DESIGN-BUILD
RFP CONTRACT BOOK 1
INSTRUCTIONS TO
DESIGN-BUILDERS (ITDB)

TENNESSEE DEPARTMENT OF TRANSPORTATION

Interstate I-75 at Interstate I-24 Interchange Modification

Hamilton County- TENNESSEE

CONTRACT NUMBER: DB1801

July 27, 2018

Addendum #1 August 24, 2018
Addendum #2 September 26, 2018
Addendum #3 November 13, 2018
Addendum #4 November 16, 2018

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STANDARD INSTRUCTIONS TO DESIGN-BUILDERS

A. SCOPE OF SOLICITATION / PROJECT DESCRIPTION

1. INTRODUCTION

This **Contract Book 1 (ITDB - Instructions to Design-Builders)** is issued by the Tennessee Department of Transportation (the Department) to all firms and teams of firms ("Design-Builders") that the Department has shortlisted for the Department's Request for Proposals (RFP) to solicit competitive Proposals for **Interstate 75 at Interstate 24 Interchange Modification, Hamilton County-TN**

Design-Build Project (the "Project"). The Department hereby invites such Design-Builders to submit competitive sealed proposals ("Proposals") for design and construction of the Project as more specifically described in the Contract Documents. Design-Builders should not rely on only the limited information contained in this **Contract Book 1 (ITDB - Instructions to Design-Builders)**, but should review and understand the specific information and requirements in the RFP.

This solicitation is a request for competitive proposals. Proposals are only invited from and will only be considered from those entities ("Design-Builders") on the short-list as determined through the evaluation of Statements of Qualifications ("SOQ") submitted in response to the Request for Qualifications ("RFQ").

The Design-Build is advised to familiarize itself with the provisions of Tennessee Code Annotated, Section 67-6-209, entitled "Use of Property Produced or Severed from the Earth-Exemptions", which relates to the payment of taxes on the use of tangible personal property severed from the earth. This tax is in addition to those levied for other tangible personal property.

The Design-Build must have at their disposal the necessary equipment to put on the Project when instructions are issued to begin work, and to do the work within the time specified. In the event the Design-Builder has been awarded contracts for highway work in the past, they shall have financed the work in such a manner that just and proper claims in the discretion of the Department, representing labor and materials entering therein, have not been filed with the Department.

This **Contract Book 1 (ITDB - Instructions to Design-Builders)** contains Technical Proposal, Price Proposal, and other submittal requirements, a description of the procurement process to be used, Technical Proposal evaluation criteria, and other instructions to Design-Builders. This **Contract Book 1 (ITDB - Instructions to Design-Builders)** shall be used by Design-Builders in conjunction with the other Contract Documents for the generation and submission of responsive Technical Proposals, sealed Price Proposals, and other required pre-award submittals.

Submittal of a Price Proposal and the execution by Design-Builders of the signature sheets contained in the RFP, shall constitute the Design-Builder's acknowledgement and understanding of the procurement process, submittal requirements, and evaluation criteria contained herein.

The Contract will include **Contract Book 1 (ITDB - Instructions to Design-Builders), Contract Book 2 (Design-Build Contract),** and **Contract Book 3 (Project Specific Information), Design-Builder Standard Guidance** and all referenced documents, including, but not limited to, the listing in the **Contract Book 2 (Design-Build Contract)** are to set forth the rights and obligations of the Parties and the terms and conditions governing completion of the work.

The Project shall consist of the modification and reconstruction of I-75 Interchange at I-24 in Hamilton County. The roadway improvements shall begin at the Georgia state line and extend on I-75 to a point approximately 455' south of the existing I-75 bridge over CSX railroad, and to a point just west of the I-24/Spring Creek Road bridges as depicted on the Functional Plans.

The Project shall include the widening of the I-75 roadway to include an additional lane in each direction, widening of all interstate-to-interstate ramps to three lanes, modifications to I-24 ramps to enter and exit I-75 from the right side, and modifications to the Ringgold Road and Welcome Center traffic pattern.

The Design-Builder's obligations shall include without limitation the following:

- Furnishing all design services, Quality Management, materials, equipment, labor, transportation, and incidentals required to complete the Project according to the approved Plans, the Department's Standard Specifications, as amended, and terms of the Contract;
- Performing the construction work according to the lines, grades, typical sections, dimensions, and other details shown on the approved Plans, as modified by Change Order or other written directive issued by the Department;
- Performing all work determined by the Department to be necessary to complete the Contract; and
- Contacting the Department Alternative Contracting Office for any necessary clarification or interpretation of the Contract prior to proceeding with the affected work.
- All Project components identified in the Contract and performance of all work described in accordance with all Contract requirements. The Design-Builder shall determine the full Project requirements through comprehensive examination of the Contract and the Project Site.
- Designing, furnishing, constructing, and installing all components of the Project, except for those components, if any, as may be stipulated within the **Contract Book 3 (Project Specific Information)** to be furnished and/or installed by the Department or others.

The Design-Builder shall be fully and totally responsible for the accuracy and completeness of all work performed under the Contract, and shall indemnify and hold the Department harmless for any additional costs and all claims against the Department which may arise due to errors or omissions of the Department in the Provided Materials, and of the Design-Builder in performing the work.

2. PROJECT OVERVIEW

Project Description: **Interstate 75 at Interstate 24 Interchange Modification**
This project will consist of:

- Replacement of the median barrier with a 51-inch high median barrier from the Georgia State Line to south of Spring Creek;
- Replacement of the storm sewer system on I-75 from the Georgia State Line to south of Spring Creek;
- Adding an additional lane on I-75 as shown on the Functional Plans;
- Provide a minimum 50-mph design speed for all interchange ramps;
- Widening I-75 to add an additional lane from S. Chickamauga Creek to a point south of the CSX Railroad as shown on the functional plans. Concrete pavement with concrete shoulders will be used for the area to be widened;
- Concrete pavement rehabilitation for the existing pavement from S. Chickamauga Creek to a point south of the CSX Railroad as shown on the functional plans;
- New bridges and widening the existing bridge over S. Chickamauga Creek;
- Widening the I-75 southbound to I-24 westbound interstate-to-interstate ramp and I-24 eastbound to I-75 northbound interstate-to-interstate ramp from two to three lanes;
- Realignment and widening of the I-75 northbound to I-24 westbound interstate-to interstate-ramp and the I-24 eastbound to I-75 southbound interstate-to-interstate ramp from two to three lanes;
- Proposed sidewalk, curb and gutter along both sides of Spring Creek Road.
- Addition of new noise walls;
- Removal and replacement of all guardrail. New guardrail in locations shown on the Functional Plans;
- Resurfacing all existing asphalt pavement within the project limits;
- Modifications to existing drainage structures and installation of proposed drainage improvements;
- Replacement of all lighting within the project limits;
- Utility relocations;
- ITS relocations and improvements; and
- Installation of new overhead signs and sign structures as shown in the roll plots.

Additionally the Design-Builder shall be responsible for:

- Easements required for the construction of the Project. Any easement required to construct the Project shall be in the name of Tennessee Department of Transportation.
- Coordinating the construction/ relocation of private utilities with the appropriate owners.
- Development and installation of the Traffic Control and Pavement Marking Plans.
- All erosion prevention and sediment control designs and implementation.
- Preparing all documents necessary for to obtain the environmental permits. Should the Design-Builder's activities be in violation of the environmental permits, law and/or regulations and therefore cause fines and/or penalties to be assessed against the Department, said fines and/or penalties will be deducted from monies due the Design-Builder.
- Following all reference guidance as stated in **Design-Build Standard Guidance**.
- Specific Technical requirements as stated in **Contract Book 3 (Project Specific Information)**.
- Preparing a design exception request needed for FHWA Approval in accordance with TDOT Design Guidelines.
- Coordination and communication with all stakeholders, including but not limited to:
    - Tennessee Department of Transportation (Headquarters Construction, Region 2, and Structures Division)
    - City of Chattanooga
        - Chattanooga City Public Works
        - Chattanooga Department of Transportation
    - Chattanooga Airport
    - City of East Ridge
        - East Ridge Police Department
    - Georgia Department of Transportation
    - Hamilton County
    - FHWA
    - Utility Companies

3. RFP COMMUNICATION

The Department Alternative Contracting C.E. Manager 2 for the duration of the procurement process, together with address, phone number, fax number, and e-mail address, are set out in the Contract.

a. CORRESPONDENCE

All correspondence and submittals must be submitted in a sealed envelope or package addressed to the Department Alternative Contracting C.E. Manager 2 and labeled as set out in Section C.2 of **Contract Book 2 (Design-Build Contract)**.

Return Address – The Design-Builder's must also include on the envelope or package the Design-Builder's name and return address.

Any Department designated contact person specified in the **Design-Build Standard Guidance** for a specific technical area will be disclosed to the contracted Design-Builder within the Initial Notice to Proceed (NTP).

b. OTHER MEANS OF COMMUNICATION

The Design-Builders may also communicate with the Department Alternative Contracting C.E. Manager 2 by fax, phone, or e-mail (or if the Program Manager is unavailable, as a secondary contact, the Department Director of Construction by telephone at 615-741-2414. Advance copies of submittals delivered to the Department by fax or e-mail are not considered official until the Department receives the hard copy. Official communications will only be disseminated in writing by the Department.

c. COMMUNICATIONS WITH DESIGN-BUILDER; DESIGN-BUILDER'S SINGLE POINT OF CONTACT AND ADDRESS

The Department Alternative Contracting C.E. Manager 2 shall be the Design-Builder's single point of contact for all communications during the procurement process prior to the Proposal Due Date. The Design-Builder's single point of contact for communications during the procurement process shall be the only contact person to request information.

4. THE DEPARTMENT'S DISSEMINATION OF INFORMATION

a. INFORMAL COMMUNICATIONS

The Department may post informal advance notices of Addenda and information on the Project website, and may also utilize e-mail alerts (lia.obaid@tn.gov). However, the Design-Builders may not rely on oral communications, or on any other information or contact that occurs outside the official communication process specified herein. Official communications will only be disseminated in writing, by e-mail, or via the website by the Department.

In the event the Department determines that a change of RFP or Contract terms or specifications are warranted, the Department will issue formal written clarifications or Addenda.

b. RESPONSES TO FORMAL REQUESTS

Questions on or modification of provisions of the RFP or any Addenda can be pursued through submittal of Form QR. The Department will provide responses to all:

- Requests for QPL product determination;
- Requests for answers; and
- Requests for change of Contract terms or specifications.

Information that the Department issues to the Design-Builders in writing responding to the questions submitted on Form QR will be posted to the website for all Design-Builders to view.

c. ADDENDA

If the Department determines that a formal request or protest raises an issue that should be resolved by amending a RFP provision, specification or Contract term, the Department will do so by issuing a formal Addendum clearly identifying the change as amending, revising, or modifying the RFP provision, specification or Contract term in question.

The Department may issue Addenda up to five (5) Calendar Days prior to the Proposal Due Date, unless the Department extends the Proposal Due Date concurrent with issuance of the Addendum.

d. REQUESTS FOR QPL PRODUCT DETERMINATION

The Design-Builder may request a product in lieu of a QPL product by identifying the product category included on the QPL. The shall provide sufficient manufacturer product information, together with supporting documentation such as industry studies and test results, and product demonstration, if relevant, as may be reasonably necessary to enable the Department to make a determination as to the inclusion of said product on the Department's QPL. The Design-Builder shall not submit any proprietary items, unless specified in accordance with 23 CFR 635.411 and approved by the Department prior to the request.

The Department may reject any request without recourse by the Design-Builder. The Department has no obligation but to review the product and shall not be liable for failure to accept or act upon any request. The Department shall be the sole judge of the acceptance or rejection of a product. If an agreement has not been reached by five (5) Calendar Days prior to the Proposal Due Date, the product shall be deemed rejected.

e. QUESTIONS

The Design-Builders may provide questions on RFP provisions, Contract provisions, and specifications that the Design-Builder considers unclear or incomplete. To be considered, the questions must identify the unclear language or

omission, or the specific discrepancies between identified provisions that result in ambiguity. All requests shall be submitted to the Department Alternative Contracting C.E. Manager 2 and will only be accepted in the format of Form QR in electronic format by e-mail (lia.obaid@tn.gov) or fax. Any questions to addenda issued after the question deadline will be considered and answers issued if time allows.

f. REQUESTS FOR CHANGE OF CONTRACT TERMS OR SPECIFICATIONS

The Design-Builders may submit a request for change of Contract terms or specifications setting out the language for which change is sought and indicating the document title, page, and subsection where the language is located. To be considered, the request must include the reason for the requested change, supported by factual documentation, and the proposed change. All requests shall be submitted to the Department Alternative Contracting C.E. Manager 2 and will only be accepted in the format of Form QR in electronic format using MS Word by e-mail (lia.obaid@tn.gov) or fax.

g. PROHIBITED DESIGN-BUILDER COMMUNICATIONS

No member of Design-Builder's organization (employees, agents, Principal Participants, the Designer, Key Personnel or the Technical Manager) may communicate with members of another Design-Builder's organization to give, receive, or exchange information, or to communicate inducements, that constitute anti-competitive conduct in connection with this procurement.

The Design-Builders shall not contact stakeholder staff regarding the RFP content or the requirements for the Project. Stakeholder staff includes employees of the Department, city(ies) and county(ies) in which the Project or any part of it are located.

Prohibited communications do not include contact with regulatory/county/city officials for the limited purpose of obtaining information regarding available detour routes and conditions associated with such use or regulatory/county/city guidelines.

5. PROCUREMENT SCHEDULE/SUBMITTAL DEADLINES

The Procurement Schedule and submittal deadlines are set out below**.** The Department will not consider requests on any submittal received by the Department after the deadline for its submittal date stated below. The Department will not consider requests on any submittals pertaining to an Addendum after the deadline established in the Addendum.

Deadline for Submittal of Alternate Technical Concepts (Dependent on Completion the NEPA Document)	***On or before November 12, 2018 4:00 p.m., CT.***
Deadline for Response to Alternate Technical Concepts,	***November 19, 2018 4:00 p.m., CT.***
Deadline for Submittal of Question Requests, and Requests for QPL Determination	***November 9, 2018 4:00 p.m., CT.***
Anticipated Deadline for Issuance of Last Addendum	***November 19, 2018 4:00 p.m., CT.***
Technical Proposal and Price Proposal Due Date and Time	***November 30, 2018 4:00 p.m., CT.***
Public Price Proposal Opening	***December 12, 2018 10:00 a.m., CT.***
Anticipated Award of Design-Build contract, or rejection of all proposal	***On or before December 21, 2018***
Anticipated Issuance of Initial Notice to Proceed	***January 18, 2019***

The Department will not consider any late Proposals. Proposals received after the Proposal Due Date will be returned to the unopened. The Department will not consider any Proposal modifications submitted after the Proposal Due Date. Nor will the Department acknowledge Proposal withdrawals submitted after the Proposal Due Date. Any such attempted withdrawal will be ineffective.

If the Design-Builder does not submit a Proposal by the Due Date and the Department chooses to issue a new, revised, or modified RFP, the Proposal will be considered non-responsive to the requirements set forth herein. As a result, the Design-Builder will not be eligible to respond to any additional RFP requests from the Department on this project.

6. CONTRACT DOCUMENTS

- Contract Book 1 (ITDB - Instructions to Design-Builders);
- Contract Book 2 (Design-Build Contract);
- Contract Book 3 (Project Specific Information);
- Design-Build Standard Guidance and Addendum;
- The Department Standard Specifications;
- The Department Supplemental Specifications;
- The Department Design Guidelines, and Addendum;
- The Department Construction Circular Letters;
- The Department Standard Drawings;
- Design Procedures for Hydraulic Structures;
- Drainage Manual;

- FHWA scour publication HEC-18, FHWA publication HEC-21 or HEC-22;
- Exhibit A (Technical Proposal), including any ATCs;
- Change Orders;
- Force Account Work Orders;
- Written Orders and Authorizations Issued by the Department;
- All Other Programmatic Plans or any Other Documents;
- All Material Included by Reference in any of the above Documents.
- The Department Material and Test Standard Operating Procedures.

7. COMPLETION DATES

- Contract Completion Time – The Design-Builder shall specify the number of Calendar Days after receipt of the Initial Notice to Proceed required for completion of the project within their Price Proposal. Completion of the project is completion of all work to be done under the Contract, except for plant/vegetation establishment, and the Department has provided final acceptance as stated in the Department's Standard Specifications. The number of Calendar Days specified by the Design-Builder in their Price Proposal will be placed in the Contract prior to execution of this Design-Build Contract.
- Interim Completion Dates – To be determined by the Critical Path Method (CPM) Schedule.

8. CRITICAL PATH METHOD (CPM)

The Technical Proposal CPM Schedule shall follow the applicable categories within the Schedule of Items and other cost control systems, including the Payment Progress Process.

The CPM Schedule shall include all major activities of work required under the Contract, in sufficient detail to evaluate design and construction process. The Design-Builder shall provide adequate time in the schedule for all parties involved with the Project to complete their work, including inspections, procurement activities, and testing. The Design-Builder's plan, as presented in the CPM, shall adhere to all Contract requirements. The Design-Builder shall include in the CPM schedule the work of subcontractors, vendors, suppliers, utilities, railroads, permitting agencies, the Department, and all other parties associated with the Project. Failure by the Design-Builder to include any element of its work or the work of others required for completion of the Project will not excuse the Design-Builder from completing the Project by the Contract Completion Date(s).

The scheduling compatible software employed by the Design-Builder shall be with the current and any future scheduling software employed by the Department. The Department's current software in use is Primavera Project Manager (v 5.0). The software shall be compatible provided in an electronic file version of the Project

Schedule that can be loaded or imported by the Department using the Department's scheduling software with no modifications, preparation or adjustments.

The CPM Schedule shall show the order in which the Design-Builder proposes to carry on the work, the time frame which it will start the major items of work and the critical features of such work (including procurement of materials, plant, and equipment), and the contemplated time frames for completing the same. For the purposes of developing the CPM Schedule, the Design-Builder shall use ten (10) business days for the Review and Approvals performed by the Department. The CPM Schedule shall include, at a minimum, the following items:

- Controlling items of work, major work and activities to be performed;
- Seasonal weather limitations;
- Land disturbance restrictions;
- Phase duration or milestone events, based on selected option as applicable;
- Specified contract completion time (defined above) from Price Proposal.

The purpose of this scheduling requirement is to ensure adequate planning and execution of the work and to evaluate the progress of the work. The CPM Schedule proposed shall meet or exceed minimum Contract requirements, as determined by the Department in its sole discretion, where all Design-Builder risks are mitigated with schedule logic. The Design-Builder is and shall remain solely responsible for the scheduling, planning, and execution of the work in order to meet the Project Milestones, the Intermediate Contract Times, and the Contract Completion Date(s).

Within ten (10) business days after award of the Contract, the Design-Builder shall assign a percentage of the Pay Item Cost to each activity in the proposed CPM that reflects an accurate percentage value to each activity based on estimated costs plus associated profit and overhead. The profit and overhead assigned by the to the individual activities starting shall be equal to or less than the mark-up applied to the work when establishing the Contract Lump Sum Price. The schedule shall be in a suitable scale to indicate graphically the total percentage of work scheduled to be completed at any time.

Review and Comment by the Department shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Design-Builder of providing sufficient materials, equipment, and labor to guarantee completion of the Project in accordance with all Contract requirements. The Department Review and Comment shall not be construed to modify or amend the Contract, Interim Completion Dates, or the Contract Completion Date. The updated CPM Schedule may be utilized to facilitate the Department's Quality Assurance (QA) activities.

If at any time the design of the project potentially affects the approved FHWA NEPA document, the Design-Builder shall cease work and contact the Department Alternative Contracting Office.

The Department acceptance of any schedule does not relieve the Design-Builder of responsibility for the accuracy or feasibility of the schedule, does not modify the Contract, will not be construed as an endorsement or validation of the Design-Builder's plan, and does not guarantee that the Project can be performed or completed as scheduled. the Department's acceptance of the Design-Builder's schedules in no way attests to the validity of the assumptions, logic constraints, dependency, relationships, resource allocations, resource availability, manpower and equipment, or any other aspect of the means and methods of performing the work.

The Design-Builder shall produce a schedule that does not contain open-ended activities, except for the first and last activity in the schedule.

9. SUBMITTALS

Design-Build submittals will be based on the approved CPM Schedule. All submittals must be stamped into the Department designated contact office before 12:00 p.m. CST to start the review period that day. If submittals are received after 12:00 p.m. CST, the review period will begin on the following business day. The review period includes only the Department workdays.

Submittals shall be transmitted in a logical order and in accordance with the submittal schedule. All submittals shall be stamped by a Professional Engineer licensed in Tennessee.

B. PREPARATION OF PROPOSAL

1. METHOD OF PROCUREMENT

The Contract will be for Design-Build services to be paid on a lump sum basis for each Pay Item Number. The Department will award the Contract to the Design-Builder that submits a responsive Proposal that is determined by the Department to offer the lowest Adjusted Price considering the evaluation factors set forth in this ITDB.

The procurement process includes two steps:

Step One: RFQ (determination of Short list); and,
Step Two: RFP (selection of from submitting responsive Proposals).

Evaluation of Proposals will be based on information submitted in the Proposals or otherwise available to the Department, and will involve both pass/fail factors and price, as further detailed below

The Design-Builder shall comply with the Proposal preparation instructions set out in this **Contract Book 1 (ITDB - Instruction to Design-Builders)**, the **Contract Book 2 (Design-Build Contract)**, the **Contract Book 3 (Project Specific Information)**, the **Design-Build Standard Guidance** and any other Contract Documents released for this procurement.

2. ALTERNATIVE TECHNICAL CONCEPTS – SUBMITTAL REQUIREMENTS AND AUTHORIZATION TO USE

a. INFORMATION

To accommodate innovation that may or may not be specifically allowed by the RFP Documents, the Design-Builder has the option of submitting Alternative Technical Concepts.

An Alternative Technical Concept (ATC) is a private query to the Department that requests a variance to the requirements of the RFP or other Contract Documents that is equal or better in quality or effect as determined by the Department in its sole discretion and that have been used elsewhere under comparable circumstances.

The Design-Builder may include an ATC in the Proposal only if the ATC has been received by the Department by the deadline identified in this **Contract Book 1 (ITDB - Instruction to Design-Builders)** and it has been approved by the Department).

The submittal original deadline applies only to initial ATC submittals. Resubmittal of an ATC that has been revised in response to the Department's requests for further information concerning a prior submittal shall be subsequently received as directed by the Department.

An ATC shall in no way take advantage of an error or omission in the RFP. If, at the sole discretion of the Department, an ATC is deemed to take advantage of an error or omission in the RFP, the RFP will be revised without regard to confidentiality.

By approving an ATC, the Department acknowledges that the ATC may be included in the design and RFC (Readiness-for-Construction) plans; however, approval of any ATC in no way relieves the of its obligation to satisfy (1) other Contract requirements not specifically identified in the ATC submittal; (2) any obligation that may arise under applicable laws and regulations; and (3) any obligation mandated by the regulatory agencies as a permit condition.

A proposed ATC is not acceptable if it merely seeks to reduce quantities, performance, or reliability, or seeks a relaxation of the contract requirements. ATCs shall be submitted by the Design-Builder and pre-approved in writing by the Department. All Technical Proposals must include the Department's pre-approval letters for consideration of the ATCs.

b. SUBMITTAL REQUIREMENTS

Each ATC submittal shall include two (2) individually bound copies and shall use Form ATC located in **Contract Book 3 (Project Specific Information)**. Each ATC shall include the following information:

1) Description. A detailed description and schematic drawings of the configuration of the ATC or other appropriate descriptive information (including, if appropriate, product details [i.e., specifications, construction tolerances, special provisions] and a traffic operational analysis, if appropriate).
2) Usage. Where and how the ATC would be used on the Project.
3) Deviations. References to all requirements of the RFP that are inconsistent with the proposed ATC, an explanation of the nature of the deviations from said requirements, and a request for approval of such variance(s).
4) Analysis. An analysis justifying use of the ATC and why the variance to the requirements of the RFP should be allowed.
5) Impacts. Discussion of potential impacts on vehicular traffic, environmental impacts identified, community impact, safety and life-cycle Project impacts, and infrastructure costs (including impacts on the cost of repair and maintenance).
6) History. A detailed description of other projects where the ATC has been used, the success of such usage, and names and telephone numbers of project owners that can confirm such statements.
7) Risks. A description of added risks to the Department and other entities associated with implementing the ATC; and
8) Costs. A description of the ATC implementation costs to the Department, the Design-Builder, and other entities (right-of-way, utilities, mitigation, long term maintenance, etc.).

The ATC, if approved, shall be included in the Price Proposal if the Design-Builder elects to include it in their Technical Proposal.

c. REVIEW OF ATCs.

A panel will be selected to review each ATC, which may or may not include members of the Design-Build Review Committee. The Design-Builder shall make no direct contact with any member of the review panel, except as may be permitted by the Department Alternative Contracting C.E. Manager 2. Unapproved contact with any member of the review panel will result in a disqualification of that ATC.

The Department may request additional information regarding a proposed ATC at any time. The Department will return responses to, or request additional information from, the within ten (10) business days of the original submittal. If additional information is requested, the Department will provide a response within ten (10) business days of receipt of all requested information.

Under no circumstances will the Department be responsible or liable to the Design-Builder or any other party as a result of disclosing any ATC materials, whether the disclosure is deemed required by law, by an order of court, or occurs through inadvertence, mistake or negligence on the part of the Department or their respective officers, employees, contractors, or consultants.

d. THE DEPARTMENT RESPONSE

The Department will review each ATC and will respond to on Form ATC as shown in **Contract Book 3 (Project Specific Information)** with one of the following determinations:

1) The ATC is approved.
2) The ATC is not approved.
3) The ATC is not approved in its present form, but may be approved upon satisfaction, in the Department's sole discretion, of certain identified conditions that shall be met or certain clarifications or modifications that shall be made (conditionally approved).
4) The submittal does not qualify as an ATC but may be included in the Proposal without an ATC (i.e., the concept complies with the baseline requirements of the RFP Documents).
5) The submittal does not qualify as an ATC & may not be included in the Proposal; or
6) The ATC is deemed to take advantage of an error or omission in the RFP, in which case the ATC will not be considered, and the RFP will be revised to correct the error or omission.

e. ATC INCLUSION IN TECHNICAL PROPOSAL

The Design-Builder may incorporate one or more approved ATCs as part of its Technical and Price Proposals. If the Department responded to an ATC by stating that it would be approved if certain conditions were met, those conditions must be stipulated and met in the Technical Proposal. If the ATC is used in the submittal, the approved Form ATC shall be included in the Technical Proposal.

In addition to outlining each implemented ATC, and providing assurances to meet all attached conditions, the shall also include a copy of the ATC approval letter with approved form from the Department in the Technical Proposal within the Appendix and these will not count towards the page limit maximum; however the ATC must be discussed within the Technical Proposal Response Category for scoring.

Approval of an ATC in no way implies that the ATC will receive a favorable review from the Design-Build Review Committee. The Technical Proposals will be evaluated in regards to the evaluation criteria found in this **Contract Book 1 (ITDB - Instructions to Design-Builders)**, regardless of whether or not ATCs are included.

The Price Proposal shall reflect all incorporated ATCs. Except for incorporating approved ATCs, the Technical Proposal may not otherwise contain exceptions to, or deviations from, the requirements of the RFP.

3. SELECTION PROCEDURE

The Department will utilize a ***Meets Technical Criteria (A+B)*** selection process in this procurement to award a Contract to the responsible Design-Builder that demonstrates it meets the technical criteria and can deliver the best combination of price and time (A+B) in the design and construction of the Project.

Price Proposals will be calculated in accordance with the following method:

Total Contract (A+B) = A+ (B x TIME)
Where, A = Contract Amount
B = the number of Calendar Days (from the Initial Notice to Proceed) indicated by the time needed to complete the Project in their Price Proposal and will become the contract completion time to be shown in the contract book.

TIME VALUE = Value associated with time of completion on this Project.

B: Calendar Days
Amount of one Calendar Day is $30,000 as stated in Special Provision 108B.

It is intended that all construction be completed by the earliest feasible date to minimize public inconvenience and enhance public safety. Should the total number of calendar days that the Design-Builder placed in the Proposal under the "B" portion of the Proposal to be deemed excessive, then the Proposal will be rejected. To this end the Design-Builder shall pursue the work rigorously utilizing the necessary work week, work hours and/or work shift schedules to expedite the work. The total Contract (A+B) cost will be used by the Department to determine the Apparent Design-Builder, but reimbursement to the Design-Builder shall be based solely on the Proposal Price total "A" and any incentive or disincentive payment made in accordance with the Contract.

IMPORTANT: The number of Calendar Days "B" is to be placed in the Price Proposal. Failure to enter a value for "B" will make the Proposal irregular and be cause for rejection.

Calendar days will be charged in accordance with the Contract and time charges will begin on the date shown on the initial NTP letter. Time charges will continue until work is complete, excluding punchlist items and vegetation establishment, on the Project in accordance with the Contract.

Notwithstanding any other provision of this Contract to the contrary, no time adjustments will be allowed for:

- Adverse weather conditions;
- The time required to Review and Approve Shop Drawings;
- The time required to review VECPs;

- The time to process Change Orders or plan revisions requiring additional Review and Approval;
- The time to complete work not on the CPM Schedule;
- Any delays typically encountered during a Project regardless of the source.

Time adjustments may be considered for:

- The time for plan revisions requiring additional Review and Approval if the Design-Builder was unable to work on the controlling item of work without revised plans or shop drawings;
- The time for ordering and delivery of materials for Extra Work directed by the Department that affects the CPM Schedule;
- Delays encountered due to a catastrophic event, beyond the control of the Design-Builder, that the Department determines adversely affected the progress of work.

The Department reserves the right to reject any or all Proposals, to waive technicalities, or to advertise for new Proposals, if, in the judgment of the Department, the best interests of the public will be promoted thereby. In putting together their Proposals, the Design-Builder should keep in mind and address the Project goals stated herein.

C. RELATIVE WEIGHTS ALLOCATED TO TECHNICAL AND PRICE PROPOSALS

The selection method to be utilized for this Project is "Meets Technical Criteria (A+B)". The Technical Proposal will be evaluated on the pass/fail and technical evaluation factors identified herein. A Proposal must achieve a **Pass** rating for RC I, II, III, and IV. The Department shall first determine whether the Proposals are responsive to the requirements of the RFP. Prior to making such determination, the Department may offer a Design-Builder the opportunity to provide supplemental information or clarify its Proposal. Each responsive Technical Proposal shall be evaluated based on the criteria provided herein. After evaluation of the Technical Proposal, the Department, as required by Department Rule 1680-5-4, Procedures for the Selection and Award of Design-Build Contract, will publically open and read the Total Contract Amount (A+B). Although the selection will be made on the bid proposal that qualifies as the lowest and best adjusted bid, the cost of the Contract will be the amount received as the Proposal Price "A" and will be placed in **Contract Book 2 (Design-Build Contract)** upon award.

D. TECHNICAL RESPONSE CATEGORIES AND SCORING

Proposal responses for Response Categories I through IV will be evaluated using the rating guidelines set out in this **Contract Book 1 (ITDB - Instruction to Design-Builders)**.

EVALUATION FACTORS	POINTS
RESPONSE CATEGORY I	**PASS/FAIL**
RESPONSE CATEGORY II	**PASS/FAIL**

RESPONSE CATEGORY III	**PASS/FAIL**
RESPONSE CATEGORY IV	**PASS/FAIL**
TOTAL	

During the evaluation period, each Technical Proposal will be reviewed by the Department Design-Build Review Committee (DBRC) individually.

