure that the length is sufficient to penetrate from the top of sod to at least 2 in. into subsoil.

M18.12 PLANT MATERIALS.

Use plant materials that conform in size, grade, and quality to the AAN American Standard for Nursery Stock, as approved by the USA Standards Institute that are in effect at the time of invitation for bids. Ensure that all scientific and common plant names of the items specified conform to Standardized Plant Names, as adopted by the American Joint Committee on Horticultural Nomenclature that is in effect at the time of invitation for bids.

Ensure that all plant material has been nursery grown; no collected material will be accepted. Use plant material that is free from insects, pests, plant diseases, disfiguring knots, stubs, sunscald, abrasions, cuts of the bark, or any other form of injury harmful to the health of the plant material or of objectionable disfigurement. Use plant material that complies with the State and Federal laws with respect to inspection for plant diseases and insect infestations.

M18.13 PLANTING INCIDENTALS.

M18.13.1 Stakes.

Use stakes for tree supports that are from a hardwood source, free of knots, insects, and fungi. Use stakes of uniform size and shape that have a minimum of 2 sq in., have a length sufficient to be driven into the ground 3 ft, and have an above ground stake height of 8 in. above the point of attachment of the guy webbing. Ensure that the bottom of the stake is pointed with a taper of no less than 4 in. Ensure that uniform stakes are used throughout the job.

M18.13.2 Guy Webbing.

Use guy webbing that is a low abrasion, woven, fiber webbing with a break strength of 900 lb or better. Ensure that the width of the webbing is no less than ⅝ in. nor greater than ¾ in. Ensure that the length is sufficient to be attached to the tree trunk and stake.

M18.13.3 Burlap.

Use burlap that is jute burlap in 4-ft wide strips with a weight of approximately 8 oz/sq yd. Ensure that the burlap is sound, dry, uncontaminated, and free from rips, tears, and holes.

M18.13.4 Twine.

Use twine for securing burlap that is 3-ply jute twine.

M18.13.5 Tape.

Use tape for identifying guy webbing that is bright yellow with a waterproof adhesive backing. Ensure that the burlap is 1½ in. wide and is uniform throughout the job.

M18.13.6 Antidesiccant.

Use an antidesiccant that is an emulsion or other material that, when mixed with water, will provide a protective film over plant surfaces (leaf) that will reduce or retard the loss of moisture through transpiration. Deliver the antidesiccant in containers clearly marked with the manufacturer's name and instructions. Mix and apply the antidesiccant according to the manufacturer's guidelines.

M18.14 HERBICIDES.

Use herbicides that are packaged in standard containers marked with the name of the material, the name of the manufacturer, and the net quantity contained therein and that meets the provisions of the Federal and State rules and regulations in effect at the time of delivery to the job site.

M18.14.1 Pre-Emergent Herbicide.

Use pre-emergent herbicide for application in mulch areas and for other uses that is granular and has the active ingredient Trifluralin 5.0 percent. Ensure that all application rates and product uses meet the manufacturer's guidelines.

M18.14.2 Nonselective Herbicide.

Use nonselective herbicide that has the active ingredient Glyphosate, N-(Phosphonomethyl) Glycine that is 41 percent by volume. Ensure that all application rates and product uses meet the manufacturer's guidelines.

M18.15 PLANT PROTECTION DEVICES.

M18.15.1 General.

All materials become the property of the Contractor after removal.

M18.15.2 Tree Protection.

Use wood framing that is of nominal lumber 6 ft in length and has a width and thickness that vary from 2 in. × 2 in. to 2 in. × 6 in., depending on trunk diameter. Use binding material that is of a single strand, 9-gauge wire.

M18.15.3 Shrub and Drip-Line Protection.

Use fencing that is standard snow fencing. Use steel poles a minimum of 6 ft in length to stabilize and support the fencing.

M18.16 WATER FOR LANDSCAPE USE.

Obtain water from clean, fresh water sources, and ensure that it is free from injurious chemicals and other toxic substances harmful to plant life. Do not use any water that is brackish. Identify to the Engineer all sources of water at least two weeks before use. The Engineer may take samples of the water at the source or from the tank at any time and may have a laboratory test the samples for chemical and saline content.

M18.17 PAVERS.

M18.17.1 Concrete Pavers.

Use concrete pavers (interlocking or brick like) that conform to ASTM C936, Standard Specifications for Solid Concrete Interlocking Paving Units. Ensure that the average compressive strength of concrete after 28 days is not less than 8000 psi. Ensure that the concrete pavers do not have a water absorption rate greater than 5 percent when tested according to ASTM C140 and can withstand, without cracking or showing any sign of damage, the freeze-thaw test according to ASTM C67, Section 8, Method A, 50 cycles.

Ensure that individual materials used to manufacture concrete pavers conform to the following:

- Cement — ASTM C150, Portland Cement
- Aggregates — ASTM C33, Washed, Graded Sand, and Limestone Aggregates
- Other Constituents — Non-fading synthetic iron oxide color pigments, integral plasticizers, and densifying agents established as suitable for use in concrete

Use concrete pavers that have a size of 4 in. × 9 in. × 2 in. or 4 in. × 9 in. × 3-3/16 in. (nominal size for interlocking pavers) and 4 in. × 8 in. × 2 in. or 4 in. × 8 in. × 3-3/16 in. (nominal size for brick like pavers).

M18.17.2 Brick Pavers.

Use brick pavers that conform to ASTM C216, Grade SW, Type FBS. Use a size and trueness of shape that complies with ASTM C216, Table VI and VIII for Type FBS. Ensure that the approximate size of the brick paver is 4 in. × 8¼ in. × 2¾ in.

M18.17.3 Granite Pavers.

Use cut granite pavers that conform to ASTM C615 and are free of cracks, starts, and seams. Ensure that the cut granite pavers do not have a water absorption rate greater than 4 percent when tested according to ASTM C97, have a density of 160 lb/cu ft, and have a minimum compressive strength of 19,000 psi. Ensure that the modulus of rupture of the cut granite pavers are a minimum of 1500 psi according to ASTM C99.

Use cut granite pavers that have a nominal size of 4 in. × 8 in. × 4 in. Use a tolerance for face sizes ±⅛ in.

Use cut granite pavers that have all side and top surfaces sawn; the bottom may be sawn or split. Ensure that all angles are square and true and equal to 90 degrees. Ensure that the top surface (face) is flame finished and that the color is light gray.

M18.17.4 Granite Cobble Pavers.

Use granite cobble pavers that conform to ASTM C615 and are free of cracks, starts, and seams. Use granite cobble pavers that are uniform in size and shape.

M18.18 STONE FINE SETTING BED AND JOINTING MATERIAL.

Use material that is sharp, washed concrete sand that does contain more than 3 percent silt and is free from deleterious soluble salts. Ensure that the gradation meets the following requirements:

Sieve Size	Percentage Passing
⅜ in.	100
No. 4	95 – 100
No. 8	70 – 100
No. 18	50 – 85
No. 30	25 – 60
No. 50	10 – 30
No. 100	5 – 20
No. 200	0 – 10

SECTION M19 — ANTI-GRAFFITI SYSTEMS

M19.01 APPROVED PRODUCTS.

Use an anti-graffiti protective coating system that is one of two types — sacrificial or non-sacrificial. The system may be applied to any construction material surface, but only apply the material to substrates for which they are formulated. Use a system that is on the RIDOT Approved Products List and is approved by the Department for the application.

M19.02 NON APPROVED PRODUCTS SUBMITTED FOR APPROVAL.

Products not on the RIDOT Approved Products List may be considered by the Department but, if proposed, submit the request to the Engineer a minimum of 45 days before any application for review and approval.

The system may be clear, showing the original color and texture of the substrate or pigmented opaque. There are two types of anti-graffiti coating systems, defined as follows:

- A sacrificial system, where the top layer is entirely removed during cleaning and re-applied as soon as practical to restore protection.
- A non-sacrificial system, where the top layer can resist the cleaning process needed to remove the graffiti.

Either type of system may employ a cleaner provided by the manufacturer of the anti-graffiti system to facilitate removal of graffiti; however, ensure that the system does not require a cleaner for total removal. Ensure that the manufacturer conducts a demonstration of the system's ability to provide effective protection against graffiti, which will consist of the complete removal of a range of tagging paints provided by the Engineer from the surface treated with the system.

a. Product Performance. Use a system that has a proven performance history of effectively protecting surfaces, demonstrated by documentation of a minimum of five applications in the last five years.

   When applied to concrete, ensure that the system is formulated not to cause degradation of the concrete in an aggressive freeze/thaw environment.

b. Documentation. Provide proper surface preparation procedures from the manufacturer's specifications for Project substrates.

   Use the minimum rates of coverage, number of coats for each layer, and equipment as needed for the application according to the manufacturer's specifications.

   Provide a Materials Safety Data Sheet (MSDS) for each component of the system.

c. Product Delivery and Storage. Deliver the product to the job site in the manufacturer's containers with seals unbroken. Properly label the containers including the batch number and the date of manufacture.

Protect the materials from the elements, and ensure that the materials remain in the original unopened containers until the time of immediate use to prevent contamination by foreign materials.

SECTION M20 — GEOTEXTILES

M20.01 GEOTEXTILES.

Furnish materials for use in soil sediment, erosion control, and soil stabilization that is on the Department's Approved Materials List, or as approved by the Engineer, and meet the following specifications:

- Silt fence and reinforced silt fence: AASHTO M288 Table 6.
- Inlet sediment control, riser pipe assembly for sediment trap, sump pit, portable sediment tank, sediment basin outlet structure (corrugated metal): AASHTO M288, Table 5, Class 1 or 2.
- Riprap ditch, perimeter dike/swale, earth dike, temporary slope drain, stilling well, geotextile lined channel diversion, dewatering basin: AASHTO M288, Table 2, Class 2 or 3.
- Stabilized construction entrance: AASHTO M288, Table 1, Class 1, Tables 3 and 4.
- Separation fabric: Filter fabric AASHTO M288 Table 1, Class 2, Table 3 and Table 4.
- Stabilization fabric: AASHTO M288 Table 1, Class 1 and Table 5.
- Underdrain: AASHTO M288 Table 1, Class 2 and Table 2.

M20.02 LANDSCAPE FILTER FABRIC.

Use material that is nonbiodegradable, nonwoven, 100 percent polypropylene fabric that is black. Use fabric that conforms to the following minimum specifications:

Properties	Value
Grab Tensile Strength (lb) ASTM D4632	120 min.
Grab Elongation at failure (%) ASTM D4632	50 min.
Trapezoid Tear Strength (lb) ASTM D4533	50 min.
Mullen Burst Strength (psi) ASTM D3786	225
Flow Rate (gpm) ASTM D4491	95
UV Resistance after 500 hours (ASTM-D4355)	70%
Puncture Strength (lb) ASTM D4833	70 min.
Permittivity (sec^{-1}) D4491	0.10 min.
Apparent Opening Size (AOS) US Std. Sieve D4751	#70 – #100

Part T
TRAFFIC CONTROL SYSTEMS

SECTION T01 — ELECTRICAL WORK

T01.01 DESCRIPTION.

This work includes performing electrical work common to the installation of traffic signals, highway lighting, and illuminated signs at the required locations, the National Electric Code, the National Electric Safety Code, and the electrical utility company. The work includes all resources necessary to provide lighting systems, traffic signal systems and cable systems for police and fire alarms. The work includes excavation, backfill, conduit and appurtenances, whether encased in concrete, attached to structures, or buried in the ground.

All references to the code of standards mentioned refers to the code or standard that is in effect on the date of advertisement for bids.

T01.02 MATERIALS.

Use rigid steel conduit, PVC conduit, fiberglass conduit, handholes, pull boxes, manholes, wire and cable that conform to **SECTION M15**.

Only materials listed and tested by nationally recognized laboratories will be considered for acceptance for the services indicated. Ensure that all materials are new and that all electrical equipment bears the manufacturer's name, trademark, or other descriptive marking that identifies the organization responsible for the product. Provide other markings identifying voltage, current, wattage, or other ratings as required. Use electrical equipment that is designed, manufactured, tested, and rated according to ANSI and the National Electrical Manufacturer's Association. Ensure that all markings have a durability that will withstand the environment involved. Where two or more items of the equipment class are required, use products of the same manufacturer.

The Engineer will approve all materials before installation.

T01.03 CONSTRUCTION METHODS.

T01.03.1 Foundations.

Ensure that the foundations comply with **Subsection T11.02.2** and the RIDOT *Standard Details*.

T01.03.2 Bonding and Grounding.

Ensure that traffic signals, highway lighting, illuminated sign circuits, conduits, and aboveground equipment is effectively bonded and grounded. Use bonding and grounding that conforms to the National Electric Code and the utility company.

Use ground wire and grounding rods that conform to **SECTION M15**.

Maintain 25 ohm to ground resistance in all systems.

T01.03.3 Connection with Utility Services.

For electrical work, install conduits and electric conductors according to the requirements of the utility company and subject to its approval. The division of work will be:

- Overhead Services. The Contractor installs conduit directly from the meter socket to the overhead secondary line according to the Plans. The Utility makes the final connection once inspected.
- Underground Services. The Contractor installs conduit directly from the meter socket to the RIDOT hand hole and from the hand hole to 10 ft away from the Utility manhole. The Utility-approved contractor installs the last 10 ft to the Utility manhole and makes the final connection once inspected.

Coordinate with the servicing Utility to complete service connections.

T01.03.4 Testing.

Upon the completion of each wiring system, and before any connection is made to operating equipment, perform, in the presence of the Engineer, the following tests of each circuit to determine whether the installations are in acceptable working order:

- Tests for continuity.
- Tests for grounds.
- Test for insulation resistance from circuit wires to ground and between circuit wires; ensure that the insulation resistance is not less than the value specified in the National Electric Code.

With all equipment connected to the wiring system, perform a functional test, in the presence of the Engineer, to demonstrate that the system function as specified. Repair or replace any defective materials or faulty or improper installation at no additional cost to the Department.

Test lighting circuits as required by the utility company. Perform these tests in the presence of the Engineer and the utility company's representative.

Include the cost of testing in the prices bid for other scheduled items of work as specified in **SECTIONS T03** through **T14**.

T01.03.5 Painting.

Paint signal heads, including hanger, with two coats of federal yellow enamel, except finish the interior of hoods with two coats of flat black enamel. Do not paint aluminum or galvanized steel fittings and parts unless part of an adjacent assembly will be painted.

If the Plans indicate that another color must be used on signal heads, traffic poles, traffic cabinets, decorative light pedestals, or other related items, ensure that the coloring is applied at the factory.

Include the cost of painting in the prices bid for other scheduled items of work as specified in **SECTIONS T07** through **T09** and **T11** through **T14**.

T01.03.6 Topsoiling and Seeding.

Use topsoiling and seeding after excavation and backfill that conforms to **SECTIONS L01** and **L02**.

Include the cost of topsoiling and seeding in the prices bid for other scheduled items of work as specified in **SECTIONS T04** through **T14**.

T01.03.7 Shop Drawings.

Submit the manufacturer's Shop Drawings, layout drawings, and specifications for equipment and appurtenances for the approval of the Engineer according to **Subsection 105.02**. The following also apply:

a. Design Computations. Include the following in the design computations for mast arms and poles, span poles, and lighting standards:

- Consideration for all parts of the structure
- Consideration for all possible loading combinations including wind and ice loads
- Design stresses and allowable stresses for all components that comprise the proposed structure
- Cross section information

Ensure that all Shop Drawings and design computations bear the stamp of a Professional Engineer licensed by the State of Rhode Island. The Engineer will approve the Shop Drawings before fabrication.

b. Equipment Lists. Within 60 days of signing the Contract, furnish for the approval of the Engineer all traffic signal equipment proposed for use, supplemented by catalog cuts, manufacturer's specifications, and other descriptive or pictorial data sufficient to identify and explain the method of operation and construction of the proposed equipment. For cut sheets provided that have different items, specify exactly which item on each cutsheet is being used. Upon approval, the Engineer will notify the Contractor of the Shop Drawings approval.

T01.03.8 Existing Systems.

Where existing systems will be modified, salvage the existing equipment and materials and incorporate into the revised system, or salvage for other use by the Department, or remove and dispose of. Remove and stockpile the salvaged material required on site as designated in the Contract Documents or as directed by the Engineer.

Existing systems or portions thereof may be abandoned in place only with the written permission of the Engineer.

T01.03.9 Excavation and Backfill.

Ensure that excavation and backfill for the construction of manholes, handholes, foundations, conduits, cables, and other appurtenances conform to **SECTION 203**.

T01.03.10 Disruption of and Damage to Existing Improvements.

When placing foundations, handholes, or conduit in existing asphalt sidewalks, replace the entire width of sidewalk. For concrete sidewalks, make saw cuts at score lines, and replace the entire square of concrete. Make the saw cuts at no additional cost to the Department.

T01.04 METHOD OF MEASUREMENT.

Electrical Work will not be measured separately but will be included in the measurement of specific items such as conduit, foundations, standards and poles, luminaires, traffic signal controllers, and traffic signal heads.

T01.05 BASIS OF PAYMENT.

Electrical Work will not be paid for separately but will be included in the price of specific items, such as conduit, foundations, standards and poles, luminaires, traffic signal controllers, wire and cable, and traffic signal heads, as specified in **SECTIONS T04** through **T14**.

The cost of excavation and backfill for manholes, handholes, foundations, conduits, cables, and other appurtenances will be included in the prices bid for these structures and appurtenances. The excavation of rock encountered in the excavation for the structures and appurtenances will be paid for under the provisions of Trench Excavation – Rock as set forth in **SECTION 205**.

SECTION T02 — HIGHWAY LIGHTING

T02.01 DESCRIPTION.

This work includes furnishing and installing highway lighting of multiple circuit type and/or modifying existing highway lighting. A highway lighting installation is composed of two systems:

- An underground multiple circuit installation that includes conduits, handholes, and concrete foundations for lighting standards or service pedestals.
- An aboveground multiple circuit installation that includes lighting poles, luminaires, lamps, service pedestals, wiring, bonding, grounding, and all other incidental work.

T02.02 MATERIALS.

Refer to **SECTIONS T03** through **T09** for materials requirements.

T02.02.1 Warranties for Highway Lighting Installations.

a. Manufacturer's Warranties. Submit copies of all warranties from each manufacturer for all electrical or mechanical equipment pertinent to the satisfactory operation of highway lighting installations to the Department at the time of acceptance. Ensure that each warranty indicates its expiration date. Ensure that the warranty will be in effect for a period equal to the customary trade practice, or ten years from the date of Final Acceptance or of Partial Acceptance if approved, whichever is greater.

b. Contractor's Warranties. Warrant the satisfactory in-service operation of the mechanical and electrical equipment and related components for six months following the acceptance of work by the Department. During this period, when notified by the Engineer, repair or replace equipment or materials necessary to ensure satisfactory operation of the system and to correct any deficient work at no additional cost to the Department. Any labor necessary to comply with the requirements of the manufacturer's warranties will be compensated by Extra Work in **Subsection 104.05**.

T02.03 CONSTRUCTION METHODS.

Refer to **SECTIONS T03** through **T09** for specifics on construction methods.

T02.04 METHOD OF MEASUREMENT.

Highway Lighting will not be measured separately but will be included in the measurements of specific items such as conduit, cable, luminaires, poles, bases, handholes, etc.

T02.05 BASIS OF PAYMENT.

Highway Lighting will not be paid for separately but will be included in the price of specific items as listed in the Proposal.

SECTION T03 — GROUND RODS AND BARE GROUND WIRE

T03.01 DESCRIPTION.

This work includes effectively grounding lighting circuits, service pedestals, conduits, lighting and signal poles, illuminated sign circuits, and traffic signal controller cabinets according to the National Electric Code.

T03.02 MATERIALS.

Use ground rods that conform to **Subsection M15.01**. Use ground wire that conforms to **Subsection M15.02.2**.

T03.03 CONSTRUCTION METHODS.

Provide equipment grounding conductors for all lighting circuits between service pedestals and lighting standards. Connect conductors to each ground rod at each handhole and at each lighting standard.

Furnish the Engineer with the results of all resistivity tests, indicating the values obtained for each installation, which will become a permanent Project record.

T03.04 METHOD OF MEASUREMENT.

Ground Rods and Bare Ground Wire will not be measured for payment but will be included with the pay item with which they are associated. Additional ground rods required to reduce the resistance according to the NEC will not be paid for separately.

T03.05 BASIS OF PAYMENT.

Ground Rods and Bare Ground Wire will not be paid for separately but will be included with the pay item with which they are associated. The accepted quantities of additional Ground Rods will be paid according to **Subsection 109.04**.

SECTION T04 — WIRE AND CABLE

T04.01 DESCRIPTION.

This work includes furnishing and installing wire and cable of the type and at the required locations and the use of material and equipment for furnishing and installing splice kits in handholes and manholes according to the currently adopted edition of the National Electric Code.

T04.02 MATERIALS.

Use wire, cable, and splice kits that conform to **Subsection M15.02**.

T04.03 CONSTRUCTION METHODS.

Ensure that wires on poles are installed by a licensed electrician and/or a licensed journeyman.

Ensure that wiring installed in raceways has slack cable left at all pulling points. Do not install wiring until conduit systems have been approved by the Engineer.

Ensure that the installation of splice kits is as recommended by the manufacturer and the National Electric Code And that all splices are in a handhole, manhole, or junction box.

Submit for approval the manufacturer's notarized certificates of compliance for all wire and cable.

T04.04 METHOD OF MEASUREMENT.

T04.04.1 Wire and Cable.

Wire and Cable will be measured by the linear foot of each type installed.

Measurement will be along the centerline of the conduit. A 5-ft allowance will be made for slacked cables in handholes. A 6-ft allowance will be made for slacked cables in traffic signal controller cabinets.

T04.04.2 Splice Kits.

Splice Kits will be measured by the number of units installed, regardless of the number of actual splices made at each unit.

T04.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Wire	LF
Cable	LF
Splice Kits	EA

T04.05.1 Wire and Cable.

The prices constitute full compensation for all materials, equipment, tools, labor, and incidentals required to finish the work, complete and accepted.

T04.05.2 Splice Kits.

The unit price includes the labor cost to install splice kits of all sizes and types. The price constitutes full compensation for furnishing and installing all tools, labor, splice kits, equipment, and incidentals required to finish the work, complete and accepted.

SECTION T05 — HANDHOLES AND PULL BOXES

T05.01 DESCRIPTION.

This work includes providing various types of Handholes and Pull Boxes at the required locations.

T05.02 MATERIALS.

T05.02.1 Precast Handholes and Pull Boxes.

Use precast handholes and pull boxes that conform to **Subsection M15.03.1**.

T05.02.2 Metal Pull Boxes.

Use pull boxes that conform to **Subsection M15.03.2**.

T05.03 CONSTRUCTION METHODS.

T05.03.1 Plant Requirements for Precast Units.

Ensure compliance with **SECTIONS 601** and **809**.

T05.03.2 Setting.

Place precast units on previously prepared gravel borrow subbase to the required lines and grades.

Ensure that the grade of the handhole frame and cover is even with the surrounding ground. The maximum allowable adjustment for the frame and cover is 3 in.

Drill all holes for conduit and ground wire. Do not punch holes. Grout all holes drilled in handholes with a material approved by the Engineer. Provide a frame and cover with a ground connector, and bond both items to the ground rod using a #6 bare ground wire.

T05.03.3 Metal Pull Boxes.

Ensure that pull boxes, when used in cast-in-place bridge parapets or barriers, are adequately anchored in place to prevent displacement during concrete pouring operations. Anchor surface mounted pull boxes with stainless steel mechanical anchors.

T05.04 METHOD OF MEASUREMENT.

Handholes and Pull Boxes will be measured by the number of units of each type installed.

T05.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Handholes	EA
Pull Boxes	EA

The prices constitute full compensation for all materials, labor, tools, and equipment including concrete, ground wire, grounding clamps and support grips, ground rods, gravel, cast iron frame and cover, grounding of frame and cover, excavation and backfill, and incidentals required to finish the work, complete and accepted.

Payment for Trench Excavation – Rock will be made under **SECTION 205**.

SECTION T06 — CONDUIT

T06.01 DESCRIPTION.

This work includes furnishing and installing rigid steel conduit, polyvinyl chloride (PVC) plastic conduit, and fiberglass conduit of the size specified, including the necessary fittings, at the required locations.

T06.02 MATERIALS.

Use conduit and fittings that conform to **Subsection M15.04**.

T06.03 CONSTRUCTION METHODS.

Perform all work according to the currently adopted edition of the National Electrical Code.

T06.03.1 Rigid Steel Conduit.

Bends that are not smooth or that show any evidence of flattening or destruction of the protective coating will not be accepted. Ensure that all joints requiring rethreading are manufactured with a zinc-based, cold galvanized, spray-applied compound applied to the male threads. Remove oils from the threads before applying the galvanizing compound. Tighten all threaded couplings until the ends of the conduit are brought together to form a tight connection.

Install a nylon pulling rope in all conduits that do not carry conductors under the Contract. There will be no separate payment for the cost of the pull rope.

Ensure that conduit bends and elbows made in the field have a radius of not less than 12 times the inside diameter of the conduit, and ensure that all bends are made without crimping, heating, denting, or otherwise damaging the conduit.

Supply conduit ends at handholes with insulated bonding bushings with threaded ends. Ensure that all conduits are bonded to the ground rod within the handhole using #6 bare ground wire.

a. Conduit Underground. Conduit underground refers to all conduit placed underground in non-paved areas and in paved areas where the pavement will be replaced as part of the Project. Ground all conduit according to the currently adopted edition of the National Electrical Code. Fill ends that have bonding clamps with sealing compound to prevent the entrance of moisture, except at handholes. Ensure that all ground lugs are copper, bronze, or brass. Place underground conduit at a minimum depth of 24 in. under vehicular travel areas and 18 in. under non-vehicular travel areas.

   Place conduits on a 6-in. sand bed. Backfill conduits within roadways with Class 1 controlled low-strength material (CLSM) to the bottom of the gravel subbase. Place yellow warning tape 1 ft below finished grade.

   When two or more conduits are placed in the same trench, use conduit spacers. Place spacers at 6-ft intervals.

Notify the Engineer of trench-bottom conditions that are suspected to be unsatisfactory. If the condition of the bottom of the trench is in any way unsatisfactory, the Engineer may require the Contractor to excavate additional material and replace it with clean gravel to provide a firm bearing for the conduit. Compact the backfill in layers not more than 6 in. in thickness before compaction.

After the trench is backfilled, test, in the presence of the Engineer, the installation by pushing or pulling a mandrel, not less than ¼-in. less than the inside diameter of the conduit, through the entire length of the conduit. Remove all debris, including stones and dirt.

b. Conduit Under Existing Pavement. Conduit under existing pavement refers to all conduit placed under existing paved areas where removal of the pavement is required only for the placement of conduit and the pavement will be restored as part of this item. Place conduit under existing pavement according to Para. a of this Subsection. When conduit is placed in existing paved sidewalks, replace the sidewalk according to **Subsection T01.03.10**.

c. Conduit Overhead. Securely attach all conduit above grade using clamps and/or hangers at intervals not exceeding 5 ft. Ensure that all clamps and hangers are galvanized. Install a weather head on all risers.

d. Conduit In or On Structure. Support conduit to be embedded in concrete structures in the concrete form by methods and materials that will not cause injury to the zinc coating of the conduit.

Provide conduit installations on bridges and other structures with expansion fittings at all structure expansion joints. Install the expansion joint fittings according to **Subsection M15.04.4**.

T06.03.2 PVC Plastic Conduit.

Install PVC plastic conduit in conformity with the requirements in **Subsection T06.03.1**, except those referring specifically to rigid steel conduit.

Install PVC plastic conduit with bell ends on the inside of each handhole.

T06.03.3 Fiberglass Conduit.

Install fiberglass conduit in conformance with **Subsection T06.03.1**, except those referring specifically to rigid steel conduit.

T06.04 METHOD OF MEASUREMENT.

Rigid Steel Conduit, PVC Plastic Conduit, and Fiberglass Conduit will be measured by the number of linear feet installed with no deduction for fittings and couplings. The pull rope is not measured for payment.

T06.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Conduit – All Types	LF
Expansion Couplings	EA

T06.05.1 Conduit Underground.

The prices constitute full compensation for furnishing all materials, equipment, tools, and labor, including fittings, couplings, saw cutting pavements, excavation and backfill, Class B bedding, restoration of existing ground surfaces including all materials necessary for such restoration, testing, and all incidentals necessary to finish the work, complete and accepted.

T06.05.2 Conduit Under Existing Pavement.

The prices constitute full compensation for furnishing all materials, equipment, tools, and labor, including fittings, couplings, saw cutting, excavation and backfill, Class B bedding, restoration of existing pavements and sidewalks including all materials necessary for such restoration, testing, restoration of pavement markings, and all incidentals required to finish the work, complete and accepted.

T06.05.3 Conduit Overhead.

The prices constitute full compensation for furnishing all materials, equipment, tools and labor, including fittings, couplings, clamps and hangers, weather head, and all incidentals required to finish the work, complete and accepted.

T06.05.4 Rigid Steel or PVC Plastic Conduit in Structure.

The prices constitute full compensation for furnishing all materials, equipment, tools and labor, including fittings, couplings, and all incidentals necessary to finish the work, complete and accepted.

T06.05.5 Fiberglass Conduit on Structure.

The price constitutes full compensation for furnishing all materials, equipment, tools and labor, including fittings, hangers and support systems, expansion fittings, and all incidentals necessary to finish the work, complete and accepted.

T06.05.6 Expansion Couplings.

The price constitutes full compensation for furnishing all materials, equipment, tools labor, and all incidentals necessary to finish the work, complete and accepted.

SECTION T07 — LUMINAIRES

T07.01 DESCRIPTION.

This work includes furnishing and installing 133- or 260-watt LED cutoff luminaires on appropriate lighting standards and understructure luminaires, including their supports and protective screens, at the required locations.

T07.02 MATERIALS.

Ensure that luminaires, understructure luminaires, and controls conform to **Subsection M15.05**.

T07.03 CONSTRUCTION METHODS.

T07.03.1 LED Luminaires.

Mount the 133-watt luminaire to 30-ft aluminum poles and crossarms, and mount the 260-watt LED luminaire to a 40-ft aluminum poles and crossarms. Securely attach luminaires to the ends of arms, and ensure that the luminaires are accurately plumbed, with the luminaire reflector properly and accurately placed.

Note: Ensure that luminaires installed on bridges are secured with a belt through the end of the davit arm in addition to the manufacturer's recommendation due to possible vibration of the bridge span.

T07.03.2 Understructure Luminaire with or without Protective Screen.

Drill angle iron to accept wire mesh. Crimp the wire mesh ends at every end into holes in the angle iron. Ensure that the protective screen is the required size and is secured to the bridge structure with galvanized C clamps located in each corner. Ensure that the furnishing and installing of supports for the understructure luminaires include ¾-in. conduit installed between the luminaire and the junction box. Ensure that tunnel or underpass luminaries without protective screens are specified and ordered with tempered rated glass lens.

T07.04 METHOD OF MEASUREMENT.

T07.04.1 LED Luminaires.

133-watt LED Luminaires or 260-watt LE Luminaires will be measured by the number of units of each type installed.

T07.04.2 Understructure Luminaire with Protective Screen.

Understructure Luminaire with or without Protective Screen will be measured by the number of units installed.

T07.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
133-Watt LED Luminaires	EA
260-Watt LED Luminaires	EA
Understructure Luminaires with or without Protective Screens	EA

T07.05.1 LED Luminaires.

The price constitutes full compensation for all materials, equipment, tools and labor, including ballast, lamp and photo-electric control, and all incidentals required to finish the work, complete and accepted.

T07.05.2 Understructure Luminaire with or without Protective Screen.

The price constitutes full compensation for all materials, including angle, mesh and clamps for the protective screen, luminaire support, luminaire, ballast, photo-electric cell (if needed), lamp and conduit, and all labor, tools, equipment, and all incidentals required to finish the work, complete and accepted.

SECTION T08 — ALUMINUM LIGHTING STANDARDS AND FOUNDATIONS

T08.01 DESCRIPTION.

This work includes furnishing and installing aluminum lighting standards, foundations, anchor bolts, in-line fused and unfused kits, and breakaway support couplings of the sizes and at the required locations.

T08.02 MATERIALS.

T08.02.1 Light Standards.

Provide light standards that conform to **Subsection M15.06.1**.

T08.02.2 Light Standard Foundations.

Provide light standard foundations that conform to **Subsection M15.06.2**.

T08.03 CONSTRUCTION METHODS.

T08.03.1 Light Standards.

Securely bolt lighting standards to foundations in a vertical position employing shims if necessary.

Securely attach arms to poles to develop the full design strength of the arm and aligned perpendicular to the centerline of roadway.

Limit the use of breakaway support couplings to pole heights that provide luminaire mounting heights of 50 ft or less and a total pole, arm, and luminaire weight of 600 lb or less.

T08.03.2 Light Standard Foundations.

a. Cast-in-Place Concrete Units. Complete excavation as near as practical to the dimensions shown for the concrete foundation. Remove all loose material before the forms are installed. Install all conduits, ground rods, reinforcing steel, and anchor bolts rigidly in place before the concrete is placed. Space anchor bolts by use of a template furnished by the pole manufacturer. Wrap anchor bolts and conduit extending above the top of the base with oiled burlap for protection until the pole is mounted on the base. Place the concrete according to **SECTION 808**.

   Provide grounding through the ground rod in the associated handhole with a bare copper ground wire. If there is no associated handhole, install a ground rod in the light standard foundation. Ensure that the ground rod extends 3 in. above the top of the base and is equipped with a copper clamp to secure the ground wire.

   After the concrete foundation has been placed, finished level, and cured, remove the forms. Backfill and compact the area around the concrete base in 6-in. uniform layers. Use available stones in the area to chink the backfill to ensure that the concrete foundation remains in a stable vertical position.

   Protect the foundation and anchor bolts until the system is accepted by the Department.

After backfilling, replace all pavement or surface treatment that has been disturbed by the construction operation with similar material at no additional cost to the Department.

Neatly trim the site and leave in a satisfactory condition. Remove and dispose of all excess materials according to **SECTION 202**.

b. Precast Units. Ensure that precast foundation units are manufactured according to **SECTIONS 601** and **809**.

c. Preparation of Subbase. Place the subbase according to **Subsections 302.03.1** and **302.03.2**.

d. Setting. Place the units on previously prepared gravel borrow subbase to the required lines and grades.