1. RESPONSE CATEGORY I

The submittals required under Response Category I as stated in this **Contract Book 1 (ITBD - Instruction to Design-Builders)** will be evaluated as a matter of responsibility on a pass/fail basis.

a. FORMS

1) All required contract forms filled out. All Response Category forms and any forms specified within a Response Category shall be placed within the appropriate response category below. If any Response Category item requires additional sheets, the form shall indicate at the bottom of the item, see additional sheets. Additional forms can be used, but are not necessary if only one item requires additional sheets.
2) All other forms are to be placed within this Response Category.

b. OTHER

1) City and state where assigned staff will be located, particularly the location(s) of design staff.
2) List of DBEs Contacted and most likely to be utilized (Include identification of the type of work considered).

2. RESPONSE CATEGORY II: DESIGN-BUILDER'S ORGANIZATION AND EXPERTISE

Submit as much of the following for Evaluation on the Response Category II form in **Appendix A**, will be evaluated as a matter of responsibility on a pass/fail basis (be as specific as possible):

a. ORGANIZATION

1) Project-Wide Organizational Chart, including Design and Construction Functions; Key Personnel and Design Professionals.
   - Include responsibilities and reporting relationships or chain of command, clearly identifying the Project Manager, and personnel who will be assigned to the various tasks identified in this RFP.
2) Description of those categories of work which the Design-Builder anticipates will be performed by the Design-Builder's own forces and those categories which will be performed by Subcontractors.
3) Plans and procedures for management of Subcontractors.

4) Personnel Organization

b. PROJECT EXPERTISE

1) The Design-Builder shall identify all major subcontractors in the Technical Proposal.
2) Describe the overall strengths of the Design Team and their ability to fulfill the design requirements of this Project.

3. RESPONSE CATEGORY III: PROJECT CONTROLS AND MANAGEMENT

Submit as much of the following for Evaluation on the Response Category III form in Appendix A will be evaluated as a matter of responsibility on a pass/fail basis (be as specific as possible):

a. PROJECT UNDERSTANDING

1) Describe or outline the objectives, goals, and tasks to show or demonstrate the Design-Builder's view and understanding of the nature of the contract. Consider if the Scope of Services attached to this RFP is sufficient to attain the Department's goals and objectives.
2) Identify any potential right-of-way and utility conflicts.
3) Identify innovative approaches to minimize any impacts to the right-of-way. Describe any temporary impacts and associated minimization approaches.

b. SCHEDULE MANAGEMENT

1) CPM Time Schedule (to be submitted in color) meeting the requirements established in the Contract, and consistent with the Department's Project Sections, and Pay Items identified. See Section A.7 and A.8 of this **Contract Book 1 (ITDB - Instruction to Design-Builders)**.
2) Describe or outline the assumptions upon which the CPM Schedule was based, risks, constraints, contingencies, sequence of work, the controlling operation or operations, intermediate completion dates, milestones, project phasing, anticipated work schedule and estimated resources that impacted the schedule.
   a) The CPM Schedule shall indicate how the Design-Builder intends to:
      - Divide the Project into work segments to enable optimum construction performance and explain the planned sequence of work, the critical path, proposed phasing of the Project, and any other scheduling assumptions made by the Design-Builder.
      - Plans and procedures to insure timely deliveries of materials to achieve the Project schedule.
      - Categories of work that anticipates will be performed by Design-Builder's own direct labor force, those categories that will be performed by Subcontractors, those categories that will be performed by project specific teams, and those categories that will be performed by existing teaming arrangements.
      - An explanation of Design-Builder's methodology for updating it.

b) The Design-Builder may adjust the list to more accurately reflect planned sequences and methods, although the level of detail shall be similar to that reflected in the list of required Pay Items in the Schedule of Items.

3) Submit a description of Pay Item Breakdowns including the physical features and activities included in the Pay Item, and all work included in the Pay Item Totals as reflected on the Schedule of Items.

For example, but not limited to:

105-01.20 Design-Build Construction Stakes, Lines & Grades

- Field Survey
- Construction Staking

105-01.55 Design-Build Design Services

(All Design Activities shall be included in this item.)

- Definitive Design and Reviews
- Readiness-for-Construction Plans and Reviews, Specification and quantity estimates
- Working Drawings
- As-Built Plans and Reviews

105-08.20 Design-Build Contract Management

- Project Administration
- Project progress (scheduling)
- Contract progress submittals for payment

109-04.50 Design-Build ROW Services

- Appraisal
- Acquiring
- Public meetings if required

109-10.01 TRAINEE

Trainee at the unit price $0.80 per hour for each hour approved training provided, as indicated in SP1240

203-01.95 Design-Build Grading & Roadways

- Road and Drainage excavation
- Borrow excavation (rock)
- Borrow excavation (other than solid rock)
- Undercutting

204-05.50 Design-Build Geotechnical

- Borings
- Geotechnical Investigations
- Sinkholes
- Rock Fall Mitigation

209-01.50 Design-Build Environmental Management

- EPSC measures, EPSC installation
- EPSC inspections
- Permit Acquisitions

301-50.50 Design-Build Pavement

- Any aggregate base
- Any Bituminous Plant Mix Base (HM) (A, BM-2, Etc.)
- Any Bituminous Concrete Surface (HM) (D, E)
- Treated Permeable Base Or Lean Concrete Base
- Any Portland Cement Concrete Pavement (≤ 10 in. Thickness)
- Any Portland Cement Concrete Pavement (> 10 in. Thickness)
- Tack, Prime coat

604-10.95 Design-Build Bridges

- Components (steel, deck drains, etc.)
- Bridge
- ABC superstructure units
- Bridge Repairs
- Inspections

604-50.50 Design-Build Minor Structures (Other)

- Removal of Existing Buildings and Improvements
- Box Culvert
- Retaining Walls
- Endwalls
- Wingwalls
- Temporary structures
- Noise Walls

610-10.50 Design-Build Drainage

- Catch Basins
- Storm Drainage System
- Side drain
- Under drain

712-01.75 Design-Build Maintenance of Traffic

- Work Zone Safety Plan
- Barrier Rail

- Changeable Message Sign
- Traffic Control
- Project photography and videography

714-40.75 Design-Build Utilities and Railroad

- Coordination
- Relocation
- Lighting
- ITS

713-15.25 Design-Build Signing

- Footings
- Installation
- Removal and Disposal

716-99.50 Design-Build Striping/Pavement Markings

- Material
- Raised Pavement Markers
- Snowplowable Raised Pavement Markers

717-99.95 Design-Build Mobilization

4) Issues Resolution Plan

c. PROJECT MANAGEMENT

1) Describe the administrative and operational structure that would be used to perform the proposed work, including:
   - Describe how design personnel will interface with the construction personnel.
   - Communicating and coordinating between the Department and the Design-Builder. Include the approach for change management during construction for design initiated, field initiated, and the Department-initiated changes.
   - Describe existing design and/or construction quality management plan(s) that the Design-Builder may have already developed, and how it (they) will be implemented into work performed. Describe coordination of design and construction activities to ensure consistency in quality. Explanation of how independence of quality staff and function will be maintained.
   - Approach to managing costs under this Contract while fulfilling required tasks and assuring quality of work.
   - Describe or outline the process for constructability, durability, maintainability, safety, aesthetics and environmental mitigation in the design and construction processes.
   - Describe or outline the process for coordinating design and construction functions, including both design and construction components and all Subcontractor activities. Include a brief description (Construction

Management Plan) of the Design-Builder proposes to deal with unexpected disruptions (e.g., weather- or accident-related).

- Describe or outline the process (Design Review Plan) on how the Design-Builder will facilitate and implement Design Reviews as required under the Contract. Describe how the Designer and the design staff will be involved during construction. Also include the Design-Builder's Construction Staging and Phasing Plan, indicating timing and sequencing of major activities for the Project.
- Describe or outline the process (Diversity Plan) of the plan to ensure projected subcontracting plan is applied at all tiers. Describe how the Design-Builder will achieve the goal set forth on this project. Participation shall be accomplished by including certified DBEs in any part of the Contract work that is necessary to complete the Contract obligation. A certified DBE may participate as a Design-Builder, subcontractor, joint venture member, material supplier, material manufacturer, or professional service provider. Identify DBE and EEO representatives and their roles and responsibilities and identification of specific strategies and approaches that will be taken by the Design-Builder to meet the requirements of the Affirmative Action and Equal Employment Opportunity provisions described in **Design-Build Standard Guidance**.
- The Design-Builder will also be responsible for fulfilling FHWA 1273 "Contract Provisions"

d. ENVIRONMENTAL COMPLIANCE

1) Identify any potential environmental impacts.
2) Describe or outline the process for environmental compliance.
3) Describe or outline the approach to Erosion Prevention and Sediment Control for the Project.
4) Describe or outline the understanding of the overall approach to permitting and the comfort level with obtaining the required permit application/ modification within the allowed timeframe.
5) Identify innovative approaches to minimize any impacts in environmentally sensitive areas.

e. INNOVATION

1) Identify any design or construction solutions that the Design-Builder considers innovative and how those solutions will better serve the Project. Include a description of ideas that were considered, whether implemented or not. If this is an alternate technical concept, include only approved ATCs.
2) Identify any potential innovative traffic control and how those solutions will better serve the Project. Describe any temporary impacts and associated with innovations.
3) Will these innovations add to, subtract from or have no effect on the costs?

4. RESPONSE CATEGORY IV: TECHNICAL SOLUTIONS

Submit as much of the following for Evaluation on form Response Category IV form in **Appendix A**(be as specific as possible):

a. It is not the intent of the Department for the Design-Builder to submit design plans. The details submitted shall be of sufficient detail to illustrate color, texture, pattern, emblems, proportion, corridor consistency, complementing details, or other such visual effects. For those details used in multiple locations, typical details will suffice with the locations for their use noted in narrative or graphic form.

b. Conceptual plans, drawings, etc. within the Technical Proposal (these plans are in addition to and are separate from the ROW Acquisition sheets required in **Contract Book 3 (Project Specific Information))** shall include at a minimum the following:
   - Show plan view of design concepts with key elements noted.
   - Show preliminary drawing of bridge elements.
   - Identify preliminary horizontal and vertical alignments of all roadway elements.
   - Show typical sections for the mainline of the Project.
   - Identify drainage modifications and designs to be implemented.
   - Identify the appropriate design criteria for each feature if not provided.
   - Identify all bridge types to be constructed, including any special design features or construction techniques needed.
   - Identify any deviations or proposed design exceptions, from the established design criteria that will be utilized. Explain why the deviation is necessary.
   - Describe any geotechnical investigations to be performed by the Design-Builder.
   - Describe how any utility conflicts will be addressed and any special utility design considerations. Describe how the design and construction methods minimize the Department's utility relocation costs.
   - Describe how the design will affect the right-of-way costs.
   - Identify types of any retaining walls and /or noise walls if applicable.

c. The Technical Proposal shall include half-size plan sheets depicting those elements required by the RFP.

d. Describe any traffic control requirements that will be used for each construction phase.

e. Describe how traffic will be maintained as appropriate and describe understanding of any time restrictions noted in the RFP.

f. Describe the safety considerations specific to the Project.

g. Discuss overall approach to safety.

h. Describe any proposed improvements that will be made prior to or during construction that will enhance the safety of the work force and/or traveling public both during and after the construction of the Project.

E. PROPOSALS

1. MINIMUM CONTRACT REQUIREMENTS

The RFP Contract Documents constitute the minimum Contract requirements established by the Department. Please refer to the **Contract Book 2 (Design-Build Contract)** for the order of precedence established in the Contract. Therefore, those portions of the Proposal that meet or exceed minimum Contract requirements established by the Department, as determined by the Department in its sole discretion, will themselves become minimum Contract requirements upon Contract execution.

The award of the Contract does not in any way imply that the Department will modify, relax, or relieve the Contract Documents in favor of the details of the Technical Proposal submitted by the Design-Builder.

a. TOTAL PROPOSAL SUBMITTAL

The Proposal consists of the Technical Proposal, the Price Proposal, and all required Contract Documents. The Technical Proposal shall be delivered in a sealed container within the mailing package clearly identified, labeled, and addressed as follows:

- **Recipient (the Department) set out in the Contract and "Proposal - Procurement Sensitive"**
- **Return address: Design-Builder's name, contact person's name, mailing address;**
- **Date of submittal;**
- **Contents labeled as "Interstate 75 at Interstate 24 Interchange Modification"; and "Design-Build Project (DB1801)" and "Design-Build Technical Proposal".**

The Technical Proposal may be sent by United States Mail or private carrier (i.e., Federal Express, United Postal Service, etc.), or be hand-delivered to the address shown in Section C.2 of **Contract Book 2 (Design-Build Contract)**. The container shall include the packaged sealed manila envelope as follows:

- Technical Proposal Package labeled as such (including required forms) and all other required Contract Documents.

Text for all documents can be single spaced, Times New Roman, 12-point font shown in English units. Font size on tables and figures may be of any size so long as it is easily readable. Pricing shall be in US currency, in current dollars and cents. In each case in which a form is required to be submitted, it will be found in the **Contract Book 2 (Design-Build Contract)** or in **Contract Book 3 (Project Specific Information)** and its use is mandatory. Technical Proposals shall be organized and formatted as specified herein. Each Technical Proposal Response Category shall be preceded by a simple tab divider identifying the Response

Category (e.g., "Response Category I," "Response Category II Design-Builder's Organization and Expertise," etc.) with each appropriate Response Category Form.

Technical Proposal pages shall be 8-½ inch x 11-inch white paper. Drawings or sketches shall be submitted on 11-inch x 17-inch and/or 8 ½-inch x 11-inch white paper. Schedule plots shall be on 8-½-inch x 11-inch or 11-inch x 17-inch paper. Double-sided pages shall be used except for pre-printed information, such as corporate brochures, and the original copy of all signed forms, which shall be single-sided.

The Technical Proposal should present information clearly and concisely. Text or other information that is difficult to read may be disregarded, potentially resulting in either a lowered score or rejection of the Proposal as non-responsive.

All Technical Proposal responses shall be easily reproducible by normal black and white photocopying machines. Color photographs, renderings and brochures shall be adequately bound and suitably protected for handling and circulation during review.

Three (3) originals and eight (8) copies of the Technical Proposal. Label the original Technical Proposals "ORIGINAL" and label each copy "COPY ___ of 8".

Price Proposals shall be submitted using Internet bidding with electronic bid bond. The Design-Builder shall not submit a hardcopy Price Proposal to the Department. The Internet bid and electronic bid bond executed by the Design-Builder and their Surety will be considered as a complete Price Proposal and will be printed at the time of the public opening. Letters recognizing the addenda to the RFP and amendments to the electronic bidding file will be posted on the Bid Express website. Design-Builder must acknowledge addenda by completing the Technical Proposal Signature Page (Form TPSP) found in RFP **Contract Book 2 (Design-Build Contract)** and placed within your Technical Proposal. Also, by submitting the EBS bid file within your Price Proposal you are also acknowledging all addenda associated with the Price Proposal. It is the bidder's responsibility to notify all affected manufacturers, suppliers and subcontractors of any change. Failure to acknowledge receipt of Addenda or to apply any applicable amendments to the electronic bidding file is grounds for rejection. The electronic bid "A" shall be the Total Bid Amount using the ATC.

There will be projects that will have numerous alternates. The will be required to bid on only one alternate for each construction item. The proper procedure for entering alternate bids is to enter prices for the intended alternate item(s) of construction and leave the undesired alternate item(s) of construction blank.

Additionally, one (1) electronic copy of the Technical Proposals and the ROW Acquisition sheets required in **Contract Book 3 (Project Specific Information),** shall be submitted in Adobe .pdf format on flash drive, organized and numbered consistent with the required organization.

1) TECHNICAL PROPOSAL

Place the required Technical Proposal forms, except the Response Category Forms, in Technical Proposal Response Category I after a tab labeled "Forms."

Technical Proposal Response Category I – There is *no page limit* on the information required to be submitted under Response Category I.

Technical Proposal Response Categories II through IV – Proposal responses to Response Categories II through IV shall be limited to the combined maximum total of 75 page count (not pages), not including section dividers and tabs, certain contract forms (Response Category Forms will be counted toward the total page count). The forms provided for response shall be used for the information requested. All information submitted in Response Categories II through IV will be counted in calculating page count, regardless of format or medium, including all materials attached to section dividers and tabs.

2) PROPOSAL PRICE

Design-Builders are cautioned that the total of price proposed in the Price Proposal "Schedule of Items" (the "A") shall become the Contract Amount upon Contract execution, and shall constitute total compensation to the selected for performing the Contract, including but not limited to all minimum Contract requirements. Therefore, the fact that a selected Design-Builder's Technical Proposal may contain elements that do not meet or exceed all minimum Contract requirements, as determined by the Department in its sole discretion, shall not entitle the selected to receive compensation in excess of the amount of the Proposal Price as a condition of performing the minimum Contract requirements or any other Contract obligation. Nor shall such fact entitle the selected to perform below minimum Contract requirements or fail to perform any other Contract obligation.

2. PROPOSAL OPENING

a. TECHNICAL PROPOSALS

The Department Alternative Contracting C.E. Manager 2 and the Design-Build Review Committee will open the Technical Proposal Package from each Design-Builder. They will determine responsiveness and the Pass/Fail rating for RC I to RC IV. Responsive and Passing Technical Proposals that meet all minimum criteria will be opened at the Proposal Due Date and time set out in this **Contract Book 1 (ITBD - Instruction to Design-Builders)** Section A.5, page 7. All technical proposals deemed non-responsive or failing to meet the minimum criteria will be notified prior to the public opening of the price proposals.

b. PRICE PROPOSALS; PUBLIC OPENING

Upon concluding its evaluation and scoring of the Technical Proposals, the Department will conduct a public opening of the Price Proposals for each responsive bid at the following location:

505 Deaderick Street, J.K. Polk Bldg.

Suite 700, Nashville, TN 37243, 7th floor Large Conference Room.

on the date and time set out in above in Section A.5, page 7.

Totals read at the opening of the Price Proposals are not guaranteed to be correct and no final award of the Contract will be made until Proposals have been checked and re-checked.

On all projects which are financed in whole or in part by funds received through Federal agencies and other third parties, the awarding of Contracts by the Department will be subject to approval or concurrence by the party or parties through which funds are received. The Department reserves the right to reject any Proposal which is not acceptable to any such third party set out above, although such bid proposal would otherwise qualify as the best Proposal in accordance with the Contract. It shall be the responsibility of the Department to determine which projects are so financed in part by third parties, such information being available upon request from the Department.

3. PROPOSAL STIPEND

A stipulated fee of **$200,000** will be awarded to each eligible Design-Builder on the short-list that provides a responsive bid, but unsuccessful, Proposal. If a contract award is not made, all Design-Builder's on the short-list that submits a responsive Proposal shall receive the stipulated fee. If the Department chooses to continue the process by revising, modifying, or issuing a new RFP, or issuing a Best and Final Offer, the stipend will only be paid to each eligible responding to the additional request and/or requirement. The Department Alternative Contracting C.E. Manager 2 will be notified of the opportunity to request to invoice for the stipulated fee from each eligible Design-Builder within thirty (30) days after the award of the Contract or the decision not to award. If the Design-Builder requests and accepts the stipulated fee, the Department reserves the right to use any ideas or information contained in the Proposals in connection with any contract awarded for the Project, or in connection with any subsequent procurement, with no obligation to pay additional compensation to the unsuccessful Proposers. Unsuccessful Design-Builders may elect not to invoice and thus refuse payment of the stipulated fee to retain any rights to its Proposal and the ideas and information contained therein.

The decision to issue a new RFP, a modified/revised RFP, or a "Best and Final Offer" indicates the Departments decision to continue with the award on or not to cancel the

project; therefore the stipend will only be paid once after the conclusion of the entire procurement process.

F. PRICE PROPOSAL EVALUATION

1. PRICE PROPOSAL EVALUATION METHODOLOGY

a. PRELIMINARY EVALUATION

1) PRICE REALISM AND REASONABLENESS

The Department will make a preliminary evaluation of the Price Proposal to determine if the prices set forth reflect Price Realism and Price Reasonableness in comparison with the Departments cost estimate. In making this evaluation, the Department may require review of Price Documents. In such case, the Design-Builder shall make itself available upon the Department's request to conduct a joint review of the Price Documents. If the Department concludes that the Price Proposal does not reflect Price Realism or Price Reasonableness, the Department will consider the Price Proposal non-responsive.

2) UNBALANCED PRICING

The Department will prepare a cost estimate prior to accepting Price Proposals. This will be used as a basis for a preliminary evaluation of the Price Proposal to determine if any of the prices are significantly unbalanced to the potential detriment of the Department. An unbalanced Proposal is considered to be one containing lump sum which does not reflect reasonable actual costs plus a reasonable proportionate share of the Design-Builder's anticipated profit, overhead costs, and other indirect costs which are anticipated for the performance of the items in question in comparison with the Departments cost estimate.

G. TECHNICAL PROPOSAL RESPONSE CATEGORIES AND REQUIRED TECHNICAL PROPOSAL CONTENT

Additional information or requirements for each Response Category, or modifications to the Response Category instructions and requirements set out below, will be identified in the **Contract Book 3 (Project Specific Information)**. **Design-Builders are therefore advised to download this Contract Book 1 (ITDB - Instruction to Design-Builders) and the Contract Book 3 (Project Specific Information) and read them together.**

Regardless of the score assigned to any Technical Proposal evaluation factor or Response Category, and notwithstanding the fact that a Proposal is selected for award, only those portions of Sections II through IV of the Technical Proposal that meet or exceed the Department's minimum Contract requirements, as determined by the Department in its sole discretion, shall be incorporated into the resulting Contract. Those portions that do not meet or exceed the stipulated criteria, as determined by the Department in its sole

discretion, shall not be incorporated into the resulting Contract or modify any of the terms and conditions of the Contract.

1. RESPONSE CATEGORY I through IV

The submittals required under Response Category I through IV will be evaluated as a matter of responsibility on a pass/fail basis. Submit responses for each element of Category I through IV using the required forms as instructed acknowledging receipt of RFP, all Addenda and responses to questions, if any, issued by the Department.

a. COVER LETTER

The Design-Builder shall provide with its Technical Proposal a cover letter (maximum two pages) indicating its desire to be considered for the Project and stating the official names and roles of all Principal Participants, the Designer, and Project Manager. The Design-Builder shall identify a single point of contact and the address and telephone and fax numbers and e-mail address to which communications should be directed. An authorized representative of the Design-Builder's organization shall sign the letter. If the Design-Builder is not yet a legal Entity or is a joint venture or general partnership, authorized representatives of all Principal Participants shall sign the letter. Additionally, if the Design-Builder wishes to add, delete, or substitute a Principal Participant, or wishes to substitute its Designer or any Key Personnel that it identified in its SOQ, the Design-Builder must make such request in this cover letter. In addition to including such a substitution or change request in its cover letter, the Design-Builder must follow the procedures and submit the information required under this RFP.

The Design-Builder shall attach to the cover letter the Acknowledgment of Receipt acknowledging receipt of RFP, all Addenda and responses to questions, if any, issued by the Department.

b. FORMS

Form Question Request (QR), Form Alternate Technical Concepts (ATC), and Response Category Forms are located in **Appendix A**. All other contract forms are located within **Contract Book 2 (Design-Build Contract) Appendix C**.

c. EVIDENCE OF CORPORATE EXISTENCE; CERTIFICATE OF AUTHORITY

Submit the following, as applicable:

- A Certificate of Good Standing issued by the Design-Builder's state of residence; or
- For Entities not residents of the State of Tennessee, a Certificate of Authority to transact business in Tennessee.

d. EVIDENCE OF AUTHORITY TO ENTER INTO JOINT VENTURE; EXECUTE JOINT-VENTURE AGREEMENT

If the Design-Builder is a joint venture; submit a copy of the joint venture agreement. Also, for each joint venturer submit the partnership agreement or corporate resolution authorizing it to enter into the joint venture and authorizing named individuals to execute the joint venture agreement on the joint venturer's behalf.

e. EVIDENCE OF PROPOSAL SIGNATORY AUTHORITY

Submit bylaws, or the corporate resolution, partnership agreement, or joint venture agreement evidencing authority of each signatory to the Technical Proposal Signature Page and Proposal Firm Offer to execute it on behalf of the Design-Builder. NOTE: If the is a joint venture or partnership, each joint venture or partner must sign the Technical Proposal Signature Page (Form TPSP).

H. PRICE PROPOSAL RESPONSE CATEGORIES AND REQUIRED PRICE PROPOSAL CONTENT

Submit responses for each element below, using the required forms where instructed. All prices quoted shall be in U.S. currency.

1. PRICE PROPOSAL CONTENTS

Design-Builders shall include each of the following in the Price Proposal:

- Electronic Price Proposal (including specified Contract Completion Time); and
- Electronic Proposal Security in the amount of five (5%) percent of the Proposal Price. Proposal Security may be submitted in the form of a Proposal Bond or Proposal Guarantee issued by an insured institution or certified check payable to the Department of Transportation.

2. INSTRUCTIONS REGARDING PREPARATION OF SCHEDULE OF ITEMS

Design-Builders shall complete and submit in compliance with the following instructions:

a. Provide a lump-sum price for each Pay Item Total in each Pay Item. The lump-sum price shall represent the total price to complete and integrate all work represented by that Pay Item into the Project, inclusive of associated overhead, labor, materials, equipment, tools, transportation and Project administration. These are not bid items and will be used as a basis in developing the cost-loaded CPM after award.
b. Utilize the same titles, contents, and limits as are shown on Schedule of Items.
c. Price Proposal supporting documentation may be requested by the Department.

I. FORMS

The following forms are required to be used in preparation of the Proposal. They are located within **Contract Book 2 (Design-Build Contract)** and **Appendix A**. The Design-Builders shall download the forms and complete them in accordance with the instructions contained in the forms and the text of this **Contract Book 1 (ITDB - Instruction to Design-Builders)** or the **Contract Book 2 (Design-Build Contract)** in which the forms are referenced.

1. DESIGN-BUILDER QUESTIONS

- FORM QR, Question Request Form.

2. TECHNICAL PROPOSAL FORMS

- RESPONSE CATEGORY FORMS II THRU IV;
- ATC FORM;
- FORM AT, ATTESTATION RE PERSONNEL USED IN CONTRACT
- FORM COI, CONFLICT OF INTEREST DISCLOSURES;
- FORM TPSP, TECHNICAL PROPOSAL SIGNATURE PAGE FORM;

3. BONDS AND FORMS TO BE SUBMITTED BY THE APPARENT DESIGN-BUILDER

- FORM CP&PB, CONTRACT PAYMENT AND PERFORMANCE BOND (submitted after award of the Contract).
- FORM LC, LOBBYING CERTIFICATE

J. PROPOSAL MEETINGS

The Department may elect to hold meetings with all Design-Builders. The Design-Builders are strongly encouraged to attend, and will be expected to bring (a) appropriate members of its anticipated Key Personnel, and if required by the Department, (b) senior representatives of the proposed Designer and proposed Technical Manager. The Department shall provide sufficient time to the Design-Builder's for travel and preparation for the meetings.

The information received by the Department will be part of the procurement process and will not be disclosed by the Department until award of the Contract, at which time the information will be subject to disclosure except as to information that is subject to exemption from disclosure under the Tennessee Open Records Law.

1. MANDATORY PRE-PROPOSAL MEETINGS

The Department does not expect to hold a pre-proposal meeting on this project; however, the Department may hold one or more mandatory pre-proposal meetings with all Design-Builder's prior to the Proposal Due Date, to provide additional opportunity

for questions and comments. Failure of a Design-Builder to attend any such meetings will result in elimination of that from the short-List, and any Proposal submitted by that will be rejected. The decision to hold pre-proposal meetings will be disclosed by the Department no later than the date shown in Section A.5 for the anticipated deadline for issuance of the last addendum

The Department will respond, orally or in writing, to Design-Builders' questions, if any, raised at the meetings. In the event the Department determines that formal answers or change of the RFP, specifications or Contract terms is warranted, the Department will issue formal written clarifications or Addenda in accordance with the terms of **Contract Book 2 (Design-Build Contract)**.

2. ORAL PRESENTATIONS AFTER SUBMISSION OF PROPOSALS

The Department may elect, in its sole discretion, to require each to make a one-on-one oral presentation regarding the Technical Proposal. The oral presentations will be mandatory, and failure of a Design-Builder to appear and make the presentation will result in elimination of that Design-Builder from the Short-List. The Department will give no further consideration to that Design-Builder's Proposal, and that will be ineligible for a stipend. If the Department elects to require oral presentations, the Department will notify the Design-Builders in writing or by e-mail of the dates, times and locations, rules, requirements and protocols for the oral presentation.

The oral presentation will be an opportunity for the Design-Builders to either explain or present their Technical Proposals and respond to the Department requests for clarification, but such presentations will not be a substitute for, nor be a means to modify or augment, any part of the Technical Proposal. The oral presentations will be used by the Department to assist in the evaluation of the Technical Proposals, and the information from the oral presentations may be used by the Department to evaluate the Technical Proposal Score.

K. CHANGES IN DESIGN-BUILDER'S ORGANIZATION AFTER SUBMITTAL OF SOQ

Key Personnel identified in the SOQ shall not be modified in the Technical Proposal without written approval of the Department. Any request for modification shall be sent to the Department Alternative Contracting C.E. Manager 2. The written approval to modify the Key Personnel shall be included in Technical Proposal Response Category I. Failure to comply with this requirement may be justification for removing the Design-Builder from further consideration for this Project.

The must submit with any request the same information about the proposed Principal Participant or team member that was originally required to be submitted in the SOQ, including legal and financial information (pass/fail) and Technical evaluation information. If a Major Participant is being added, deleted, or substituted, the must submit such additional information as may be required by the Department to demonstrate that the

changed organization still meets the RFQ criteria upon which short-list selection was based.

L. MODIFYING A PROPOSAL PRIOR TO PROPOSAL DUE DATE

1. ERASURES, INTERLINEATIONS, STRIKEOUTS

If the initial Proposal has been modified by hand-written interlineations, strikeouts, or erasures, **EACH** such alteration must be initialed in blue ink by the signatory to the Technical Proposal and submitted to the Department Alternative Contracting C.E. Manager 2.

2. SUBSEQUENT TO THE INITIAL SUBMITTAL

Subsequent to Proposal submittal, a Design-Builder may submit written modifications identified either by redlined text or on Design-Builder's letterhead indicating the revisions with reference to the Proposal or form section, subsection, paragraph (if applicable) and page number. The must submit with its Proposal modifications an affirmation signed by each of the original signatories that the modifications amend the terms of the Proposal previously submitted and submitted to the Department Alternative Contracting C.E. Manager 2.

M. WITHDRAWING A PROPOSAL

1. BY WRITTEN NOTICE

A Design-Builder may withdraw its Proposal prior to the Proposal due date by submitting written notice to the Department Alternative Contracting C.E. Manager 2 on the Design-Builder's letterhead signed by an authorized representative. The notice must include the name and telephone number of the Design-Builder's representative that will be contacted to arrange for the Design-Builder to retrieve the withdrawn Proposal.

2. IN PERSON

A Design-Builder may withdraw its Proposal in person prior to the Proposal Due Date upon presentation of identification and evidence of authorization to act for the Design-Builder. If possible, the Department will return all Proposal materials at the time an in-person withdrawal is presented. However, Proposals are in the possession of one individual and are available only when that person is present.