During hauling, storage, hoisting, and handling of the units, prevent cracking or damage. Remove and replace or repair any units showing defects or damage at no additional cost to the Department.

Install foundations so that no portion of the foundation or any non-breakaway portion of the installation extends more than 4-in. above the finished grade. Take the measurement according to the currently adopted edition of the AASHTO LRFD *Specifications for Structural Supports for Highway Signs and Traffic Signals*.

Ensure that the location of the light standard foundation meets the current requirements of the ADA.

T08.03.3 Breakaway Support Couplings.

Ensure that the installation conforms to the manufacturer's recommendations, using torque control nuts or galvanized steel hex nuts that yield at the load specified by the manufacturer.

T08.04 METHOD OF MEASUREMENT.

T08.04.1 Light Standard.

Light Standards will be measured by the number of units furnished and installed.

T08.04.2 Light Standard Foundations with Anchor Bolts.

Light Standards Foundation with Anchor Bolts will be measured by the number of units furnished and installed.

The 2-in. rigid steel conduit contained within the concrete base and the first 4 in. outside thereof will be considered as part of the foundation unit and will not be paid for separately.

T08.04.3 Breakaway Support Couplings.

a. New Foundations. Breakaway Support Couplings for Light Standards will not be measured separately for payment but will be included in the payment for Light Standard Foundation with Anchor Bolts.

b. Existing Foundations. Breakaway couplings to be installed on existing foundations will be measured by the number of existing foundations on which a set of four such couplings are installed.

T08.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Light Standard	EA
Light Standard Foundations with Anchor Bolts	EA
Furnish and Install Breakaway Support Couplings on Existing Light Standard Foundations	EA

T08.05.1 Light Standards and Foundations with Anchor Bolts.

The price constitutes full compensation for all labor, materials, tools, and equipment, including poles, cast aluminum bases, ground wire, ground lugs, grounding bushings, in-line fused or unfused kits, No. 10 AWG cable between the luminaire and the inline fused or unfused kits,

T08.05.2 Light Standard Foundations with Anchor Bolts.

The price constitutes full compensation for all labor, materials, tools, and equipment, including anchor bolts, breakaway support couplings, ground rods, reinforcing steel, conduit, conduit couplings, washers and nuts, excavation, backfilling and compaction, replacing flexible pavement, concrete, or other surface treatment, and for all labor, tools, equipment, and incidentals required to finish the work, complete and accepted.

Allowance for rock excavation will be made for a distance of 1 ft outside the foundation and 6 in. below the bottom of the foundation, as constructed, and will be paid for as Trench Excavation – Rock under **SECTION 205**.

T08.05.3 Furnish and Install Breakaway Support Couplings on Existing Light Standard Foundations.

The price constitutes full compensation for all materials, labor, tools, and equipment, including furnishing and installing breakaway support couplings on each existing light standard foundation anchor bolt, removing and resetting existing light standards on the existing foundations, extending existing conduit stubs, and all incidentals required to finish the work, complete and accepted.

SECTION T09 — SERVICE PEDESTAL

T09.01 DESCRIPTION.

This work includes furnishing and placing the service pedestal, the service riser, concrete mat, and anchor bolts at the required locations.

T09.02 MATERIALS.

Ensure that all materials for this item of work conform to **Subsection M15.07**.

T09.03 CONSTRUCTION METHODS.

Perform all work according to the National Electric Code and the National Electric Safety Code. Install the pedestal on the concrete mat with the power distribution panel mounted inside. Place the concrete pad on 12 in. of gravel subbase. Ensure that the enclosure is watertight. Apply a bead of silicon sealer to the base of the cabinet, inside and out. Enclose all electrical conductors within the cabinet in PVC conduit. Ensure that all rigid steel conduits in the service cabinet are bonded together and grounded to the cabinet with No. 6 AWG bare copper conductors. Install a ground grid system consisting of four ground rods and #2 bare copper wire around the foundation and as shown in the Standard Details. Ensure that the foundation rebar and pedestal enclosure are bonded to the ground grid.

Provide a Shop Drawing of the service pedestal foundation showing the location of all conduit.

T09.04 METHOD OF MEASUREMENT.

Service Pedestal will be measured by the number of units furnished and installed.

T09.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Service Pedestal	EA

The price constitutes full compensation for all material, labor, and equipment, including furnishing and installing the service pedestal, anchor bolts, concrete foundation, grounding system, crushed stone, excavation and backfill, meter socket, contactor, panelboard, photo control, relays, neoprene gasket, grounding bushings and ground wire, and all incidentals required to finish the work, complete and accepted.

The work under this item includes all conduit contained within the concrete base.

SECTION T10 — TRAFFIC SIGNAL SYSTEMS

T10.01 DESCRIPTION.

This work includes furnishing and installing all necessary materials and equipment to complete the traffic signal systems at the designated locations.

T10.02 MATERIALS.

Use signal heads, controllers, standards and poles, electrical conduits and fittings, wire and cable, detectors and relays, handholes, and pull boxes that conform to **SECTION M15** and the National Electric Code. Use concrete for foundations as specified in **SECTION 601**.

Only use new materials.

T10.02.1 Warranties for Traffic Signal Systems.

a. Manufacturer's Warranties. Provide to the Department copies of all warranties that the Contractor receives from each manufacturer on all electrical or mechanical equipment pertinent to the satisfactory operation of traffic signal installations at the time of acceptance at no additional cost to the Department. Ensure that each warranty indicates its expiration date, and ensure that the warranty will be in effect for a period equal to the customary trade practice.

b. Contractor's Warranties. The Contractor will warrant the satisfactory in-service operation of the mechanical and electrical equipment and related components for six months following the acceptance of the Contract by the Department. During this period, when notified by the Engineer, repair or replace equipment or materials necessary to ensure satisfactory operation of the system, and correct malfunctions attributable to installation deficiencies.

   Install a temporary traffic controller, and replace any auxiliary equipment in the control cabinet when the approved traffic controller or auxiliary equipment must be removed from the job site for repairs so that the traffic signal system is operating immediately after the Contractor has been notified of any breakdown or malfunction of any unit.

   Install a new controller that meets the applicable specifications and with the approval of the Engineer when the approved traffic controller cannot be repaired within 30 days after a breakdown or malfunction of any controller part.

   The Contractor will be back-charged by the Maintenance Division of the Rhode Island Department of Transportation for all tools, workmanship, parts, equipment, and all appurtenances necessary to repair or replace any controller part or auxiliary equipment in the control cabinet that malfunctions within the above warranty period to maintain the traffic signal system in proper operating condition at all times as approved by the Engineer.

   Any labor necessary to comply with the requirements of the manufacturer's warranty will be compensated by Extra Work in **Subsection 104.05**.

T10.03 CONSTRUCTION METHODS.

Ensure that the work complies with **Subsections T01.03**, **T03.03**, **T04.03**, **T05.03**, **T06.03**, **T11.03**, **T12.03**, **T13.03**, and **T14.03**.

Securely bolt poles, pedestals, and controller cabinets to foundations in a vertical position, employing shims if required. Accurately position push button assemblies and securely fasten in place. The Engineer will approve the final location in the field before installation.

Install all wiring and perform the bonding and grounding in conformance with the Plans, the requirements of the National Electric Code, and the requirements of **Subsection T01.03.2**.

In addition, ensure that all splices made in wiring signals are made inside the signal heads at the provided terminal strips.

Bond and ground rigid steel conduits, poles, pedestals, detectors, controller cabinets, and pedestrian push button stations.

Furnish all incidental parts not shown on the Plans or specified that are required to complete the traffic signal or other electrical systems, and install the parts as though such parts were shown on the Plans or specified, at no additional cost to the Department. Ensure that all systems are complete and in operation to the satisfaction of the Engineer at the time of completion of the work. All such incidental parts will be approved by the Engineer before installation.

T10.04 METHOD OF MEASUREMENT.

Traffic Signal Systems will not be measured separately but will be included in the measurements of specific items such as conduit, cable, controllers, signal heads, etc. Refer to **SECTIONS T04** through **T06** and **T11** through **T14** for specific methods of measurement.

T10.05 BASIS OF PAYMENT.

Traffic Signal Systems will not be paid for separately but will be included in the price of specific items as outlined in **Subsection T10.04**.

Full compensation for all additional materials and labor, not shown on the Plans or specified, that are necessary to complete the installation of the traffic signal systems will be included in the prices bid for the individual items, and no additional allowance will be made.

SECTION T11 — TRAFFIC SIGNAL MAST ARMS, POLES AND FOUNDATIONS

T11.01 DESCRIPTION.

This work includes furnishing and installing Steel Mast Arms and Poles with Foundations and Steel Span Poles with Foundations at the required locations.

T11.02 MATERIALS.

T11.02.1 Manufacture.

Use traffic signal mast arms, poles, and span poles with steel conforming to **SECTION M16** and that are manufactured with materials as follows:

- Use structural steel tube that conforms to ASTM A595 Grade A or ASTM 572 Gr 50 (minimum). Tubes may be cylindrical, hexagonal, octagonal, or elliptical and of constant section or tapered. Ensure that tubes can withstand the applied load and serviceability deflection requirements without a back guy.
- Use structural steel plates that conform to **Subsection M05.05.1(b)**, AASHTO M270 (ASTM A709) Grade 50, or ASTM 572 Grade 50 (minimum).
- Use structural tubing that conforms to **Subsection M05.05.3** or ASTM A500, Grade B, or use structural pipe that conforms to **Subsection M05.05.7** or ASTM A53, Grade B.
- Ensure that the steel mast arm and span pole assemblies are galvanized according to AASHTO M111.
- Use arm and pole fasteners that conform to **Subsection M05.05.4(b)**. Use bolts that conform to ASTM F3125. Use nuts that conform to ASTM A563 GR DH. Ensure that hardware has been hot-dipped galvanized according to ASTM A153.
- Use anchor rods that conform to ASTM F1554, Grade 55 (minimum). Use leveling nuts that conform to ASTM A563, Heavy Hex Grade A or ASTM A563, Heavy Hex Grade DH. Ensure that the anchor bolts and the nuts have been hot-dipped galvanized according to ASTM A153. Ensure that the internal threads of nuts have been re-tapped after galvanizing to accommodate the increased diameter of the rods. Use flat washers that conform to ASTM F436.
- Ensure that anchor bolt nut covers are compatible with the base connection and galvanized coatings.

Ensure that traffic signal structures comply with the currently adopted edition of the AASHTO *LFRD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*. Include a minimum truck-induced gust loading based on a 30 mph truck speed for fatigue analysis.

Rake the poles back to allow for the anticipated dead load pole deflection as indicated in the Shop Drawings so that the final position of the poles under dead load is vertical. Ensure that the Shop Drawings identify the theoretical dead load deflection.

If the pole or mast arm is manufactured in two pieces, join the sections by a manufacturer-approved method.

For the traffic signal mast arm structures, use a RIDOT-accepted steel mast arm manufacturers, or furnish an alternative mast arm manufacturer's Shop Drawings and computations for review and approval. Ensure that the alternative mast arm conforms to RIDOT Standard Detail 19.2.0 and the heavy maximum design configuration (equipment weights, surface areas, and location dimensions) for the arm length proposed on the Plans. Ensure that the alternative mast arm design documentation includes computations and applicable details for the foundation. To allow interchangeability with standard mast arm types and mast arm lengths, ensure that the alternative structure's connection to the foundation conforms to the bolt projection above the top of the foundation on RIDOT Standard Detail 19.5.0A and conforms to the anchor bolt circle, number of anchor bolts, diameter of anchor bolts, and anchor bolt embedment on RIDOT Standard Detail 19.5.0B, Step 2. To be considered for inclusion on the list of RIDOT-accepted steel mast arms, the alternative manufacturer shall submit standard Shop Drawings for all structure loading scenarios depicted in RIDOT Standard Detail 19.2.0.

Do not use vibration mitigation devices.

T11.02.2 Foundations.

a. Concrete. Use Class XX (¾ in.), 4000 psi at 28 days, and concrete that conforms to **SECTION 601**.

b. Reinforcing Steel. Use steel that conforms to ASTM Designation A615, Grade 60 and is galvanized per **SECTION 810**.

c. Hardware and Equipment. Use ground rods, rigid metal conduits, fittings, and drain pipes within the foundation that conform to **SECTION M15**.

d. Crushed Stone. Use crushed stone under structures that meets **SECTION 203** and meets the gradation requirements of Column II, Table I in **Subsection M01.09**.

e. Slurry. If slurry methods are used to maintain the open hole of the foundation, use a polymer-based slurry. Do not use bentonite slurry.

T11.02.3 Design.

Design span pole structures and foundations and, when required, site-specific mast arm structure and foundation designs. Submit span pole and site-specific mast arm designs that are designed and stamped by a Rhode Island Registered Professional Engineer. Design span pole and site-specific mast arms according to Section 3.8 of the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*. Ensure that the design also includes the following:

- Ensure that the traffic signal mast arms are bolted with a minimum of six anchor bolts at the foundation according to the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

Ensure that street signs comply with **SECTION T15**.

Design structure components and their connections to resist the worst-case fatigue loading, upon evaluation of all applicable cases acting separately.

Design foundations according to the requirements of the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.* Size the foundations to resist overturning according to Brom's Design Method with a safety factor that includes an overload factor of 2.0 and understrength factor of 0.7.

T11.02.4 Submittals.

Submit Shop Drawings according to **Section 105.02** in addition to the following requirements.

T11.02.4.1 Foundations.

For all standard and site-specific foundations where survey is not provided, obtain survey elevations of the ground surface at the foundation. Submit to the Engineer for approval an elevation view of the foundation showing:

- The proposed foundation with elevations at the top and bottom of the proposed foundation; ensure that the top of foundation in a pedestrian path matches the existing pathway elevation
- The existing ground elevations at the high and low side of the proposed foundation

Provide the approved foundation elevations to the reinforcing bar detailer. Include these elevations with the foundation reinforcing Shop Drawings submission.

Submit a foundation constructability plan that includes the following:

- Access to the area including the following, when applicable:
  - Removal of guard rails and/or concrete barriers
  - Utility locations and drainage installations that could obstruct construction
  - Clearing and grubbing
- Maintenance and Protection of Traffic plans (if the Contractor chooses to use a traffic control setup that is not included in the Plan set)
- Drilling operation, including all calculations and specifications associated with the proposed drilling procedure and tools and machinery used

Submit Shop Drawings for the reinforcement, including the following:

- A note indicating that no welding of reinforcement will be allowed.
- Supplemental cages or ties that will be used to lift the reinforcing cage and prevent distortion. Tie reinforcing cages adequately for handling. Internal ties or cages, which shall be detailed for approval, may be necessary. Arrange the support bars or cage, if intended to remain in the finished foundation, to not interfere with concrete placement or proposed anchorage.

Ensure that the design of anchor bolts will result in a ductile steel failure before any sudden brittle failure of the concrete.

When the clearance between the bottom of the leveling nuts and the top of the concrete is equal to or greater than one bolt diameter, consider the bending stresses in the anchor bolts in the design.

Submit Shop Drawings for the anchor rods and plates including the following:

- Material designations
- Length and diameter of anchor rods
- Number of anchor rods
- Thickness and dimensions of anchor plate
- Anchor rod hole diameters and locations, including bolt circle diameter and edge distance
- Angular orientation of the anchor rods around the bolt circle
- Galvanizing requirements

Design the temporary earth retaining and dewatering systems, where required, and ensure that the Shop Drawings are stamped by a Professional Engineer registered in the State of Rhode Island and are submitted to the Engineer for review and approval.

Ensure that the standard and site-specific design and construction methods are appropriate to result in undisturbed soils above and below the water table.

T11.02.4.2 Standard Mast Arm Signal Structures.

Provide a mast arm submittal that includes the following items:

- Standard mast arm loading type
- Selected RIDOT-accepted steel mast arm Shop Drawings
- Copy of the boring log
- Soil conditions used to select the standard foundation

T11.02.4.3 Site-Specific Mast Arm and Span Pole Signal Structures.

- Provide Shop Drawings that include Plans and calculations for the traffic signal structures.
- Provide Plans that include complete details of each traffic signal structure, including cross sections and details necessary for the fabrication and erection of each structure.
- Provide Plans that include a materials list specifying size, material type, finish, location, and quantity for each element of each structure.
- Provide calculations for each traffic signal structure, including foundation design, and specify all loads, load combinations, design capacities, allowable capacities, assumptions, and design references.
- For site-specific traffic signal supports, include the following notes on all Plans and/or Shop Drawings in reference to anchor bolts:

- Pre-tension all anchor nuts by tightening to 1/6th turn beyond the snug-tight position for 1½-in. diameter anchor bolts or greater and 1/3rd turn beyond the snug-tight position for anchor bolt diameters less than or equal to 1½-in. diameter according to the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.*
- The maximum clearance between the bottom of the leveling nuts and the top of the concrete is critical. Ensure that all anchor bolts do not exceed the amount specified on the Drawing.

Where overhead utilities are present, ensure that Shop Drawings include a detail that shows that the mast arm structure will accommodate the required clearances from overhead utilities and the roadway vertical clearance. Ensure that the sketches include the approximate horizontal and vertical locations of the overhead wires with clearances dimensioned from the overhead wire to the mast arm tube and shaft, with all features drawn to scale, and clearances dimensioned from the mast arm tube to the roadway surface at the proposed curb line, crown line, and outer end of the mast arm.

Do not perform any work until approved Shop Drawings have been approved.

T11.03 CONSTRUCTION METHODS.

T11.03.1 Steel Poles.

- Workmanship. Ensure that the workmanship and finish are equal to the best general practice of modern metal fabrication shops.
- Traffic Signal Poles. Install traffic signal poles according to the currently adopted edition of the National Electric Safety Code (NESC).

Before the start of fabrication of the mast arm signal structure, in the field, verify the field location of foundations and establish and verify all elevations, dimensions, and longitudinal grades. Assemble the signal structure after galvanizing and before shipment to ensure fit up. It may be disassembled for shipping.

To prevent warping of the tubular members, base plates, connection plates, and splice plates during welding of the plates, take precautions such as by the use of steel strongbacks bolted to the plates.

Ensure that the mast arm structure connections and splices are trial fitted and bolted in the fabricator's shop after cambering and galvanizing. The fabricated members will be rejected by the Engineer if the mating surfaces of the plates have a gap greater than ¼ in. at any location before the bolting or if the interface of the plates is not in full contact at each bolt location after bolting. Do not reuse bolts used for the trial shop fit-up in the final field assembly.

Check the horizontal member on the mast arm structure for proper residual camber before galvanization. Bolt the horizontal member with the splice together with temporary bolts for checking camber. With the horizontal member supported at its ends, measure the residual camber at mid-span, and reject the member if the camber does not fall within the following limits:

- Minimum residual camber — Span/1000
- Maximum residual camber — Span/500

Ensure that all connections using high strength bolts conform to **SECTION 824**.

Before assembly, plane the top and bottom surfaces of the base plates or heat straighten the plate. Ensure that the poles are faced at the bottom end.

T11.03.2 Foundations.

Ensure that all structural excavation and temporary earth retaining systems comply with **SECTION 203** and **SECTION 805**.

Ensure that foundation construction can be constructed in the required locations without modifying the existing paved roadways and sidewalks beyond the limits indicated. Notify the Engineer of any existing items not identified on the Plans as requiring modification that will be disturbed during construction before initiating work. Otherwise, repair or replace the items disturbed or damaged to the satisfaction of the Engineer at no additional cost to the Department.

Place and compact crushed stone under structures on a prepared surface to a 12-in. minimum thickness. Place the surface of the crushed stone layer so that a generally level bed is produced.

Locate the foundation and notify the Engineer two weeks before beginning to drill the foundation.

Submit a sequence plan outlining drilling, casing, slurry, reinforcement, and concrete placement procedures for the Engineer's review.

Ensure that the construction of drilled shafts complies with the currently adopted edition of the AASHTO *LRFD Bridge Construction Specifications*, Section 5 and with the USDOT Publication FHWA-NHI-10-016, "Drilled Shafts: Construction Procedures and Design Methods" and the latest revisions to these publications.

Ensure that the top of the foundation's maximum allowable horizontal variation from the required location is 1 in.

Ensure that the concrete shaft is not out of plumb by more than 1 percent of the total length.

If the depth of drilled shaft extends below the depth shown on the Shop Drawings, extend a minimum of one half of the longitudinal bars required in the upper portion of the shaft the additional length by adding longitudinal reinforcing bars at the bottom of the cage. Continue tie or spiral bars for the extra depth, and extend the stiffener bars to the final depth. Lap splice all longitudinal and transverse bars or splice with mechanical splices. Do not weld to the reinforcing steel.

Provide feet (bottom supports) to ensure that the bottom of the reinforcing cage maintains the proper distance above the base.

Do not use hooked anchor bolts.

Set anchor bolts using a template to ensure proper spacing, bolt projection, and rotation to allow for mast arm and hand hole orientation per the Shop Drawings. Ensure that the center of bolt

pattern template coincides within ½ in. of the center of concrete foundation. Ensure that each anchor rod is fitted with base plate and leveling nuts and double nuts at the anchor plate.

Place and secure rigid metal conduit and drain pipe in proper position in the formed portion of the top of foundation. Extend electrical conduits 2 ft out from the side of the formed portion of the foundation. Cap all conduit ends terminating below grade with a malleable iron cap. Terminate all above grade conduit ends with an insulated bonding bushing (phenolic type). Install conduit caps before the concrete is placed, and allow these to remain in place until the cable is installed. Use a template to hold the required ground rod sleeve and conduits in their correct positions.

Place concrete in the forms according to **SECTION 808**.

Place the drilled shaft concrete as soon as possible after the placement of reinforcing steel. Monitor the bottom of the shaft for accumulation sediments; remove any sediment greater than 1 in. before placement of concrete.

Remove casings, if used in drilling operations, from the hole. The casing may be removed as concrete is placed if a 5-ft head of concrete is maintained, or the casing may be removed after the concrete has been poured, if the concrete has not been set. Do not attempt to separate the concrete by hammering or otherwise vibrating the casing during withdrawal operations.

Place concrete according to **Subsection 808.03.5**. Do not allow the concrete to impact the reinforcing, supporting cage, or side walls of the shaft before it reaches the base. Direct concrete placement down the center of the shaft with a hopper and drop chute.

Place concrete in wet installations by gravity tremie method according to **Subsection 808.03.5(f)** or by the concrete pump tremie method according to **Subsection 808.03.6**. Ensure that concrete deposited in water conforms to **SECTION 601**. Ensure that concrete placement is continuous from the bottom of the drilled shaft to the top of the foundation.

Allow the concrete to cure according to **SECTION 601**.

Finish the portions of the foundations that will remain exposed to view in conformance with **Subsection 808.03.11**.

Install the signal pole after the concrete has reached 28-day compressive strength as confirmed by test cylinders. Cast, cure, and test concrete cylinders according to **SECTION 601**.

Where a foundation is placed within or adjacent to a concrete sidewalk, replace the entire section of sidewalk between joints.

Do not use grout under base plates.

Ensure that the signal structure supports have a ground lug internal to the pole and are grounded according to the currently adopted edition of the NEC.

If earth adjacent to the foundation is disturbed or removed beyond the neat lines of the shaft foundation, replace with concrete fill. After curing, remove the forms and backfill with suitable material and compact in 12-in. layers.

Remove the top leveling nuts and the leveling template before placing the base plate and pole assembly on the foundation.

Ensure that all connections using high strength bolts conform to **SECTION 824**.

Repair all damaged galvanized areas with two coats of zinc paint conforming to Federal Specification TT-P-641-b(2).

Place dielectric material between dissimilar metals to prevent corrosion by electrolysis.

Restore areas around existing drainage swales to the grades that existed before the excavation of foundations.

Provide topsoil and seeding at all disturbed grassed areas according to **SECTIONS L01** and **L02**.

T11.04 METHOD OF MEASUREMENT.

Steel Mast Arms and Poles and Foundations and Steel Span Poles and Foundations will be measured by the number of items furnished and installed.

T11.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Steel Mast Arms and Poles and Foundations	EA
Steel Span Poles and Foundations	EA

The prices constitute full compensation for all design, materials, labor, tools, equipment, and incidentals required to finish the work, complete and accepted.

SECTION T12 — TRAFFIC SIGNAL CONTROLLERS AND CABINETS

T12.01 DESCRIPTION.

T12.01.1 New Installation.

This work includes supplying and installing a NEMA TS-2 Type 1 actuated traffic signal (8-phase or 16-phase) controller, cabinet, and foundation with internal time-base coordination and internal pre-emption capabilities at the required locations. Ensure that all controllers are identical models of current production and recent manufacture and that all software is the most recent revision.

T12.01.2 Modifications to Existing Installations.

This work includes signal head relocations, rewiring/wiring terminations, and reprogramming in existing controller cabinets. Modifications include signal equipment relocation, removal and stockpiling of existing signal head, installation of new polycarbonate signal head, phasing and timing adjustments, and programming of detector relays and phase assignments. This work also includes making any adjustments and additions or replacements to the controller, system master, malfunction management unit (MMU), load switches, detector relays, back panel or any other components within the traffic controller cabinet. Ensure that the work includes restoring the signal to existing conditions, including relocating moved equipment, and all phasing and timing adjustments, programming of detector relays and phase assignments, and/or as directed by the Engineer.

T12.01.3 ADA Compliance.

Ensure that the location and size of controllers and cabinets comply with the provisions of the ADA. This applies to locations within a sidewalk or another Pedestrian Access Route (PAR) and applies to projections of a pole-mounted controller into a sidewalk or PAR.

T12.02 MATERIALS.

T12.02.1 16-Phase Controller Units.

a. General. Use controller units that are entirely digital solid-state capable of a minimum of sixteen phases that, when connected to traffic detectors or other means of actuation or a combination thereof, operate the electrical traffic signal system at one or more intersections. Ensure that the controller unit (CU) communicates with the malfunction management unit (MMU) via port 1.

   Use a controller unit that is a Type A1 configuration conforming to Section 3 of the latest edition of the NEMA Standards Publication TS-2, Traffic Controller Assemblies. Ensure that the controller, malfunction management unit (MMU), bus interface unit (BIU), and all other ancillary traffic signal control components included in the traffic control cabinet comply with NEMA Standards Publications TS-2, Traffic Controller Assemblies. Ensure that the CU uses an input/output interface conforming to Subsection 3.3.1 of the NEMA TS-2 Standards for all input/output functions with the back-panel terminals and facilities, malfunction management unit, traffic detector rack(s), and auxiliary devices.

Use TS 2 Type 1 Controllers and Cabinet Assemblies that conform to Section 3, Controller Units of NEMA Standards Publications TS-2, Traffic Controller Assemblies.

Use TS 2 Type 1 cabinets that meet the requirements of configuration 3 as defined in Table 5-2, "Type 1 Configurations" of the NEMA Standards Publications TS 2 Standard.

- Controller Display. Use controller units that have liquid crystal displays and can be internally illuminated for night viewing. Ensure that the display consists of a minimum of four lines of text with a minimum of 40 characters per line. As a minimum, ensure that the model number and software version level is displayed.

- Controller Security Codes. Use a controller unit that provides for a user-specified code entry before allowing any data to be altered. All parameters may, however, be viewed without entering a valid security code. Ensure that the security code access is terminated at a fixed time after access was gained or a keystroke was made. The CU may have the ability via keyboard to disable security code access allowing for constant access to parameter changes.

- Battery Backup. Use controllers that have a backup for the real-time clock only, which can maintain the real-time clock for a period of 30 days. Maintain all program timings in Electronically Erasable Programmable Read-Only Memory (EEPROM).

b. Functional Requirements. Use local intersection controller units that meet the following functional requirements:

- Programming is accomplished by front-panel menu-driven keyboard entry.

- Controller units provide a user programmable daylight savings time capability.

- Controller units provide data uploading and downloading capability to both a remote central computer station and a direct link to a laptop computer. Provide a minimum 25-ft laptop communications cable configured for the supplied equipment in the controller cabinet.

- Controller units can perform dynamic self-diagnostic testing per NEMA TS-2 Standards, Section 3.9.

- Controller units and all auxiliary devices meet all environmental requirements as set forth in NEMA TS-2 Standards, Section 3.9.

- Ensure that both the firmware and the software version for each timer unit supplied is the same throughout the Project and is the latest version available for that product. In addition, furnish and install for the owner the latest versions of both firmware and software through the last day of the inspection period, guarantee period or warranty period, whichever date is later.

- Furnish one cable with each new timer unit to connect a controller to a laptop computer. Ensure that this cable has a termination at one end to match the controller and a termination on the other end to match the type of serial port found on laptop computers, usually DB9. Ensure that this cable is wired to provide serial RS232C communication between the controller and the computer.

c. Additional Requirements.

- Controller Coordination and Pre-emption. Use a controller unit that can coordinate operation and pre-emption operation according to the NEMA TS-2 Standards, Section 3.

  Given split and cycle timings, provide a controller unit that can automatically calculate coordination yield points, permissive periods, and force-offs.

- Phase Designations. Ensure that the phase data in the controller unit matches the numbering scheme shown on the Plans and operates in the same sequence as shown in the Phase Sequence Diagram on the Plans. Changes to the phase numbering or phase sequence must be approved by the Department's Traffic Design Unit before being implemented.

- Programmable Field Hardware Documentation. Before the traffic signal is placed in operation, ensure that each programmable field hardware component is entirely programmed to reflect the required timings or settings. Programming is defined as user programmable keyboard entries or switch settings. Programmable field devices include controller units, closed loop system masters, malfunction management units, detector units, modems, radios, pre-emption devices, etc.

- Controller Guarantee. Ensure that the entire controller unit is warranted to be free from defects in workmanship and material for one year or for the greater length of time common to trade practice from the date of acceptance by the Engineer. Ensure that the warranty includes the replacement of any defective parts free of charge. Manufacturers' warranties shall become the property of the Department at the time of acceptance.

T12.02.2 Controller Cabinet.

a. General. Enclose the traffic signal control equipment within a dust and moisture-proof aluminum cabinet installed with the back toward the nearest line of traffic. Provide controller cabinets that conform to Section 7 of the NEMA TS-2 Standards. Ensure that the minimum size controller cabinet supplied is a size 6(P) cabinet. Where practical, locate the controller cabinet and foundation a minimum horizontal distance of 4 ft from the back of curb. Where there is no curb, locate the controller cabinet and foundation outside of the clear zone from a non-yielding object to the edge of the traveled way. In both cases, locate the controller cabinet and foundation within the right-of-way. Provide a cabinet finish that is unpainted, natural aluminum, degreased and free of scratches and blemishes. Ensure that the traffic signal number is stenciled on the inside and outside of the cabinet door on Department owned signals in 3-in. block letters.

   Ensure that the controller cabinet foundation does not obstruct a sidewalk or crosswalk so that passage by physically challenged persons is impaired. Adjust the cabinet height with the by use of an 18-in. cabinet extender. Ensure that the LCD or other visual display window of the controller is no more than 4 in. above finished grade in front of the cabinet and that the top of the cabinet door opening is at least 6 in. above finished grade. Any technical provision plan detail, standard specification, or other standard drawing to the

contrary shall not apply if it conflicts with this viewing height requirement. Ensure that the door has a gasket that forms a weather tight seal between the door and the cabinet and that the lower portion of the door is vented with louvers on the exterior to provide 100 cu ft/min of air flow. Use a filter held firmly in place by side and bottom brackets to cover the louver vents on the door's interior. Furnish a door restraint to prevent door movement during windy conditions.

b. Concrete Work Pad. In unpaved areas, install a 48″ × 30″ × 4″ concrete work pad in front of the cabinet door, and ensure that the pad is approximately level, approximately 1 in. above the surrounding unpaved surface, or at even grade with the adjacent surface if paved. Abut the pad against the front of the cabinet, projected at least 1 in. to each side of the cabinet and projected at least 3 in. in front. Place the pad on 6 in. of gravel borrow subbase. Use Class A concrete conforming to **SECTION 601**. No pad is required if the front of the cabinet immediately abuts an existing or proposed paved sidewalk or other paved surface.

c. Shelves and Document Tray. Furnish each cabinet with a minimum of two movable shelves suitable for placing the controller, MMU, detector racks, modems, radios, or any other required equipment. Mount a slide-out document tray below the bottom shelf at a height between 4 in. and 44 in. above finished grade in front of the cabinet. Ensure that the tray has a sufficient size to hold cabinet wiring diagrams and two manuals. Ensure that the tray operates by sliding out on nylon rollers or ball bearings and opening a hinged cover to remove documents. Use a closed cover that provides a suitable support for resting documents and/or the bottom of a laptop computer. Tie away all cables to allow the tray to be opened and closed smoothly without any obstructions.

d. Electrical Outlets. In addition to the requirements of the NEMA TS-2 Standards, Section 5.4.2.6, furnish local controller cabinets with a GFI receptacle on the cabinet door and a duplex outlet within the body of the cabinet. For cabinets that will contain a closed-loop system master controller, a local controller, and auxiliary communications equipment (radios or modems), provide two duplex outlets in addition to the door mounted GFI receptacle.

e. Interior Lighting. In addition to the requirements for an incandescent fixture in NEMA TS-2 Standards, Section 5.4.2.7, provide cabinets with a goose neck lamp having a flexible arm and using a 25 watt, R14 bulb (115VAC). Mount the lamp at a location on the side panel approximately level with the load switch/terminal panel for concentrated illumination of this area. Use a lamp that has its own on/off switch on the unit.

f. Controller Cabinet Documentation. Provide two sets of complete cabinet schematics and operating manuals for the controller unit, loop detector units, closed loop system master, modem, and any other programmable field hardware as part of the cabinet documentation.

   Supply three hard copy sets of all programmed data to the Department at the time the controller is installed in the field with each set bound and covered.

g. Controller Cabinet Service Switches. Clearly label all cabinet switches to indicate the switch's function. Ensure that the toggle switches indicate the state of each switch position.

- Open Door Alarm. Install a pushbutton switch on a bracket in the top right of the controller cabinet door. Connect the output of the switch to the alarm No. 1 input as defined by the NEMA TS-2 Standards, and record the opening of the cabinet door as a local alarm.

- Police Door Switches. Ensure that the police door switches have the following:

  - An Auto/Manual switch that toggles between automatic operation and manual operation. During manual operation, use an extendible hand-control pushbutton to use Manual Control Enable and Interval Advance to control the intersection operation. Install the hand-control pushbutton inside the police door. Ensure that the hand control pushbutton has a rugged construction with a weatherproof covering over the cord's pushbutton switch.