3. SUBSEQUENT PROPOSAL SUBMITTAL NOT PRECLUDED

Withdrawal of a Proposal will not preclude a Design-Builder from subsequently submitting a new Proposal, so long as that new Proposal is properly submitted and

received by the Department's Alternative Contracting C.E. Manager 2 prior to the Proposal Due Date.

If the Design-Builder withdraws their Proposal and the Department chooses to issue a new, revised, or modified RFP after the Proposal Due Date (as stated in Section T), the Design-Builder must state within their withdraw written notice their request to be considered eligible to submit a Proposal in this instance. If the withdrawal is in person or the written notice does not state this request, the Design-Builder will no longer be considered eligible for the Project.

N. CONFLICT-OF-INTEREST DISCLOSURE REQUIREMENTS

If the Design-Builder finds that a Principal Participant, Design Professionals, or any Key Personnel listed in its SOQ is no longer eligible to be part of its organization or team for this procurement due to a conflict of interest (as defined in 23 CFR 636), if the Design-Builder's organization has changed since submittal of the Design-Builder's SOQ, or if additional potential conflicts of interest have developed since the Design-Builder's submittal of its SOQ, the Design-Builder shall comply with the following disclosure requirements.

1. THE DESIGN-BUILDER ORGANIZATION CHANGE OR ADDITIONAL POTENTIAL CONFLICTS OF INTEREST

If the Design-Builder's organization has changed and the change has been approved by the Department per Section G., or additional potential conflicts of interest have developed since the Design-Builder's RFQ submittal, the Design-Builder shall submit with its Proposal a new RFQ submittal for that SOQ Section and making a full disclosure of all potential 23 CFR 636 organizational conflicts of interest other than those already disclosed in the SOQ. If the Design-Builder's organization has not changed and no additional potential conflicts of interest have developed since initial submittal of the Design-Builder's SOQ, the Design-Builder shall submit a signed statement that no potential 23 CFR 636 organizational conflicts currently exist other than those already disclosed within the Design-Builder's SOQ. Also see **Design-Build Standard Guidance**, and the COI Guidelines provided with Form COI regarding State conflict of interest standards and disclosure regarding former the Department employees.

2. SUBCONTRACTORS

The Design-Builder shall include in its subcontracts a completed Conflict of Interest statement from each Subcontractor for whom the Design-Builder will utilize on the Project. The Design-Builder shall provide each Subcontractor with the Department's "Conflict of Interest Guidelines, and Disclosure Process" attached hereto.

O. PROPOSALS RESPONSIVENESS, RESPONSIBILITY AND REJECTION

1. SUBSTANTIAL COMPLIANCE REQUIRED

The Department may in its discretion reject any Proposal that does not substantially comply with the requirements set forth in the RFP, including this **Contract Book 1 (ITDB – Instruction to Design-Builders)**, and applicable public procurement procedures.

2. RESPONSIVENESS

The Department has determined that failure to properly submit the following items (all contract forms are located in **Contract Book 2 (Design-Build Contract)**) and in **Contract Book 3 (Project Specific Information)** will render the Proposal non-responsive:

- Technical Proposal;
- Technical Proposal Response Category Forms;
- Technical Proposal approved ATC Form, if utilizing ATC (In Appendix);
- Electronic Bid Price Proposal Schedule of Items;
- Electronic Proposal Bond or Electronic Proposal Guarantee; and
- USB drive with the Technical Proposal and the ROW Acquisition sheets.

3. COMPLETENESS

The following items must be properly submitted for a complete Proposal:

- Technical Proposal Forms (In RC Category I)
  - Form QR (This is the most current FORM QR with all Department answers);
  - Form AT;
  - Form COI;
  - Form TPSP;
  - Form LC (Submit Blank if not applicable);

4. UNINTENTIONALLY INCOMPLETE OR OMITTED PROPOSAL RESPONSES

Unless the Department, in its discretion, determines that a submitted Proposal is not in substantial compliance with RFP requirements, unintentionally incomplete, qualified, or omitted responses to the Technical Proposal, unlike the omission of any required submittals above, will be dealt with as a matter of Proposal scoring/review as opposed to responsiveness.

5. THE DEPARTMENT"S RIGHT TO SEEK CLARIFICATION; WAIVER

As permitted by Law, the Department Points of Contact may seek clarification of or discuss any response with the Design-Builder, in the Department's sole discretion, and the Department may waive minor informalities and irregularities it deems necessary or advisable that the best interest of the Department and/or the public will be promoted thereby.

As permitted by Law, the Department may hold meetings and conduct discussions and correspondence with one or more of the Design-Builders responding to this RFP to seek an improved understanding and evaluation of the responses to this RFP.

6. RESPONSIBILITY AND REJECTION OF PROPOSALS

The Department will reject any Proposal submitted by a Design-Builder that does not meet the applicable standards of responsibility.

7. REJECTION IN THE PUBLIC INTEREST

The Department reserves the right to reject any Proposal at its discretion. The Department may reject all Proposals for good cause upon a finding that to do so is in the public interest.

P. CONFIDENTIALITY

Documents submitted pursuant to this RFP will be subject to the Tennessee Open Records Law, TCA §§ 10-7-503 to 10-7-506, et. seq. Information submitted will be kept confidential until award by the Department, unless otherwise provided by law. The State shall not be liable for disclosure or release of information when authorized or required by Law to do so. The State shall also be immune from liability for disclosure or release of information.

Q. PROPOSAL BOND

1. REQUIREMENTS

- Each Proposal must be accompanied by a Design-Builders bidder's bond, in an amount of equaling not less than five (5%) percent of the Proposal Price electronically through Bid Express.
- If the Design-Builders bidder's bond is offered as guaranty, the bond must be made by a surety company, qualified and authorized to transact business in the State of Tennessee and must be acceptable to the Department.

R. APPARENT DESIGN-BUILDER REQUIRED SUBMITTALS

Within ten (10) Calendar Days of the date of the delivery of the Contract by the Department, the apparent Design-Builder shall provide the Department, in writing the following:

1. PAYMENT AND PERFORMANCE BOND

A Contract Payment and Performance Bond, in the amount of 100 percent of the Contract Amount on the form furnished by the Department (Form CP&PB).

2. INSURANCE CERTIFICATES

Insurance certificates evidencing the required insurance coverage. (Refer to the **Design-Build Standard Guidance**).

3. EVIDENCE OF AUTHORITY

- The names of all signatories to the anticipated Contract, their capacities and the names of their respective principals if not already provided.
- Corporate Resolutions or Bylaws evidencing the authority of each named signatory to act for its principal in executing the Contract and bind the principal to the terms of the Contract, if not already provided.

4. LICENSES

Evidence that the Apparent Design-Builder and its personnel are properly licensed to perform the work, unless previously provided.

5. ATC BREAKDOWN COST SAVINGS

Price Proposal ATC Breakdown, only if an approved ATC was submitted (format will be a one page summary of the Contract Amount including the original cost for Base Technical Concept cost minus ATC cost savings).

S. MODIFICATION OF CONTRACT

The Department may make modifications to the Contract as it may determine, in the exercise of its sole discretion, to be necessary to fully incorporate the terms of the Apparent Design-Builder's Proposal, to correct any inconsistencies, ambiguities, or errors that may exist in the Contract, and to clarify Contract terms, including technical requirements and specifications, if any. If, in the Department's sole discretion, it determines that the parties will be unable to reach a mutually-acceptable Contract, the Department may terminate discussions with the Apparent Design-Builder. The Department will then continue the process of discussion with the next highest-ranked Design-Builder until the Department either successfully executes a Contract or cancels the procurement.

The Department may investigate the qualifications of any Design-Builder under consideration, may require confirmation of information furnished by a Design-Builder, and may require additional evidence of qualifications to perform the Work described in this RFP.

T. MODIFIED OR NEW RFP ISSUANCE

The Department reserves the right, in its sole and absolute discretion, to:

- Reject any or all Proposals.
- Issue new RFP.
- Cancel, modify, or withdraw the RFP in their entirety.
- Solicit subsequent "Best and final offer" (BAFO) from Design-Builders.
- Modify the RFP process (with appropriate notice to Design-Builders).

A BAFO is a change to a design-builder's technical and/or price proposal made at the request of, or as allowed by, the Department within a best and final offer RFP after the solicitation closing date when all price proposals exceed an acceptable range of the Department's estimate. In the event initial price proposals exceed an acceptable range of the Department's Estimate may choose to make amendments to the details of the RFP and request a Best and Final Offer within a new RFP called a "Best and Final Offer" RFP.

Alternately, the Department reserves the right to redistribute a new or modified RFP for the project, outside the issuance of a BAFO RFP, to the eligible shortlisted firms if in the judgment of the Department that the best interest of the Department or the public will be promoted.

This may occur at any time prior to the execution by the Department of the Design-Build Contract, without incurring any obligations or liabilities.

U. CONTRACT EXECUTION; DELIVERY OF REQUIRED DOCUMENTS

1. BY APPARENT DESIGN-BUILDER

The Apparent Design-Builder must execute three (3) originals of the Contract and return the executed originals, together with (a) the rest of the Contract (Technical (*Exhibit A*) and Price Proposals) and (b) the Apparent Design-Builder required submittals set out above in this **Contract Book 1 (ITDB - Instruction to Design-Builders)**, to the Department within ten (10) Calendar Days of the date of the delivery of the Contract by the Department, or within such longer period as the Department may set in writing prior to or during the response period established herein. The Apparent Design-Builder's failure to execute and deliver the duly-executed Contract, Contract, and required submittals to the Department within the response period, will result in (a) forfeiture of the Proposal Security as Liquidated Damages payable to the Department, and (b) the Department's commencement of discussions with the second highest-

ranking Design-Builder. If the Apparent Design-Builder is a joint venture or partnership, each joint venture member or partner must sign the Contract on behalf of both itself and Design-Builder.

2. BY THE DEPARTMENT

If the Department fails to execute the Contract and deliver to the Apparent Design-Builder an original of the Contract within forty-five (45) Calendar Days following receipt of the Apparent Design-Builder's duly-executed Contract, and other required submittals, the Design-Builder shall have the right to withdraw the Proposal without penalty.

The following information applies to Federal-Aid construction projects:

To report bid rigging activities call: 1-800-424-9071

The U.S. Department of Transportation (DOT) operates the above toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

Nothing in this **Contract Book 1 (ITDB - Instruction to Design-Builders)** shall be construed to obligate the Department to enter into a Contract with any Design-Builder.

APPENDIX A

CONTRACT BOOK 1 (ITDB - INSTRUCTIONS TO DESIGN-BUILDERS) FORMS

FORM NAME	FORM DESIGNATION
ALTERNATE TECHNICAL CONCEPTS (ATC) SUBMITTAL	FORM ATC
RFP QUESTION REQUEST	FORM QR
RESPONSE CATEGORY II	FORM RC II
RESPONSE CATEGORY III	FORM RC III
RESPONSE CATEGORY IV	FORM RC IV
Receipt of Addenda/Clarifications	FORM C

ALTERNATE TECHNICAL CONCEPTS (ATC) SUBMITTAL

For TDOT use only					
The ATC:					
☐	Is Approved	☐	Does not qualify as an ATC, but may be included in the Proposal without an ATC.	☐	Is Conditionally approved with identified conditions attached.
☐	Is Not approved	☐	Does not qualify as an ATC and may not be included in the Proposal.	☐	Is Deemed to take advantage of an error or omission in the RFP and will not be considered. The RFP will be revised to correct this.

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Description. A detailed description (attach schematic drawings) of the configuration of the ATC or other appropriate descriptive information (including, if appropriate, product details [i.e., specifications, construction tolerances, special provisions] and a traffic operational analysis, if appropriate).

4. Usage. Where and how the ATC would be used on the Project.

5. Deviations. References to all requirements of the RFP those are inconsistent with the proposed ATC, an explanation of the nature of the deviations from said requirements, and a request for approval of such variance(s).

6. Analysis. An analysis justifying use of the ATC and why the variance to the requirements of the RFP should be allowed.

7. Impacts. Discussion of potential impacts on vehicular traffic, environmental impacts identified, community impact, safety and life-cycle Project impacts, and infrastructure costs (including impacts on the cost of repair and maintenance).

8. History. A detailed description of other projects where the ATC has been used, the success of such usage, and names and telephone numbers of project owners that can confirm such statements.

9. Risks. A description of added risks to TDOT and other entities associated with implementing the ATC.

10. Costs. A description of the ATC implementation costs to TDOT, the Design Builder, and other entities (right-of-way, utilities, mitigation, long term maintenance, etc.).

RFP QUESTION REQUEST
FORM QR

PROJECT: I-75 at I-24 Interchange Modification, Hamilton County

DB CONTRACT No.: DB1801 DATE:

RFP Book No. and Section ID	Question	Reserved for Agency Response

RFP QUESTION REQUEST
FORM QR

RFP Book No. and Section ID	Question	Reserved for Agency Response

RESPONSE CATEGORY II: ORGANIZATION

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Describe responsibilities and reporting relationships or chain of command clearly identifying assignments of various tasks for Design and Construction Functions, Key Personnel and Design Professionals. ☐ Organizational Chart included.

4. Description of those categories of work which the Design Builder anticipates will be performed by the Design Builder's own forces and those categories which will be performed by Subcontractors.

5. Plans and procedures for management of Subcontractors

RESPONSE CATEGORY II: PROJECT EXPERTISE

1. Design-Builder Name:

6. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

2. The Design-Builder is encouraged to identify all major subcontractors in the Technical Proposal as omission of this information may affect the evaluation under this evaluation criterion.

3. Describe the overall strengths of the Design Team and their ability to fulfill the design requirement of this Project.

RESPONSE CATEGORY III: PROJECT UNDERSTANDING

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Describe or outline the objectives, goals, and tasks to show or demonstrate the Design Builder's view and understanding of the nature of the contract. Consider if the Scope of Services in this RFP is sufficient to attain the Department's goals and objectives.

4. Identify any potential right-of-way and Utility impacts or state no potential impacts. If impacts, identify innovative approaches to minimize any impacts to the right-of-way and/or to the Utility.

RESPONSE CATEGORY III: SCHEDULE MANAGEMENT

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Describe or outline the assumptions upon which the CPM Schedule was based, risks, constraints, contingencies, sequence of work, the controlling operation or operations, intermediate completion dates, Milestones, project phasing, anticipated work schedule and estimated resources that impacted the schedule.

   ☐ CPM Schedule included in the Proposal.

   The CPM Schedule shall indicate how the Design Builder intends to:

   - Divide the Project into work segments to enable optimum construction performance and explain the planned sequence of work, the critical path, proposed phasing of the Project, and any other scheduling assumptions made by the Design Builder.
   - Plans and procedures to insure timely deliveries of materials to achieve the Project schedule.
   - Categories of work that Design Builder anticipates will be performed by Design Builder's own direct labor force, those categories that will be performed by Subcontractors, those categories that will be performed by project specific teams, and those categories that will be performed by existing teaming arrangements.

   Provide an explanation of Design Builder's methodology for updating the CPM.

4. Describe Pay Item Breakdowns, including the physical features and activities included in the Pay Item, and all work included in the Pay Item Totals as reflected on the Schedule of Items.

5. Describe the Design Builder Issue Resolution Plan

RESPONSE CATEGORY III: PROJECT MANAGEMENT

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Describe how the Design Builder would bring experience, expertise, innovation, and "not business as usual" skills in leadership and technical ability.

4. Describe the administrative and operational structure that would be used to perform the proposed work, including:

   - Management plan to attain the necessary staff required.

   - Describe how design personnel will interface with the construction personnel.

   - Communicating and coordinating between TDOT and the Design Builder. Include the approach for change management during construction for design initiated, field initiated, and TDOT-initiated changes.

   - Describe existing design and/or construction quality management plan(s) that the Design Builder may have already developed, and how it (they) will be implemented into work performed. Describe coordination of design and construction activities to ensure consistency in quality. Explanation of how independence of quality staff and function will be maintained. Indicate the minimum number of inspectors that will be supplied at different stages during the Project duration.

   - Approach to managing costs under this Contract while fulfilling required tasks and assuring quality of work.

   - Describe or outline the process for constructability, durability, maintainability, safety, aesthetics and environmental mitigation in the design and construction processes.

   - Describe or outline the process for coordinating design and construction functions, including both design and construction components and all Subcontractor activities. Include a brief description (Construction Management Plan) of the Design Builder proposes to deal with unexpected disruptions (e.g., weather- or accident-related).

RESPONSE CATEGORY III: PROJECT MANAGEMENT

- Describe or outline the process (Design Review Plan) on how the Design Builder will facilitate and implement Design Reviews as required under the Contract. Describe how the Designer and the design staff will be involved during construction. Also include the Design Builder's Construction Staging and Phasing Plan, indicating timing and sequencing of major activities for the Project.

- Describe or outline the process (Diversity Plan) of the plan to ensure projected subcontracting plan is applied at all tiers. Describe how the Design Builder will achieve the goal set forth on this project. Identify DBE and EEO representatives and their roles and responsibilities and identification of specific strategies and approaches that will be taken by the Design Builder to meet the requirements of the Affirmative Action and Equal Employment Opportunity provisions described in **DB Standard Guidance**.

RESPONSE CATEGORY III: ENVIRONMENTAL COMPLIANCE

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Identify any potential environmental impacts.

4. Describe or outline the process for environmental compliance.

5. Describe or outline the approach to Erosion Prevention and Sediment Control for the Project.

6. Describe or outline the understanding of the overall approach to permitting and the comfort level with obtaining the required permit application/ modification within the allowed timeframe.

7. Identify innovative approaches to minimize any impacts in environmentally sensitive areas.

8. A description of instances on projects within the last three years where there has been success in meeting and/or exceeding environmental performance standards and permit conditions. If none, state none.

9. A description of instances on projects within the last three years where the Design-Builder, including Major Participants and Subcontractors have not met environmental performance standards and permit conditions. For each of these instances, describe the non-compliance act, the reason(s) the non-compliance act occurred, plans implemented to correct the non-compliance act and lessons learned from these instances, and internal procedures developed to ensure similar issues do not occur on future projects. If none, state none.

RESPONSE CATEGORY III: INNOVATION

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Identify any innovative design or construction solutions that the Design Builder considers innovative and how those solutions will better serve the Project. Include a description of ideas that were considered, whether implemented or not.

4. Identify any potential innovation in traffic control and how those solutions will better serve the Project. Describe any temporary impacts and associated with innovations.

5. Will these innovations add to, subtract from or have no effect on the costs?

RESPONSE CATEGORY IV: TECHNICAL SOLUTION

1. Design-Builder Name:

2. Name of Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

3. Conceptual Plans, Drawings:
   - ☐ Plan View of design concepts with key elements noted included.
   - ☐ Preliminary horizontal and vertical alignments of all roadway elements included.
   - ☐ Typical Sections included.

4. Identify drainage modifications and designs to be implemented.

5. Identify the appropriate design criteria for each feature if not provided.

6. Identify all bridge types to be constructed, including any special design features or construction techniques needed.

7. Identify any deviations or proposed design exceptions, from the established design criteria that will be utilized. Explain why the deviation is necessary. Describe any geotechnical investigations to be performed by the Design-Builder.

8. Describe how any utility conflicts will be addressed and any special utility design considerations. Describe how the design and construction methods minimize TDOT's utility relocation costs. If none, state none.

9. Describe how the design will affect TDOT right-of-way costs. If none, state none.

10. Identify types of any retaining walls and /or noise walls if applicable. If none, state none.

11. Identify any aspects of the design or construction elements that are considered innovative. Include a description of alternatives that were considered, whether implemented or not. Attach a copy of any approved ATCs used in this Technical Proposal. If none, state none.

RESPONSE CATEGORY IV: TECHNICAL SOLUTION

12. Describe any traffic control requirements that will be used for each construction phase. Describe how traffic will be maintained as appropriate and describe understanding of any time restrictions noted in the RFP. Specifically describe how business and residential access will be maintained, if applicable. Describe any required road closures and duration thereof.

13. Describe the safety considerations specific to the Project. Discuss overall approach to safety. Describe any proposed improvements that will be made prior to or during construction that will enhance the safety of the work force and/or traveling public both during and after the construction of the Project.

Form C
Receipt of Addenda/Clarifications

Design-Build Project: I-75 at I-24 Interchange Modification, Hamilton County (DB1801)

Design-Builder's Name: _____

The undersigned acknowledges receipt of the addenda to the RFP as indicated below.

ADDENDA

Addendum/Clarification No.	_____	Dated	_____
Addendum/Clarification No.	_____	Dated	_____
Addendum/Clarification No.	_____	Dated	_____
Addendum/Clarification No.	_____	Dated	_____
Addendum/Clarification No.	_____	Dated	_____

Failure to acknowledge receipt of all addenda may cause the Proposal package to be considered non-responsive to the solicitation. Acknowledged receipt of each addendum must be clearly established and included with response to this RFP.

By: _____ Print Name: _____

Title: _____ Date: _____

DESIGN-BUILD
RFP CONTRACT BOOK 2
CONTRACT

TENNESSEE DEPARTMENT OF TRANSPORTATION

Interstate 75 at Interstate 24 Interchange Modification

Hamilton County - TENNESSEE

CONTRACT NUMBER: DB1801

July 27, 2018

Addendum #2 September 26, 2018

Addendum #3 November 13, 2018

Addendum #4 November 16, 2018

Addendum #5 November 19, 2018

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DESIGN-BUILD CONTRACT

THIS Design-Build Contract is entered into by and between the State of Tennessee, acting by and through the Department of Transportation (the "Department") and---------- (the "Design-Builder"), (collectively, the **"**Parties**"**) as of the Effective Date of the Contract.

RECITALS

WHEREAS, the Department requires the improvements for the project known as the **Interstate 75 at Interstate 24 Interchange Modification, Hamilton County**- TENNESSEE Design-Build Project (the "Project") more particularly described in **Contract Book 1 (ITDB - Instructions to Design-Builders)** and **Contract Book 3 (Project Specific Information)**. The Project will be funded with state and federal dollars, thereby requiring that the Design-Builders adhere to all pertinent state, federal, and local requirements.

and

WHEREAS, the parties intend for the Contract to be a lump-sum Design-Build contract obligating the Design-Builder to perform all work necessary to complete the Project by the deadlines specified herein, for the Contract Amount, subject only to certain specified limited exceptions. To allow the Department to budget for the Project and to reduce the risk of cost overruns, the Contract includes restrictions affecting Contractor's ability to make claims for an increase to the Contract Amount or an extension of the Completion Deadlines. The Department may require additional related work within the general vicinity of the Project which, if required, shall be included in the Project and added to the Contract by Change Order; and

WHEREAS, the Department requires a Design-Builder competent to perform all work necessary to complete the Project in accordance with the terms and conditions of the Contract, and able to do so within the Contract Time allocated herein. If the Design-Builder fails to complete the Project within the time limitations set forth in the Contract, then the Department will suffer substantial losses and damages. The Contract therefore provides that a deduction shall be made from monies due the Design-Builder, not as a penalty, but as Liquidated Damages, as stated in **Contract Book 3 (Project Specific Information),** if such completion is delayed;

and

WHEREAS, Design-Builder asserts that it is competent and prepared to perform all work necessary to complete the Project in accordance with the terms and conditions of the Contract, and that it is able to do so within the Contract Time allotted herein;

WHEREAS, the Department is authorized under Section 54-1-119 of the Tennessee Code Annotated to enter into this Contract;

NOW, THEREFORE, in consideration of the mutual promises contained herein, and for other good and valuable consideration, the Department and the Design-Builder agree as follows:

AGREEMENT

A. GENERAL CONTRACT PROVISIONS, DEFINED TERMS AND GENERAL SCOPE OF WORK

1. INCORPORATION OF RECITALS

The foregoing Recitals incorporated herein and made a part hereof for all purposes as if fully set forth constitute additional promises or representations and warranties of the Parties.

2. CONTRACT DOCUMENTS

The Contract Documents, made a part hereof for all purposes as if fully set forth, are intended to reflect the complete understanding of the Parties concerning their respective rights and responsibilities under the Contract.

3. EFFECTIVE DATE

The Contract shall become effective on the date on which each Party has signed this Contract and all approvals have been obtained (the "Effective Date").

4. THE CONTRACT

The Contract, which includes this **Contract Book 2 (Design-Build Contract)** and all other Contract Documents, forms the entire agreement between the Parties.

5. DEFINED TERMS AND ACRONYMS

Defined terms and acronyms utilized in **Contract Book 1 (ITDB - Instructions to Design-Builders)**, this **Contract Book 2 (Design-Build Contract), Contract Book 3 (Project Specific Information)** and in the other Contract Documents are either set forth in **Design-Build Standard Guidance**, or defined in the text accompanying the term.

6. APPLICABLE VERSION OF LAW OR STANDARD

All work shall be performed pursuant to the applicable law and in accordance with the standards in effect at the time of the RFP issuance, including addenda, unless otherwise specified in the Contract or by amendment.

7. MINIMUM CONTRACT REQUIREMENTS

a. DEPARTMENT SUPPLIED

Among the Contract, the Department has mandated certain Contract requirements from which the Design-Builder may not deviate in the scope of the work, except as instructed by the Department. The Department has also established certain minimum Contract requirements that set a minimum

standard of performance or quality that the Design-Builder must meet or exceed in performance of the Contract.

b. DESIGN-BUILDER SUPPLIED

Design-Builder has established certain minimum Contract requirements located in *Exhibit A* (Design-Builder's Technical Proposal), consisting of those provisions of its Proposal that meet or exceed minimum Contract requirements established by the Department and upon which the Department has relied in awarding the Contract to the Design-Builder.

Any non-standard Department specification or provision shall be considered the Design-Builder-supplied Contract provisions and requires Department Review and Approval which will obligate the Design-Builder within this the Contract.

c. MANAGEMENT PLANS

A Transportation Management Plan is required, pursuant to the **Design-Build Standard Guidance**. A Quality Plan, Safety Plan and Health, Environmental Compliance Plan or other management plans (e.g. a Project Management Plan), pursuant to the **Design-Build Standard Guidance,** have to be submitted under this Contract.

8. RIGHT- OF-WAY/UTILITY COORDINATION SERVICES

Right-of Way (ROW) and Utility Coordination and acquiring services are expected under this Contract. See **Contract Book 3 (Project Specific Information)** for information on ROW services, ROW acquisition and ROW acquisition cost and/or Utility Coordination services required for the Design-Builder's Technical Proposal.

9. DESIGN SERVICES

The design services required under the Contract shall include, at a minimum, each of the following:

- Performance of all design services, including but not limited to roadway design, pavement design, geotechnical design, environmental design, drainage design, structural design, hydraulic/hydrologic design, traffic control and survey;
- Performance of all other engineering design services required under the Contract and/or otherwise necessary to complete the work in accordance with all Contract requirements; and
- All Design Documents and Design Reviews shall be provided by the Design-Builder and performed in accordance with the Design Review schedule established in the Critical Path Method (CPM) Schedule, and in accordance with all Contract requirements.

All design services to be performed under the Contract are appurtenant to construction services being provided by the Design-Builder.

a. LICENSE REQUIREMENTS; STANDARD OF CARE

Whether the Design-Builder is a design professional, has a design professional as a member or on staff, or will otherwise provide an outside source to perform the services of a design professional, all design services (whether constituting the practice of architecture, the practice of engineering, the practice of surveying, or the practice of other design services) referred to in this Contract shall be provided by duly-licensed and competent design professionals employed or otherwise retained by the Design-Builder. The design professionals currently designated to provide such design services are listed in Subsection 3.4. All design services shall be performed by a design professional of the appropriate professional discipline in accordance with the degree of skill and care ordinarily used by competent practitioners of the same professional discipline under similar circumstances, taking into consideration the contemporary state of the practice and the project conditions.

b. DESIGN DOCUMENTS

The Design-Builder shall generate and provide to the Department all Design Documents. The Design-Builder shall make a comprehensive design check and Design Review at the following five (5) stages of design development, stated in more detail within **Design-Build Standard Guidance**:

- Definitive Design;
- Interim designs;
- Readiness-for-Construction Plans, Specification and quantity estimates;
- Working Plans;
- As Built Plans.

1) READINESS-FOR-CONSTRUCTION PLANS AND SPECIFICATIONS

Upon completion of the Definitive Design Reviews, Working Plan Design Reviews, Interim Design Reviews (if any), and Readiness-for-Construction Design Reviews, as specified in the **Design-Build Standard Guidance**, the Design-Builder shall finalize the Readiness-for-Construction Plans and Specifications. In performing these services, the Design-Builder shall meet the following requirements:

- Readiness-for-Construction Plans and Specifications shall comply with all applicable Laws and all Contract requirements.
- Readiness-for-Construction Plans and Specifications shall be a complete, fully coordinated, integrated package, without any significant modifications or further clarifications required.
- The Design-Builder shall file all documents required for the approval of Authorities having jurisdiction over the Project, shall obtain all necessary permits not obtained by the Department, and shall pay for all

associated fees, including application, filing, plan review, and appeal fees.

- The Design-Builder shall provide the Department with written certification and all Design Documents required for the Readiness-for-Construction certification, in accordance with **Design-Build Standard Guidance**.
- The Design-Builder shall submit to the Department all documentation and Design Quality Records required under **Design-Build Standard Guidance**.
- The Design-Builder shall submit to the Department As-Built Plans and the Design-Builder Specifications, compiled and organized in accordance with all Contract requirements that incorporate all changes in the design and construction of the Project.
- The Design-Builder shall prepare and deliver to the Department all As-Built Plans, the Design-Builder Specifications, and other Design Documents, information, and data required under the Contract to be provided to the Department.

2) VALUE ENGINEERING COST PROPOSALS

During development of the Design Documents, the Design-Builder and the Department may collaborate on identifying, evaluating and implementing value engineering cost proposal (VECP) options in accordance with **Design-Build Standard Guidance**. The Design-Builder's development of the Design Documents and completion of the Readiness-for-Construction Plans and Specifications shall not preclude further identification and implementation by the Design-Builder and the Department of additional cost-reduction options during construction. VECPs adopted by the Department will be implemented through Change Orders pursuant to **Design-Build Standard Guidance**.