    Connect the auto/manual switch to alarm No. 2 as defined by the NEMA TS-2 Standards. When the switch is placed in the manual position, record as a local alarm.

  - A Signal/Flash switch that toggles between automatic and flashing operation. To ensure that the controller exits flash properly, ensure that the controller External Start input is active in the flash position and inactive in the signal (automatic) position. Record the activation of the flash switch as a local alarm.

  - A Signal/Off switch that toggles power on and off to the controller assembly and signals.

  - Permanently label each switch to identify its function.

- Main Door Switches. Provide cabinets that have the following switches on the main door. Ensure that these switches are accessible only when the main door is open.

  - Momentary pushbutton switches providing calls to vehicle phases 1 through 8, any concurrent or exclusive pedestrian phases, and calls to intersection pre-empt displays.

  - A Timer On/Off toggle switch that turns power on/off to the controller only. Ensure that the MMU and other cabinet equipment are not affected by this switch.

  - A three-position Modem Power switch on all controller assemblies containing modems. Label this switch "Modem Power" and perform the following functions:

    + On — When in this switch position, ensure that constant power is supplied to the modem no matter what the user defined output is set for.

    + Off — When in this switch position, ensure that no power is supplied to the modem no matter what the user defined output is set for.

    + T.O.D. — When in this switch position, ensure that power is supplied to the modem as a function of the user-defined output controlled by time-of-day programming.

Permanently label each switch to identify its function.

h. Controller Cabinet Terminal Strips. Mark all terminal connections with a number and, where appropriate, the corresponding NEMA function. Ensure that all labels are silk screened or have permanent labels.

i. Lightning Protection.

- AC Service Protection. Equip the traffic signal control assembly with surge protection installed at the power distribution panel. For the surge protector, use an EDCO ACP 340 filtering surge protector, or approved equal, and meet or exceed the following electrical specifications:

  - Peak Current — 20,000 amps (8 × 20 microseconds)
  - Clamp Voltage @ 20kA — 250 volts typical
  - Response Time — voltage never exceeds 250 volts during surge
  - Operating Temperature — -40 to 85 degrees C.

- Vehicle Loop Detector Protection. Install surge protection on each loop detector circuit. For the surge protection, use an EDCO SRA6LCA vehicle loop detection surge protection device or approved equal. Ensure that the device is configured with the type of mounting that best accommodates the type of loop detector lead-in terminal block supplied. Ensure that the device meets or exceeds the following specifications:

  - Peak Surge Current:

    + Differential Mode – 400 amps (8 × 20 microseconds)
    + Common Mode – 1000 amps (8 × 20 microseconds)

  - Estimated Occurrences – 500 @ 200 amps
  - Response Time – 40 nanoseconds
  - Input Capacitance – 35 picofarads
  - Operating Temperature – -40 to 85 degrees C
  - Clamp Voltage @ 400 amps differential mode – 30 volts max

- Clamp Voltage. Ensure that these are @ 1000 amps common mode – 40 volts max.

j. Radio Interference Suppressors. Equip each cabinet with a radio interference suppressor meeting the requirements of Section 5.4 of the NEMA TS-2 Standards.

k. Cabinet Wiring. As a minimum, wire cabinets according to the NEMA TS-2 Standards, Section 5, Terminals and Facilities, as it applies to Type 1, Configuration 3 cabinets. Shield any power supplies with a non-conductive material to prevent accidental contact. Sealers or compounds that are not non-conductive will not be accepted.

Provide a panel suitable for terminating a minimum of 16 loop lead-ins, Rack Power and Ground, Detector Call Terminations, and Phase 2, 4, 6, and 8 pedestrian pushbuttons.

l. Detector Racks. Provide the cabinet for a minimum of 16 channels of detection, fully wired for all channels.

Rack mount all loop detector units. Ensure that detector units and racks to the NEMA TS-2 Standards, Sections 2, 5, and 6. Use racks of metal construction, providing top and bottom guides for all slots. Bolt racks to the top shelf of the cabinet using wing nuts to simplify their removal. Where an emergency vehicle priority system is being installed, auxiliary rack positions may be used instead of a separate rack to accommodate the selector modules.

Supply and install on the upper left-hand corner of the back of the cabinet door a laminated intersection graphic and table depicting the traffic detector relay channel assignments. Ensure that the diagram is a graphic of the intersection oriented similar to the Plans showing the locations of each loop detector. Ensure that the diagram, at a minimum, includes detector numbers, street names, north arrow (oriented similar to Plans), and controller cabinet location. Include the assignment information in a table that includes, at a minimum, approach name, detector number, terminal numbers, detector rack slot number, relay number, relay channel number, and the phase associated with each detector.

Program all detector unit delay and extension timings in the controller unit, not in the detector unit.

m. Load Switches and Flash Transfer Relays. In addition to the requirements of the NEMA TS-2 Standards, Section 6, Auxiliary Devices, ensure that all load switches use optically isolated, encapsulated modular solid-state relays. Discrete components on circuit boards will not be accepted. For load switch indicator lights, use LED type and wired on the input side of the device.

   Wire the field electrical loading for flash operation through the transfer relays such that the load on the two-circuit flasher is as balanced as possible within the limitations of the signal phasing.

   Furnish controller cabinets with a full complement of load switches and flash transfer relays. This requires a load switch and a flash transfer relay for each back-panel position, even if the position is not used.

n. Malfunction Management Unit (MMU). Ensure that the MMU conforms to the requirements of Section 4 of the NEMA TS-2 Standards. Use MMUs that are configured to operate as Type 16 units.

o. Master or Local Modem. Make provisions for a telephone connection in the cabinet at all master controller locations and at selected local controllers. At these locations, supply a shelf mounted modem. Ensure that the modem provides a full duplex operation using a 2-wire, dial-up telephone line, and comply with Part 66, FCC Docket 19528. Ensure that the modem will support the communications rate of the system software and synchronous and asynchronous data transfer.

   Wire the modem so that it can power down and power up via a user-defined controller output to automatically reset the modem. Ensure that the user-defined output uses an interface relay in controlling power to the modem. Initially program the user-defined output to be on at all times except for a one-minute interval starting at 1:00 a.m. each day.

Provide Originate Manual or Auto Answer operating modes. Ensure that the modem provides an Auto Disconnect function that will disconnect the modem due to lack of carrier after 18 seconds. Ensure that the front diagnostic L.E.D.s display, at a minimum, the operational status of the following:

Modem Ready	Terminal Ready	Receive Data	Send Data
Off Hook	Carrier Detect	Auto Answer	High Speed

Ensure that the modem reset is controlled by a switch on the cabinet door as described in para. g, third closed bullet, third open bullet of this **Subsection**.

Ensure that the modem includes an easily accessible on/off switch operating with power supplied from a controller cabinet duplex outlet. Ensure that the modem has an operating temperature range of -34°C (-30°F) to +74°C (+165°F). Ensure that the organization and construction of the controller cabinet allows the opening and closing of the cabinet door without interfering with the modem's power cable.

p. Bus Interface Unit (BIU). Ensure that the BIU furnished is of the latest manufacture and complies with Section 8 of the NEMA TS-2 Standards. Ensure that the BIU is fully interchangeable with any other manufacturer's unit and interchangeable in a NEMA TS-2 Type 1 cabinet assembly.

T12.03 CONSTRUCTION METHODS.

T12.03.1 New Installation.

Install controllers and cabinets according to the manufacturer's recommendations and the latest edition of the NEMA Standards.

When traffic signal poles, signal heads, conduit conductor cable, detectors, and other traffic signal appurtenances are installed, and if the specified controller is not available provide, at no additional cost to the Department, a temporary controller capable of operating the installation as specified on the Plans.

T12.03.2 Modifications to Existing Installations.

Make the required modifications in the existing equipment as required to accommodate the traffic signal phasing, timings, and detection. Do not initiate this work until authorized by the Engineer. Use existing cable(s) unless noted otherwise or found damaged.

Upon restoration of the traffic signal equipment and controller operations, if any changes are made that impact the record information in the cabinet, supply two copies of box prints showing all modifications that have been made, and install a revised cabinet door sticker table showing the detector assignment information, including the:

- Approach names
- Detector numbers
- Terminal numbers
- Detector relay slot number
- Relay number

- Relay channel number
- Phase associated with each detector

Install a revised intersection graphic (oriented similar to the plan) that shows the locations of each loop detector and its respective number, street names, north arrow, and controller cabinet location. Ensure that the door stickers are suitably durable for long term use in an outdoor environment.

T12.04 METHOD OF MEASUREMENT.

Actuated Controllers, Cabinets, and Foundations will be measured by the number of units installed.

Modify Existing Traffic Signal Controller/Cabinet and Traffic Actuated Controllers will be measured by the number of units installed.

T12.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
8-Phase Actuated Controllers, Cabinets, and Foundations	EA
16-Phase Actuated Controllers, Cabinets, and Foundations	EA
Modify Existing Traffic Signal Controller/Cabinet	EA
Traffic Actuated Controllers	EA

The prices for both 8-Phase and 16-Phase Actuated Controllers, Cabinets, and Foundations constitute full compensation for all labor, materials, tools, and equipment, including mounting hardware, foundations, concrete work pad, ground wire, ground rod, malfunction management unit (MMU), bus interface unit (BIU), detector racks, programming and all required tests, appurtenances, and all incidentals required to finish the work, complete and accepted.

The prices for Modify Existing Traffic Signal Controller/Cabinet and Traffic Actuated Controllers constitute full compensation for furnishing all labor, equipment, tools, materials, rewiring, splicing, reprogramming, restoration, and incidentals required to finish the work, complete and accepted.

SECTION T13 — DETECTION, PREEMPTION, AND PRIORITY CONTROL SYSTEM

T13.01 DESCRIPTION.

This work includes furnishing and installing vehicle detectors, detector relays, pedestrian detectors, and all necessary wiring, associated equipment, and appurtenances at the required locations. The work also includes furnishing and installing the components of an optically activated traffic signal preemption and priority control system consisting of a matched system of optical emitters, optical detectors, optical detector cable, confirmation beacons, and phase selectors at the required locations. The optical emitters are not included as part of this work.

Ensure that the optical detector system complies with **SECTION T04**.

T13.02 MATERIALS.

T13.02.1 Detectors and Relays.

Use loop detector wire, loop detector lead-in cable, loop detector relays, and pedestrian detectors that conform to **Subsections M15.02.5**, **M15.02.6**, **M15.14**, and **M15.17**.

T13.02.2 Optically Activated Traffic Signal Preemption and Priority Control System.

The preemption control system includes a data-encoded phase selector to be installed within the traffic control cabinet.

Use a phase selector that is a rack-mounted plug-in device. Ensure that the processor is capable of infra-red (IR) operation and Global Positioning System (GPS) operation.

Ensure that the supplied system and components are compatible with existing equipment owned by the applicable local jurisdictions.

T13.03 CONSTRUCTION METHODS.

T13.03.1 Scheduling Detector Installations and Restoration.

When a new roadway or driveway is installed and detector installations are stipulated, ensure that the detection is installed and operational before opening the roadway or driveway to traffic.

When the Contractor mills and overlays or otherwise resurfaces an existing roadway that will be open to traffic, and these operations damage existing detection thereby rendering it non-functional, restore properly operating detection within seven calendar days. When the existing detection is rendered non-functional by the Contractor's operations, restore properly operating detection within 72 hours.

T13.03.2 Inductance Loop Detector Installation.

Complete handholes, conduits, and curb cuts before beginning the loop installation. Outline the loop on the pavement to conform to the specified configuration.

Cut a slot in the pavement of sufficient width (min. ⅜ in.) to allow placement of loop wire (single or twisted pair) into the saw cut and with a depth that will place the last loop turn between 1½ in. and 2½ in. below the final surface. Smooth any sharp edges in the corners. Overlap the intersection of saw cuts so that the slots have full depth and a smooth bottom.

Immediately after sawing, clean the slot and pavement with high pressure clean water to remove the saw slurry. Use filtered compressed air to remove all dust and moisture from the slot. Do not proceed with the installation until the slot is dry. Hot air may be used to dry the saw slot.

To protect the loop wire at the edge of the pavement or curb, install a 1-in. minimum diameter flexible PVC or vinyl conduit(s) between the pavement and handhole.

Install the loop wire starting at the roadside handhole, around the loop for the specified number of turns, and back to the handhole. Do not allow splices outside the handhole. Depress the wire in the slot without the use of sharp objects that might damage the wire insulation. Hold the loop in place every 2 ft with 2-in. (approximate) strips of open-celled polyurethane backer rod. Leave the hold down strips in place when the slot is filled with roadway loop embedding sealer. Where the loop wire crosses pavement joints and cracks, protect the loop wires as required.

Apply a waterproof seal to the ends of the vinyl or PVC tubing encasing the wire immediately after placing the wire to prevent moisture from entering the tube. Ensure that the tubing has a continuous length from the curb to the handhole.

Twist together the pair of loop wires between the edge of the loop and the splice to the shielded lead-in cable in the handhole 3 to 5 turns per ft.

Ensure that the splice between the loop wires (twisted pair) and the shielded lead-in cable is moisture proof and has a dielectric strength at least equal to that of the original insulation.

Ensure that there is no moisture in the splice during the operation and that the work is performed in dry weather or under shelter. Ensure that all parts of the splice and tools involved are clean and dry. Stagger individual splices in each wire to minimize the outside diameter of the finished splice. Twist and solder the bared conductor ends, and reinsulate using an electrical grade fast drying sealant and plastic polyvinyl chloride tape. Extend the reinsulation approximately 1 in. onto the adjacent insulation at each end. Apply sufficient layers so that the thickness is one and one-half times that of the original insulation.

Ensure reinsulation of the outer jacket similarly, except extend the reinsulation approximately 4 in. onto the adjacent jacket at each end.

Continue the shielded lead-in cable (no splices) from the splices to the loop wires to the controller cabinet terminals only.

Ensure that the completed loop installation, including the shielded lead-in to the controller cabinet, has a minimum of 100 megohms leakage resistance to ground. Test this resistance after the splice is made between the loop wires (twisted pair) and shielded lead-in.

In addition to measuring the leakage to ground, use test instruments capable of measuring electrical values of the installed loop wires and lead-ins, measure induced AC voltage, inductance in microhenries, high “Q” indication, and the resistance of the conductors in ohms. Upon

measuring the loops, report to the Engineer any unusual readings or readings not in agreement with the calculated values. Testing of the loop may occur during or after the installation of the loop. When a loop does not meet calculated values, install a new loop in its place.

Ensure that the pavement temperatures are 40°F minimum and rising before the sealer is placed. Perform all work involving the sealer according to the manufacturer's specifications. When the loop embedding sealer has set sufficiently to open the loop to traffic, but the surface remains tacky, the loop may be dusted with cement to facilitate opening the loop to traffic.

T13.03.3 Pedestrian Detector Installation.

Install pedestrian pushbuttons according to **Subsection T10.03**. Mount all pushbuttons, regardless of mounting type, at a height of 3 ft 6 in. Take the measurement from the center of the pushbuttons to the finished sidewalk elevation. Ensure that the maximum reach to the pushbutton is 10 in. from the finished, level, ADA-compliant surface.

Ensure that all pedestrian pushbutton detector housings are Federal Yellow in color, unless the Contract calls for other signal equipment within the same intersection to be a different color. In the latter case, match the color of the pushbutton detector housing to that of the other signal equipment.

Test each accessible pedestrian detector in the field after initial installation according to the manufacturer's recommendations and with the Engineer present, plus other representatives when so designated by the Contract. Test the programming and operation of audible speech messages, percussive tones, locator tones, confirmation light, and all other features required and check for conformance with these Specifications. If any are not operating properly or to the satisfaction of the Engineer, correct the equipment and retest the features until accepted by the Engineer.

T13.03.4 Optically Activated Traffic Signal Preemption and Priority Control System.

Install all components of the preemption system according to the manufacturer's recommendations. The manufacturer or the manufacturer's representative shall, upon request, assist the Contractor and the Engineer to ensure that all traffic controllers are properly programmed for preemption system interface.

Ensure the proper programming of the phase selectors, orientation of the optical detectors, and all other work necessary to provide a complete and operating preemption system. The Contractor may be required to field adjust the location of the optical detectors in the presence of the Engineer to properly detect preemption calls from approaching vehicles.

Program the phase selector with a PC-based computer using unit specific software. Supply one copy of software that is licensed to the RIDOT as part of the Contract. Provide a hard copy of final programming data in the control cabinet at each installation location. Supply a complete set of interface cables for phase selector to laptop connection.

Install a confirmation beacon as required. Ensure that the confirmation beacon is only active when pre-emption is active in the controller and the pre-emption phase(s) is green.

T13.04 METHOD OF MEASUREMENT.

T13.04.1 Traffic Detector Loop.

Traffic Detector Loops will be measured by the number of linear feet of saw cut made.

T13.04.2 Traffic Detector Relays – Loop, 2 and 4 Channel.

Traffic Detector Relays – Loop, 2 and 4 Channel will be measured by the number of units furnished and installed.

T13.04.3 Pedestrian Detectors.

Pedestrian Detector – Pushbutton with Sign and Accessible Pedestrian Detector – Pushbutton with Sign will be measured by the number of units furnished and installed.

T13.04.4 Optically Activated Traffic Signal Preemption and Priority Control System.

The individual components of the preemption system will be measured for payment as follows:

a. Phase Selector and Chassis. Optical Phase Selector and Chassis will be measured by the number of units installed, tested, and accepted by the Engineer.

b. Confirmation Beacon. Optical Detector Confirmation Beacon will be measured by the number of units installed, tested, and accepted by the Engineer.

c. Optical Detector. Optical Detector – Single Channel, One-Way will be measured by the number of units installed, tested, and accepted by the Engineer. The Optical Detector Cable is incidental to this item.

T13.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Traffic Detector Loops	LF
Traffic Detector Relays – Loop, 2 and 4 Channel	EA
Pedestrian Detectors – Pushbutton with Sign	EA
Accessible Pedestrian Detector – Pushbutton with Sign	EA
Accessible Pedestrian Detector – Configuration Device	EA
Optical Phase Selector and Chassis	EA
Optical Detector Confirmation Beacon	EA
Optical Detector	EA

T13.05.1 Traffic Detector Loops.

The price constitutes full compensation for all materials, tools, labor and equipment, including saw cut, loop cable, flexible PVC or vinyl conduit under the curb, sealing compound, splicing and connecting, testing, and all incidentals required to finish the work, complete and accepted.

When replacing existing loops, include the cost of installing flexible conduit between the handhole and the curb in the cost of the loop.

T13.05.2 Traffic Detector Relays – Loop, 2 and 4 Channel.

The prices constitute full compensation for all labor, materials, tools, and equipment, and all incidentals required to finish the work, complete and accepted.

T13.05.3 Pedestrian Detectors.

The prices constitute full compensation for all labor, materials, tools and equipment, including ADA-compliant pushbuttons and housings, wiring, pedestrian signs, mounting and installation hardware, furnishing and installation of accessible pedestrian detector control units, all programming, configuration, testing required before and after installation of pedestrian detectors in the field, and all incidentals required to finish the work, complete and accepted.

T13.05.4 Optically Activated Traffic Signal Preemption and Priority Control System.

The accepted quantity of the individual system components will be paid for as follows:

a. Detector Cable. The price constitutes full compensation for all materials, labor, tools, equipment and all other incidentals required to finish the work, complete and accepted.

b. Phase Selector and Chassis. The price constitutes full compensation for programming, interface cables, all materials, labor, tools, equipment, testing, and all other incidentals required to finish the work, complete and accepted.

c. Confirmation Beacon. The price constitutes full compensation for all materials, labor, tools, equipment, mounting hardware, testing, and all other incidentals required to finish the work, complete and accepted. The cost of the strobe cable will be paid for separately.

   The cost of the optical emitters will be borne by the local fire department and are not included in the Contract.

d. Optical Detector. The price constitutes full compensation for all materials, labor, tools, equipment, mounting hardware, testing, optical detector cable, and all other incidentals required to finish the work, complete and accepted.

SECTION T14 — TRAFFIC SIGNAL HEADS

T14.01 DESCRIPTION.

This work includes furnishing and installing vehicular signal heads and pedestrian signal heads.

T14.02 MATERIALS.

Use pedestrian signal heads that meet the requirements of the currently adopted edition of the MUTCD, Section 4E and the currently adopted edition of the ITE “Specifications for Pedestrian Traffic Control Signal Indications (PTCSI),” Part 2: Light Emitting Diode (LED).

Use pedestrian signal housings that are one-section, 16-in. aluminum. Use a light source that can display each symbol independently. Do not use outlined images.

T14.03 CONSTRUCTION METHODS.

Ensure that the pedestrian change interval countdown display is LED overlaid filled countdown style and only operates in clearance cycle countdown mode. Ensure that the countdown display will start counting when the flashing clearance signal turns on and will count down to “0” and turn off when the steady UPRAISED HAND signal turns on. Provide a pedestrian change interval countdown display color that is Portland orange according to ITE requirements.

Ensure that the LED pedestrian signal module and the countdown timer operates from -40°F to +165°F and is completely sealed against dust and moisture intrusion per the requirements of NEMA Standard 250-2014 for Type 4 enclosures.

Ensure that the measured chromaticity coordinates for the “lunar white” WALKING PERSON and the Portland orange hand conforms to the chromaticity requirements of Section 8.04 and Figure 1 of the Vehicle Traffic Control Signal Heads (VTCSH) standard published by ITE.

Ensure that the luminance, uniformity, and distribution of the LED displays comply with ITE requirements in the Specifications for “Pedestrian Traffic Control Signal Indications (PTCSI),” Part 2: Light Emitting Diode (LED).

Provide a LED countdown signal module that has a microprocessor capable of setting its own time when connected to the traffic signal controller. Ensure that the microprocessor is monitored by a watchdog circuit with a flashing LED for confirmation of proper operation. Ensure that the LED countdown signal module continuously monitors the traffic signal controller for any changes to the pedestrian phase time and re-programs itself automatically if needed.

Provide a LED countdown signal module that has an internal conflict monitor to prevent any possible conflicts between the UPRAISED HAND/WALKING PERSON symbols and the pedestrian change interval countdown display signals.

Ensure that the LED countdown signal module automatically clears to “0” if a flashing hand becomes solid for more than 0.80 seconds.

Attach vehicular signal heads to mast arms, pedestal poles, and span wires with cast iron or steel signal head hanger assemblies and galvanized steel safety chains.

Mount the bottom of the signal head housing so that it is not less than 16 ft 3 in. above the roadway for a 3-section head or 15 ft above the roadway for a 4-section head. Ensure that the bottom of the housing is no more than 19 ft above the roadway. When mounted over a sidewalk, ensure that the bottom of a vehicular signal head is 10 ft above the sidewalk. Ensure that pedestrian signal heads are 8 ft above the finished sidewalk. Include 2 ft of slack in the cable to form a drip loop adjacent to the signal head.

Mount the signal heads so that the top of the assembly does not exceed the heights shown in Figure 4D-1 in the *Manual of Uniform Traffic Control Devices*, latest edition.

Supply all new signal heads with red, yellow, and green LED modules. Install the modules according to the manufacturer's recommendations.

When vehicular or pedestrian signal heads are bracket mounted to steel or aluminum poles, mount the heads to the pole using stainless steel straps. When vehicular or pedestrian signal heads are mounted on wood poles, attach the heads with bolts.

At all new locations, ensure that the system is fully operational before the signal heads are installed. Install the heads and place the system immediately into the flash mode.

At locations with existing signals, cover all new signal heads with an opaque material upon erection which, when in place, will ensure passing motorists that the signal heads are not in operation. Allow the covering to remain in place until the new signal system is operational, at which time the existing signal heads shall be covered or removed.

T14.04 METHOD OF MEASUREMENT.

Vehicular and Pedestrian Signal Heads will be measured by the number of units installed.

T14.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Vehicular and Pedestrian Signal Heads	EA

The prices constitute full compensation for furnishing and installing all materials, tools, labor, and equipment, including mounting hardware, tethering hardware, visors, backplates, safety chains, lamps, LED modules, and all incidentals required to finish the work, complete and accepted.

SECTION T15 — DIRECTIONAL, REGULATORY, AND WARNING SIGNS

T15.01 DESCRIPTION.

This work includes furnishing and installing directional, regulatory, warning, street, and parking signs on designated supports, and reflective sheeting at the required locations. The work also includes the removal and relocation of existing directional, regulatory, warning, street, and parking signs.

This item of work includes the furnishing and installation of red, yellow, white, or fluorescent yellow-green reflective sign post panels on sign posts. This item of work includes furnishing and installing or replace a solar-powered, pedestrian actuated, rectangular rapid flashing beacon (RRFB) system at the required locations.

Ensure that all work conforms to the currently adopted edition of the MUTCD and the FHWA *Standard Highway Signs*. Ensure that breakaway devices conform to the currently adopted edition of the AASHTO *Roadside Design Guide*.

T15.02 MATERIALS.

T15.02.1 Directional, Regulatory, and Warning Signs.

Use aluminum sheets, sign posts, reflective sheeting, and hardware that conform to **SECTION M16**.

T15.02.2 Reflective Sign Post Panel.

Use Reflective Diamond Grade Sign Post Panels that meet ASTM D4956-11a Type VIII sheeting (Type VIII, Type IX, or Type XI sheeting will be accepted).

Ensure that each reflective sign post panel measure 3 in. wide by a minimum of 72 in. high. Ensure that the color of the reflective panel matches the background color of the sign supported by the post, except that the color of the panel for YIELD and DO NOT ENTER signs shall be red. Trim panels in the field to accommodate sign heights.

T15.02.3 Rectangular Rapid Flashing Beacon (RRFB) System.

T15.02.3.1 General.

Ensure that each RRFB system is a complete system for each crossing location including the complete assembly that consists of both poles and foundations, signage for each pole, sign mounting onto each pole, 4 LED lights on one light bar on each pole (four lights per bar), one bar per pole, down arrow signage for each pole, push button, pole kits, and control cabinet with electrical components (wiring, solid-state circuit boards, etc.).

For the RRFB, use a Tapco Traffic and Parking Control Co, Inc., Rectangular Rapid Flashing Beacon LED Light Assembly with Large LED Arrays (RRFB-XL2™) or approved equal. Ensure that each RRFB assembly consists of two rapidly and alternately flashing rectangular yellow indications having LED array based pulsing light sources (four per direction) and that the assembly conforms to all applicable MUTCD standards and guidelines and that the assembly

exceeds the minimum requirements specified in FHWA Memorandum IA-11, “Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons.”

Ensure the RRFB is activated by an ADA compliant push button. Ensure that the RRFB is normally dark and initiates operation only upon pedestrian actuation and that the RRFB ceases operation after a predetermined time limit (based on MUTCD procedures).

When activated, ensure that the RRFB unit indications flash in a rapidly alternating wigwag flashing sequence (left light on, then right light on) and flash in a 2-4...1 pattern per FHWA requirements. Ensure that each of the RRFB's indications have 70 to 80 periods of flashing per minute.

Ensure that the activation length of the flashing lights are programmable 1 second to 24 hours in one second, minutes, and hours. Ensure that the system provides an actuation counter that can be downloaded at site to a PC using standard cables.

T15.02.3.2 Light Bar.

Use a light bar housing that is constructed of durable, corrosion-resistant powder-coated aluminum with stainless steel fasteners. Ensure that the enclosed components are modular in design, whereby any component can be easily replaced using common hand tools without having to remove the housing from the pole. Provide all mounting hardware required for mounting the light bar housing and that the housing is universal to multiple poles.

Ensure that the vehicle RRFB-XL2™ LED Modules (1 per pole/direction) is approximately 7.00 in. wide × 2.8 in. high. Side mount a pedestrian LED indication, approximately 0.5 in. wide × 1.75 in. high, in the light bar housing and ensure that the assembly is directed at and visible to pedestrians in the crosswalk. Dimensions of the light bar when mounted are 23.56-in.W × 3.76-in.H × 1.37-in.D. Ensure that each light head has eight amber LEDs with a minimum output of 600,000 mCd.

T15.02.3.3 APS Push Button.

Use an APS push button that has an eight-wire XAV2E-LED pushbutton station or approved equal. Mount the APS push button at a height of 42 in. above the finished sidewalk grade, and ensure that the assembly is capable of continuous operation within a temperature range of -30°F to 165°F.

Raise the pedestrian pushbutton controls from or flush with their housings, and ensure that the controls are a minimum of 2 in. in the smallest dimension. Ensure that the force required to activate the controls is no greater than 3.5 pound force.

Ensure that the APS push button is equipped with a speaker, a 10-watt RMS audio amplifier, a noise monitoring microphone for auto volume control, and LED lights. Ensure that the audible tone includes the standard auditory message "Yellow Lights Are Flashing" and has the option to be field programmable. Ensure that the volume of the locator tone is at least two decibels (dB) and no more than five dB greater than the ambient noise level and is responsive to level changes.

T15.02.3.4 Solar Powered RRFB.

Ensure that the control circuit can independently flash up to two independent outputs and can flash RRFB, beacons, or LED signs. Ensure that the LED light outputs and flash pattern are programmable.

Ensure that the flashing output has 70 to 80 periods of flashing per minute with a 100-millisecond duration on time. Ensure that the output reaches the output current as programmed for the duration of the pulse and that the flashing output is programmable. Use a battery that is a 12VDC absorbed glass mat (AGM) sealed lead acid, maintenance free battery. Ensure that the battery is rated at 105AH minimum and conforms to the Battery Council International (BCI) specifications. Use a replaceable battery independent of other components.

Provide a controller that is housed in a NEMA rated aluminum enclosure, intended for indoor or outdoor use, primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage from ice formation. Ensure that the controller can store input count data in preset intervals, with downloadable capabilities using optional Windows-based PC software program and standard RS232 programming cable. Use a controller that is replaceable independently of other components.

Ensure that the RRFB-XL2™, or approved equal, uses spread spectrum wireless activation. Ensure that the wireless transceiver radio is solar powered, operating on a FCC-approved 900mhz frequency, hopping spread spectrum network with a normal operating range of 1000 ft. Use radios that provide wireless communication between the assemblies to integrate the pushbutton activation of indications. To ensure that all integral indications consistently flash in unison, ensure that the radio can synchronize the controllers to activate the indications within 120 msec of one another and remain synchronized throughout the duration of the flashing cycle.

Use radio systems that operate from 3.6 VDC to 15 VDC. Use a radio that is replaceable independently of other components.

Ensure that the solar panel provides 85 watts at peak total output.

T15.03 CONSTRUCTION METHODS.

T15.03.1 Preparation of Aluminum Sheets.

Prepare sign panels according to the manufacturer's recommendations.

T15.03.2 Sign Face.

The Engineer reserves the right to make any changes in sign layouts and legend before sign manufacture at no additional cost to the Department. Submit drawings showing dimensions, sizes, shapes, spacing of letters, and arrows for all directional signs. Submit the sheeting type to the Engineer within 30 days following Contract award.

T15.03.3 Application of Reflective Sheeting and Finish.

a. Method. Apply reflective sheeting according to the recommendations of the manufacturer.

b. Splices. At splices, overlap pressure-sensitive, adhesive-coated sheeting not less than 3/16 in. Heat-activated, adhesive-coated sheeting may be spliced with overlap of not less than 3/16 in. or butted, with a gap not to exceed 1/32-in. Use only butt splices on signs screen processed with transparent color. Extend sheeting applied to extruded sections over the top edges and down the side legs a minimum of 1/16 in.

c. Finish. Seal reflective sheeting splices and sign edges and clear coated signs with materials supplied and according to the manufacturer's instructions. Ensure that clear coat overlays are of the same manufacturer as the reflective sheeting to avoid voiding the manufacturer's warranty.

T15.03.4 Locations.

The approximate locations of the signs are shown on the Plans, but determine exact locations, approved in advance in the field by the Engineer. Erect posts plumb. Erect signs to face 2 degrees away from the direction of approaching traffic so that there will be no specular glare from the reflective sheeting. Locate signs to maximize traversable path widths where applicable, with the preferred location behind the sidewalk or at the back of sidewalk.

Mount street signs horizontally on the posts according to standard commercial processes.

T15.03.5 Post Holes.

A tolerance of plus or minus 3 in. will be permitted in the depth of the holes for wood posts. Set the exposed portions of the posts plumb and true to line and grade, and backfill holes with sound earth and tamped in 6-in. layers so as not to displace the posts.

Install sign posts within paved sidewalks in a sleeve. Place backfill in the earth within the sleeve to within 2 in. of finished grade. Finish the remaining 2 in. to match the surrounding sidewalk material.

Core the post holes to be excavated through an existing concrete or asphalt surface with a 6-in. minimum diameter, and finish as prescribed above in. Place preformed expansion joint filler between the core and the patch.

T15.03.6 Remove and Relocate Signs.

Relocate the sign panels and posts as a complete unit. If any hardware or posts are damaged or faulty, use posts and hardware from other sign assemblies within the Contract that are being removed and disposed. Install signs in their new locations according to the provisions in **Subsection T15.03.4**.

T15.03.7 Street Signs.

Ensure that street sign blade dimensions and text sizes comply with the following:

a. Height and Letter Sizes. Comply with the MUTCD and the *Standard Highway Signs and Markings Book*.

b. Length and Letter Series. Comply with the MUTCD.

T15.03.8 Parking Signs.

a. Posts. Place the post so that the sign is at an angle of not less than 30 degrees nor more than 45 degrees with a line parallel to the flow of traffic. Ensure that the edge of the sign is 18 in. from the face of curb unless space does not permit, in which case the edge of sign will be 12 in. from the face of curb. Do not place the sign closer than 12 in. to the face of curb. Ensure that the sign does not obstruct the accessible pedestrian path.

b. Panel. Attach the sign panel to the post using two, 5/16-in. × 2½-in. galvanized bolts with two 0.070-in. washers per bolt.

T15.03.9 Signs Mounted on Mast Arms.

Ensure that all signs attached to traffic signal mast arms include galvanized steel safety chains. Hold the mounting bracket used for the overhead street signs in place with stainless steel bands, and ensure that they are adjustable so that the sign blade is perpendicular to the direction of traffic. Ensure that the mounting supports the sign rigidly in place and resists movement in all directions. Use two brackets to hold sign blades 60 in. and greater in length in place.

T15.03.10 Reflective Sign Post Panels.