10. CONSTRUCTION SERVICES

The construction services required under the Contract shall include, at a minimum, each of the following:

- Performance of all construction services, including but not limited to construction and removal, if required, of temporary and/or permanent roadway, structures, and erosion prevention and sediment control, materials testing, signing, traffic control, paving and pavement markings;
- Protection of environmental resources, including plant and animal life and associated habitats; and
- Performance of all other construction services required under the Contract and/or otherwise necessary to complete the work in accordance with all Contract requirements

The Design-Builder shall provide all necessary work to furnish to the Department complete, fully-functional road improvements specified in **Design-Build Standard Guidance**, capable of being fully utilized for the purposes described in the Contract, and constructed in compliance with all Contract requirements. The Design-Builder shall perform the construction services as follows:

- The Design-Builder shall supervise and administer all construction activities in accordance with Contract requirements.
- In the event of the existence of any dispute between the Parties under the Contract, the Design-Builder shall continue to perform in accordance with the Contract terms and seek resolution in accordance with **Design-Build Standard Guidance.**
- The construction work shall be of good quality, free from faults and defects, and in conformance with all Contract requirements. At its own expense, the Design-Builder shall correct construction work that does not conform to these requirements.
- The Design-Builder shall utilize new materials and equipment in the work, unless otherwise specified in the Contract.
- The Design-Builder shall pay all taxes, fees, and costs associated with the acquisition of tools, equipment, materials, and the performance of the work, in accordance with **Design-Build Standard Guidance**.
- The Design-Builder shall comply with all applicable laws.
- The Design-Builder shall keep the work location and its vicinity free from accumulation of waste materials and rubbish caused by the Design-Builder's operations.
- The Design-Builder shall notify the Department when the work or an agreed upon portion thereof has been completed, in accordance with **Design-Build Standard Guidance**.
- The Design-Builder shall maintain, on the work location, a copy of all approved Management Plans, environmental permits, approved design documents, project records and the entire Contract and any other document required in accordance with **Design-Build Standard Guidance.**
- As the Project constitutes "Highway construction" utilizing Federal funds, the Design-Builder shall comply with any Federal requirements and appropriate Department Special Provisions as provided by **Design-Build Standard Guidance** and **Contract Book 3 (Project Specific Information)**, respectively. Consistent with **Design-Build Standard Guidance**, the Design-Builder shall be fully responsible for initiating, maintaining, and supervising safety precautions and programs in connection with the work, including but not limited to, taking reasonable precautions to ensure the safety of, and prevention of damage, injury, or loss to:
  - Employees of the Department present on or in the vicinity of a work location, employees of the Design-Builder and other persons performing

work on or in the vicinity of a work location, and other persons, including the traveling public, who may be affected;
  - Materials and equipment to be incorporated into the Project;
  - Portions of the Project under construction or completed; and
  - Other property within or adjacent to a work location.
- The Design-Builder shall be liable for damage to or loss of property at work locations and on private property affected by the Design-Builder's activities, pursuant to **Design-Build Standard Guidance**. This subparagraph shall in no way affect the applicability or coverage of the bonds and insurance required under Section 7.0 of this Contract.
- The Design-Builder shall deliver to the Department all notices regarding completion of the work pursuant to **Design-Build Standard Guidance**.
- The Design-Builder shall perform all other construction work required to complete the Project in conformance with all Contract requirements, including Legal Requirements.

11. QUALITY MANAGEMENT SERVICES

Quality Management services will include performance, at a minimum, of all activities and obligations, including preparation of all documentation, described in **Design-Build Standard Guidance**, and as otherwise necessary to ensure that the work is performed in accordance with all Contract requirements.

12. PROJECT MANAGEMENT SERVICES

Project management services shall be integrated with the design services and construction services described herein and in the Contract, and shall include, at a minimum, the following:

- Project Controls (including Risk Management, Scheduling, Reporting and Document Management).
- Construction management;
- Contract management;
- Safety management; and
- Traffic management.

B. GENERAL STANDARDS FOR PERFORMANCE OF THE WORK

1. GOOD FAITH

The Design-Builder shall provide and perform all design services, quality management, project management, and construction services in good faith and as expeditiously as is consistent with the applicable standards of skill and care ordinarily exercised by members of the profession under similar conditions and circumstances, and the orderly prosecution of the work.

2. PERFORMANCE STANDARDS

Where specific performance standards for any aspect of the work have been established in the Department Special Provisions as stated in Appendix B, pursuant to **Contract Book 3 (Project Specific Information),** the work shall be performed so as to meet or exceed such standards.

3. CRITICAL PATH METHOD (CPM) SCHEDULE

The CPM Schedule establishes the schedule and deadlines for Contract performance, with which the Design-Builder must comply. The CPM Schedule, as it may be modified during the course of the Project pursuant to the **Design-Build Standard Guidance**, shall anticipate and accommodate such periods of time shown in **Contract Book 1 (ITDB - Instructions to Design-Builders)** as may be required for the Department's review of Design Documents, and for approval by Authorities having jurisdiction over the Project of any required submissions, including but not limited to, applications for permits and environmental impact evaluations. Since time is of the essence in the Design-Builder's successful completion of its assignment, the Design-Builder agrees to begin work on each work location immediately after receiving authorization from the Department to proceed with its work efforts.

4. REVIEW AND COMMENT, OR ACCEPTANCE

The Department's consideration, Review and Comment, or Acceptance of any matters, or the Department's authorization of any action, will not be deemed or construed as relieving the Design-Builder of its sole responsibility for, and its complete and exclusive control over the means, methods, sequences and techniques for, performance of the work in accordance with the terms of the Contract.

5. EXTRA WORK TO BE PROVIDED BY THE DESIGN-BUILDER

The Design-Builder shall perform Extra Work in accordance with **Design-Build Standard Guidance**.

C. RELATIONSHIP AND ROLES OF THE PARTIES

1. INDEPENDENT ENTITY

The Design-Builder is an independent entity and not an officer, employee, or agent of the Department.

2. DEPARTMENT REPRESENTATIVE AND CONTACT INFORMATION

The Department's representative for this Project is

Ms. Lia Obaid, P.E.
CONSTRUCTION DIVISION REPRESENTATIVE

Address: **TENNESSEE DEPARTMENT OF TRANSPORTATION**
505 DEADERICK STREET, SUITE 700
NASHVILLE, TN 37243

E-mail: **lia.obaid@tn.gov**

Telephone Number: **615-532-7522** **Fax Number**: **615-741-0782**

3. DESIGN-BUILDER REPRESENTATIVE

The Design-Builder's representative for this Project is

_____
Design-Builder's Project Manager

Address: _____

_____

_____

E-mail: _____

Telephone Number: _____

Fax Number: _____

4. KEY PERSONNEL AND DESIGN PROFESSIONALS

The Design-Builder's Key Personnel, Design Professionals, shall perform the functions established under the Contract for the duration of the Contract and are listed below.

a. KEY PERSONNEL

Design-Builder's Project Management Personnel (Level "1" Personnel) shall consist of the following:

- Project Manager: _____
- Design Manager: _____
- Construction Manager/Superintendent: _____
- Traffic Engineering Manager: _____
- Traffic Control Supervisor: _____
- Environmental Compliance Manager: _____

b. DESIGN PROFESSIONALS

The Design-Builder's design professionals (Level "2" Personnel) shall consist of the following:

- Utilities Design Engineering/Coordination Supervisor: _____
- Design Lead Engineer - Structures: _____
- Design Lead Engineer - Roadway: _____
- Design Lead Engineer – Geotechnical:
- Erosion Prevention/Sediment Control Inspector: _____

5. SUBSTITUTION OF KEY PERSONNEL AND/OR DESIGN PROFESSIONALS

The Parties agree that each Key Personnel, Design Professional and Subcontractor is unique, and that the Department has relied upon their qualifications in selecting the Design-Builder to perform the Contract. Therefore, the Design-Builder shall not replace any Key Personnel or Design Professional during the term of the Contract. Notwithstanding the foregoing, in those limited circumstances in which the Department elects to consider substitutions, the process shall be governed by the provisions of **Design-Build Standard Guidance**. In the event the Department approves a substitution request, the Department retains the right to strictly enforce this Section C.5 in the event of future requests for substitution. No individual substitution approval or pattern of substitution approvals shall constitute a waiver of this requirement. Should the Department, in its sole discretion, elect to authorize a substitution, such authorization shall not relieve the Design-Builder of its sole responsibility under the Contract to complete all work and deliver the Project in accordance with all Contract requirements.

D. DATE OF COMMENCEMENT AND COMPLETION OF SERVICES

1. TIME FOR PERFORMANCE

The Contract shall take effect on the Effective Date and shall be performed by the Parties according to its terms, unless earlier terminated, until Final Acceptance by the Department in accordance with **Design-Build Standard Guidance.**

2. COMMENCEMENT OF SERVICES

The Design-Builder is authorized to commence the work within the Contract for post award submittals pursuant to **Design-Build Standard Guidance**. The Design-Builder shall not perform any services beyond post award submittal until the issuance of first Notice to Proceed (NTP) and for each subsequent phase requiring a Review and Approval NTP.

3. COMPLETION DATES

The Design-Builder shall complete all work to be done under the Contract, except for plant/vegetation establishment, by / / and not later than **August 31, 2023.**

The Design-Builder shall specify the number of calendar days for completion of the project within their price proposal. The number of calendar days specified by the Design-Builder in their price proposal will be placed in the Contract above prior to execution of this Design-Build contract.

E. COMPENSATION

1. CONTRACT AMOUNT

The Department agrees to compensate the Design-Builder for all work performed under the Contract for a fixed price of **$_____** the "Contract Amount"). The Contract Amount includes the entire cost of completing the Project in accordance with all Contract requirements as contemplated by the Parties under the Contract, and further includes all contingencies and the Design-Builder's overhead and profit. The Contract Amount shall be payable in accordance with **Design-Build Standard Guidance.**

2. PROGRESS PAYMENTS

The Department shall make progress payments to the Design-Builder in accordance with **Design-Build Standard Guidance**. Progress payments shall be based upon the Design-Builder's Schedule of Items submitted with the Price Proposal, which shall include the cost of all work. The Department's payment of progress payments shall not be deemed by either Party to constitute Acceptance or Approval of any Pay Item covered by such payment, or a waiver of a claim or demand for repair of any defects therein.

3. ADJUSTMENTS TO THE CONTRACT AMOUNT

The Contract Amount shall only be adjusted through issuance of properly-authorized Change Orders.

4. PAYMENTS FOR EXTRA WORK

The Department will make payments for Extra Work in accordance with the provisions of **Design-Build Standard Guidance.**

5. DEDUCTIONS FROM MONIES DUE

The Department may deduct from monies due or to become due the Design-Builder, as follows:

- Amounts representing price adjustments authorized under the provisions D**esign-Build as specified in Contract Book 3 (Project Specific Information)**;
- Amounts representing recoupment of damages, including but not limited to Liquidated Damages as stated in **Contract Book 3 (Project Specific Information)**;
- Amounts assessed by Authorities (e.g., fines and penalties) for which the Design-Builder is responsible under the terms or the Contract or by law;
- Amounts the Department is compelled by court order or other legal mandate to withhold and/or tender to Authorities or third parties; and
- Any other amounts authorized under the Contract or by law to be deducted.

F. CHANGES IN THE WORK

Changed work and Extra Work shall be authorized by the Department only under the circumstances set forth in, and pursuant to the terms of, **Design-Build Standard Guidance**. The Design-Builder shall not begin performance of any Changed work or Extra Work until the Department has issued a properly-authorized Change Order, and the Design-Builder shall perform all such work strictly in accordance with the terms of the Change Order.

G. INSURANCE AND BONDING REQUIREMENTS

1. INSURANCE REQUIREMENTS

During the term of the Contract, the Design-Builder shall maintain in full force, at its own expense, from insurers holding a current certificate of authority to transact the business of insurance in the State of Tennessee, all of the insurance coverage's required under **Design-Build Standard Guidance.**

The Design-Builder, being an independent contractor, agrees to maintain errors and omissions insurance in such an amount (**$ 1,000,000.00 minimum**) and form as are agreeable to the Department.

2. BONDING REQUIREMENTS

During the term of the Contract, the Design-Builder shall maintain in full force, at its own expense and from Sureties licensed to do business in Tennessee, Performance and Payment Bond in the full Contract Amount. The Parties understand and agree that the obligation of the Design-Builder's Surety for the faithful performance of the Contract shall include not only all construction, but also the performance of all design services under the Contract.

3. INDEMNIFICATION

The Design-Builder shall, at all times, observe and comply with all applicable federal, state and local laws, ordinances and regulations and shall indemnify and hold harmless the State of Tennessee and all of its officers, agents and servants

against any claim of liability or assessment of fines or penalties arising from or based upon the Design-Builder's and/or its employees' or agents' violations of any such law ordinance or regulation.

The Design-Builder shall hold harmless and indemnify the Department for all claims and damages which result from the failure of the Design-Builder to perform its engineering and design duties in conformance with the reasonable standard of care within the State of Tennessee. Said indemnification shall include, but not be limited to, costs for the redesign of plans and the preparations of new specifications as well as the costs for repairs to the construction work itself.

The Design-Builder shall be responsible for any and all injury or damage to persons or to property arising from the prosecution of the work and due to any act, omission, neglect or misconduct in its manner or method of prosecuting the work or due to its non-execution of the work or due to defective work or materials. The Design-Builder shall indemnify and hold harmless the State, the Department, and all of its officers, agents, and employees from all suits, actions or claims of any character arising from the Design Builder's acts or omissions in the prosecution of the work, use of unacceptable materials in constructing the work, infringement of patent, trade mark or copyright, or claims for Workers' Compensation.

If any such suit, action or claim is filed, the Department may retain from the monies due to the Design-Builder under this Contract a sum deemed sufficient by the Department to protect the Department from loss therefrom. Upon resolution of the suit, action or claim, any remaining retained funds will be released.

These requirements of indemnification shall be a continuing obligation of the Design-Builder and shall survive the termination of the Contract regardless of cause.

H. OWNERSHIP AND USE OF WORK PRODUCT OF THE DESIGN-BUILDER

All work product of the Design-Builder arising from performance of the Contract shall be the exclusive property of the Department, as more particularly provided for under **Design-Build Standard Guidance**.

Plans, specifications and any maps prepared or obtained under the terms of this Contract shall be delivered to and become the property of the Department pursuant to **Design-Build Standard Guidance**. Basic design notes and sketches, charts, computations, all original drawings, and other data prepared or obtained under this Contract shall be made available, upon request, to the Department without restriction or limitation of their use.

I. PROJECT RECORDS

1. FINANCIAL AND OTHER PROJECT RECORDS

The Design-Builder shall maintain complete Project Records as described in **Design-Build Standard Guidance**, in the manner required under the terms of the Contract. The Design-Builder shall keep full and detailed accounts and exercise such controls as may be necessary for proper financial management of the Project. The accounting and control systems shall be satisfactory to the Department.

2. RECORD RETENTION PERIOD

The Design-Builder shall retain and preserve all Project Records for a period as stated in **Design-Build Standard Guidance**, after final payment or for such longer period as may be required by law (the "Record Retention Period").

3. ACCESS TO RECORDS

The Department, the Department's representatives and FHWA shall be afforded reasonable and regular access to the Project Records for the duration of the Contract and the Record Retention Period. This requirement to make Project Records available to the Department shall be a continuing obligation of the Design-Builder and shall survive the termination of the Contract regardless of cause.

4. SUBCONTRACT RECORD RETENTION REQUIREMENTS

The Design-Builder shall require each Subcontractor to retain its Project Records for the Record Retention Period, and to provide equivalent access to Project Records to the Department, the Department's representatives and FHWA. The Design-Builder shall require each Subcontractor to include in lower-tier subcontracts the same Project Record retention and access requirements.

5. LOCATION

The Design-Builder shall maintain all Project Records at the locations required under the terms of the Contract for the duration of the Contract. Subsequent to Contract completion, the Project Records shall be maintained for the Record Retention Period with suitable security, protection against damage and casualty loss, and access to the Department.

J. TERMINATION OR SUSPENSION

1. TERMINATION FOR CONVENIENCE AND NO FAULT; PAYMENT

The Contract may be terminated for convenience by the Department in accordance with Department Standard Specifications, as amended. In such case, the Department will make payment in accordance with **Design-Build Standard**

Guidance. However, the amount to be paid to the Design-Builder shall in no event exceed the Contract Amount.

2. TERMINATION FOR CAUSE; AMOUNTS PAYABLE

The Contract may be terminated by the Department for default in accordance with Department Standard Specifications, as amended, and **Design-Build Standard Guidance**. In addition to the acts listed in the above documents the following shall also be considered defaults for which the Contract may be terminated:

- The Design-Builder or its Design Professionals no longer hold the licenses or certificates required to perform the work or any portion thereof;
- The Design-Builder so fails to perform any agreed-upon portion of the work or Contract item or applicable standard of care as to materially affect the Design-Builder's performance under the Contract in accordance with its terms, and such breach, default or failure is not cured within the requirements of **Design-Build Standard Guidance**; or
- The Design-Builder made knowing or reckless misrepresentations, concealed facts, or failed to disclose information in Design-Builder's Proposal. Such shall constitute fraudulent inducements, and shall entitle the Department to recover reliance damages, in addition to any other available remedies to which it may show itself entitled.

In case of termination for cause, the Department will make payment consistent with the payment provisions included in **Design-Build Standard Guidance** and at the Department's option, including payment for materials left on hand, in accordance with Department Standard Specifications, as amended.

3. CONTRACT NOTICE OF CONTRACT TERMINATION

The Department may terminate the Contract, in whole or in part, immediately upon notice to the Design-Builder, or at such later date as the Department may establish in such notice, in accordance with Department Standard Specifications, as amended.

4. QUALITY OF THE WORK

In the event of the Department's termination of the Contract, regardless of reason, the Design-Builder shall remain responsible for the quality of the work performed through the date of termination.

5. LITIGATION

In the event of litigation instigated by the Design-Builder in accordance with the Contract or by the Department for breach of contract or fraudulent inducement, the Department may pursue both recoupment and set-off in addition to its other available remedies.

K. ENUMERATION OF CONTRACT

The Contract includes the following:

1. ***CONTRACT BOOK 1 (INSTRUCTIONS TO DESIGN-BUILDERS - ITDB);***
2. ***CONTRACT BOOK 2 (DESIGN-BUILD CONTRACT);***
3. ***CONTRACT BOOK 3 (PROJECT SPECIFIC INFORMATION);***
4. ***DESIGN-BUILD STANDARD GUIDANCE AND ADDENDUM;***
5. ***THE DEPARTMENT STANDARD SPECIFICATIONS;***
6. ***THE DEPARTMENT SUPPLEMENTAL SPECIFICATIONS;***
7. ***THE DEPARTMENT DESIGN GUIDELINES, AND ADDENDUM;***
8. ***THE DEPARTMENT CONSTRUCTION CIRCLULAR LETTERS;***
9. ***THE DEPARTMENT STANDARD DRAWINGS;***
10. ***THE DEPARTMENT MATERIAL AND TEST STANDARD OPERATING PROCEDURES;***
11. ***EXHIBIT A (TECHNICAL PROPOSAL);***
12. ***CHANGE ORDERS;***
13. ***FORCE ACCOUNT WORK ORDERS;***
14. ***WRITTEN ORDERS AND AUTHORIZATIONS ISSUED BY THE DEPARTMENT;***
15. ***ALL OTHER PROGRAMMATIC PLANS OR ANY OTHER DOCUMENTS; IN ANY FORM, REQUIRED TO BE SUBMITTED TO THE DEPARTMENT PURSUANT TO THE TERMS OF APPLICABLE CONTRACT.***
16. ***ALL MATERIAL INCLUDED BY REFERENCE IN ANY OF THE ABOVE DOCUMENTS.***

L. ORDER OF PRECEDENCE

All Contract Documents are intended to be complementary. Conflicts, if any, will be resolved utilizing the following descending order of precedence.

1. ***CONTRACT BOOK 3 (PROJECT SPECIFIC INFORMATION) AND ADDENDA;***
2. ***CONTRACT BOOK 2 (DESIGN-BUILD CONTRACT);***
3. ***CONTRACT BOOK 1 (INSTRUCTIONS TO DESIGN-BUILDERS - ITDB);***
4. ***THE DEPARTMENT SUPPLEMENTAL SPECIFICATIONS;***
5. ***THE DEPARTMENT CONSTRUCTION CIRCLULAR LETTERS;***
6. ***THE DEPARTMENT STANDARD SPECIFICATIONS;***
7. ***THE DEPARTMENT DESIGN GUIDELINES AND ADDENDUM;***
8. ***THE DEPARTMENT STANDARD DRAWINGS;***
9. ***DESIGN-BUILD STANDARD GUIDANCE;***
10. ***ALL OTHER PROGRAMMATIC PLANS OR ANY OTHER CONTRACT DOCUMENTS;***

11. ALL MATERIAL INCLUDED BY REFERENCE IN ANY OF THE ABOVE DOCUMENTS.

M. DESIGN-BUILDER CERTIFICATIONS AND DISCLOSURES

1. NONDISCRIMINATION

The Design-Builder shall follow the nondiscrimination provisions as provided in this **Contract Book 2 (Design-Build Contract)**.

2. DBE COMPLIANCE

The Design-Builder shall follow the DBE provisions as provided in the Special Provisions provided in this **Contract Book 2 (Design-Build Contract)**. The Design-Builder shall comply with the Department DBE requirements in the **Design-Build Standard Guidance**, and shall require that all Subcontractors so comply. The Design-Builder shall include the Department DBE requirements in all subcontracts.

3. ILLEGAL IMMIGRANTS

The Design-Builder shall follow the Illegal Immigrant provisions as provided in this **Contract Book 2 (Design-Build Contract)**.

4. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS - PRIMARY COVERED TRANSACTIONS

The Design-Builder shall follow the debarment, suspension, and other responsibility matters provisions as provided in this **Contract Book 2 (Design-Build Contract)**.

5. CERTIFICATION FOR GRANTS, LOANS, AND COOPERATIVE AGREEMENTS.

The Design-Builder shall follow the provisions as provided in this **Contract Book 2 (Design-Build Contract)**.

The Design-Builder agrees that if any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Contract, the Design-Builder shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

6. GOALS AND TARGETS

There is a DBE Utilization Goal of **10%** for this Project. If a goal is stated, the Design-Builder shall follow the DBE provisions as provided in **Contract Book 2 (Contract)**.

N. MISCELLANEOUS PROVISIONS

1. EMPLOYMENT OF DEPARTMENT WORKERS

The Design-Builder shall not engage, on a full, part-time, or other basis during the period of this Contract, any professional or technical personnel who are or have been at any time during the period of the Contract in the employ of the Department, except regularly retired employees, without the written consent of the Department.

2. COVENANT AGAINST CONTINGENT FEES

The Design-Builder warrants that it has not employed or retained any company or person other than a bona fide employee working solely for the Design-Builder to solicit or secure this Contract, and that it has not paid or agreed to pay any company or person, other than a bona fide employee working solely for the Design-Builder, any fee, commission, percentage, brokerage fee, gifts, or any other consideration, contingent upon or resulting from the award or making of this Contract. For breach or violation of this warranty, the Department shall have the right to deduct from the Contract Amount or consideration, or otherwise recover, the full amount of such fee, commission, percentage, brokerage fee, gifts, or contingent fee.

3. ENERGY POLICY AND CONSERVATION ACT

Under this Contract, the Design-Builder shall give due consideration to and, as applicable, comply with the standards, orders, and requirements relating to energy efficiency contained in the Department energy conservation plans issued in compliance with the Energy Policy and Conservation Act (P.L. 94-165).

4. ADDITIONAL EMPLOYMENT REGULATIONS

The Design-Builder shall comply with the Vocational Rehabilitation Act of 1973 as approved by Congress on September 26, 1973, herein incorporated by reference, which prohibits employment discrimination against physically handicapped persons. Further, the Design-Builder shall comply with Section 2012 of the Vietnam Era Veterans Readjustment Act of 1974 which requires the Design-Builder to take affirmative action to employ and advance in employment qualified veterans of the Vietnam Era.

5. COPYRIGHTING

The Design-Builder shall be prohibited from copyrighting any papers, reports, forms or other material which is a part of any work under this Contract without

written approval from the Department. Publication rights to any documents produced are reserved by the Department.

6. GOVERNING LAW; JURISDICTION; VENUE

The Design-Builder is assumed to be familiar with and observe and comply with those Federal, State, and local laws, ordinances, and regulations in any manner affecting the conduct of the work and those instructions and prohibitive orders issued by the Department and Federal Government regarding fortifications, military and naval establishments and other areas. The Design-Builder shall observe and comply with those laws, ordinances, regulations, instructions, and orders in effect as of the date of this Contract.

This Contract shall be governed by and construed in accordance with the laws of the State of Tennessee. The Design-Builder agrees that it will be subject to the exclusive jurisdiction of the courts of the State of Tennessee in actions that may arise under this Contract. The Design-Builder acknowledges and agrees that any rights or claims against the Department or its employees hereunder, and any remedies arising there from, shall be subject to and limited to those rights and remedies, if any, available under TCA § 9-8-101 through 9-8-407.

7. CONTRACT INTERPRETATION

Notwithstanding anything in the Contract to the contrary, no field explanations or interpretations provided by the Department at any meetings, and no comments by the Department on Design Documents or Construction Documents, shall be deemed, construed or interpreted to (a) amend, supersede or alter the terms, requirements, limitations or meaning of any Contract Document or (b) release or relieve the Design-Builder from full responsibility for the design of the Project in accordance with the Contract. However, written interpretive engineering decisions from the designated Department contact person(s) pursuant to the Contract may be relied upon to provide information, and interpretations of ambiguous or uncertain requirements set forth in the Contract.

8. NOTICES

Notices to be given hereunder shall be given in writing by personal delivery, facsimile, e-mailing or mailing the same, postage prepaid, to the Design-Builder or the Department at the addresses or numbers set forth in Sections C.2 and C.3, or as either Party may hereafter indicate pursuant to this Section. Any notice delivered by facsimile and email shall be deemed to be received when confirmation of successful transmission is generated by the transmitting machine. Any notice so mailed, personally delivered, facsimile or e-mail transmission shall be the sole responsibility of the Design-Builder to track and confirm receipt by the Department and shall be confirmed by telephone notice to the Department for the Project. Any notice shall be effective as to the Design-Builder upon delivery into the possession of one of the Design-Builder's designated management personnel, and as to the

Department, upon delivery to the Department. Regular, day-to-day communications may be transmitted through one of the methods set forth above, in person, by e-mail, or by other similar electronic transmission.

9. DISCLOSURE OF TAX IDENTIFICATION NUMBER

The Design-Builder shall provide its federal tax ID number to the Department. The Tax Identification Number provided pursuant to this authority will be used for the administration of State, Federal and local tax law.

10. SEVERABILITY

The Parties agree that if any term or provision of the Contract is declared by a court of competent jurisdiction to be illegal or otherwise invalid, the validity of the remaining terms and provisions shall not be affected, and the rights and obligations of the Parties shall be construed and enforced as if the Contract did not contain the particular term or provision held to be invalid.

11. NO WAIVER

The failure of the Department to enforce any provision of the Contract shall not constitute a waiver by the Department of that provision or any other provision of the Contract.

12. MEDIA CONTACTS; CONFIDENTIALITY

Unless otherwise specifically authorized in writing, the Design-Builder shall provide no news release, press release, or any other statement to a member of the news media regarding this Project without the Department's prior written authorization. The Design-Builder shall require this clause within all Subcontractors agreements.

13. ORGANIZATIONAL CONFLICTS OF INTEREST

The Design-Builder shall identify all relevant facts relating to past, present, or planned interest(s) of the Design-Builder's (including the Major Participants, proposed Design-Builder members, and their respective chief executives, directors, and Key Personnel) which may result, or could be viewed as, an organizational conflict of interest in connection with this Project.

The Design-Builder shall disclose:

a. any current contractual relationships with the Department (by identifying the Department contract number and project manager);
b. present or planned contractual or employment relationships with any current Department employee;
c. any current relationships between the Major Participants, Key Personnel. and/or Design Professionals of the Design-Builder on other Department projects; and

d. any other circumstances that might be considered to create a financial interest in the contract for the Project by any current Department employee if the Design-Builder is awarded the contract.

The Design-Builder must also disclose any current contractual relationships where the Design-Builder is a joint venture. The foregoing is provided by way of example, and shall not constitute a limitation on the disclosure obligations.

For any fact, relationship, or circumstance disclosed in this Section 14.13, the Design-Builder must identify steps that have been or will be taken to avoid, neutralize, or mitigate any organizational conflicts of interest.

In cases where Major Participants on different Design-Builder organizations belong to the same parent company, each Design-Builder must describe how the participants would avoid conflicts of interest through the qualification and proposal phases of the Project. All Organizational Conflicts of Interest shall be addressed on Form COI.

14. THE DEPARTMENT'S INSURANCE

The State of Tennessee is self-insured and such insurance shall cover the Department's operations and activities under the Contract.

15. JOINT VENTURES AND PARTNERSHIPS

If the Design-Builder is a joint venture or a partnership, each joint venture member or partner is executing this Contract on behalf of both itself and the Design-Builder, and each joint venture member or partner and Design-Builder shall be jointly and severally liable under this Contract.

16. MERGER CLAUSE

The Contract constitutes the entire Contract between the Parties on the subject matter addressed herein. The terms of this Contract cannot be waived or amended, in any manner whatsoever, except by written instrument signed by the Parties and containing all required State of Tennessee approvals. Any waiver, if made, shall be effective only in the specific instance and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, regarding this Contract except as contained or incorporated by reference herein.

THIS CONTRACT is executed in three (3) original copies, of which one is to be delivered to the Design-Builder, and the remainder to the Department.

The Design-Builder's authorized representative, by his/her signature below, hereby acknowledges that he/she has read this Contract, understands it, and can affirm that the Design-Builder agrees to be bound by its terms and conditions. This Contract may be executed in several counterparts, each of which shall be an original, and all of which shall constitute but one and the same instrument.

IN WITNESS WHEREOF, the Parties have executed this Contract, which shall be effective as of the Effective Date.

DESIGN-BUILDER NAME: _____

_____	_____	_____
Company Officer Signature	Printed Name and Title	Date

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

This Contract is accepted this _____ day of _____, _____, and

is effective on the _____ day of _____, _____.

_____
John Schroer, Commissioner

_____
John Reinbold, General Counsel
Approved as to Form and Legality

APPENDIX A

SUPPLEMENTAL SPECIFICATIONS TO THE STANDARD SPECIFICATIONS

The following, revised as noted, incorporates the Supplemental Specifications by reference for bidding purposes and will be printed with the contract after award. These Supplemental Specifications may be obtained from the Department's website:

https://www.tn.gov/tdot/tdot-construction-division.html

Supplemental Specifications to the Standard Specifications Revision Date

Supplemental Specification to Section 100 ---------- 05/14/2018
Supplemental Specification to Section 200 ---------- 05/14/2018
Supplemental Specification to Section 300 ---------- 05/15/2017
Supplemental Specification to Section 400 ---------- 05/14/2018
Supplemental Specification to Section 500 ---------- 05/14/2018
Supplemental Specification to Section 600 ---------- 05/14/2018
Supplemental Specification to Section 700 ---------- 11/06/2017
Supplemental Specification to Section 900 ---------- 05/14/2018

S T A T E **O F** **T E N N E S S E E**

(Rev. 3-30-15)
(Rev. 11-16-15)
(Rev. 6-27-16)
(Rev. 12-2-16)
(Rev. 5-15-17)
(Rev. 11-6-17)
(Rev. 5-14-18)
(Rev. 7-2-18)

January 1, 2015

Supplemental Specifications - Section 100

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 101.03 (pg. 10) 5-15-17; Add the following definition for Specialty Items:

> "**Specialty Item.** Work items identified in the contract which are not bid normally associated with highway construction and require highly specialized knowledge, abilities, craftsmanship, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract in general, these items are to be limited to minor components of the overall contract."

Subsection 102.11 (pg. 18), 3-30-15; Add the following to the second paragraph:

> "The Department may retain the Proposal Guaranty, not as a penalty, but as liquidated damages in the event a bidder does not have a license at the time of award."

Subsection 104.04 (pg. 27), 3-30-15; Add the following as the first full paragraph on page 27:

> "If a holiday falls on Saturday or Sunday, do not close lanes or restrict traffic from the preceding Friday at 6 am to the following Monday at 6 am."

Subsection 105.03 (pg. 38), 12-2-16; Add the following to the end of the section:

> "Products listed on the QPL which fail to comply with Departmental performance expectations shall be removed from the QPL. Products removed from the QPL shall be replaced with an equivalent product from the QPL. At the Departments discretion, an equitable adjustment may be made to the contract for invoice price deviations."