Ensure that each reflective sign post panel measures 3 in. wide and a minimum of 72 in. high. Ensure that the color of the reflective panel matches the background color of the sign supported by the post, except that the color of the panel for YIELD and DO NOT ENTER signs are red. Trim panels accordingly in the field to accommodate sign heights.

Install the reflective sign post panels according to the manufacturer's recommendations using antitheft bolted connections to the sign post. Extend each installed panel the full length of the sign post between the bottom of the sign to the bottom of the post.

T15.03.11 Rectangular Rapid Flashing Beacon (RRFB) Assembly.

T15.03.11.1 Installation (New).

Mount the RRFB on a 4.5-in. OD pedestal pole with breakaway base and bolt kits.

Provide an extension bracket mounted on signal posts such that the pedestrian pushbutton detector is located within 10 in. from a level landing area. Ensure that the extension bracket including pushbutton and signs do not encroach into a level landing that results in a level landing area smaller than 4 ft × 5 ft. Ensure that the bracket extension allows the provision of a mounting pushbutton and 9 in. × 15 in. sign required per ADA and MUTCD guidelines. Install the bracket extension per the manufacturer's recommendations and verify the length of the extension in the field and adjust as needed. If the final installed location of the pushbutton and sign is located outside of the specified range, reinstall the bracket extension with pushbutton at the specified location.

The final location will be approved by the Engineer.

Affix the solar panel to an aluminum plate and bracket, adjustable at an angle of 45° to 60° to facilitate adjustment for maximum solar collection and optimal battery strength. Mount the solar panel assembly (panel, plate and bracket) on a side of the pole mount bracket to facilitate adjustment for maximum solar collection and optimal battery strength.

Provide a three-year warranty for all systems and with the warranty period beginning on the date the RRFBs are accepted by the Engineer.

T15.03.11.2 Replace Existing.

Diagnose and replace any part of the pedestrian activated warning system that is defective in workmanship, material, or functioning within six months of final acceptance by the Engineer. This requirement does not supersede the warranty period on materials specified in **SECTION T10**.

T15.04 METHOD OF MEASUREMENT.

T15.04.1 Directional, Regulatory, and Warning Signs.

Directional, Regulatory, and Warning Signs will be measured by the number of square feet furnished and installed.

T15.04.2 Remove and Relocate Signs.

Remove and Relocate Signs will be measured by the number of units removed, relocated, and reinstalled.

T15.04.3 Street Sign Assembly.

Street Sign Assembly will be measured by the number of units furnished and installed. Each unit may consist of multiple sign blades on one post mounting.

T15.04.4 Overhead Street Sign.

Overhead Street Sign will be measured by the number of units furnished and installed.

T15.04.5 Parking Signs.

Parking Signs will be measured by the number of square feet furnished and installed.

T15.04.6 Reflective Sign Post Panels.

Reflective Sign Post Panel will be measured by the number of each panel furnished and installed.

T15.04.7 Rectangular Rapid Flashing Beacon (RRFB) Assembly.

Furnish and Install or Replace Rectangular Rapid Flashing Beacon Assembly will be measured for payment by the number of units.

T15.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Directional, Regulatory and Warning Signs	SF
Remove and Relocate Signs	EA
Street Sign Assembly	EA
Overhead Street Sign	EA
Parking Signs	SF
Reflective Sign Post Panel	EA
Rectangular Rapid Flashing Beacon Assembly	EA

T15.05.1 Directional, Regulatory, and Warning Signs.

The price constitutes full compensation for all labor, tools, materials and equipment, including posts, bases, hardware, sidewalk sleeves, excavation and backfilling, and all incidentals required to finish the work, complete and accepted.

T15.05.2 Remove and Relocate Signs.

The price constitutes full compensation for all labor, tools, materials and equipment, including new breakaway hardware, sidewalk sleeves, installing stockpiled materials, and all incidentals required to finish the work, complete and accepted. Include all costs for the replacement of damaged or faulty hardware and/or posts in this item of work. Include new slip bases in this item of work.

T15.05.3 Street Sign Assembly.

The price constitutes full compensation for all labor, tools, materials and equipment, including post, bases, sidewalk sleeves, hardware, sign blades (two or more as required), mounting brackets, straps, and all incidentals required to finish the work, complete and accepted.

T15.05.4 Overhead Street Sign.

The price constitutes full compensation for all labor, tools, materials and equipment, including sign blades, mounting hardware, galvanized steel safety chain, and all incidentals required to finish the work, complete and accepted

T15.05.5 Parking Signs.

The price constitutes full compensation for all labor, materials and equipment, including posts, bases, sidewalk sleeves, and hardware, and all incidentals required to finish the work, complete and accepted.

T15.05.6 Reflective Sign Post Panels.

The price constitutes full compensation for all labor, tools, materials and equipment, including hardware and all incidentals required to finish the work, complete and accepted.

T15.05.7 Rectangular Rapid Flashing Beacon Assembly.

The price constitutes full compensation for all labor, materials, labor, and equipment required to finish the work, complete and accepted.

SECTION T16 — GROUND MOUNTED EXTRUDED ALUMINUM SIGN PANELS, POSTS, AND BREAKAWAY SUPPORTS

T16.01 DESCRIPTION.

This work includes ground mounted extruded aluminum sign panels furnished and installed, including the posts, breakaway supports, and concrete bases for supporting posts, at the required locations.

Also included is the removal and relocation of existing ground mounted sign panels and posts, including the installation of new foundations and breakaway support inserts.

T16.02 MATERIALS.

Use extruded aluminum sign panels, sign posts, breakaway couplings, reflective sheeting, text, borders, colors, and hardware that conform to **SECTION M16**.

T16.03 CONSTRUCTION METHODS.

T16.03.1 Posts.

Select and design the steel posts and breakaway couplings based on the charts provided in the Plans.

T16.03.2 Foundations.

Construct foundations with Class A cast-in-place concrete that conforms to **SECTION 601**.

Ensure that the design for foundations that are founded on rock or otherwise unsuitable material conforms to Section 3.8 of the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

Fill oversized augured holes with concrete to provide good bearing against existing soil or against newly compacted fill. If the wall along the neat lines of earth excavation collapses, fill the hole and compact, and re-excavate to the neat lines of the proposed footing.

Install foundations so that no portion of the foundation, including any portion of the breakaway device that remains after the support has broken away, exceeds 4 in. above a line between the straddling wheels of a vehicle on 60-in. centers. The line connects any point on the ground surface on one side of the support to a point on the ground surface on the other side, and it is aligned radially or perpendicular to the centerline of the roadway.

T16.03.3 Sign Panels.

Comply with **Subsections T15.03.1** through **T15.03.3**.

When each sign face comprises two or more pieces or panels of reflective sheeting, match the sign face for color at the time of fabrication to provide a uniform appearance and brilliance during day and night.

Use the following method of attachment of the extruded aluminum panels to an overhead sign bracket assembly or a ground mounted assembly. Use two clips at the top and bottom of the sign panel and at each joint between two extruded panels as shown on the Plans. Do not attach any sign panels to the posts below the hinge point of the breakaway device.

T16.03.4 Locations.

Comply with **Subsection T15.03.4**. Where possible, locate signs outside of the clear zone. Do not locate the near edge of sign less than 10 ft from the edge of roadway or within the deflection area of a roadside barrier. Do not locate a sign post within a ditch or drainage swale.

T16.03.5 Shop Drawings.

Within 30 days after award of the Contract and before fabrication, furnish in duplicate for approval by the Engineer, complete Shop Drawings or the manufacturer's standard specifications and drawings. After investigating the site conditions, develop the Shop Drawings according to **Subsection 105.02** and include:

- The arrangements and spacing of texts
- The colors of texts and reflective sheeting
- The cross sections of the highway where applicable
- The dimensions, types, and positioning of the signs to be mounted
- The posts, foundation depth, overhead, and underground utilities
- The material and design of the structure proposed to be erected, including the details of bases and the method of attaching signs to the structure
- The foundations and structural supports based on the Plan details

T16.03.6 Sign Covering.

Cover all signs that have been erected until the message on the signs is pertinent to traffic operations. Ensure that the covering is per the manufacturer's recommendations to not void the sheeting warranty. Ensure that the color of the covering is dull green or similar.

T16.03.7 Identification.

Identify extruded aluminum signs on the front left corner of the panel with the sign size and date of fabrication. Provide a label that is 1 in. in height. Match the legend color to the border color.

T16.03.8 Remove and Relocate Signs.

Relocate the sign panels and posts to the required locations. Provide new concrete foundations and breakaway couplings. Install signs in their new location according to **Subsection T16.03.4**.

T16.04 METHOD OF MEASUREMENT.

T16.04.1 Ground Mounted Extruded Aluminum Sign Panels.

Ground Mounted Extruded Aluminum Sign Panels will be measured by the number of square feet furnished and installed.

T16.04.2 Remove and Relocate Ground Mounted Sign.

Remove and Relocate Ground Mounted Sign will be measured by the number of units furnished and installed.

T16.04.3 Ground Mounted Sign Post – Steel Breakaway.

Ground Mounted Sign Post – Steel Breakaway will be measured by the number of units furnished and installed.

T16.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Ground Mounted Extruded Aluminum Sign Panels	SF
Remove and Relocated Ground Mounted Sign	EA
Ground Mounted Sign Post – Steel Breakaway	EA

T16.05.1 Ground Mounted Extruded Aluminum Sign Panels.

The price constitutes full compensation for all labor, tools, materials and equipment, including application of reflective sheeting, sign clips, exit sign panels, legends, borders, arrows, shields, hardware, sign coverings, Shop Drawings, and all incidentals required to finish the work, complete and accepted.

T16.05.2 Remove and Relocate Ground Mounted Sign.

The price constitutes full compensation for all labor, tools, materials and equipment, including removal, stockpiling, reinstallation, furnishing and installing new breakaway couplings, posts, furnishing and installing new concrete foundations, restoration of surrounding areas around the new sign location, and all incidentals required to finish the work, complete and accepted.

Removal and disposal of the existing concrete bases will be paid for under a separate item.

T16.05.3 Ground Mounted Sign Post – Steel Breakaway.

The price constitutes full compensation for all labor, tools, materials and equipment, including foundations, breakaway couplings, Shop Drawings, posts, the restoration of existing ground surfaces, and all incidentals required to finish the work, complete and accepted.

SECTION T17 — OVERHEAD EXTRUDED ALUMINUM SIGN PANELS AND SUPPORTS

T17.01 DESCRIPTION.

This work includes furnishing, fabricating, transporting, and erecting overhead extruded aluminum sign panels and steel overhead sign structures, including concrete foundations of the type and at the required locations. Provide the sign structure design with construction contingent upon approval of the Engineer.

T17.02 MATERIALS.

Use extruded aluminum sign panels, structural sign supporting members and shapes, reflective sheeting, text, borders, colors, and hardware that conform to **SECTION M16**. For concrete for bases, use Class A that conforms to **SECTION 601**.

T17.03 CONSTRUCTION METHODS.

T17.03.1 Sign Design.

Design, fabricate, and erect each complete sign, which includes sign structure, sign panel, and sign panel supporting frame, to withstand wind loadings and design stress values based on the currently adopted edition of the AASHTO *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

T17.03.2 Steel Overhead Sign Structure.

Before fabricating the overhead sign supports, verify the locations of the foundations in the field, and establish and verify all elevations, dimensions, and longitudinal grades.

For all connections, use high strength bolts that conform to **SECTION 824**.

Before assembly, plane the top and bottom surfaces of the base plate, or hot straighten the plate. Ensure that the post is faced at the bottom end.

Remove the top leveling nuts and the grout leveling template before placing the base plate and post assembly on the foundation.

T17.03.3 Sign Panel.

Use signs that have been fabricated of extruded aluminum sign panels according to **Subsection T16.03.3**.

T17.03.4 Shop Drawings.

Comply with **Subsection 105.02**. Ensure that structural Shop Drawings include a cross section of the overhead sign installation.

T17.04 METHOD OF MEASUREMENT.

T17.04.1 Overhead Sign Panels.

Overhead Sign Panels will be measured by the number of square feet of panels furnished and installed.

T17.04.2 Overhead Sign Structures.

Overhead Sign Structures will be measured by the number of each unit furnished and installed.

T17.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Overhead Sign Panels	SF
Overhead Sign Structures	EA

T17.05.1 Overhead Sign Panels.

The price constitutes full compensation for all labor, tools, materials and equipment, including reflective sheeting, legend, borders, arrows, exit sign panels, shields, hardware, and all incidentals required to finish the work, complete and accepted.

T17.05.2 Overhead Sign Structures.

The price constitutes full compensation for all labor, tools, materials, and equipment, including foundations, hardware, Shop Drawings, and all incidentals required to finish the work, complete and accepted.

An allowance for rock excavation will be made for a distance of 1 ft outside the foundation and 6 in. below the bottom of the foundation, as constructed, which will be measured and paid for as Trench Excavation – Rock under **SECTION 205**.

SECTION T18 — DELINEATORS AND OBJECT MARKERS

T18.01 DESCRIPTION.

This work includes furnishing and erecting delineators, object markers, guardrail end delineator panels, and post supports of the required type. This work also includes furnishing and installing flexible delineator posts.

T18.02 MATERIALS.

T18.02.1 Delineators and Object Markers.

Use single or multi-reflector delineators, object markers, reflectorized sheeting, and posts that conform to **SECTION M16**.

T18.02.2 Guardrail End Delineator Panels and Post Supports.

Use retro-reflective panel sheeting that is 6 in. × 12 in. and ASTM Type XI sheeting (unmetalized cube corner micro-prismatic) per ASTM D4956-11a, "Standard Specification for Retroreflective Sheeting for Traffic Control." Use posts that are steel U-channel galvanized finish, 7 ft long, and 1.12 lb/ft minimum weight. Ensure that all mounting hardware is galvanized. Use steel posts that conform to the **SECTION M16**. See **SECTION 901** for specifications on guardrail delineators.

T18.02.3 Flexible Delineator Posts.

Use delineators that have been manufactured from a flexible material that meets the following requirements:

a. Height. Ensure that the overall dimensions of the delineator post are installed according to the manufacturer's instructions and that the top of the post is 48 in. above the final surface.

b. Delineator Posts. Use delineator posts that remain flexible at temperatures between 0°F and 140°F and are durable and resistant to impact, ultraviolet light, ozone hydrocarbons, and other atmospheric weathering.

c. Posts. Posts may be either a one-piece system or a two-piece system. When a two-piece system is used, ensure that the post portion is readily replaceable without removing or partially removing the anchor and without displacing the soil around the anchor.

d. Surfaces. Ensure that both the front and back surfaces of the delineator have smooth surfaces capable of accepting reflective sheeting.

T18.02.4 Sheeting.

Use reflective sheeting that complies with **Subsection M16.02**, which is applied to one or both sides of the post.

T18.03 CONSTRUCTION METHODS.

T18.03.1 Delineators.

Ensure that the spacing, placement, type, and color of the delineators that conform to the currently adopted edition of the *Manual on Uniform Traffic Control Devices*. Install delineators on delineator posts of the required size and type.

T18.03.1 Guardrail End Delineator Panels and Post Supports.

Drive the delineator posts or auger the hole, and thoroughly tamp and backfill. Ensure that the posts are plumb above ground and remove and replace any post bent or otherwise damaged at no additional cost to the Department.

For flared end guardrail sections, mount the delineator within 6 in. perpendicular to the web of the first post, the post at the break point of the guardrail, and the last full height guardrail post. For non-flared end guardrail sections, mount the delineator within 6 in. perpendicular to the web of the first and last full height guardrail post.

T18.03.2 Flexible Delineator Posts.

Install one-piece flexible delineator post in a pilot hole ¼ in. × 4 in. × 18 in. deep, seated, and tamped to the satisfaction of the Engineer. Form the pilot hole by a hand held pilot hole driver as recommended by the manufacturer. Do not drive a delineator into the ground.

When using a two-piece system, drive the anchor into the ground using a hand or mechanical driver. Attach the post to the anchor according to the manufacturer's instructions.

T18.03.3 Object Markers.

Use Type 1 and Type 4 object markers that consist of groups of reflector units placed as shown or directed. Mount the markers at a height of 4 ft above the pavement, except when applied directly to a hazardous object that requires higher or lower mounting.

Use Type 3 object markers that consist of alternating fluorescent yellow and black strips sloped down at a 45 degree angle towards the side on which traffic will pass. Where traffic can pass on either side of the obstruction, ensure that the alternating strips form a chevron.

T18.03.4 Flexible Delineators – Barrier Mounted.

Use barrier mounted flexible delineators that consist of a reflector placed on top of a median barrier with a width no less than 4 in. and a height of no less than 2.5 in. Provide a delineator that is reflective on both sides.

T18.04 METHOD OF MEASUREMENT.

Delineators, Flexible Delineator Posts, Hazard Markers, and Flexible Delineators – Barrier Mounted will be measured by the number of units furnished and installed.

Guardrail End Delineators are incidental to guardrail work and not measured for payment.

T18.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Delineators	EA
Flexible Delineator Posts	EA
Object Markers	EA
Flexible Delineators – Barrier Mounted	EA

The prices constitute full compensation for all labor, tools, materials and equipment, including the reflector units, assembly bolts and theft-resisting nuts, posts, and all incidentals required to finish the work, complete and accepted. Where applicable, include one-tenth mile station notation in the price of Delineators and/or Flexible Delineator Posts.

SECTION T19 — MILEPOST MARKERS

T19.01 DESCRIPTION.

This work includes milepost markers furnished and installed at the required locations.

T19.02 MATERIALS.

Use aluminum sheets, reflective sheeting, sign posts, and bolts that conform to **SECTION M16**.

T19.03 CONSTRUCTION METHODS.

Drive the post into the ground to a depth of 2 ft, using a driving cap to protect the post. Attach the milepost markers to the post so that the bottom of the marker is 4 ft above grade.

For sign faces, comply with **Subsection T15.03.2**.

T19.04 METHOD OF MEASUREMENT.

Milepost Markers will be measured by the number of units installed.

T19.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Milepost Markers	EA

The price constitutes full compensation for all labor, tools, materials and equipment, including reflective sheeting, legend, posts, hardware, and all incidentals required to finish the work, complete and accepted.

SECTION T20 — PAVEMENT MARKINGS

T20.01 DESCRIPTION.

This work includes furnishing, laying out, and installing and/or removing the following types of pavement markings at the locations indicated in the Contract Documents, as well as the ancillary work of removing existing markings and other surface preparation before new marking installations, completion of Contractor quality control activities, and incidentals, all according to these Specifications.

- Waterborne paint pavement markings.
- Epoxy resin pavement markings.
- Bi-directional control devices.
- Preformed pavement marking tape.
- Preformed thermoplastic pavement markings.

T20.01.1 Definitions.

1. Channelizing Lines. Pavement marking lines that delineate the outside boundary of gore areas.

2. Final Epoxy Markings. Epoxy resin pavement markings installed by the Contractor that shall remain in place and be visible to traffic following completion of the Project.

3. Handwork. All pavement markings not included in the definition for Longitudinal Line Markings, including but not limited to symbols, words, crosswalk markings, markings inside of gore areas, and parking space markings.

4. Interim Epoxy Markings. Temporary epoxy resin pavement markings installed by the Contractor when such markings need to be or are expected to remain installed between December 15 and April 15 of the following calendar year.

5. Longitudinal Line Markings. All linear pavement markings installed via motorized vehicle, including edge, center, lane, and channelizing lines, including all solid, broken, and dotted variations as described by the MUTCD.

6. Lot. A section of roadway or facility within which the total quantity of each distinct item of pavement marking work as listed in the Proposal shall be considered a single unit for the purposes of inspection, certification, and acceptance.

This work includes furnishing and applying and/or removing the following items of pavement markings, at the required width and locations:

- Waterborne pavement markings
- Thermoplastic pavement markings
- Epoxy resin pavement markings
- Bi-directional control devices
- Temporary reflectorized pavement markings (tape)
- Temporary fast drying waterborne pavement markings
- Removal of existing pavement markings

T20.02 MATERIALS.

Use a composition, binder, pigments, thermoplastic compound pavement marking material, reflective glass spheres, and epoxy resin marking material that conform to **SECTION M17**.

T20.03 CONSTRUCTION METHODS.

T20.03.1 Cleaning Pavement.

Ensure that all dirty pavements are swept or air blasted clean. Remove and dispose of the piles of dirt obtained by sweeping.

Remove oil, grease, and similar adherent matter by washing with a suitable solvent. Wipe excess solvent from the pavement, and allow the solvent to evaporate before applying pavement marking material.

Ensure that the pavement surface has been cleaned and inspected according to the manufacturer's recommendations before applying the markings.

T20.03.2 Defective Work.

Obliterate any unsatisfactory markings resulting from the presence of dirt, oil, grease, scale, moisture, or other foreign substances and all other traffic markings rejected by the Engineer by a method approved by the Engineer and replace at no additional cost to the Department.

T20.03.3 Temporary Pavement Markings.

a. Condition in Container. Ensure that the paint as received shows no livering, skinning, mold growth, corrosion of the container, or hard settling of the pigment. Disperse any settling when stirred by hand with no persistent foaming.

b. Packaging. Ensure that containers are either rust resistant (e.g., stainless steel or coated with a good quality epoxy or phenoxy clear coating) 30-gal open-head drums with drum lever lock, or ring and bolts, with rust resistant cover; or 250-gal rust-resistant moveable totes. Ensure that drums are tight-filled and have a floating polyethylene lid liner in contact with the paint surface.

   Use containers and lids that are white or off-white on the outside to avoid excessive heat build-up when sitting in sunlight.

   Seal the field samples tightly immediately upon sampling and submit to the Materials Testing Laboratory within 72 hours for laboratory testing.

c. Installation. Ensure that the paint is reflectorized for night visibility by adding glass beads before the paint dries or sets by using drop-on or pressurized methods. Ensure that the glass beads are evenly dispersed on a wet paint film of 14 to 16 mils (110 to115 sq ft per gal) at a rate of 6 lb/gal.

   Apply the lines with airless or air-assisted spray equipment so that the paint is at a temperature of 150°F maximum in the heat exchanger and between 120° and 140°F at

the spray nozzle. Ensure that the maximum no-tracking time is not exceeded when the pavement temperature is greater than 45°F under humidity conditions of 85 percent or less on dry pavement.

Apply paint according to **Subsection T20.03.5(a)**.

d. Acceptance. Ensure that the markings conform to the greater of the applicable minimum retroreflectivity requirements of that pavement marking material or 50 mcd/m and that the markings maintain the minimum retroreflectivity of 50 mcd/m for the entire duration of their intended use. Replace the markings at no additional cost to the Department if the retroreflectivity falls below the 50 mcd/m level.

T20.03.4 Temporary Waterborne Pavement Markings.

Schedule temporary pavement markings such that they are placed on newly paved roadways, which shall be opened to traffic at the completion of each day's paving operations.

T20.03.5 Thermoplastic Pavement Markings.

When thermoplastic pavement markings are specified, use material that is a thermoplastic compound, free of volatiles, which is designed for machine application from approved equipment and readily extrudes at temperatures between 400°F to 425°F to produce a cross section of line ⅛-in. to 3/16-in. thick. After cooling to the ambient temperature and without polymerization or other chemical change, ensure that the line forms a pavement marking continuous and uniform in shape, having a clear and sharp dimension and of the quality and appearance specified. Use material that is especially compounded for traffic marking and does not lose its bond with the pavement when the ambient temperature falls below 32°F.

Ensure that the reflectorization is obtained from approved glass beads conforming to **Subsection M17.01**.

Apply additional glass beads by the drop-on method at the rate of 0.08 lb/sq ft of marking.

Use pigmented binder that is well dispersed and free from all skins, dirt, foreign objects, or ingredients that will cause bleeding, staining, or discoloration due to dissolution of asphalt in the pavement.

After application and drying time, ensure that the material shows no appreciable deformation or discoloration under local traffic conditions and in air and road temperatures ranging from 0°F to 120°F and that adheres securely under repeated freezing and thawing.

Maintain the stripes in the original dimensions and placement. Ensure that the exposed surface are free from tack. Ensure that the cold ductility of the material permits normal movement with the road surface without chipping or cracking to prevent dimensional distortion as a result of traffic impact within the temperature range specified. Ensure that the ability to resist distortion by natural discoloration is retained for the life of the stripe.

Ensure that the compound does not deteriorate by contact with sodium chloride, calcium chloride or mild acids, alkalies, or other chemicals used against the formation of ice on roadways; by oil contained in the pavement material; or by oil drippings from vehicular traffic.

When installed at an air temperature of 70°F, between ⅛-in. and 3/16-in. thick, ensure that the composition is completely solid and shows no effect of tracking after 15 minutes.

Provide equipment to ensure removal of dust, debris, and other foreign matter from the road surface immediately before the installation of the pavement marking.

Thermoplastic applicating equipment will be approved by the Engineer before the start of work.

For heating the thermoplastic composition, ensure that the application equipment includes a melting kettle(s) of such capacity as to allow for continuous marking operations.

a. Weather Conditions. Place thermoplastic pavement markings on dry pavement surfaces. At the time of installation, ensure that the pavement surface temperature is a minimum of 50°F and rising.

   As an option, if the surface temperature is 45°F and rising, the Contractor may choose to apply thermoplastic pavement marking material provided that the surface is dry and the Contractor accepts all responsibility for the performance of the thermoplastic line striping for a period of one year from the date of application. Submit the request in writing to the Engineer for approval. Replace any thermoplastic material that fails for any reason during the one-year period at no additional cost to the Department.

   No payment will be made for that quantity of material placed at surface temperatures below 50°F for the period of one year.

T20.03.6 Epoxy Resin Pavement Markings.

a. General. Before any pavement marking work is initiated, submit a schedule of operations for the approval of the Engineer. At least five days before starting striping, provide the Engineer with the epoxy manufacturer's written instructions for use, including material mixing ratios and application temperatures.

   When pavement markings are applied under traffic flow conditions, provide all necessary signs, cones, arrow boards, etc., according to the Contract and the currently adopted edition of the MUTCD to maintain and protect the traffic, the marking operation, and the pavement markings until thoroughly set.

b. Application. Perform the application of pavement markings in the general direction of traffic.

   If it is not possible to place epoxy lane and center lines within the guidelines and restrictions of the Contract, and no previous lines exist, place the appropriate color of 4-in. reflective temporary pavement markings for the entire length of the roadway that is unstriped according to the currently adopted edition of the MUTCD at no additional cost to the Department. The type of temporary markings will be approved by the Engineer.

   Remove, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

c. Test Strip and Calibration. Before the start of striping operations, construct one or more test strips. Ensure that each test strip includes approximately 100 linear feet of pavement with white and yellow striping (lane and edgeline) similar to that required for the Project. The purpose of the test strip(s) is to demonstrate the capability of the proposed epoxy resin striping material, and the equipment and procedures to place epoxy resin traffic stripes that comply with these Specifications including retroreflectivity, dimensions, appearance (uniform color and crisp, well-defined edges), wet film thickness, drying time and glass bead quantity, application, and retention. When the test strips are in compliance, the Contractor will be permitted to proceed with the striping operations.

   Use a test strip for each applicator unit used. Additional test strips may be required when major equipment repairs or adjustments are made or at any time requested by the Engineer.

d. Procedures. Clean the road surface to be free from all dirt, oil, grease, and other foreign material, including curing compound on new Portland cement concrete, immediately before the striping operation. New epoxy markings may be applied over worn, well-bonded epoxy if approved by the Engineer; remove all others, such as thermoplastic, tape, and newly striped paint, as follows and as approved by the Engineer:

   - Grinding. Remove markings to a minimum of 95 percent of their surface area. Ensure that the method does not damage the surface in any way and has no more than a moderate color and/or texture change. Ensure that the grinding truck can remove 80,000 linear feet of 6-in. line per day. and is equipped with a vacuum and dust collector that is 99.99 percent efficient in removing particles no bigger than 0.5 microns. Replace any pavement markings removed within one day. Removal is at no extra cost to the Department. Use a sweeper with the capacity to pick up grindings simultaneously with the removal operation. If the Contract eliminates grinding of material, use power washing.

   - Power Wash. Remove all special patterns, handwork, and oil or other deleterious substances by a power wash machine with a pressure of 2400 to 2800 psi with the water heated to 180 to 195°F. Do not add chemicals to the water in the process. Equip the machine with a turbo blast tip with oscillating head that can supply 5 gal/min/gun.

   - Cleaning. Ensure that pavement cleaning includes at least a brushing with a rotary, non-metallic broom and additionally as may be recommended by the material manufacturer, all to the satisfaction of the Engineer. Clean new Portland cement concrete by sandblasting to remove any surface treatments and/or laitance. Perform surface cleaning and preparation work only in the area of the epoxy markings applications. Air-blast the pavement surface to remove dirt and residues just before the application of the markings.

   - Restrictions. Apply epoxy striping material to substantially dry pavement surfaces. Ensure that the pavement surface temperature and the ambient temperature are a minimum of 35°F at time of application. Do not initiate or continue operations during periods of rain or in the case of damp pavement. Cease operations until the Engineer determines that the roadway surface is dry enough to achieve adhesion.

- Heating. Heat the individual epoxy components to the temperatures recommended in the epoxy manufacturer's written instructions for use or as stated in the FHWA *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects* (note the maximum temperature of 140°F).

- Ratio. Monitor the ratio of the two components during the application, using the installed metering devices. If the ratio falls outside the range of ±5 percent of the manufacturer's specified mixing ratio for over 30 seconds or at any time falls outside of the range of ±10 percent, stop the application, and determine the cause of the problem and correct before proceeding.

e. Application. Ensure that epoxy pavement markings are reflectorized for night visibility by adding reflective spheres before the paint dries or sets by the double-drop method. Evenly disperse the reflective spheres, Type I followed immediately by Type II, on a minimum wet film thickness of 20 mils on existing and new pavements at a minimum rate of 12 lb/gal for each type of glass sphere. Ensure that all special patterns and handwork (e.g., stop bars, arrows, legends, symbols) meet the above application rates with the following exception: For the double-drop application of glass spheres, use the Type II gradation only with two applications at a minimum of 12 lb/gal each.

   Place the necessary spotting at appropriate points to provide horizontal control for striping and to determine necessary starting and stopping points. Use longitudinal joints, pavement edges, and existing markings to serve as horizontal control when approved by the Engineer.

   Do not initiate marking operations until the applicable surface preparation work has been completed according to the manufacturer's recommendations. The temperature of the mixed epoxy may be adjusted as required for prevailing conditions, including air temperature and pavement temperature to achieve the prescribed no-track time. Do not allow the speed of the applicator truck to exceed the recommended rate for the combination of the truck rate, pressure in the lines, and the tip opening and height of the spray gun to ensure the required thickness.

f. Quality Control. A tolerance of ¼ in. under or over the specified width will be allowed for striping if the variation is gradual and does not detract from the general appearance. Ensure that alignment deviations for the control guide do not exceed 2 in. if the variation is gradual and does not detract from the general appearance. Do not apply material over a longitudinal joint. Establishment of these tolerances shall not relieve the Contractor of its responsibility to comply as closely as practical with the planned dimensions.

g. Retroreflection Measurement. Measure retroreflection using a 30-meter geometry unit following ASTM D6359 with the following exceptions: Ensure that the minimum values are not less than 350 mcd/lum/m^2 for white and 225 mcd/lum/m^2 for yellow as measured by the Engineer and that the measurement for acceptance is performed between 14 and 60 days after placement.

h. Defective Markings. Repair any epoxy reflectorized pavement markings that, after application and curing, are determined by the Engineer to be defective and not in conformance with this Specification. Perform the repairs to the satisfaction of the Engineer

at no additional cost to the Department. Detail the repair methods and submit for approval to the Engineer before corrective action.

T20.03.7 Symbols and Word Messages.

Apply the symbols and word messages to the pavement where designated on the Plans or as directed by the Engineer. Elongate the letters in the direction of traffic as shown on the Plans or as directed by the Engineer.

T20.03.8 Bi-directional Control Device.

Apply the Raised Reflective Pavement Markings (RRPMs) and thermoplastic markings according to the method indicated in the Specifications for each item and as detailed on the Plans.

T20.04 METHOD OF MEASUREMENT.

Waterborne Pavement Markings, Thermoplastic Pavement Markings, Epoxy Resin Pavement Markings, Temporary Fast-Drying Waterborne Pavement Markings, Temporary Pavement Markings (Tape), and Remove Existing Pavement Markings will be measured by the number of linear feet (including skips and spaces) installed or removed.

The following items will be measured by the number of each unit furnished and installed:

- Waterborne Pavement Arrow - Straight Left, Right or Combined
- Waterborne Pavement Marking Word “ONLY”
- Waterborne Pavement Marking Word “STOP”
- Preformed Thermoplastic Shield
- Bi-directional Control Device
- Epoxy Resin Pavement Arrow - Straight, Left, Right or Combined
- Epoxy Resin Pavement Marking Word “ONLY”
- Epoxy Resin Pavement Marking Word “STOP”

In certain cases, any or all of the items of work may be paid for on a lump sum basis. In such cases, no measurement is required.

T20.05 BASIS OF PAYMENT.

The Department will pay for the completed and accepted quantities at the Contract unit prices as follows.

Pay Item	Pay Unit
Pavement Markings	LF
Temporary Pavement Markings	LS
Arrows, Words, Symbols, Bi-Directional Control Device	EA

T20.05.1 Pavement Markings.

The prices constitute full compensation for all labor, tools, materials and equipment, including protection of newly applied markings from traffic, layout, cleaning and sweeping, furnishing and applying the pavement markings, and all incidentals required to finish the work, complete and accepted.

T20.05.2 Epoxy Retroreflection Values.

Payment will be as follows:

- Minimum 350 / 225 (white/yellow): 100% Contract unit price
- Minimum 330 / 205 (white/yellow): 90% Contract unit price
- Minimum 310 / 185 (white/yellow): 80% Contract unit price
- Minimum 300 / 175 (white/yellow): 75% Contract unit price
- Below 300 / 175 (white/yellow): 0% Contract unit price

T20.05.3 Temporary Pavement Markings.

The price constitutes full compensation for all labor, tools, materials, and equipment, including protection of newly applied markings, cleaning and sweeping pavement, applying pavement markings and removal of pavement markings when no longer in use, and all incidentals required to finish the work, complete and accepted. Fifty percent of the Contract bid price will be paid at the time of installation and 50 percent upon removal of the markings.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