Subsection 105.03 (pg. 38), 6-27-16; Add the following to the end of the section:

"All products must be listed on the Qualified Products List (QPL) and perform as specified at the time of use regardless of Letting date. Any products removed from the QPL or that do not perform as specified, must be supplied or replaced at the Contractor's expense."

Subsection 105.06 (pg. 40), 3-30-15; Replace 2nd sentence of 1st paragraph with

"The contractor must attend a preconstruction conference arranged by the Engineer."

Subsection 105.10 (pg. 46), 5-15-17; Revise 2nd sentence of the first paragraph:

"Such inspection may extend to any part or to all of the Work and to the preparation, fabrication, or manufacture of materials to be used."

Subsection 105.11 (pg. 46), 5-15-17; Revise the 1st sentence:

"The Engineer or its representative will inspect all materials and each part or detail of the Work ."

Subsection 105.13 (pg. 48), 5-15-17; Remove the 2nd paragraph.

Subsection 105.15 (pg. 49), 5-15-17; Remove last paragraph:

Subsection 106.06 (pg. 61), 5-15-17; Revise the first paragraph of A. and subsection A.2:

"Provide a Type A Laboratory consisting of a building, room, or dedicated area having at least 120 square feet of floor area with a minimum width of 8 feet and a minimum height of 7 feet. Provide laboratory space that is floored, roofed, sealed inside, weather-tight, and furnished with electricity. Furnish the space with adequate work benches, cabinets, and drawers. Provide suitable heat and air conditioning, and equip the laboratory with a laboratory oven capable of maintaining a temperature of 230 °F ± 9 °F. Stove tops and hot plates may be used to determine moisture conditions of aggregates. Provide lights, electrical outlets, and adequate ventilation for the tests being performed.

When the determination of aggregate gradation is required, furnish the following equipment:

1. Scales of appropriate capacity and design to weigh the required samples. Scales are to be sensitive to within 0.2% of the sample to be weighed. Provide standard weights for scale calibration.

2. Screens of appropriate size and mesh to separate the samples into the required series of sizes. Woven wire cloth shall conform to AASHTO M 92. Screens for running gradations of coarse aggregates shall meet AASHTO T27.

3. A mechanical shaker approved by the Engineer and suitable for running both coarse and fine aggregate.

4. Facilities to perform wash tests according to AASHTO T 11 that include an adequate and suitable water supply."

Subsection 107.08 (pg. 69), 5-15-17; Add the following to the end of the third paragraph:

"All costs associated with any support activities including obtaining permission from landowners, permits, and compliance are to be included in the bid cost for the project."

Subsection 107.08 (pg. 71), 11-6-17; Add the following as section E:

"E. Migratory Birds

The following procedure will be automatically implemented by TDOT, unless FWS approves in writing deviations due to special circumstances, or for a specific variance.

Cliff swallow and barn swallow nests, eggs, or birds (young and adults) will not be disturbed between April 15 and July 31. From August 1 to April 14, nests can be removed or destroyed, and measures implemented to prevent future nest building at the site (i.e., closing off area using netting).

Exceptions:
(1) If there are no eggs in the nests prior to April 15, TDOT will be allowed to destroy the nests and prevent further nest building at the site, by installing netting. Net openings shall be ½ inch or smaller after installation, and shall be installed securely and in such a manner that it will not pose a safety hazard. Absence of eggs prior to net installation must be documented by using appropriate means for determination, such as, but not limited to, site visits and photographs.
(2) If there are no birds (young or adult) left in any of the nests at a specific site prior to July 31, the nests can be removed or destroyed. Absence of birds must be documented by using appropriate means for determination, such as, but not limited to, site visits, photographs, and observations of no birds using the nests.

Osprey, Double Crested Cormorants, Great Horned Owls, Barn Owls, Black Vulture, and Eastern Phoebes:
If these avian species are encountered on a bridge project, TDOT Ecology should be contacted immediately for further assistance.

The Contractor will be assessed the amount of any and all fines and penalties assessed against and cost incurred by TDOT which are the result of the Contractor's failure to comply with this specification. TDOT will not be responsible for any delays or costs due to the Contractor's failure to comply. Additional compensation or contract time due to noncompliance will not be granted.

All costs incurred with this specification will not be measured or paid for separately, but will be considered included in the contract unit prices bid for other items of the contract."

Subsection 108.01 (pg. 78) 5-15-17; Subletting of Contract, Add the following list of specialty items:

"Do not sublet, allow second tier sublet, sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof or a right, title, or interest in the Contract without the Engineer's written consent. If the Engineer consents to subletting or second tier subletting a portion of the Contract, the Contractor shall self-perform work amounting to not less than 30% of the total original Contract cost. For items designated in the Contract as "specialty items," the Contractor may sublet or second tier sublet this work and deduct the cost of such specialty items from the total original cost before computing the amount of the Work required to be self-performed by the Contractor with its own organization.

As stated above, unless there is a Special Provision 108A in the proposal, the following items are designated as Specialty Items:

Item 105-01 - Construction Stakes, Lines and Grades
Item 202-01.02 – Removal of Asbestos
Item 209 - EPSC Item 411-12.**Shoulder Scoring
Item 501-03.12 – Concrete Shoulder Rumble Strip
Item 602-03 - Steel Structures
Item 602-04 - Steel Structures
Item 602-10.13 / .14 - Navigational LightingItem 602-10.81 – Heat Straightening
Item 603-02 - Repainting Steel Structures
Item 603-05 - Containment and Disposal of Waste
Item 604-04.01 - Applied Texture Finish (New Structures),
Item 604-04.02 - Applied Texture Finish (Existing Structures)
Item 604-04.62 - Clean and Texture Finish Median Barrier
Item 604-05.31 - Bridge Deck Grooving (Mechanical)
Item 604.07 – Retaining Wall
Item 604-42.01 – Underwater Divers
Item 606-26.05 – Core Drilling for Piles (Abandoned)Item 617 - Bridge Deck Sealant
Item 624 – Retaining Wall Items
Item 625-01.08,10,11 – Inclinometer, Drilled Shaft Inspections
Item 640 - Weigh Station Items
Item 705 - Guardrail, Anchors, etc.
Item 706 - Guardrail Items
Item 707 - Fencing ItemsItem 712 - Traffic Control Items
Item 713 - Signing Items
Item 714 - Lighting Items
Item 716 - Pavement Marking Items
Item 720-03, 720-04, 720-05, 720-06, 720-07, 720-08, 720-09 – Railroad Highway Crossing
Item 721-01.06 – Irrigation System Repair
Item 721-10, 721-11.20, 721-11.30, 721-12 – Landscape and Irrigation Item 725 – ITS items
Item 730 - Traffic Signal Items
Item 7** - Utility Items
Item 750.01 – Mitigation Site
Item 801 - Seeding
Item 802 - Landscaping Items
Item 803-01 - Sodding

Item 805 - Erosion Control
Item 806 - Project Mowing"

Subsection 108.09 (pg. 90) 5-14-18; Failure to Complete the Work on Time, Table 108.09-1: Modify the Daily Charge ($/Day) as shown below:

Table 108.09-1: Liquidated Damages for Failure to Complete the Work on Time

Original Contract Amount ($)			Daily Charge ($/day)
0	to	500,000	400.00~~250.00~~
> 500,000	to	1,000,000	580.00~~420.00~~
> 1,000,000	to	2,000,000	800.00~~740.00~~
> 2,000,000	to	10,000,000	1,000.00
>10,000,000	to	20,000,000	1,600.00
>20,000,000			2,500.00~~1,800.00~~

Subsection 109.01 (pg. 98-100) 11-16-15; Measurement of Quantities, E. Weight; Remove the 12th paragraph and replace with the following:

"The scales shall be checked by an independent certified scale company. The check shall be performed on a semiannual basis; January through June and July through December. The results shall be maintained onsite and made available for review to Departmental personnel. If deficiencies are reported, all corrections shall be performed, documented, and verified prior to supplying material for TDOT projects."

Subsection 109.01 (pg. 98-99) 5-15-17; Measurement of Quantities, E. Weight, Modify the 6th paragraph to the following:

"Employ a Certified Public Weigher as defined in the Certified Public Weigher Law of 1981, Tennessee Code Annotated, Section 47-26-801, et seq., as amended. The Engineer will measure all applicable materials in accordance with the Certified Public Weigher Law and Department policy on scales approved by the Engineer. Provide weight (haul) tickets in accordance with Department policy and as directed by the Engineer. These requirements apply to entities located both inside and outside the state of Tennessee"

Subsection 109.01 (pg. 98-100) 5-15-17; Measurement of Quantities, E. Weight, Modify the 12th paragraph to the following:

"The scales shall be calibrated and certified by an independent certified scale company. The calibration and certification shall be performed on a semiannual basis; January through June and July through December. Scales shall be validated on a quarterly basis to ensure their continued accuracy. Validation shall be made by a verified known weight, or other scales that are approved by the Department or other State agency. A verified known weight shall be checked for

continued accuracy each time the scales are calibrated. The results shall be maintained onsite and made available for review to Departmental personnel. If deficiencies are reported, all corrections shall be performed, documented, and verified prior to supplying material for TDOT projects."

Subsection 109.01 (pg. 98-100), 11-9-17; E. Weights, Revise subsection to the following:

"E. Weight
The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, the Engineer will accept certified weights for materials measured or proportioned by weight that are shipped by rail or truck transport, provided that only the actual weight of the material used is paid for.

For bituminous materials, net certified scale weights or weights based on certified volumes in the case of rail or truck transport shipments, unless otherwise specified, will be used as a basis of measurement, subject to correction when bituminous material has been lost, wasted, or otherwise not incorporated in the Work.

In all cases where measurement of materials is based on certified weights, provide the Engineer with certified weigh bills showing the net tons of materials received in each shipment. The Engineer will not pay for materials in excess of the amounts represented by the certified weigh bills.

Certified Weigh Tickets for Asphalt Mixtures and Aggregate Materials shall list on the ticket:

1. Date
2. Time
3. The ticket number
4. Gross weight of the loaded truck
5. Tare weight of the truck
6. Net weight of the material to be paid
7. Running Daily Total for the particular material
8. Truck number
9. Truck Legal limit

Employ a Certified Public Weigher as defined in the Certified Public Weigher Law of 1981, Tennessee Code Annotated, Section 47-26-801, et seq., as amended. The Engineer will measure all applicable materials in accordance with the Certified Public Weigher Law and Department policy on scales approved by the Engineer. Certified Weigher licenses shall be posted near the

scale beam or weight indicator in full view at all times. Certified Weigher shall be the only person allowed to operate the scale or weigh recording equipment. Provide weight (haul) tickets in accordance with Department policy and as directed by the Engineer. These requirements apply to entities located both inside and outside the state of Tennessee.

Certified Weigher shall weigh each load with the maximum load not to exceed the legal limit established by law. The proposed haul route shall be known prior to deployment.

Provide a standard brand of platform truck scales with a sufficient rated capacity to weigh the maximum gross load to which they will be subjected. Do not use truck scales to measure weights in excess of the manufacturer's rated capacity. Clearly post the manufacturer's rated capacity on the scale manufacturer's plate and in the shelter provided for the weigher.

At the time of installation or modification of existing scales, test the scales before using to ensure they are within the allowable tolerances. Use a qualified scale technician to perform any alteration (e.g., electrical readout) or change in the rated capacity. Document all changes or alterations made by the scale technician and furnish a copy of the documentation to the Department.

House the recording mechanism of the scale in a suitable shelter furnished with adequate light, heat, chairs, tables, and storage drawers as needed for the convenience of the weigher. In addition, keep the scale platform and scale pit free of debris that could affect the accuracy of the scales.

Provide digital readout and scale printers as the primary weight indicator or as accessory equipment. The Department will inspect and approve all scale control and recording equipment.

Ensure the scale's accuracy within a tolerance of 0.5%. Provide a straight approach at each end of the platform scale in the same plane as the platform and of sufficient length and width to ensure the level positioning of vehicles longer than the scale platform during weight determinations. Weigh each truck and trailer with no brakes set on any wheel. Locate the scale platform so that surface water will drain away from it and to allow for an adequate foundation of concrete or other approved materials. Construct the foundation of sufficient strength and durability to withstand repeated capacity loading without affecting the accuracy of the scales.

Check the scales as often as necessary to ensure their continued accuracy. If the scales cannot be checked within the time frame set by Department policy, the Engineer may give tentative approval, based on check truckloads weighed on other scales that are approved by the Department or other State agency. The scales shall be calibrated and certified by an independent certified scale company. The calibration and certification shall be performed on a semiannual basis; January through June and July through December. Scales shall be validated on a quarterly basis to ensure their continued accuracy. Validation shall be made by a verified

known weight, or other scales that are approved by the Department of other State agency. A verified known weight shall be checked for continued accuracy each time the scales are calibrated. The results shall be maintained onsite and made available for review to Departmental personnel. If deficiencies are reported, all corrections shall be performed, documented, and verified prior to supplying material for TDOT projects.

Weigh tickets shall be certified either manually or electronically. If certified manually, the Certified Weigher shall sign his official registered signature and place his seal on the original ticket. The ticket shall be filled out in ink and delivered to the project site with the material.

For materials directly paid for by the ton, the Engineer will be furnished a daily recap of all materials delivered to the project. The daily recap sheet must list the ticket number, type of material by item number, and a quantity of materials for each load hauled. Any discrepancy between the certified weigh bills and the daily recap will be reviewed along with the contractor's initialed copy of weigh bills.

Due to possible variations in the specific gravity of aggregates, the tonnage used may vary from the proposal quantities and the Department will not make adjustments in the Contract unit price because of such variations.

The truck tare to be used in the weighing operation shall be the weight of the empty truck determined with full tank(s) of fuel and the operator seated in the cab. A daily weight shall be recorded at the beginning of each work day prior to use of truck. If preferred, a new tare may be determined for each load. When a new tare is obtained for each load, the requirement for full tank(s) of fuel shall be waived.

All weight of trucks shall be recorded to the nearest 20 pounds.The cost of providing facilities and equipment for the accurate weighing, proportioning, or measuring of materials is incidental to the associated pay items in the Contract."

Subsection 109.02 (pg. 100-101), 11-9-17; Replace the last paragraph:

"Document on the Prompt Payment Certification Form the actual amount paid to all subcontractors, during the estimate period for which the certification is being made. Ensure all Disadvantaged Business Enterprise (DBE) or certified Small Business Enterprise (SBE) are listed and classified on the form, including DBE or SBE off-site haulers and DBE or SBE material suppliers"

Subsection 109.02 (pg. 100-101), 7-2-18; Remove paragraphs 5, 6 and 7, beginning with, "Provide a monthly payment certification…." and replace with the following:

"Scope of Payment

The Department will pay, and the Contractor agrees to accept, the compensation provided in the Contract for the work acceptably completed and measured for payment under each Contract item. Payment of a Contract item is full compensation for furnishing all materials, equipment, tools, labor, and incidentals required to complete the item; and for all risk, loss, damage, or expense arising out of the nature or the performance of the work, subject to **107.19** and **109.11**.

If the "Basis of Payment" clause in the Specifications relating to a unit price in the bid schedule requires that the price of the Contract item cover and be considered compensation for certain work or material essential to the item, the Department will not measure or pay for this same work or material under any other pay item that may appear elsewhere in the Specifications.

When two or more projects are included in the same Contract, the Contractor will be required to furnish any item listed in the Contract to any or all of the projects at the Contract unit price.

The Department requires that the Contractor pay subcontractors, material suppliers, and haulers promptly for their work after receipt of payment for the associated work from the Department. The Contractor shall pay each subcontractor, ~~and~~ material supplier, and hauler for work performed or materials supplied under its subcontract no later than thirty (30) calendar days from the date the Contractor receives payment for the work from the Department. Any payment to the Contractor from which any amount has been withheld in accordance with **107.19** or **109.11** shall constitute full payment for the associated work, and the Contractor shall remain obligated to pay all subcontractors, material suppliers, and haulers fully and promptly for all associated work. The same prompt payment requirements apply to subcontractors at all tiers.

~~Provide a monthly payment certification to the Department entitled "Prompt Payment Certification Form." An officer of the Contractor shall sign this certification form. The Department will withhold estimate payments if the required information is not submitted or if subcontractors, at any tier, or materials suppliers are not paid after the thirty (30) calendar day time period. Also, all required certifications must be submitted to the field office and accepted before such work is deemed satisfactorily completed. Any delay or postponement of payment beyond the thirty (30) calendar day time frame will result in accrual of interest as provided under TCA §12-4-707(b).~~

~~The prime contractor, or subcontractors, at any tier, shall not withhold any retainage from progress payments made to their subcontractors.~~

~~Document on the Prompt Payment Certification Form the actual amount paid to any certified Disadvantaged Business Enterprise (DBE) or certified Small Business Enterprise (SBE) during the estimate period for which the certification is being made.~~ Ensure each subcontractor, including all Disadvantaged Business Enterprises (DBE), certified Small Business Enterprises (SBE), and DBE or SBE haulers or material suppliers, has registered for AASHTOWare Project Civil Rights & Labor (CRL) prior to commencing Work.

Document within CRL the actual amount paid to all subcontractors, material suppliers, and haulers during the monthly estimate period for which the certification is being made. The Department will withhold estimate payments if the required information is not submitted or if subcontractors, at any tier, material suppliers, or haulers are not paid after the thirty (30) calendar day time period. Any delay or postponement of payment beyond the thirty (30) calendar day time frame will be subject to terms listed in TCA §12-4-707(b). The Contractor shall remain obligated to pay all subcontractors, material suppliers, and haulers fully and promptly for all work associated with a pay estimate from the Department, notwithstanding any withholding of payment from the Contractor for failure to pay a subcontractor, material supplier, or hauler within thirty (30) calendar days.

The prime contractor, subcontractors, at any tier, material suppliers, or haulers shall not withhold any retainage from progress payments made to their subcontractors.

Subsection 109.04 (pg. 106), 3-30-15; Replace C. Force Account, 4. Equipment, c. with:

"Idle or standby cost will not be paid for more than 8 hours in a day or 40 hours in a week".

S T A T E **O F** **T E N N E S S E E**

(Rev. 5-18-15)
(Rev. 11-16-15)
(Rev. 5-15-17)
(Rev. 5-14-18)

January 1, 2015

Supplemental Specifications - Section 200

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 201.03 Clearing and Grubbing, A. General (pg. 118-119), 5-15-17; remove the third paragraph:

Subsection 201.03 Clearing and Grubbing, C. Clearing and Grubbing Activities, 5. Borrow Pit Areas (pg. 120), 5-15-17; remove the last sentence in the last paragraph:

> **"**In areas approved as borrow pits by the Engineer, clear and grub all trees, stumps, brush, and heavy vegetation.
>
> In areas designated for obtaining construction material other than borrow, clear and grub trees, stumps, brush, and vegetation, and strip overburden lying above the material to be obtained.
>
> Complete this work prior to removing borrow or construction materials. "

Subsection 202.03 General (pg. 125), 5-15-17; remove the last sentence of the 2nd paragraph:

> **"**Remove material designated for salvage in readily transportable pieces, and store the removed pieces at specified locations within the Project limits. Replace with new material, at no additional cost to the Department, those materials designated for salvage that are damaged during removal, transport, or storage operations. Take ownership of material not designated for the Department's use, and dispose of such material beyond view from the Project limits. "

Subsection 203.02 (pg. 134), 5-15-17; remove the last sentence of the 1st paragraph:

> "Borrow Excavation consists of material required for the construction of embankments or other portions of the work. "

Subsection 203.04 (pg. 139), 5-15-17; add 5. to the list of provisions:

"1. The cost of this material is more economical than borrow excavation.
2. The material is available within the adjusted balance where the shortage exists or the material may be hauled outside the limits of adjusted balance if the cost of the material is more economical than borrow after considering the additional cost of overhaul.
3. The material can be excavated without blasting.
4. There is a minimum of 20 feet between the top of the existing slope and the top of the new slope and a minimum of 5 feet between the top of the new slope and right-of-way line or Control Access fence. The 20-foot minimum will not apply when the existing slope is 4:1 or flatter or to overlapping or near overlapping slopes in medians or between parallel roads or ramps. The Engineer may reduce the 20-foot minimum at the Contractor's written request.
5. The material has not been designated as potentially acid producing material."

Subsection 203.04 (pg. 139-140), 5-15-17; add the 2nd paragraph as follows, revise the 5th paragraph to remove the reference to the *Procedures for Providing Offisite Waste and Borrow on TDOT Construction Projects*:

"**E. Borrow Areas**

Notify the Engineer before opening any borrow area to allow adequate time for the Engineer to take cross-section elevations and measurements of the ground surface after being stripped, and to test the borrow material before use. Obtain approval for the borrow area according to the *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*. Allow at least 14 days for testing borrow materials or other material from roadside pits proposed for construction purposes.

Borrow materials shall not contain acid producing materials. Representative samples of the proposed borrow material shall be tested for pH (EPA600/2-78-054 or ASTM D4239). Material with a pH less than 5 is considered acid producing and will not be accepted.

Unless otherwise allowed, do not place borrow material until after the roadway excavation material has been placed in the embankments. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the Department will deduct the amount of such waste from the measured borrow volume. Do not excavate beyond the dimensions and elevations established.

The Contractor may remove highway fencing to obtain borrow materials. Replace the fencing removed with new fence at no cost to the Department, and assume responsibility for confining livestock, as necessary.

Excavate borrow pits to be self-draining where possible and practicable, and of a shape that can be easily cross-sectioned.

After completing excavation operations, provide the area with a neat appearance. Cover all self- draining borrow areas with topsoil and stabilize. Provide and place topsoil and seeding (with mulch) as specified in **203.06** and **801**, respectively.

For borrow pits 1 acre or larger in size that are not self-draining, refer to Sections 53-801 through 53-809 of the TCA. Full information regarding the requirements to be complied with and the necessary permits that the property owner must secure for the construction of a pond, lake, borrow pits, etc., 1 acre or larger that is not constructed to drain, will be supplied upon application to the TDEC."

Subsection 203.07 (pg. 141-142), 5-15-17; replace the last paragraph:

"Ensure the offsite disposal grading plan is properly designed (including but not limited to slope stability and fill placement recommendations) regulated, and implemented."

Subsection 204.06 – 2 (pg.152-154), 5-14-18**;** replace Table 204.06-3 with the following:

Table 204.06-3: Specification Limits for EFF

Property	Specification Limit
Air content (ASTM D6023)	Maximum 30% (1)
Load Application (ASTM D6024)	24 hours maximum in any condition
Consistency	15 inches minimum as tested per 204.06.B.1
Compressive strength (ASTM D4832) (2)	30 psi minimum at 28 days 100 psi maximum at 28 days

(1) When using air entrained mixture design

(2) ASTM D4832 4 x 8 inch cylinder molds may be used. The preferred capping method to be used is wetsuit neoprene restrained in rigid retainers.

Subsection 204.06 – 2 (pg.152-154), 5-18-15**;** replace Tables 204.06 with the following:

1. General Use Flowable Fill

Table 204.06-2: Specification Limits for General Use Flowable Fill

Property	Specification Limit
Load Application (ASTM D6024)	24 hours maximum in any condition
Consistency	15 inches minimum tested as specified in this **204.06.B.1**

2. Excavatable Flowable Fill (EFF)

Table 204.06-3: Specification Limits for EFF

Property	Specification Limit
Air content (ASTM D6023)	Maximum 30% (1)
Load Application (ASTM D6024)	24 hours maximum in any condition
Consistency	15 inches minimum as tested per **204.06.B.1**
Compressive strength (ASTM D4832) (2)	30 psi minimum at 28 days

(1) When using air entrained mixture design

(2) ASTM D4832 4 x 8 inch cylinder molds may be used. The preferred capping method to be used is wetsuit neoprene restrained in rigid retainers.

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3. Early Strength Flowable Fill (ESFF)

Table 204.06-4: Specification Limits for ESFF

Property	Specification Limit
Air content (ASTM D6023)	Maximum 30% (1)
Load Application (ASTM D6024)	6 hours maximum in any condition
Consistency	15 inches minimum as tested per **204.06.B.1**
Compressive strength (ASTM D4832) (2)	30 psi minimum at 24 hours

(1) When using air entrained mixture design

(2) ASTM D4832 4 x 8 inch cylinder molds may be used. The preferred capping method to be used is wetsuit neoprene restrained in rigid retainers.

Subsection 204.06 (pages. 153-154) 11-16-15; Excavatable Flowable Fill - delete the first sentence of the first full paragraph after Table 204.06-3 on page 153, Early Strength Flowable Fill – delete the first sentence of the second paragraph below Table 204.06-4 on page 154:

Subsection 206.03 (pg. 180-181), 5-15-17; remove the reference to the *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects* in the next to last sentence of the first paragraph:

"Perform final dressing by hand work and machines to produce a uniform satisfactory finish to all parts of the roadway and other components of the Project. Shape the roadbed, shoulders, ditches, and slopes to within reasonably close conformity to the specified lines, grades, and cross-sections. Dress spoil banks, borrow areas, waste areas, and similar areas. Clear rock cuts of all loose fragments, and leave in a neat, safe, and workmanlike condition."

Subsection 209.01 (pg.190), 5-15-17; revise the 1st sentence of the 2nd paragraph:

> "Implement erosion prevention and sediment control (EPSC) measures during all phases of construction. Ensure that all EPSC measures shown on the Stormwater Pollution Prevention Plan (SWPPP) are in place before beginning soil disturbing activities."

S T A T E **O F** **T E N N E S S E E**

(Rev. 11-16-15)
(Rev. 6-27-16)
(Rev. 12-2-16)
(Rev. 5-15-17)

January 1, 2015

Supplemental Specifications - Section 300

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 303.01 (pg. 220) 5-15-17; add the following sentence as the last sentence of the 2nd paragraph:

"Mineral aggregates base shall be Type A or Type B, whichever is shown on the Plans and called for in the bid schedule. Reclaimed Concrete Aggregate (RCA) may be used as an alternate for Type A or Type B base material."

Subsection 303.02 (pg. 220-221) 5-15-17; add the following sentence to the last sentence of the 1st paragraph:

"Depending upon whether the Plans require Type A or Type B base, provide mineral aggregate meeting 903.05. For Type A base, use aggregate of Grading D. For Type B base, the Contractor may use aggregate of Grading C or D. For RCA, use grading specified in 903.05-C."

Subsection 303.07 (pg. 222-223) 5-15-17; modify the 1st sentence of the 1st paragraph to the following:

"Construct Mineral Aggregate Base, Type A, ~~or~~ Type B, or RCA in one or more layers, to the compacted thickness shown on the Plans."

Subsection 303.08 (pg. 223-224) 5-15-17; add the last sentence to the last paragraph of subsection A:

"For Mineral Aggregate Base, Type A, use the stationary plant method. For Mineral Aggregate Base, Type B, requiring the blending of two or more materials, use either the stationary plant method or the road mix method (mechanical mixer), except as provided for in **903.05**. For Mineral Aggregate Base, Type B, requiring additive, use either stationary plant mixing or road mixing. When using RCA as a replacement for Mineral Aggregate Base, Type A or Type B, use the intended method of mixing for the material listed above."

Subsection 303.10 (pg. 225-227) 5-15-17; add subsection c.:

"**2. Density Requirements**

a. **Type A Base.** The average density of each lot of Type A base, unless otherwise specified, shall be within 100% of maximum density as determined according to AASHTO T 99, Method D, with no individual test less than 97% of maximum density.

b. **Type B Base.** The average density of each lot of Type B base, unless otherwise specified, shall be not less than 97% of maximum density as determined according to AASHTO T 99, Method D, with no individual test being less than 95% of maximum density.

c. **RCA Base.** The average density of each lot of RCA base, unless otherwise specified, shall be not less than 100% of maximum density as determined according to AASHTO T 99, Method D, with no individual test less than 97% of maximum density. The moisture content shall be within ±3% of the optimum moisture content as determined by an independent laboratory analysis. Mixing of the material with water shall be completed per Section 303.08."

Subsection 303.14 (pg. 228) 5-15-17; revise the first sentence of A.:

"**A. Mineral Aggregate for Mineral Aggregate Base, Type A or Type B, or RCA**

The Department will measure Mineral Aggregate for Mineral Aggregate Base, Type A, ~~or~~ Type B, or RCA, by the ton, in accordance with **109**."

Subsection 307.03 (pg. 246) 11-16-15; Modify Table 307.03-3:

B. Recycled Asphalt Pavement for Bituminous Plant Mix Base, Table 307.03-3

Table 307.03-3: Mixtures Using RAP

Mix Type	% RAP (Non-processed)[1]	Maximum % RAP (Processed)[2]	Maximum % RAP Processed & Fractionated [3]	Maximum Particle Size (inches)
307-ACRL	0	00	-	-
307-AS	0	00	15	-
307-A	15	20	35	1-1/2
307-B	15	30	35	1-1/2
307-BM	15	30	35	3/4
307-BM2	15	30	35	3/4
307-C	15	30	35	3/8
307-CW	15	30	35	1/2
307-CS	0	15	25	5/16

[1] "Non-processed" refers to RAP that has not been crushed and screened or otherwise sized prior to its use.

[2] "Processed" refers to RAP that has been crushed and screened

or otherwise sized such that the maximum recycled material particle size is less than that listed in Table 307.03-3 prior to entering the dryer drum.

(3) "Fractionated" refers to RAP that has been processed over more than one screen, producing sources of various maximum particle sizes (e.g., 3/4 to 1/2 inch, 1/2 inch to #4, etc.). The Contractor may use the larger percentages of fractionated RAP specified only if individual fractions of two different maximum particle size are introduced into the plant as separate material sources for increased control.

(4) RAP for 307-AS must be processed in a manner such that the minimum particle size is no smaller than 3/4" prior to solvent extraction. For RAP containing gravel as coarse aggregate, the maximum allowable RAP content shall be 10%.

2. Recycled Asphalt Shingles (RAS) RAS may be included to a maximum of 3% of the total weight of the mixture.

Subsection 307.03 (pg. 246) 5-15-17; Modify Table 307.03-3:

B. Recycled Asphalt Pavement for Bituminous Plant Mix Base, Table 307.03-3

Table 307.03-3: Mixtures Using RAP

Mix Type	% RAP (Non-processed)(1)	Maximum % RAP (Processed)(2)	Maximum % RAP Processed & Fractionated (3)	Maximum Particle Size (inches)
307-ACRL	0	00	-	-
307-AS	10	1000	1015	-
307-A	15	20	35	1-1/2
307-B	15	30	35	1-1/2
307-BM	15	30	35	3/4
307-BM2	15	30	35	3/4
307-C	15	30	35	3/8
307-CW	15	30	35	1/2
307-CS	0	15	25	5/16

(1) "Non-processed" refers to RAP that has not been crushed and screened or otherwise sized prior to its use.

(2) "Processed" refers to RAP that has been crushed and screened or otherwise sized such that the maximum recycled material particle size is less than that listed in Table 307.03-3 prior to entering the dryer drum.

(3) "Fractionated" refers to RAP that has been processed over more than one screen, producing sources of various maximum particle sizes

(e.g., 3/4 to 1/2 inch, 1/2 inch to #4, etc.). The Contractor may use the larger percentages of fractionated RAP specified only if individual fractions of two different maximum particle size are introduced into the plant as separate material sources for increased control.

~~(4) RAP for 307-AS must be processed in a manner such that the minimum particle size is no smaller than 3/4" prior to solvent extraction. For RAP containing gravel as coarse aggregate, the maximum allowable RAP content shall be 10%.~~

Subsection 307.03 (pg. 250) 6-27-16; C. revise the last paragraph to the following:

"Mix an approved antistrip agent with the asphalt cement at the dosage as specified in **921.06.B**."

Subsection 307.06 (pg. 250) 12-2-16; add the following as the second paragraph:

"Do not place AS/ACRL which cannot be covered by the next course of pavement within the same construction season."

Subsection 313.03 (pg. 273) 11-16-15; B. Bituminous Treated Permeable Base, add the following sentence to the end of the paragraph:

"Recycled Asphalt Pavement (RAP) meeting the requirements of 307.03.B may be incorporated into asphalt treated permeable base up to 15% by weight of aggregate. RAP must be processed in a manner such that the minimum particle size is no smaller than ¾" prior to solvent extraction. Treated permeable base mixtures containing RAP shall contain at least 65% virgin asphalt binder. For RAP containing gravel as a coarse aggregate, the maximum allowable RAP content shall be 10%"

Subsection 313.03 (pg. 273) 5-15-17; B. Bituminous Treated Permeable Base, revise the sentence added on 11-16-15 to the following sentence:

"Recycled Asphalt Pavement (RAP) meeting the requirements of 307.03.B may be incorporated into asphalt treated permeable base up to 10~~5~~% by weight of aggregate. ~~RAP must be processed in a manner such that the minimum particle size is no smaller than ¾" prior to solvent extraction.~~ Treated permeable base mixtures containing RAP shall contain at least 65% virgin asphalt binder. For RAP containing gravel as a coarse aggregate, the maximum allowable RAP content shall be 10%.

Mix an approved antistrip agent with the asphalt cement at the dosage as specified in **921.06.B.**"

Subsection 313.10 (pg. 276) 5-15-17; Basis of Payment, add the sentence as the third paragraph:

"The cost of antistrip additive used in Bituminous Plant Mix (Hot Mix) will be included in the price of Treated Permeable Base."

S T A T E **O F** **T E N N E S S E E**

(Rev. 5-18-15)
(Rev. 7-13-15)
(Rev.11-16-15)
(Rev. 6-27-16)
(Rev. 12-2-16)
(Rev. 1-6-17)
(Rev. 5-15-17)
(Rev. 11-6-17)
(Rev. 5-14-18)

January 1, 2015

Supplemental Specifications - Section 400

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 402.03 (pg. 282) 5-27-16; revise 0.2 to 0.05 in the range as shown in the 2nd paragraph:

> "The distributor shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable surface widths at readily determined and controlled rates from 0.05 to 0.5 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate of plus or minus 0.02 gallons per square yard."

Subsection 403.02 (pg. 285-286) 12-2-16; Bituminous Materials, remove trackless tack information from specifications and reference the QPL for approved Emulsified Trackless Tacks, remove trackless tacks from Table 403.02-1:

> "Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp……904.03 or Approved Emulsified Trackless Tack from the QPL.

Table 403.02-1: Tack Coat Application Temperatures

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS-1h, CQS-1hp and CSS-1h	60 to 140 °F

Subsection 403.02 (pg. 285-286) 11-16-15; Bituminous Materials, update the reference to 904.03, add TTT-3 to Table 403.02-1:

"Emulsified Asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1P, CQS-1h, CQS-1hp, TTT-1, TTT-2, TTT-3 ……..904.03"

Table 403.02-1: Tack Coat Application Temperatures

Material	Temperature Range
SS-1, SS-1h, CSS-1, TST-1P, CQS-1h, CQS-1hp and CSS-1h	60 to 140 °F
TTT-1	160 to 180 °F
TTT-2	120 to 160 °F
TTT-3	100 to 180 °F

Subsection 403.05 (pg. 286) 11-16-15; A. Emulsified Asphalt, Add the following paragraph at the end of the subsection:

"Take a minimum of 3 cores throughout the length of the project for informational tack coat shear testing. Include the underlying layer. Not required for mats less than one inch thick."

Subsection 403.05 (pg. 287) 11-16-15;) B. Test Strip, modify the 2nd paragraph to update the rate as 0.08 and 0.12:

"If placing the bituminous material upon a milled surface, apply the tack material at a rate of between 0.08 and 0.12 gallons of applied emulsion per square yard."

Subsection 403.05 (pg. 287) 6-27-16; revise the last sentence of the 2nd paragraph:

"If placing the bituminous material upon a milled surface, apply the tack material at a rate of between 0.08 and 0.12 gallons applied emulsion per square yard."

Subsection 403.05 (pg. 287), 11-6-17; Revise the 1st sentence of the 1st paragraph:

"When the Contract requires bituminous material for fog sealing of shoulders, provide emulsified asphalt meeting **403.02** or an item from QPL 40A**."**

Subsection 404 (pg. 289-293) 1-6-17; Remove the entire subsection. All specifications regarding Double Bituminous Surface Treatment has been incorporated into subsection 405. All references shall be updated to subsection 405.

Subsection 405 (pg. 294-298) 1-6-17; replace subsection 405 with the following:

"405.01 Description

This work consists of constructing a bituminous seal coat consisting of one or more applications each of bituminous material and cover aggregate.

MATERIALS

405.02 Materials

Provide materials as specified in:

Mineral Aggregate, Size Nos. 7, 8, 78, 89..... 903.13
Mineral Aggregate……..... 903.14
Emulsified Asphalt, CRS-2p 904.03

Apply seal coat at a temperature range of 60 to 140 °F.

EQUIPMENT

405.03 Equipment

Provide a power broom or other mechanical sweeping equipment, equipment for heating bituminous material, a pressure distributor meeting the requirements of 402.03, pneumatic-tire and steel-wheel rollers, self-propelled mechanical aggregate spreading equipment that can be adjusted so as to spread accurately at the specified rate, and such other equipment and small tools as may be required to perform the work in a satisfactory manner.

CONSTRUCTION REQUIREMENTS

405.04 Limitations

Only apply bituminous material:

1. When the designated surface is dry, firm, and properly cured;

2. Between April 15 and October 1; and, unless otherwise directed,

3. When the ambient temperature in the shade and away from artificial heat is 70°F or more.

405.05 Preparing the Designated Surface

Before placing seal coat, clean all surfaces to be sealed by sweeping with a motorized broom to remove any loose material. Clean depressions and cracks not reached by the power broom using hand brooms or pressurized air.

Cover any utility installations to prevent adherence of the bituminous mixture. Suitable covering includes plywood disks, sand, craft paper, roofing felt or other approved methods. Remove the protective coverings before opening the road to traffic. The cost for these adjustments shall be included in the bid price for other items.

The Plans will indicate whether the surface is to be constructed on a treated or untreated subbase, a granular base, an asphalt base, or on an existing surface. The surface of the base or sub-base upon which the construction is to be placed shall meet the requirements of the applicable Section of Part 3, Bases and Subgrade Treatments, of these Specifications.

Condition existing surface, if called for on the Plans, as specified in 407.10. Condition existing mineral aggregate base as specified in 310.

Construct and maintain Prime Coat or Tack Coat, if shown on the Plans, as specified in 402 or 403, respectively.

405.06 Application

A. Applying Bituminous Material:

Have all equipment calibrated prior to starting work. The TDOT inspector shall be present during calibration to determine aggregate spread rate and distributor rates. Distributor trucks shall have proper calibration of spray equipment. Spray nozzles should be clean, properly angled, and appropriately sized for the desired application rate. Stop work if the distributor is not applying material properly, such as gaps in application or streaking.

Place a 500 ft. test strip for the bituminous seal coat at the beginning of the project to assure proper coverage and proper equipment calibration. The test section is to verify break time of emulsion and chip retention. The test strip shall be able to carry normal traffic within 3 hours. If normal traffic cannot be carried, the emulsion shall be adjusted and another test strip is required.

At least 14 working days before the scheduled start of construction of any bituminous seal coat, submit a sample of aggregate intended for use for the determination of the appropriate application rates of bituminous material and aggregate. Apply emulsified asphalt by pressure distributor at a uniform rate in accordance with Table 405.06-1 below. The exact rate will be established by the Engineer.

Table 405.06-1: Application Rates for Bituminous Material

Aggregate Size (per 903.22)	Aggregate Spread Rate (lb/yd^2)	Emulsion Shot Rate (gal/yd^2)
7	25 – 30	0.30 – 0.45
78	22 – 28	0.28 – 0.38
8	20 – 25	0.20 – 0.35
89	17 – 23	0.17 – 0.28

Before beginning each spread, place building paper across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Start distributors on the paper, the width of which shall allow the full force of all nozzles to be in effect before the forward edge of the paper is reached. If required by the Engineer, also stop the spread on building paper. Remove the paper immediately after its use, and dispose of properly. Immediately correct all defects in application.

The length of spread of bituminous material shall not exceed that which trucks loaded with cover material can immediately cover.

The spread of bituminous material shall not extend more than 6 inches wider than the width covered by the cover material. Do not allow the bituminous material to chill or otherwise impair retention of the cover material.

Do not allow traffic on the bituminous material until it has been covered with mineral aggregate.

Treat areas that are inaccessible to the distributor with either hand sprays or pouring pots as directed by the Engineer.

B. Application of Double Bituminous Surface Treatment:

First Application

Apply the first application of emulsified asphalt using pressure distributors at a uniform rate established by the Engineer within the range of 0.30 to 0.38 gallons per square yard. Apply each spread of bituminous material so as not to be more than 6 inches wider than the width covered by the immediate spread of cover aggregate. Each width of spread shall not be less than half the surface to be treated.

Before beginning each spread, place building paper across the roadway surface with the forward edge exactly coinciding with the end of the preceding covered spread. Start distributors on the paper, the width of which shall allow the full force of all nozzles to be in effect before the forward edge of the paper is reached. If required by the Engineer, also stop the spread on building paper. Remove the paper immediately after its use, and dispose of properly. Immediately correct all defects in application.

Treat areas that are inaccessible to the distributor with hand sprays or pouring pots as directed by the Engineer.

If treating less than the full width of the roadway, do not spread the aggregate on the inside 6 inches of either the first or second application until the adjacent lane has been treated. Immediately following each application, uniformly cover the applied bituminous material with Size No. 7 mineral aggregate that is reasonably free of surface moisture.

Spread the aggregate at a rate between 24 and 30 pounds per square yard, as established by the Engineer, using a self-propelled mechanical spreader; except on short projects of 1/2 mile in length or less, self-propelled mechanical spreading equipment will not be required. Back the truck on the aggregate being spread, without driving on or over uncovered bituminous material.

The length of bituminous material spread shall not exceed that which trucks loaded with cover material can immediately cover.

Second Application

Apply the second application of emulsified asphalt in the same manner as the first application, at a uniform rate established by the Engineer within the range of 0.20 and 0.35 gallons per square yard.

Spread mineral aggregate, Size No. 8, in the same manner as the first spread at a rate established by the Engineer within the range of 16 to 28 pounds per square yard.

Immediately after each spread of cover aggregate, broom to achieve uniform coverage. Use a power source, which is independent of the drive train that propels the equipment, to power the revolving brooms of mechanical sweeping equipment. Place additional aggregate by hand on thin or bare areas.

405.07 Spreading and Rolling Aggregate

A. Spreading

Immediately after bituminous material has been applied, no more than two minutes, spread and embed the mineral aggregate cover in the bituminous material. Spread the aggregate as close to the application of bituminous material as is practicable, and cover each distributor load applied immediately. Aggregates shall be moistened and visually damp at the time of placement.

Spread the aggregate in accordance with the rates specified in Table 405.06-1. The exact rate will be established by the Engineer. Back the truck on the aggregate being spread, without driving on or over uncovered bituminous material. If treating less than the full width of roadway, do not spread the aggregate on the inside 6 inches of the bituminous spread until the adjacent lane is treated. Immediately after spreading the aggregate, perform hand-brooming to achieve uniform coverage. Place additional aggregate by hand on thin or bare areas.

The speed of the spreader shall be such that the aggregates are not rolling over, and starting and stopping of the spreader is minimized. Use of previously used (swept) aggregates is not permitted.

B. Rolling – Bituminous Seal Coat

Immediately after distributing the aggregate, roll the entire surface by moving in a longitudinal direction, beginning at the outer edges and progressing toward the center of the roadway, with each trip of the roller overlapping the previous trip by half the width of the rear wheel. Perform initial rolling with a self-propelled pneumatic tire roller, and follow with steel-wheel rolling. The amount and sequence of rolling shall be as directed by the Engineer. Complete the initial rolling of the aggregate within 1 hour after applying the bituminous material.

Use power brooms to correct irregularities by sweeping the aggregates from areas of thick or heavy distribution to areas of thin or light distribution. Then continue rolling using both steel-wheel and pneumatic rollers until the aggregate is thoroughly embedded in the bituminous material. The Engineer may require additional rolling at a later date. Redistribute excess or loose aggregate that was thrown out of place.

Slow moving traffic may use the section or roadway upon which the aggregate has been spread.

Rolling and Curing – Double Bituminous Seal Coat

Immediately after spreading and brooming the cover aggregate, roll the entire surface, beginning at the edges and progressing to the center. Begin rolling within 30 minutes after spreading the aggregate. Perform initial rolling with a self-propelled pneumatic tire roller, and follow with steel-wheel rolling. The amount and sequence of rolling shall be as directed by the Engineer.

Allow the first application of bituminous material and aggregate to cure for as long as deemed necessary by the Engineer before beginning the second application. Immediately before the second application of bituminous material, roll the surface with a steel-wheel roller.

For the second application of bituminous material and cover aggregate, repeat the same rolling and curing procedures as required for the first application.

The Contractor may allow slow-moving traffic to use sections of the roadway where the bituminous material has been covered with mineral aggregate.

405.08 Shoulders

Restore shoulders that have been disturbed by the Contractor's construction operations at no cost to the Department. Remove all objectionable material placed on the shoulders by the Contractor as directed by the Engineer.

Construct shoulders, when specified, as provided for under **208**.

405.09 Maintenance and Protection

Maintain in a satisfactory condition each completed section of seal coat until the entire Project is complete. Maintenance shall include making repairs where failures occur, and maintaining the seal coat in a smooth uniform condition; and brooming, dragging, and rolling when required.

After the final application, maintain the work in a satisfactory condition for at least 10 calendar days. If all other requirements of the Contract have been fulfilled, the Department will not charge working time during the 10-day maintenance period against the Contract time.

For final cleanup, sweep up all excessive quantities of loose, dislodged cover aggregate that may have collected along the edge of the completed seal coat, and dispose of this material as directed by the Engineer.

405.10 Method of Measurement

The Department will measure Mineral Aggregate and Bituminous Material by the ton in accordance with **109**. The Department may use net certified weights as a basis of measurement for mineral aggregate, subject to correction for aggregate that is lost, wasted, or otherwise not incorporated into the Work.

405.11 Basis of Payment

The Department will pay for accepted quantities of Bituminous Seal Coat, complete in place, at the contract prices as follows:

Item	*Pay Unit*
Bituminous Material	Ton
Mineral Aggregate	Ton

The Department will measure and pay for the work required to prepare the designated surface, as provided for under **405.05**, in accordance with the applicable Section or Subsection under which the work is performed."

Subsection 405.05 (pg. 295) 5-14-18; Add the following as the second paragraph:

"Before placing seal coat, clean all surfaces to be sealed by sweeping with a motorized broom to remove any loose material. Clean depressions and cracks not reached by the power broom using hand brooms or pressurized air.

Remove pavement markers and adhesives. Abrade all types of existing striping. Work shall be accomplished without the pavement being gouged or damaged and in a manner which ensures the bituminous treatment will adhere in all areas applied. Work shall be performed to the satisfaction of the Engineer.

Subsection 407.02 (pg. 300-301) 12-2-16; Replace the 4th paragraph:

"If anti-stripping additive, other than hydrated lime, meeting 921.06.B.1 is required, use approved in-line blending equipment, as specified in 407.04.A.6, to add it at the mixing plant or inject it at the asphalt terminal. Manufacture's documentation that asphalt binders will continue to meet requirements listed in subsection **904** after the anti-stripping additive is added shall be provided by the contractor with the mix design submittal. For mix designs submitted more than six months in advance, the documentation shall be resubmitted prior to use of the mix design with updated test results."

Subsection 407.02 (pg. 300) 11-16-15; Materials, add the following at the end of the fourth paragraph:

"If anti-stripping additive, other than hydrated lime, meeting **921.06.B.1** is required, use approved in-line blending equipment, as specified in **407.04.A.6**, to add it at the mixing plant or inject it at the asphalt terminal. Provide manufacture's documentation ensuring asphalt binders will continue to meet requirements listed in Subsection **904** after anti-stripping additives are added."

Subsection 407.06 (pg. 327), 5-18-15; - A. Pavers. Replace the entire first paragraph with the following:

"Bituminous pavers shall be self-contained, power-propelled units provided with an activated screed, equipped to be heated, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thickness shown on the Plans. All screed extensions shall be full assembly extensions, including activated and heated screeds. Pavers shall include throw-back blades, reverse augers, or equivalent to place mix beneath the auger gearbox. Auger extensions shall be incorporated in a manner such that the maximum distance from the augers to the end plate shall be 18 inches. Screed extensions may extend beyond the 18-inch maximum from auger extensions only when extending for short-term temporary deviations in pavement width such as driveways. Do not use strike-off boxes, with the exception of sections with continuously varying width."

Subsection 407.09 (pg. 329-331), 5-14-18; Revise the following: 3. Add two sentences as the end of the paragraph, 4. Remove the first sentence, add two sentences as new first and second sentence, Add second paragraph as shown:

"3. Do not place bituminous plant mix, with a compacted thickness of 1.5 inches or less, between November 30 and April 1. Do not place bituminous plant mix, with a compacted thickness greater than 1.5 inches, between December 15 and March 16. Only place 411-TL, 411-TLD, and 411-OGFC mixtures when the pavement surface temperature and the ambient air temperature are a minimum of 55 °F and rising; limit placement to the period from April 1 to November 1. If the temperature meets the above requirements, outside of normal paving season, a request for a seasonal limitation waiver may be submitted for Departmental consideration. Requests shall be submitted in writing at least one week before the anticipated need.

4. If determined necessary by the Department, the Contractor may request a variance from the above required temperatures and seasonal limitations to pave at lower temperatures by submitting

a Cold Weather Paving and Compaction Plan. All projects requiring a Cold Weather Paving and Compaction Plan shall utilize Intelligent Compaction to demonstrate proper coverage and compaction temperature at no additional cost to the Department; with the exception of small quantity projects, such as, but not limited to, bridge approaches, intersections, and temporary traffic shifts. Upon completion, the documentation showing appropriate coverage and compaction temperature shall be provided to the Department. ~~The Contractor may request a variance from the above required temperature and seasonal limitation to pave at lower temperatures if there is a benefit to the public.~~ Submit ~~such~~ requests in writing at least one week before the anticipated need, and include a Paving and Compaction Plan for Cold Weather that meets the Department's Procedure. The plan shall identify what practices and precautions the Contractor intends to use to ensure the mixture is placed and compacted to meet the specifications. The plan shall include compaction cooling curves estimating the time available for compaction, the intended production, haul, and compaction rates, with paver and roller speeds estimated. The Contractor may consider using such practices as the addition of rollers, reduced production and paving rates, insulated truck beds, and heating the existing surface.

In no cases will a cold weather paving and compaction plan or seasonal limitation waiver be approved for 411-OGFC, 411-TL, or 411-TLD.

If the specified densities are not obtained, stop all paving operations and develop a new plan. All mixture failing to meet specifications will be subject to price adjustments or removal and replacement at no cost to the Department.

Subsection 407.11 (pg. 332) 12-2-16; Add the following to the paragraph below Table 407.11-1:

"Minimum temperature for OGFC mixes shall be 280º."

Subsection 407.15, C. Test Strips. (pg. 340-341) 11-16-15; Add the following paragraph after the 7th paragraph of the subsection:

"Take an additional 3 cores after placement of the surface layer on the tack coat test strip described in subsection **403.05.B**. Include the underlying pavement layer for shear testing. These cores will be for informational testing only. Not required for mats less than one inch thick"

Subsection 407.15 (pg. 341) 6-27-16; remove the 2nd sentence of the 8th paragraph:

"Take cores on the test strip at ten randomly selected locations as designated by the Engineer. Provide these cores to the Department for use in calibrating the nuclear gauge and to verify that the average density of the test strip meets the density requirements of the specifications. The Department will report all densities using the corrected nuclear gauge readings. Correction factors are specific to the nuclear gauges used during the test strip construction. If a different nuclear gauge needs to be used for acceptance, it will be necessary to cut new cores from the ongoing pavement construction to calibrate the new gauge."

Subsection 407.15 (pg. 341) 12-2-16; remove "randomly selected" from 1st sentence of the 8th paragraph as follows:

"Take cores on the test strip at ten locations as designated by the Engineer."

Subsection 407.15 A. 3. c. (pg. 337-338) 5-15-17; update 10,000 square yards to 1,000 tons:

"c. Projects containing less than 1,000 tons or bituminous pavement."

Subsection 407.20 A. (pg. 345), 11-6-17; Revise the second paragraph as follows:

"The Department will pay for liquid anti-strip additive and hydrated lime anti-strip additive based on certified documentation of material costs not to exceed $15 per gallon and $90 per ton, respectively."

Subsection 407.20 (pg. 346) 5-18-15; Basis of Payment; B. Acceptance of Mixture; Modify the last paragraph to revise 500 tons to 1000 tons:

"When the total plan quantity of any mix is less than 1000 tons, the Department will accept the mix on the basis of visual inspection and Contractor Quality Control certification. The Department may run extraction, gradation analysis, or other tests deemed necessary for acceptance purposes."

Subsection 407.20 (pg. 348) 11-16-15; Table 407.20 – 2, make the following changes:

Table 407.20-2: Acceptance Schedule of Payment
(Asphalt Plant Mix Characteristics)

Characteristics	Pay Factor	Average Arithmetic Deviation of the Lot Acceptance Test from the JMF	
		1 Test	2 Tests or more
Asphalt Cement Content [1] (Extraction or ignition oven)	1.00	0.00-0.30	0.00-0.25
	0.95	0.31-0.35	0.26-0.30
	0.90	0.36-0.40	0.31-0.35
	0.80 [2]	over 0.40	over 0.35
Gradation 3/8 inch sieve and larger	1.00	0.00-6.50	0.00-5.70
	0.95	6.51-7.08	5.71-6.20
	0.90	7.09-7.66	6.21-6.69
	0.80 [2]	over 7.66	over 6.69
Gradation No. 4 sieve [3]	1.00	0.00-4.62	0.00-4.00
	0.95	4.63-5.20	4.01-4.50
	0.90	5.21-5.77	4.51-5.00
	0.80 [2]	over 5.77	over 5.00

Subsection 407.20 (pg. 350) 11-16-15; B. 5. Acceptance for Mix Density on the Roadway, Replace the entire 2nd paragraph with the following:

"For density testing purposes, the Department will divide the pavement into lots of 1,000 tons. Five density tests will be performed in each lot and the average results compared with the requirements specified in Tables 407.15-1 to 407.15-4. At the beginning of a project or at any

time it is deemed advisable, the Department may consider smaller lots to evaluate compaction methods or for other reasons as approved or directed by the Engineer."

Subsection 411.03 (pg. 363) 11-16-15; 2. Recycled Asphalt Shingles (RAS), change 5% to 3% in the 1st sentence of the 1st paragraph.

"Recycled Asphalt Shingles (RAS) may be included to a maximum of 3% of the total weight of mixture."

Subsection 411.03 B. Anti-strip Additive (pg. 365) 6-27-16; revise the 2nd paragraph:

"Mix an approved anti-strip agent with the asphalt cement at the dosage as specified in **921.06.B**."

Subsection 414.02 (pg. 369) 11-16-15; Materials, add the following paragraph to the end of the subsection:

"Ensure that no deleterious material is introduced into aggregate stockpiled at project site."

Subsection 414.02 (pg. 369) 11-6-17; Revise the last sentence:

"For a slurry seal, use a Type CQS-1h emulsified asphalt. For micro-surfacing use a type CQS-1hp or CSS-1hp emulsified asphalt."

Subsection 414.06 (pg. 379-382) 5-14-18; Remove B. 3. a., update b. to a. and revise as follows:

B. Quality Control

3. Documentation. Maintain a ~~daily report and a~~ lot sheet as follows:

~~**a. Daily Report.** Include the following information on the daily report:~~

~~(1) Aggregate used, ton (dry)~~
~~(2) Slurry or micro-surfacing emulsion used, ton~~
~~(3) Bituminous materials for tack coat and for fog seal, ton~~
~~(4) Cement used, ton~~
~~(5) Water used in mixture, gallons~~
~~(6) Additive used in mixture, gallons~~

~~b.~~a. **Lot Sheet.** Divide the Project into lots ~~of no more than 20,000 square yards~~of each day's production. For each lot, maintain a lot sheet, providing the following information:

(1) ~~Control Section, Job Number~~Contract Number, Route, ~~Engineer (Project Inspector)~~
(2) Date, Air Temperature, Pavement Surface Temperature
(3) Control Settings, Calibration Values, Unit Weight of Emulsion (pounds per gallon), Percent Residue in Emulsion
(4) Beginning and Ending ~~Intervals~~ Log Miles
(5) Computer display readings for material usage (Beginning, Ending, and Total)
(6) Length, Width, Total Area (square yards) of the construction completed for the day~~,~~
(7) ~~Pounds of~~ Aggregate used (dry ton)~~, Pounds of~~ Asphalt Emulsion used (ton), ~~Pounds of~~ additives (gallon), water (gallon), and/or Portland Cement (ton)
(8~~7~~) ~~Percent of each Material, Percent of Asphalt Cement,~~ Application Rate of asphalt emulsion, Combined Application Rate (pounds per square yard)

(98) Mix Design (Percent Portland ~~Cement~~cement, Percent Emulsion, Percent Asphalt Cement)
~~(9) Contractor's Authorized Signature~~
(10) Calibration Forms
(11) ~~(9)~~ Contractor's Authorized Signature"

S T A T E **O F** **T E N N E S S E E**
(Rev. 5-18-15) January 1, 2015
(Rev. 11-16-15)
(Rev. 5-15-17)
(Rev. 11-6-17)
(Rev. 5-14-18)

Supplemental Specifications - Section 500

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 501.03 (pg. 395), 5-18-15; 3. Mix Design Submittal; Replace the first paragraph with the following:

"Instead of the above mix design submittal, a request to use an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths."

Subsection 501.03 A. Proportioning (pg. 395) 5-15-17; Add water as 22. on the list of Design Submittal requirements, update the paragraph below the list to add water requirements:

"A. Proportioning

3. Design Submittal. Include the following information as a minimum in the proposed concrete design submittal:

1. Source of all aggregate
2. Brand and type of cement
3. Source and class of fly ash (if used)
4. Source and grade of ground granulated blast furnace slag (if used)
5. Specific gravity of cement
6. Specific gravity of fly ash (if used)
7. Specific gravity of ground granulated blast furnace slag (if used)
8. Admixtures (if used)
9. Gradation of aggregates
10. Specific gravities of aggregates (saturated surface dry)
11. Air content (if air entrainment is used)
12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete
17. Water/cement ratio (pound/pound)
18. 7-day compressive strength [minimum of two 4-inch x 8-inch cylinders]

19. 14-day compressive strength [minimum of two 4-inch x 8-inch cylinders]
20. 28-day compressive strength [minimum of two 4-inch x 8-inch cylinders]
21. Weight of each material required to produce a cubic yard of concrete
22. Water – submit testing results per Tables 921.01-1 & 921.01-2

Instead of the above mix design submittal, a request to use an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. When submitting for the use of an existing mix design, the most current water testing results per 921.01 shall accompany the submittal. The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths."

Subsection 501.03 (pg. 399-402) 11-16-15; B. Quality Control and Acceptance of Concrete, adjust the following:

"1. Test to determine aggregate gradations (AASHTO T 27 with AASHTO T 11 when required). Conduct a combined belt gradation before work starts and at least daily to verify consistency if using a dynamic, multi-aggregate feed system.

3. Calibrate the weighing systems, aggregate feed flow rate and weigh bridges, water meters, and admixture dispensing systems before starting production.

4. Ensure accurate weighing or flow rate of the aggregates and cement, the proper metering of water and admixtures, and the quality of water.

6. Adjust mix proportions due to actual moisture content of both coarse and fine aggregates, with moisture content determined according to AASHTO T 255. If using a dynamic aggregate weighing system, multi-aggregate proportioning adjustments are to be made by using an in-bin moisture sensor."

7. Conduct slump (AASHTO T119) or slump flow (ASTM C1611) and air tests (AASHTO T152).

Page 401- "Make, cure, and transport all early break cylinders (7-14 day, etc.) according to AASHTO T 23, and deliver to the Regional laboratory or other established satellite laboratories for testing. Make all early break cylinders (7-14 day, etc.) for self-consolidating concrete according to ASTM C1758, and deliver to the Regional laboratory or other established satellite laboratories for testing."

Page 402 - "Correct batch weights or aggregate feed flow rates to compensate for surface moisture on the aggregate at the time of use. The Contractor…"

Subsection 501.03 (pg. 401) 5-14-18; B. Quality Control and Acceptance of Concrete, remove AASHTO T23 and replace with specification 604.15 C."

"Make, cure, and transport all early break cylinders (7-14 day, etc.) ~~according to AASHTO T 23,~~ in accordance with 604.15.C, and deliver to the Regional Laboratory or other established satellite laboratories for testing."

Subsection 501.04 (pg. 402) 11-16-15; replace the following:

"A. Batching Plant, Multi-Aggregate Feed System, and Equipment,

1. General. The batching plant shall include bins, weighing hoppers or belt feeds with weigh bridges and load cells, and scales. If using cement in bulk,…

2. Bins and Hoppers- Add the following new paragraph under the existing paragraph

For multi-aggregate feed systems, provide bins as noted with variable size openings and variable speed belts. Each bin must have a calibrated moisture sensor to adjust aggregate feed flow rates. Assure consistent, uninterrupted aggregate flow and consistent belt speeds once aggregate feed system is calibrated.

3.Scales- Add the following new paragraph under the last paragraph in the section.

For multi-aggregate feed systems, provide a dual idler weight bridge with load cells to accurately weigh the actual aggregate flow rate."

Subsection 501.04 A. 1. (pg. 402), 11-6-17; General, Add the following after the first paragraph:

"All producers of concrete shall be on the Department's approved producer list and be actively certified by the National Ready Mixed Concrete Association (NRMCA) Plant Certification Program."

Subsection 501.04 B. 3. (pg. 403), 11-6-17; Truck Mixers and Truck Agitators, Add the following to the beginning of the first paragraph:

"Truck mixers shall be certified by the National Ready Mix Concrete Association (NRMCA) Delivery Vehicle Certification Program Option A or Option B."

Subsection 501.04 (pg. 404) 11-16-15; B. Mixers, removed the complete 4th paragraph.

Subsection 501.12 – Placing Concrete (pg. 413-415) 5-15-17; replace the subsection:

"**501.12 Placing Concrete**

Either unload the concrete into an approved spreading device, or deposit it directly on the base, and mechanically spread the concrete in a manner that prevents segregation of the materials. When using central or transit mixed concrete, deposit it in an approved spreader. Place the mixture so as to minimize rehandling and relocation from point of placement. The mechanical spreader will not be required on areas too small to accommodate the paving equipment, projects that contain 10,000 square yards or less of concrete paving, and on variable width sections and ramps. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Do not place concrete on frozen grade.

Perform any necessary hand spreading with shovels or other approved tools. Do not allow workmen to walk in the freshly mixed concrete with boots or shoes coated with earth or other foreign substances.

If placing concrete adjacent to a previously constructed lane of pavement and mechanical equipment is to be operated on this existing lane of pavement, that lane shall meet the requirements for opening to traffic specified in **501.22**. If the existing lane is to only carry finishing equipment, the Contractor may begin paving the adjoining lanes after 7 days.

Deposit concrete as near to expansion and contraction joints as possible without disturbing them; do not dump concrete from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.

Immediately remove all concrete materials that may fall on or be worked into the surface of a completed slab using approved methods.

When using the slip-form method of concrete paving, place the concrete with an approved slip-form paver meeting the requirements of **501.04.D.11**.

Ensure that the sliding forms are rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur and so that necessary finishing can be accomplished while the concrete is still within the forms. Before the concrete has hardened, correct any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch.

Operate the slip-form paver with as nearly a continuous forward movement as possible, and coordinate all operations of mixing, delivering, and spreading of concrete so as to provide uniform progress while minimizing the stopping and starting of the paver. If, for any reason, it is necessary to stop the forward movement of the paver, also immediately stop the vibratory and tamping elements. Apply no tractive force to the machine, other than that which is controlled from the machine. Replace slabs with random cracks before completion of paving operations.

Contractor may choose to utilize a single lift or two lift paving process according to the following requirements.

A. Single Lift Pavement

Use vibrators to thoroughly consolidate the concrete against and along the faces of all forms and along the full length and on both sides of all joint assemblies. Do not allow vibrators to come in contact with a joint assembly, the grade, or a side form. Do not operate the vibrator for longer than 5 seconds in any one location.

The Contractor may only use hand-operated vibrators on projects containing 10,000 square yards or less of concrete paving and on variable width sections. Only operate vibrators mounted on a machine while the machine is in motion.

Equip the slip-form paver with vibrators meeting the applicable requirements of **501.04.D.1** to vibrate the concrete for the full width and depth of the strip of pavement being placed.

B. Two Lift Composite Pavement

When placing two lift composite pavements, the upper lift shall be of a lesser thickness as designated by contract design. It shall be placed such that the result is a wet-on-wet application. The lower lift will be one foot less in width than the upper lift.

Paving operations shall be adjusted and approved by the Engineer as necessary to assure a wet-on-wet monolithic pavement section. If the bonding between lifts or the consolidation of concrete is determined to be unsuitable by the Engineer, the lower lift shall be removed and replaced prior to the upper lift placement.

1. Lower Lift. Uniformly spread concrete with a spreader or slipform machine. Internal vibration will be required for the lower lift. Tie bars and dowel bars (with the use of dowel baskets) shall be placed in the lower lift at mid-depth of the finished concrete pavement thickness. The lower lift shall not require curing, texturing, or sawing before the upper lift is placed. The lower lift shall be struck off to provide a nominal lower lift thickness that complies with the pavement design. The upper lift shall be struck off to allow for the finished total pavement to conform to the cross section shown in the contract plans.

2. Upper Lift. Place the upper lift within 45 minutes following the placement of the lower lift. Placement of the upper lift shall be such that intermingling of the two concrete mixtures is minimal. External vibration for the upper lift will be allowed if proper consolidation and finishing can be demonstrated in accordance with **501.16.** Dowel bars can be inserted during the placement of the upper

lift. Cure the upper lift only in accordance with **501.18**. At no time shall the total thickness be less than shown on the pavement design and the cross section shown in the contract plans.

Frequency of the vibrators shall be established based on the workability of the concrete mixture and past experiences. Electronic, internal, T-shaped, poker vibrators shall be used. Other types of vibrating equipment may be approved by the Engineer. Vibrator impulses shall be delivered directly to the concrete and the intensity of vibration shall be sufficient to consolidate the concrete thoroughly and uniformly throughout the depth and width of the lift. Increase in the speed of the vibrators will be allowed with the permission of the Engineer.

A paving plan shall be supplied to the Engineer for review and approval prior to pouring. The plan shall document procedures to ensure consistency of material properties during concrete placement and finishing, identify and eliminate potential for load misidentification, and maintain speed of production and paving. Concrete for each lift shall be produced from the same ready-mix facility."

Subsection 501.17 (pg. 424) 11-16-15; A. Surface Testing, modify the following:

"3. Ramps where the design speed is greater than 40 miles per hour
(a) Test sections shall terminate 100 feet from a stop or slow speed yield condition
(b) Superelevated sections greater than 40 miles per hour design speed must be ground in accordance with **Table 501.17-1**
4. Ramps where the design speed is 40 miles per hour or less
(a) Test sections shall terminate 100 feet from a stop or slow speed yield condition
(b) Superelevated sections with a design speed of 40 miles per hour or less must be ground in accordance with **Table 501.17-2**

Subsection 501.17 (pg. 425) 11-16-15; B. Pay Factors and Required Corrective Action, modify the following:

"Payment factors and required corrective actions relative to profile indexes for ramps with design speeds of 40 MPH or less shall conform to Table 501.17-2.

Table 501.17-2: Pay Factors & Corrective Action for Ramps with Design Speeds of 40 mph or less

Profile Indexes	Pay Factor	Corrective Action
<10 inches per mile	105%	None
10 to < 20 inches per mile	100%	None
20 to < 23 inches per mile	98%	Grind to 20 inches per mile
23 plus inches per mile	95%	Grind to 20 inches per mile

Subsection 501.26 – Basis of Payment (pg. 434) 5-15-17; add the following sentence to the 7th paragraph of the subsection:

"The Department will pay for additional concrete, measured in accordance with **501.25**, at the purchase price, F.O.B. the unloading point, as verified by invoices, with no compensation allowed for further handling. The State will be reimbursed from monies due the Contractor for a decrease in concrete

measured in accordance with **501.25** in an amount equal to the purchase price of the cement, F.O.B. the unloading point. No payment will be allowed for any changes in the proportions of the aggregates. No additional payment will be made if two-lift composite pavement alternate is selected."

S T A T E **O F** **T E N N E S S E E**

(Rev. 5-18-15) January 1, 2015
(Rev.11-16-15)
(Rev. 6-27-16)
(Rev. 12-2-16)
(Rev. 5-15-17)
(Rev. 11-6-17)
(Rev. 5-14-18)

Supplemental Specifications - Section 600

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 602.17 (pg.459-477), 12-2-16; Entire Subsection: Replace all references to AASHTO M164 and AASHTO M253 with ASTM F3125, Grade A325 and A490

Subsection 602.17 (pg. 459) 12-2-16; modify the first paragraph of A.:

> "All high strength bolts, or equivalent fasteners, tightened to a high tension shall be coated with permitted coatings in accordance with ASTM F3125 for their respective grade. Use the bolts in holes conforming to 602.06, 602.07, and 602.08. All Grade A325 and A490 bolts, except Type 3 bolts used in weathering steel, shall be coated. Permitted coatings for Grade A325 and Grade A490 bolts are listed in ASTM F3125, Annex A1."

Subsection 602.17 (pg. 465–469), 12-2-16; Update Tables:

Table 602.17-1: Minimum Bolt Tension [1]

Bolt Diameter (inches)	Bolt Tension (pounds)	
	(GradeA325)	GradeA490 Bolts
½	12,000	15,000
5/8	19,000	24,000
¾	28,000	35,000
7/8	39,000	49,000
1	51,000	64,000
1-1/8	64,000	80,000
1-1/4	81,000	102,000
1-3/8	97,000	121,000
1-1/2	118,000	148,000

[1] Equal to 70% of the specified minimum tensile strength of bolts.

Bolt Diameter (inches)	Grade A325 Snug Tension (kips)	Grade A490 Snug Tension (kips)
½	1	1
5/8	2	2
¾	3	4
7/8	4	5
1	5	6
1-1/8	6	8
1-1/4	8	10
1-3/8	10	12
1-1/2	12	15

Table 602.17-3: Minimum Installation Tension

Bolt Diameter (inches)	Grade A325 Tension (kips)	Grade A490 Tension (kips)
1/2	12	15
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1-1/8	64	80
1-1/4	81	102
1-3/8	97	121
1-1/2	118	148

Table 602.17-4: Rotation from Snug Condition

Bolt Length (measured in Step 1)	Grade A325 Required Rotation	Grade A490 Required Rotation
Up to and including 4 diameters	2/3	2/3
Over 4 diameters, but not exceeding 8 diameters	1	5/6
Over 8 diameters to 12 diameters	1-1/6	1

Table 602.17-5: Turn Test Tension

Bolt Diameter (inches)	Grade A325 Tension (kips)	Grade A490 Tension (kips)
1/2	14	17
5/8	22	28
3/4	32	40
7/8	45	56
1	59	74
1-1/8	74	92
1-1/4	94	117
1-3/8	112	139
1-1/2	136	170

Table 602.17-6

Bolt Length (measured in Step 1)	Required Rotation (All Grades)
Up to and including 4 diameters	1/3
Over 4 diameters, but not exceeding 8 diameters	½

Table 602.17-7

Bolt Diameter (inches)	Grade A325 Torque (ft-lbs)	Grade A490 Torque (ft-lbs)
1/2	150	180
5/8	290	370
3/4	500	630
7/8	820	1020
1	1,230	1540
1-1/8	1,730	2160
1-1/4	2,450	3050
1-3/8	3,210	3980
1-1/2	4,250	5310

Table 602.17-8

Bolt Length (measured in Step 1)	Additional Required Rotation Grade A325	Additional Required Rotation Grade A490
Up to and including 4 diameters	1/3	¼
Over 4 diameters, but not exceeding 8 diameters	1/2	1/3

Table 602.17-9: DTI Requirements for A325 Bolts

Bolt Diameter (inches)	Verification Tension (kips)	Maximum Verification Refusals	DTI Spaces	Minimum Installation Refusals
1/2	13	1	4	2
5/8	20	1	4	2
3/4	29	2	5	3
7/8	41	2	5	3
1	54	2	6	3
1-1/8	67	2	6	3
1-1/4	85	3	7	4
1-3/8	102	3	7	4
1-1/2	124	3	8	4

Table 602.17-11

Bolt Diameter (inches)	Bolt Tension (kips)	
	AASHTO M 164 Bolts (ASTM A325)	ASTM A490 Bolts
1/2	13	16
5/8	20	25
3/4	29	37
7/8	41	51
1	54	67
1-1/8	67	84
1-1/4	85	107
1-3/8	102	127
1-1/2	124	155

Table 602.17-12

Bolt Diameter (inches)	Number of Spaces	
	Bolts (GradeA325)	Grade A490 Bolts
1/2	4	N/A
5/8	4	N/A
3/4	5	6
7/8	5	6
1	6	7
1-1/8	6	7
1-1/4	7	8
1-3/8	7	8
1-1/2	8	N/A

Subsection 602.19 (pg. 478), 6-27-16; add the following as the 2nd paragraph:

"All welders shall be qualified in accordance with the AASHTO/AWS D1.5, Bridge Welding Code, current edition. Welders shall be certified for each weld process and position which they will be using."

Subsection 602.39 (pg.488), 6-27-16; revise the title as follows:

"CONSTRUCTION REQUIREMENTS – ERECTION – REMOVAL"

Subsection 602.42 (pg.489), 6-27-16; revise as follows:

"All contractors and subcontractors directly engaged in the erection or removal of structural steel, precast prestressed or mild steel reinforced concrete bridge beams or girders over active highway traffic lanes, on any route, railroad or any stream deemed navigable to commercial or pleasure water craft, shall submit an erection or removal plan prepared and stamped by a Professional Engineer licensed in the State of Tennessee. Include the following in these plans: the sequences of erection or removal, the generalized location of all pick points, and the plan to adequately stabilize the structure throughout the erection or removal process. Submit this plan to the Engineer at least 30 days before starting erection. At each stopping point in the erection or removal sequence, have a competent contractor's representative inspect the beams to ensure adequate stability.

Do not begin any erection or removal work without the Engineer's approval. The Engineer's approval does not relieve the Contractor of the responsibility for the safety of its method or equipment or from carrying out the work in accordance with the Plans and Specifications."

Subsection 604.02 (pg. 519), 11-16-15; C. 2nd paragraph, 1st sentence:

"Prior to construction, submit for approval shop drawings of the proposed precast structure and design calculations for any details which deviate from the standard box culvert drawings."

Subsection 604.02 (pg. 517-518), 5-15-17; A. General, add Class DS Concrete to the index:

604.02 Materials

A. General

Provide materials as specified in:

Hydraulic cement[1] **901.01**
Fine Aggregate, (all Classes of concrete)..... **903.01**
Coarse Aggregate
For Class A Concrete: Size No. 57 ..... **903.03**
For Class D Concrete: Size No. 57 ..... **903.03**

[1]Use Type I, Type IL, or Type IS unless otherwise specified or permitted, or Type I or Type IL cement with either fly ash and/or ground granulated blast furnace slag as a partial cement replacement unless otherwise specified or permitted. When using Type I or Type IL cement with either fly ash and/or ground granulated blast furnace slag as a partial cement replacement, comply with the requirements of **604.03**.

Subsection 604.02 C. (pg. 519), 11-6-17; Precast Box Sections, remove mylar reference in second paragraph:

"Submit shop drawings of the proposed precast box section and design calculations for approval before construction. As a minimum, the shop drawings shall include a plan and elevation view of the box culvert showing all precast sections, a typical precast box section showing dimensions and reinforcing, and notes and details required for construction. After obtaining the necessary approval, furnish the Structures Division a reproducible design file. . The Department will pay the Contractor for the precast box based on the price bid for the quantity of the items in the cast-in-place structure it replaces. Manufacture the precast reinforced box sections in accordance with Departmental procedures."

Subsection 604.03 (pg. 520-521), 5-15-17; Table 604.03-1: Composition of Various Classes of Concrete and Table 604.03-2: Use of Chemical Admixtures, Add class DS to the Tables, revise footnotes 2 and 3 of Table 604.03-1 and the note below Table 604.03-3; Update Table 604.03-4: Composition of Self-Consolidating Concrete and Table 604.03-5: Use of Chemical Admixtures to add SH-SCC, update :

Table 604.03-1: Composition of Various Classes of Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump (inches)
A	3,000	564	0.45	6 ± 2	3 ± 1 (1)
D, DS(2, 3)	4,000	620	0.40	7 (3)	8 max (4)
L (3, 5)	4,000	620	0.40	7 (3)	8 max (4)
S (Seal) (6)	3,000	682	0.47	6 ± 2	6 ± 2
X (7)					

(1) For slip forming, the slump shall range from 0 to 3 inches.

(2) Use Class DS concrete in riding surfaces as described in 903.03 and in accordance to Specification 903.24 requirements. Use Class D concrete in all other bridge decks except box and slab type structures unless otherwise shown on the Plans.

(3) Design Class D, Class DS. and Class L concrete at 7% air content. Acceptance range for pumping and other methods of placement is 4.5-7.5%. Sampling will be at the truck chute.

(4) Water reducing admixtures are acceptable; however, do not exceed the maximum water/cement ratio in order to achieve the required slump.

(5) The unit weight of air dried Class L concrete (lightweight concrete) shall not exceed 115 pounds per cubic foot as determined according to ASTM C567.

(6) The use of fly ash as a cement replacement will be allowed in Class S (Seal) concrete.

(7) Plan specific requirements.

Include chemical admixtures in the concrete mixture as specified in Table 604.03-2 based on the ambient air temperature and expected weather conditions.

Table 604.03-2: Use of Chemical Admixtures

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
A	Type A or F	Type D or G or A and B
D, DS	Type A or F	Type A or F and B or G
L	Type F	Type F and B or G
S	Type D or G or A and B	Type D or G or A and B

Table 604.03-3: Type I or Type IL Cement Modified by Fly Ash or Ground Granulated Blast Furnace Slag (GGBFS)

Modifier	Maximum Cement Replacement Rate % (by weight)	Minimum Modifier Cement Substitution Rates (by weight)
GGBFS (grade 100 or 120)	35.0	1:1
Class "F" Fly Ash	25.0	1:1
Class "C" Fly Ash	25.0	1:1

The Contractor may use ternary cementitious mixtures (mixtures with Portland cement, ground granulated blast furnace slag, and fly ash) for Class A, Class D, and Class DS concrete provided that the minimum Portland cement content is 50%. The maximum amount of fly ash substitution in a ternary cementitious mixture shall be 20%. The Department will allow Type IS cement with ternary cementitious mixtures. When using a Type IS cement, do not use any additional slag as a partial replacement for the hydraulic cement.

Table 604.03-4: Composition of Self-Consolidating Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000(1)	564	0.45	6 ± 1	25 ± 4
SH-SCC (2,3,4,5,6)	4,500	620	0.45	6 ± 1	25 ± 4

(1) Or as shown on the Plans or approved shop drawings.

(2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.

(3) Passing ability in accordance with ASTM C1621 shall be less than 2 inches for acceptance.

(4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.

(5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.

(6) Air Content may be reduced if placed under water or underground if approved by the Engineer

Table 604.03-5: Use of Chemical Admixtures

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
SCC, SH-SCC	Type A or F Type S (Viscosity Modifying)	Type D or G or A and B Type S (Viscosity Modifying)

Subsection 604.03 (pg. 520-521), 5-14-18; Table 604.03-4: Composition of Self-Consolidating Concrete and Table, update the Air Content %, Slump Flow:

Table 604.03-4: Composition of Self-Consolidating Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000(1)	564	0.45	6 ± 2~~1~~	2~~6~~5 ± 5~~4~~
SH-SCC (2,3,4,5,6)	4,500	620	0.45	6 ± 2~~1~~	2~~6~~5 ± 5~~4~~

(1) Or as shown on the Plans or approved shop drawings.
(2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.
(3) Passing ability in accordance with ASTM C1621 shall be equal to or less than 2 inches for acceptance.
(4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.
(5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.
(6) Air Content may be reduced if placed under water or underground if approved by the Engineer

Subsection 604.03 (pg. 522-523) 5-15-17; A. Classification and Proportioning and Quality Assurance: Add 22.-28, add sentence to 5th paragraph:

2. **"Mix Design Submittal.** Submit the proposed concrete design to the Engineer for approval. Develop the design using saturated surface dry aggregate weights and trial batches meeting the requirements of these Specifications. The concrete design shall be prepared by a TDOT certified Class 3 concrete technician or approved independent testing laboratory under the direction of a registered civil engineer licensed by the State of Tennessee. The concrete plant technician or the civil engineer shall certify that the information contained on the design is correct and is the result of information gained from the trial batches. The concrete design shall produce an average compressive strength to indicate that the specified 28-day strength can be obtained in the field. Make all strength determinations using equipment meeting the requirements

of, and in the manner prescribed by, AASHTO T 22. Provide concrete of the design strength specified in all applicable Special Provisions, Plans, and Standard Specifications. Build trial batches for design no more than 90 days before submitting the concrete design. The approved mix design will expire after 6 months if it is not used on a Department funded project and meet the minimum 28-day strength requirements. Assume responsibility for all costs of concrete design, preparation, and submittal.

As a minimum, include the following information in the proposed concrete design submittal:

1. Source of all aggregates
2. Brand and type of cement
3. Source and class of fly ash (if used)
4. Source and grade of ground granulated blast furnace slag (if used)
5. Specific gravity of cement
6. Specific gravity of the fly ash (if used)
7. Specific gravity of the ground granulated blast furnace slag (if used)
8. Admixtures (if used)
9. Gradations of aggregates
10. Specific gravity of aggregates (saturated surface dry)
11. Air content (if air entrainment is used)
12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete
17. Water/cement ratio (pound/pound)
18. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
19. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
20. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
21. Weight of each material required to produce a cubic yard of concrete
22. Water – submit testing results per Tables 921.01-1 & 921.01-2

In addition to the above mentioned items, for self-consolidating concrete include as a minimum the following information in the proposed SCC design submittal:

23. Slump flow, VSI, and T50, in accordance with ASTM C1611, shall be required in place of the slump test.
24. Passing ability in accordance with ASTM C1621.
25. Static segregation in accordance with ASTM C1610.
26. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
27. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
28. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders), in accordance with ASTM C1758.

Self-consolidating concrete (Classes SCC, SH-SCC and P-SCC) shall be verified prior to placement either at the ready mix facility or prestressed plant. The submitted mix design shall be reviewed by Headquarters Materials and Tests for specification compliance. The concrete producer shall then perform a trial batch verification of the submitted mix design in the presence of Regional Materials and Tests. The trial batch will ensure that all batch quantities and target admixture dosage rates are acceptable and meet TDOT specification prior to full mix design approval. If using a previously approved SCC design additional verification of the trial batch is not required. All quantities and identified admixture target dosage rates shall meet the tolerances specified in **501.09**

Instead of the above mix design submittal, an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months. When submitting for the use of an existing mix design, the most current water testing results per 921.01 shall accompany the submittal.

The approval of this concrete design submittal will not relieve the Contractor of the responsibility of providing concrete meeting the requirements of these Specifications. A temporary mix design may be issued if the 7-day or 14-day compressive strengths exceed the required 28-day strengths."

Subsection 604.03 (pg. 522 and 523), 5-18-15; 2. Mix Design Submittal; Replace the first sentence of the last paragraph on page 522 with the following:

"Instead of the above mix design submittal, an existing design may be submitted for approval provided the design has been used on a state funded project within the last six (6) months."

Subsection 604.03 (pg. 519-522), 11-16-15; A. Classification and Proportioning and Quality Assurance, modify the following:

"1a. Design and Production Parameters. Proportion the concrete based on a pre-determined minimum cement content, and a water-cement ratio that does not exceed the maximum shown in **Table 604.03-1**. Below this limit, adjust the quantity of water to meet the slump requirements. The fine aggregate shall not exceed 44% by volume calculation of the total aggregate, with the exception of slip formed Class A concrete incorporated into parapets and median barriers.
For slip formed parapet and median barriers exclusively, the percentages of fine and coarse aggregate in an approved concrete mix design may be adjusted plus or minus 2%, such that the….

1b. Self-Consolidating Concrete (SCC) Design and Production Parameters. Proportion the concrete based on a pre-determined minimum cement content, and a water-cement ratio that does not exceed the maximum shown in **Table 604.03-4**. The fine aggregate shall not exceed 50% by volume calculation of the total aggregate volume. Maximum size of coarse aggregate shall not exceed a No. 67 stone. The Contractor may elect to use SCC as an alternate/option in replacement of Class A concrete.

Document mixture adjustments in the field book and daily concrete report. Ensure that the adjusted mix complies with all of the performance criteria specified in **Table 604.03-4**.

Table 604.03-4: Composition of Self-Consolidating Concrete

Class of Concrete	Min 28-Day Compressive Strength (psi)	Min Cement Content (pound per cubic yard)	Maximum Water/Cement Ratio (pound/pound)	Air Content % (Design ± production tolerance)	Slump Flow (inches)
SCC (2,3,4,5)	3,000(1)	564	0.45	6 ± 1	25 ± 4

(1) Or as shown on the Plans or approved shop drawings.

(2) Acceptance range for the T50 test in accordance with ASTM C1611 shall be between 2-7 seconds.

(3) Passing ability in accordance with ASTM C1621 shall be less than 2 inches for acceptance.

(4) Visual Stability Index (VSI) shall not exceed 1.0 as per ASTM C1611 for acceptance.

(5) Static segregation as measured by ASTM C 1610 shall not exceed 20%.

Include chemical admixtures in the self-consolidating concrete mixture as specified in Table **604.03-5** based on the ambient air temperature and expected weather conditions. Approved viscosity modifying admixtures (VMA) may be used as part of the chemical admixtures if they are shown in the approved mixture design.

Table 604.03-5: Use of Chemical Admixtures

Class of Concrete	Temperature less than 85 °F and falling	Temperature 85 °F or greater and rising
SCC	Type A or F Type S (Viscosity Modifying)	Type D or G or A and B Type S (Viscosity Modifying)

Dosage rates for any admixtures incorporated into the concrete shall be stated during the mix design submittal process. All admixtures shall be compatible and from the same manufacturer.

2.Mix Design Submittal. Submit the proposed concrete design to the Engineer for approval. Develop the design using saturated surface dry aggregate weights and trial batches meeting the requirements of these Specifications….

As a minimum, include the following information in the proposed concrete design submittal:

1. Source of all aggregates
2. Brand and type of cement
3. Source and class of fly ash (if used)
4. Source and grade of ground granulated blast furnace slag (if used)
5. Specific gravity of cement
6. Specific gravity of the fly ash (if used)
7. Specific gravity of the ground granulated blast furnace slag (if used)
8. Admixtures (if used)
9. Gradations of aggregates
10. Specific gravity of aggregates (saturated surface dry)
11. Air content (if air entrainment is used)
12. Percentage of fine aggregate of the total aggregate (by volume)
13. Slump
14. Weight per cubic yard
15. Yield
16. Temperature of plastic concrete
17. Water/cement ratio (pound/pound)
18. 7-day compressive strength (minimum of three 4-inch x 8-inch cylinders)
19. 14-day compressive strength (minimum of three 4-inch x 8-inch cylinders)
20. 28-day compressive strength (minimum of three 4-inch x 8-inch cylinders)
21. Weight of each material required to produce a cubic yard of concrete

In addition to the above mentioned items, for self-consolidating concrete include as a minimum the following information in the proposed SCC design submittal:

22. Slump flow, VSI, and T50, in accordance with ASTM C1611, shall be required in place of the slump test.
23. Passing ability in accordance with ASTM C1621.
24. Static segregation in accordance with ASTM C1610.
25. 7-day compressive strength (minimum of three 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
26. 14-day compressive strength (minimum of three 4-inch x 8-inch cylinders), in accordance with ASTM C1758.
27. 28-day compressive strength (minimum of three 4-inch x 8-inch cylinders), in accordance with ASTM C1758.

Self-consolidating concrete (Classes SCC and P-SCC) shall be verified prior to placement either at the ready mix facility or prestressed plant. The submitted mix design shall be reviewed by Headquarters Materials and Tests for specification compliance. The concrete producer shall then perform a trial batch verification of the submitted mix design in the presence of Regional Materials and Tests. The trial batch will ensure that all batch quantities and target admixture dosage rates are acceptable and meet TDOT specification prior to full mix design approval. If using a previously approved SCC design additional verification of the trial batch is not required. All quantities and identified admixture target dosage rates shall meet the tolerances specified in **501.09**.

Subsection 604.03 (pg. 522), 12-2-16; Mix Design Submittal, modify the following:

"18. 7-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
19. 14-day compressive strength (minimum of two 4-inch x 8-inch cylinders)
20. 28-day compressive strength (minimum of two 4-inch x 8-inch cylinders)"

Subsection 604.03 B. (pg.524), 11-6-17; B. Quality Control and Acceptance of Concrete, Add the following as the last sentence of the 1st paragraph:

"If the quantity exceeds 2 cubic yards, prior approval must be obtained from the Engineer prior to placement."

Subsection 604.04 (pg. 525-527). 5-14-18; Remove the last 3 paragraphs from page 527 and insert the paragraphs as the 6th, 7th, and 8th paragraph of the subsection:

"**604.04 Equipment**

Obtain the Engineer's approval as to the design, capacity, and mechanical condition of equipment and tools used to handle materials and perform the work. Have the equipment on the jobsite sufficiently ahead of the start of construction operations to be examined and approved by the Engineer. Use equipment and construction processes that have sufficient capacity to accomplish the maximum continuous concrete placement, as governed by the construction joints shown on the Plans or as directed by the Engineer.

Meet the requirements for batching plants specified in **501.04.A**, except that when approved by the Engineer, the requirement for storage compartments in addition to weigh bins for fine and coarse aggregates may be waived, provided the batching tolerances specified in **501.09** are maintained.

Meet the requirements for mixers specified in **501.04.B**, except that the requirement for the boom-and-bucket attachment to the mixer will be waived.

Provide ample and satisfactory equipment for conveying concrete from the mixer to final position in the forms. Use closed chutes or pipes when concrete is to be dumped or dropped for a distance greater than 5 feet. Where steep slopes are required, equip the chutes with baffle boards, or use chutes in short lengths that will allow the direction of movement to be reversed.

Use vibrators of an approved type and design, and operate them under load at the rate recommended by the manufacturer and approved by the Engineer.

When placing concrete by pumping, do not use aluminum conduit.

Do not pour any concrete for bridge decks or slabs above grade before verifying the availability and operability of all necessary equipment, including finishing machines, continuous water source or portable tanks, water distribution equipment, two work bridges, vibrators, sprayers, a 12-foot straightedge, and appropriate backup items.

Provide at every concrete deck pour a portable, cold fogger capable of changing humidity and cooling air above fresh concrete. The fogger shall be designed to provide a maximum VMD (volume mean diameter) of 15 microns, and a throw distance of 60 feet.

The Contractor may mix concrete for minor structures, as identified in **604.11.B**, in a mobile volumetric continuous mixing plant.

Use a mobile mixing plant that is:

1. Designed to accurately batch aggregates and cement by volume based on weight.
2. Equipped to perform mixing by a continuous auger and/or paddles.
3. Capable of producing a uniform concrete mix meeting all requirements of the Specifications.
4. Capable of carrying in separate compartments all the necessary ingredients needed for the concrete mix.
5. Equipped with calibrated proportional devices for each material.
6. Equipped with proportioning controls that they may be set and secured for different materials and mixes.
7. Equipped with separate bins and gate openings for each type of material, including a watertight storage bin for cement. Cover the aggregate bins with tarpaulins or by other approved methods when required.

Ensure that a metal plate identifying the discharge speed and weight-calibrated constant of the machine is attached to each unit.

Make adequate standard volume measures, scales, and weights available for checking the accuracy of the proportioning mechanism.

Furnish a calibrated chart for the individual unit when required by the Engineer.

In the Engineer's presence, the producer or factory representative shall perform the calibration and gate settings according to the manufacturer's recommendations for the design to be used.

Provide a satisfactory method of setting the dosage for admixtures. If using admixtures other than air-entraining agents, add them in the manner and in the dosage recommended by the manufacturer.

~~When placing concrete by pumping, do not use aluminum conduit.~~

~~Do not pour any concrete for bridge decks or slabs above grade before verifying the availability and operability of all necessary equipment, including finishing machines, continuous water source or portable tanks, water distribution equipment, two work bridges, vibrators, sprayers, a 12-foot straightedge, and appropriate backup items.~~

~~Provide at every concrete deck pour a portable, cold fogger capable of changing humidity and cooling air above fresh concrete. The fogger shall be designed to provide a maximum VMD (volume mean diameter) of 15 microns, and a throw distance of 60 feet.~~"

Subsection 604.13 (pg. 541), 5-15-17; Mixing Concrete, add Class DS concrete to the 2nd paragraph, 3rd sentence:

"Do not retemper concrete by adding water or by other means. However, the Contractor may withhold a portion of the mixing water or chemical admixtures from transit mixers and add at the work site if all requirements of the approved mix design are met. Water added at the placement site for Class A, Class D, Class DS and Class L concrete shall not exceed 1 gallon per cubic yard. The total amount of water in the mix shall not exceed the maximum in the approved mix design. To achieve additional slump, use a water reducing admixture. If water, air entrainers, or chemical admixtures are added at the placement site, mix the concrete a minimum of 30 revolutions at mixing speed after making the additions. Do not use concrete that is not within the specified slump limits, air content limits, temperature limits, or time limits at the time of placement."

Subsection 604.13 (pg. 541), 5-14-18; Mixing Concrete, revise the 2nd and 3rd sentence of the 2nd paragraph:

"Do not retemper concrete by adding water or by other means. However, the Contractor may withhold a portion of the mixing water or chemical admixtures from transit mixers and add at the work site if all requirements of the approved mix design are met, provided the delivery ticket indicates the amount of water withheld. ~~Water added at the placement site for Class A, Class D, Class DS and Class L concrete shall not exceed 1 gallon per cubic yard.~~ The total amount of water in the mix shall not exceed the maximum in the approved mix design. To achieve additional slump, use a water reducing admixture. If water, air entrainers, or chemical admixtures are added at the placement site, mix the concrete a minimum of 30 revolutions at mixing speed after making the additions. Do not use concrete that is not within the specified slump limits, air content limits, temperature limits, or time limits at the time of placement."

Subsection 604.14 (pg. 542), 11-16-15; Consistency of Concrete, modify the following:

"The slump of the concrete when measured according to AASHTO T 119 shall meet 604.03 - **1A**. The slump flow of self-consolidating concrete when measured according to ASTM C1611 shall meet **604.03 1B**."

Subsection 604.15 (pg. 542-543), 11-16-15; B. Concrete Acceptance Cylinders, modify the following:

"The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens and adequate curing and storage facilities at no additional cost to the Department.

Concrete cylinders submitted for testing beyond 28 days shall comply with the strength requirements specified in Table 604.15-1.

Table 604.15-1: Strength Requirements

Class of Concrete	Compressive Strength (psi) at:		
	Less than 31 days	31 to 42 days	43 days to 56 days
A, S, CP, SCC	3,000	3,300	3,500
D, L	4,000	4,400	4,600
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using the concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Test shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Department's Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes."

Subsection 604.15 (pg. 543), 5-15-17; Table 604.15-1: Strength Requirements, Add Class DS to Table, update 2nd paragraph 3rd sentence to remove "cylinders and":

Table 604.15-1: Strength Requirements

Class of Concrete	Compressive Strength (psi) at:		
	Less than 31 days	31 to 42 days	43 days to 56 days
A, S, CP, SCC	3,000	3,300	3,500
D, DS, L	4,000	4,400	4,600
SH-SCC	4,500	4,950	5,175
X	Plans Requirement (Req)	Req. + Req. * (10%)	Req. + Req. * (15%)

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using the concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Test shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the

Department's Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.

Acceptance for payment may be based on cores provided by the Contractor at its expense. These cores shall meet the strength requirements specified in Table 604.15-1. The Engineer will not accept concrete cores submitted for testing beyond 56 days.

Subsection 604.15 (pg. 542-544) 5-14-18, Compressive Strength Tests of Concrete; revise the last sentence of A. and add subsection 604.15.C.:

"604.15 Compressive Strength Tests of Concrete

A. General

The Engineer will determine concrete strength by tests performed during the progress of the work, and will use these tests to determine the strength of the concrete for acceptance and pay purposes. The frequency of testing will be as specified in the sampling and testing schedule of the Department's Standard Operating Procedures.

The frequency of testing for compressive strength to determine when forms may be removed, or when a structure may be put into service, shall be as requested by the Contractor or as deemed necessary by the Engineer in accordance with 604.15.C.

B. Concrete Acceptance Cylinders

The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens and adequate curing and storage facilities at no additional charge to the Department.

Concrete cylinders submitted for testing beyond 28 days shall comply with the strength requirements specified in Table 604.15-1.

Table 604.15-1: Strength Req

Class of Concrete	Compressive Stre	
	Less than 31 days	31 to day
A, S	3,000	3,30
D, L	4,000	4,40

If the acceptance cylinders fail to meet the specified strengths, the Contractor may drill core samples from the hardened concrete as verification of concrete strength instead of using concrete cylinders. The Contractor must provide QC data from companion cylinders that meet or exceed the required strength, and TDOT Materials and Tests shall perform a nondestructive test using a Swiss Hammer on the concrete to prove required strength is achieved. If the above mentioned requirements are met, the Contractor may then elect to drill a maximum of three core samples per set of cylinders from the hardened concrete. The Contractor shall obtain the cores in accordance with the Departments Standard Operating Procedure 4-2, and bear all costs of obtaining the cores and repairing the core holes.

Acceptance for payment may be based on cores provided by the Contractor its expense. These cores shall meet the strength requirements specified in Table 604.15-1. The Engineer will not accept concrete cylinders and cores submitted for testing beyond 56 days.

The average compressive strength of the two cores taken to represent the low test cylinders will be considered to be the acceptance strength of the in-place concrete, provided that the cores are obtained and tested within 56 days after concrete placement. In accordance with 603.31, the Engineer will accept at a reduced pay concrete that meets the required strengths specified in 604.03 for the respective class, but fails to meet the requirements in Table 604.15-1.

All concrete used shall undergo acceptance testing. The Department will determine the method to formally accept in-place concrete that is represented by acceptance cylinders that have been lost, damaged, or destroyed. These methods may include coring or non-destructive testing.

C. Early Break Cylinders

Make and cure all test specimens according to AASHTO T 23, and the applicable procedures therein defined for *Field Cured Specimens*, unless otherwise specified by the Engineer. The Department will test the specimens for compressive strength according to AASHTO T 22. Provide the necessary concrete for making test specimens at no additional charge to the Department.

Field Cured Specimens, as defined in AASHTO T 23, shall be cured in accordance with AASHTO T23- *Section 10.2. - Field Curing*. Cylinders shall be representative of the concrete placed and shall be cured in the same manner and method as the placed concrete. Specimens shall be protected from the elements in the same manner as the formed work. If specimens are to be used for determining when a structure is capable of

being put into service the specimens should be removed from the molds at the time of removal of the form work.

Subsection 604.16 (pg. 545) 5-15-17; Placing Concrete, A. General – revise the 1st paragraph to add Class DS in the first sentence:

"Unless otherwise specified, before placing a bridge deck overlay of Class D , Class DS, or Class L concrete, machine scarify the surface to be covered to a minimum depth of 1 inch. In areas inaccessible to machine scarifying, and in areas of spalling where steel reinforcement is exposed, remove deteriorated concrete using hand tools or other methods approved by the Engineer. After scarifying, clean the deck of all deleterious material. Do not allow traffic on the scarified deck."

Subsection 604.19 (pg. 551-552), 5-14-18; Removal of Forms and Falsework, Revise the 3rd paragraph and 1. to incorporate references to subsection 604.15:

"The Contractor may release and remove falsework and supports under concrete structures when the following conditions are met:

1. Representative specimens of the concrete, ~~cured by the methods and in the manner of the concrete that the test specimens represent is cured,~~ made and cured in accordance with 604.15.C, attain a compressive strength of 3000 pounds per square inch."

Subsection 604.27 (pg. 560), 11-16-15; Rideability of New or Resurfaced Bridge Decks and Roadway Approaches, A. General, revise the 1st paragraph to the following:

"On all highway sections with a posted speed greater than 40 miles per hour, the following rideability provisions shall apply to new or resurfaced bridge decks and roadway approaches."

Subsection 604.31 (pg. 567-568) 5-15-17; Basis of Payment, add Class DS to item and pay unit list:

604.31 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Class A Concrete (Description)	Cubic Yard
Class D Concrete (Description)	Cubic Yard
Class DS Concrete (Description)	Cubic Yard
Class L Concrete (Description)	Cubic Yard
Class S Concrete (Description)	Cubic Yard
Steel Bar Reinforcement	Pound
Epoxy Coated Reinforcing	Pound
Scarifying	Square Yard
Applied Texture Finish	Square Yard
Hydro-demolition	Square Yard

Subsection 606.04.B.1(b) (pg. 578), 6-27-16; replace 1.b. with the following:

"(b) Except as provided in paragraph 2(b) below, develop an energy per blow in foot-pounds not less than 250 multiplied by R, where R is the required minimum bearing resistance of the pile in tons."

Subsection 606.07.A. (pg. 581), 6-27-16; revise the 1st paragraph:

"Construct cast-in-place concrete piles of the design shown on the Plans and that consist of concrete cast in drilled holes or in steel shells or pipes driven to the required bearing. Use Class A concrete meeting **604**, or use Class X concrete, as required by design, meeting **604**. Provide and place suitable casing when required to prevent caving of the hole before concrete is placed.

Subsection 611.02 (pg. 620), 11-6-17; Materials, revise the last sentence of the last paragraph to remove the mylar reference:

"After obtaining the necessary approval, furnish the Engineer an electronic reproducible design file.."

Subsection 613.02 (pg. 633), 6-27-16; add the following section:

"Brick Paving Units ……..912.05"

Subsection 615.09 (pg. 644), 11-16-15; Proportioning and Mixing of Concrete, update Table 615.09-1 and add the 3rd paragraph below the table, modify the last paragraph:

Table 615.09-1: Composition of Prestress Concrete Classes

Class of Concrete	**Minimum 28-Day Compressive Strength (psi)**	**Minimum Pounds Cement per Cubic Yard**	**Maximum Water/Cement Ratio (pound/pound)**	**Air Content %**	**Slump or Slump Flow (inches)**
P	5,000 (1)	658	0.45	0-8 (2)	2 ± 1 (3)
P-SCC (4)	5,000 (1)	658	0.45	0-6 (2)	25 ± 4

(1) Or as shown on the Plans or approved shop drawings.

(2) Air entraining is optional with the Contractor, unless otherwise shown on the Plans or shop drawings.

(3) Not to exceed 3 inches before the addition of high range admixtures, and not to exceed 10 inches after the addition of high range admixtures. If water-cement ratio is equal to or less than 0.35 then the maximum slump is 10 inches. If the water-cement ratio is 0.36 – 0.45, the maximum slump is 8 inches.

(4) Maximum coarse aggregate size of a No. 67 stone.

Comply with all applicable provisions of **604.03** except as modified herein.

Submit a concrete design to the Department for review and approval. In addition to the proportions, identify in the design submittal the source or brand of all materials and the type of cement to be used. The Contractor may use Type I or Type III cement, unless otherwise specified. Do not use calcium chloride. Use a retardant admixture when the ambient temperature

is 75 °F or higher. The slump of the concrete shall be 2 inches with a tolerance of ±1 inch at the time of placement. When an approved superplasticizer is to be used, the slump of the concrete shall be the same as above before the superplasticizer is added to the mix. After the addition of the superplasticizer, the slump may be increased to a maximum of 8 inches at the time of placement.

The slump flow of self-consolidating concrete shall be determined and within the design and production tolerances stated in **Table 615.09-1**. Include chemical admixtures in the self-consolidating concrete mixture as specified in **Table 604.03-5** based on the ambient air temperature and expected weather conditions. Approved viscosity modifying admixtures (VMA) may be used as part of the chemical admixtures if they are shown in the approved mixture design.

Handle, measure, and batch materials; mix concrete; and comply with the limitations of mixing as specified in **501.09**, **501.10**, and **501.11**, respectively.

Make concrete test specimens for Class P and Class P-SCC, in accordance with AASHTO T 23 and ASTM C1758 respectively, to determine the adequacy of the concrete design and the minimum time at which the stress may be applied to the concrete. Cure the test specimens used to determine the time at which stress may be applied in the same manner and under the same conditions as the bridge members. The initial curing of specimens to determine the design strength of the concrete shall be as specified above with additional curing water, as provided in AASHTO…

Subsection 615.17 (pg. 652), 5-18-15; Table 615.17-1: Manufacturing Tolerances in Standard Sections, Update Table 615.17-1:

Table 615.17-1: Manufacturing Tolerances in Standard Sections

Description	Tolerance	
	I-Sections	Box Sections
Nominal Depth	± 1/2 inch	± 1/2 inch
Nominal Width	± 1/2 inch	± 1/2 inch
Nominal Length	Computed Elastic Shortening ±1/2 inch	Computed Elastic Shortening ±1/2 inch
Variation in Straightness, inches	1/4 inch x (Total Length in feet)/10	1/4 inch x (Total Length in feet)/10
Variation in Camber, inches	Beams in any 1 span not more than: 1/8 inch x (Total Length in feet)/10	Beams in any 1 span not more than: 1/8 inch x (Total Length in feet)/10
Location of Voids	---------	Length ± 1/2 in Wall Thickness ± 1/2 in
Bearing	Full Bearing - Full Width of Beam	Full Bearing on at Least 2/3 of Width of Beam
Tendon Placement	± 1/2 inch	± 1/2 inch
Reinforcing Steel Placement	± 1/2 inch	± 1/2 inch
Reinforcing Steel Concrete Cover	± 1/2 inch	± 1/2 inch
Reinforcing Steel Splice Lengths	Minus 1-1/2 inches	Minus 1-1/2 inches

Subsection 622.03 (pg. 686) 12-2-16; Add the following paragraph at the beginning of the section:

"Same-as designs shall not be submitted for Shotcrete."

Subsection 622.03 (pg, 686-688) 5-14-18; Add subsection C: Placement of Shotcrete:

"**C. Placement of Shotcrete**

An ACI-certified Shotcrete Nozzleman shall be utilized to properly place shotcrete."

S T A T E **O F** **T E N N E S S E E**

(Rev. 6-27-16)
(Rev. 12-2-16)
(Rev. 5-15-17)
(Rev. 11-6-17)

January 1, 2015

Supplemental Specifications - Section 700

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 712.04 (pg. 759), 12-2-16; A. Flaggers, add ABET Accredited University Programs to the list of flagger training:

"1. American Traffic Safety Services Association (ATSSA)
2. National Safety Council (NSC)
3. Tennessee Transportation Assistance Program (TTAP)
4. ABET Accredited University Programs"

Subsection 712.04 (pg. 759). 11-6-17; A. Flaggers, replace the last paragraph with the following:

"The Department will review and determine if an alternative training program is acceptable prior to use. Alternative training programs shall meet all MUTCD requirements and follow FHWA guidance.

The Department will consider flaggers to be a general requirement of traffic control and will not make direct payment for such.

Coordinate flagging operations in a manner that causes as little delay to the traveling public as possible. Delays shall be kept within 2 minutes or ¼ mile, but shall not exceed 5 minutes or a 1 mile maximum, unless prior authorization is granted by the Department."

Subsection 712.04.B (pg.759-760) 12-2-16; revise the second paragraph of B. THP Troopers and Uniformed Law Enforcement Officers:

"B. THP Troopers and Uniformed Law Enforcement Officers
When a THP Trooper is not available, the Contractor may provide a Uniformed Law Enforcement Officer if approved by the Engineer and the Regional Safety Coordinator or Regional Operations Office. All Uniformed Law Enforcement Officers shall provide marked law enforcement vehicle equipped with blue lights and have the authority to write traffic tickets and make arrests within the project site. The Uniformed Law Enforcement Officer shall maintain a detailed written log of enforcement activities and shall submit the log to the Engineer for verification each month."

Subsection 712.04 G. (pg. 762), 11-6-17; G. Lane Closures, add the Type of Facility and Requirement table to the end of the subsection, revise the last sentence:

"G. Lane Closures
Hold the length of a lane closure to the minimum length required to accomplish the Work. Locate advanced warning signs for the Project so as to not overlap with the advanced warning signs for lane shifts and lane closures.

Use drums in all transition tapers for lane closures on multi-lane roads.

Contractor's Staff performing lane closure shall have the following certifications to close lanes on TDOT facilities and shall be onsite during each lane closure performed.

Type of Facility	Requirement
Two Lane	Flagging Operations Certification (Shall comply with Subsection 712.04 A)
Multi-Lane	*ATSSA Traffic Control Technician Training or equivalent
Controlled Access Freeways & Expressways	*ATSSA Traffic Control Technician Training or equivalent

*Proof of certification shall be provided to the Engineer at the Pre-Construction Meeting.

Subsection 712.09 (pg. 769), 12-2-16; change Uniformed Police Officer to Uniformed Law Enforcement in the last paragraph:

"The Department will pay for Uniformed Law Enforcement Officers provided by the Contractor at the invoice price of the work plus 5%, not to exceed $50 per hour for the hours present on the Project. No compensation will be made for drive time."

Subsection 713.04 (pg. 772) 5-15-17; Construction Methods and Requirements; add steel requirement as the last paragraph:

"Ensure steel meets all specifications in **602.04.**"

Subsection 713.04.C.6 (pg. 774), 6-27-16; replace C.6. with the following:

"6. Concrete. Use either (1) Class A concrete meeting 604.03 or (2) Class X concrete with a f'c as identified in the plans or required by the design. If Class X concrete is required, use a mix meeting the minimum requirements of **604.03** for Class A concrete, but with a cementitious material quantity necessary to produce the specified strength."

Subsection 713.04.C.8 (pg. 774), 6-27-16; add sentence to the end of 8.:

"8. Setting Anchor Bolts and Stubs. Set anchor bolts and stubs for sign supports to proper locations and elevations with templates, and carefully check them after constructing the sign foundation and before the concrete has set. Anchor rods shall conform to the requirements of section **730.11**"

Subsection 714 (pg. 779-800), 11-6-17; Revise the subsection as follows:

"MATERIALS

714.02 Materials

Provide materials as specified in **917** and as follows:

Portland Cement Concrete, Class A **604**
Crushed Stone Grading D..... **903.05**
Steel Bar Reinforcement for Concrete Structures..... **907.01**
Welded Steel Wire Fabric **907.03**
Gray Iron Castings..... **908.07**

Inorganic Zinc Paint **910.03**
Cement Concrete Curing Materials **913**
Conduit ..... **917.05** or **917.07**

Within 30 days after the issuance of the work order, submit to the Engineer, four collated sets of the manufacturer's descriptive literature and technical data, fully describing the types of lighting equipment proposed for use. In the descriptive literature, identify the manufacturer and model, and include sufficient information for the Engineer to determine if the equipment or material meets the requirements of the Plans and these Specifications. Include with these sets of submittal data a list of the materials submitted along with descriptive material for, but not limited to, the following items when applicable:

1. Complete photometric data of luminaires as published by the manufacturer with independent testing laboratory results.

2. Computer printouts showing illumination levels throughout each interchange area where high mast luminaires are to be installed.

3. General details of light standards, breakaway bases, and bracket arms. For light standards taller than 30 feet, submit one set of design calculations and six prints of "Design" or "Shop" drawings to the Division of Structures for approval purposes. The Department will review these drawings at the earliest possible date, and will return two prints marked "Approved for Fabrication," or "Returned for Revisions as Noted." Respond by taking appropriate action to ensure the earliest possible correction of these items so as not to delay the installation.

4. Highmast tower details with a set of design calculations for each height including access hole, base, anchorage, head frame, and lowering device. Include specification references for materials and location, type, size, and extent of welds. In addition to the set of design calculations, submit six prints of "Design" or "Shop" drawings for each highmast tower height to the Division of Structures for approval purposes, in a manner similar to that specified in Item 3 above for light standards taller than 30 feet.

5. Dimension sheets and performance data on all related equipment.

The Engineer will retain one copy and forward one copy each to the ~~Regional Materials and Tests Division~~ the local entity (city or county engineer) and the Traffic Operations ~~Design~~ Division for their review.

Also include with the submittal sets detailed scale drawings of all non-standard or special equipment and of all proposed deviations from the Plans. Deviations from the Plans or Specifications require approval from the Traffic Operations ~~Design~~ Division. Include a letter requesting deviations or alternate materials in the submittal for Traffic Operations ~~Design~~ Division approval. Upon request, submit for approval sample articles of materials proposed for use. The Department will not be liable for any materials purchased, labor performed, or delay to the Work prior to such approval.

In addition to the above, include with each submittal a notarized letter certifying that all lighting system materials listed in the submittal conform to the Plans and Specifications. Also submit to the Engineer a statement from the Maintaining Agency that the system is acceptable to the Agency.

714.03 Codes

Furnish material and perform all work in strict accordance with the latest revision of the National Electrical Code, the National Electrical Safety Code, the Illuminating Engineering Society (IES) publications, ANSI standards, and the codes, regulations, and rules prevailing in the area in which the Work is being performed, as applicable.

714.04 Reserved

CONSTRUCTION REQUIREMENTS

714.05 Conduit

Install conduit of the type and size specified at the locations shown on the Plans, or as directed by the Engineer. Install pull or drag wires of the type and size specified in conduit at the locations shown on the Plans.

A. **Underground Conduit**

1. **General.** Underground conduit shall consist of encased or direct burial conduit. Install conduit in a trench excavated to the dimensions and lines specified.

Before beginning any excavation, determine the location of all electrical, drainage, and utility lines in the vicinity, and perform work so as to avoid damaging these facilities. Ensure that the conduit will be located so as to avoid conflict with proposed guardrail, sign posts, and other features.

Build conduit runs in straight lines where possible. Where sweeps are necessary, use standard long sweep conduit bends when feasible, and meet the minimum radius required by the National Electric Code. Install pull boxes at intervals so that the tensile strength of the conductors will not be exceeded.

Obstructions encountered when excavating trenches for underground conduit may require minor changes, such as in locations of conduit runs and pull boxes. Obtain the Engineer's approval before making such changes. Where possible, provide a minimum of 12 inches between the finished lines of conduit runs and utility facilities, such as gas lines, water mains, and other underground facilities not associated with the electrical system. Where the conduit run is adjacent to concrete walls, piers, footings, and similar structures, maintain a minimum of 4 inches of undisturbed earth or firmly compacted soil between the conduit and the adjacent concrete or, when the conduit is encased, between the encasement and the adjacent concrete.

Unless shown on the Plans, do not excavate trenches in existing pavement or surfaced shoulders to install conduit. If it is necessary to place a conduit under an existing pavement, install the conduit by jacking or other approved means with galvanized rigid steel conduit or schedule 80 PVC conduit.

Keep jacking and drilling pits at least 10 feet from the edge of the paved shoulder or sidewalk unless otherwise directed by the Engineer. When the Plans specifically allow excavation of a trench through an existing pavement or surfaced shoulder, restore the pavement and/or surface and base to their original condition. Do not leave boring pits open for extended periods of time.

Unless otherwise specified, cut trenches for conduit on a slight grade for drainage, and make the walls of the trench essentially vertical. Tamp the bottom of the trench as necessary to produce a firm foundation for the conduit.

Excavate trenches for rigid metallic conduit, with or without encasement, to a minimum depth of 18 inches, plus conduit diameter, measured from the finished subgrade.

Sheet and brace the trenches as required, and adequately support all pipe and other structures exposed in trenches as necessary to prevent damage.

Ream metallic conduit after threads are cut. Ream other conduit as necessary. Cut all ends square and to butt solidly in the joints to form a smooth raceway for cables.

Ensure that conduit joints form a water-tight seal. Coat metallic conduit threads with pipe compound and then securely connect. Make conduit joints with the materials and in the manner recommended by the conduit manufacturer and as approved by the Engineer.

Install conduit bushings in conduit where necessary and required for protection of the conductors. When the conduit is installed for future use, ensure that the ends of metallic conduit runs are properly threaded and capped, and that the ends of non-metallic conduit runs are satisfactorily plugged or capped to prevent water or other foreign matter from entering the conduit system.

a. Encased Conduit. Place encased conduit under roadway and paved shoulders unless trenching is required for installation at the locations shown on the Plans. Unless otherwise specified, construct encasement as follows:

(1) Construct the encasement of Class A concrete meeting the requirements of **604.** ~~except that the coarse aggregate shall be size 67 or 78.~~

(2) Extend the encasement of conduit under roadway pavements or surfaces to the outer edges of the surfaced or paved shoulders, or 1 foot beyond the outer edge of the sidewalk, or 1 foot beyond the outer edge of the curb when no shoulder or sidewalk is indicated.

(3) Extend the conduit at least 6 inches beyond the encasement.

(4) Encase the pipe with a minimum of 3 inches of concrete.

(5) Plug the ends of the conduit temporarily to prevent the entrance of concrete or other foreign material.

(6) Do not encase any conduit with concrete until inspected and approved by the Engineer.

(7) Cure concrete encasement as specified in **604.23**, except that the curing period may be reduced to 24 hours if backfilling is to proceed at the time specified in **714.05.A.2**.

b. Direct Burial Conduit. When rock is encountered in the bottom of the trench, install the conduit on a bed of well compacted fine grain soil at least 4 inches thick.

2. Backfilling Conduit. Do not backfill encased conduit until the concrete encasement has cured a minimum of 24 hours. After the Engineer has inspected and approved the installation of direct burial conduit, promptly backfill to the required grade with approved material in layers not exceeding 6 inches in loose depth, and compact each layer as directed by the Engineer.

B. **Conduit on Structures**

Install conduits, conduit fittings, hangers, expansion fittings, and accessories on as shown on the Plans and, unless otherwise specified, in accordance with the following:

1. Run conduit parallel to beams, trusses, supports, pier caps, and similar features in the most direct manner.

2. Install horizontal runs on a slight grade, without forming low spots, to ensure proper drainage.

3. Run conduits with smooth, easy bends.

4. Hold conduits in boxes with locknuts and provide bushings for protection of the conductors.

C. **Testing Conduit**

After completing the installation of conduit, test it with a metallic mandrel in the presence of the Engineer. Use a mandrel having a diameter 1/4 inch smaller than the conduit, and a length of 2 inches. Repair, to the Engineer's satisfaction, all conduits that will not allow passage of the mandrel. If repairs cannot be accomplished, remove and replace the conduit at no additional cost to the Department.

After the mandrel test, scour all conduits with a stiff wire brush having a slightly larger diameter than the conduit.

Test conduits that have been installed under a previous contract with a mandrel and clean as described above before installing the cables.

714.06 Pull Boxes

Construct pull boxes in accordance with the design, dimensions, and at the locations shown on the Plans. Construct concrete pull boxes of Class A concrete meeting the requirements of **604**. Place non-metallic pull boxes only in non-traffic bearing locations and not in paved areas.

Provide a cast iron frame and cover or reinforced concrete cover, as shown on the Plans, with each pull box.

Plug unused conduit entrance holes and openings for conduit to be extended by others with suitable plugs of plastic, bituminous fiber, or other approved material to prevent the entrance of foreign matter.

714.07 Underground Cable for Lighting Circuits

Underground cable for lighting circuits shall consist of direct burial cable, preassembled cable in duct, or cable in conduit, as shown on the Plans.

If it is necessary to install a cable under an existing pavement or surfaced shoulder, install conduit, when specified, in accordance with the applicable provisions of **714.05**, and place the cable within the conduit.

Construct walls of trenches for cables to be essentially vertical. Unless otherwise specified, install underground cable as follows:

1. Excavate trenches for direct burial cable to a minimum depth of 24 inches plus the cable diameter as measured from finished subgrade.

2. In general, locate the trenches to avoid conflict with proposed guardrail, sign posts, and other features.

3. Protect direct burial cable, and preassembled cable in duct, in trenches by cushioning with sand or earth that passes a 1/4-inch screen. Place the cable, or preassembled cable in duct, and sand or earth in the trench so that a minimum 3-inch thickness of the cushion material will completely surround each cable.

A. **Direct Burial Cable**

Do not unreel cables and pull into the trench from one end. Unreel the cables, lay them alongside the trench, and then lay in the trench. Allow the cables to "snake" slightly in the trench to provide adequate slack for settling of earth. Ensure that there are no crossovers of cable in the trench. Where cable is brought up into the base of the lighting standard, leave sufficient slack for making the connections inside the standard.

B. **Preassembled Cable in Duct**

When installing in the trench, do not pull preassembled cable in duct taut, but allow it to "snake" in the ditch to provide not less than 18 inches slack per 100 feet of trench. The minimum bending radius on the cable duct shall be 18 inches. Where the duct is brought into the base of the lighting standard or into a pull box, leave sufficient length for trimming the duct to expose enough cable to allow for the connections to be made inside the standard or pull box.

C. **Cable in Conduit**

Carefully pull cables in conduits into place using approved methods so that the cable will be installed without electrical or mechanical damage. Pull all cables within a single conduit at the same time. If necessary to ease the pulling, ~~the Contractor may~~ use a lubricant of the type recommended by the cable manufacturer. When cables are pulled through hand holes in pole shafts, place a pad of firm rubber or other suitable material between the cable and the edges of the opening to prevent cable damage.

After the cable has been installed in the conduit, seal the ends of buried conduit with approved pliable and non-hardening material to prevent the entrance of dirt, moisture, or other foreign material.

D. **Splices**

Splice conductors as shown on the Plans. Only make splices at accessible points, such as handholes and pull boxes, unless otherwise shown on the Plans. After making a conductor splice, insulate it with heat-shrinkable tubing, supplied by the manufacturer, with an adhesive coating on the inner wall.

E. **Ground Wire**

Install ground conductors of the type and size shown on the Plans, and to be continuous in trenches with direct burial cable, and continuous inside preassembled cable in duct, and in conduit. Connect the ground conductors to the ground rod at all control points, to the ground lug in pole foundations, and to all metallic conduit runs using a grounding bushing, except that the connections to conduit in pole foundations may be omitted. Make all connections as shown on the Plans.

F. **Backfilling Underground Cable**

Backfill cable as specified in **714.05**.

G. **Cable Identification**

To assist in the identification of circuits at the pull boxes, mark the phase conductors with colored rubber-based, or equivalent, paint. When final connections are made, provide permanent tape wire markers to identify the branch circuit conductors (X1A, X1B, etc.), neutral (X1N, etc.), and the ground (g).

714.08 Light Standards

Install light standards of the designated design, kind, size, and class in accordance with and at the locations shown on the Plans. Ensure that the installed standards, complete with the bracket arm(s) and luminaire(s) as specified, provide the mounting height shown on the Plans. Determine the pole height as required by bracket arm upsweep, slope conditions, and similar characteristics.

A. **Foundations for Light Standards**

Consider transformer bases to be an integral part of the lighting standard unless otherwise specified.

1. **Bolt-Down Base Pole Foundations**

   a. **Concrete Foundations.** Excavate a hole of the size and depth shown on the Plans. Remove and dispose of all excavated material as directed by the Engineer. Place anchor bolts of the type and size specified according to the pole manufacturer's recommendations, and securely hold to ensure proper position in the completed foundation. Ensure that no realignment of anchor bolts will occur after the foundation is poured. Accurately place reinforcing steel and securely hold to avoid displacement.

   Accurately place conduits in foundations, orient them in the proper direction to accommodate service cables, and securely hold to avoid displacement.

   Place Class A concrete in the excavated area against undisturbed earth to an elevation 4 inches below the finished ground line, and in an approved form from 4 inches below said ground line to the finished top of foundation elevation, as specified. Construct the foundation with a continuous concrete pour. Chamfer the edges of the top and formed portion of the foundation. Apply a Class 2 finish, as specified in **604.21.B**, to the portion of the foundation above grade and within 4 inches of grade.

   b. **Metal Foundations.** Install metal foundations where shown on the Plans and, if desired, at locations where installation is possible without predrilling the hole.

2. **Prestressed Concrete Butt Base Pole Foundations.** E~~The Contractor may e~~xcavate prestressed concrete butt base lighting standard foundations using manual or mechanical methods. Dig or drill the holes to the depth and the diameter shown on the Plans. Place and compact in the bottom of the hole 6 inches of crushed stone, meeting the requirements of **903.05**, Grading D.

3. **Wood Poles.** Excavate for wood poles as specified for prestressed concrete butt base pole foundations in **714.08.A.2**. Dig or drill the holes to the depth shown on the Plans and in such diameter to allow satisfactory use of mechanical tamping equipment.

B. **Light Standard Installation**

Handle the standards or poles as recommended by the manufacturer and approved by the Engineer. Accomplish erection without marring the finish or otherwise damaging the standard. Ground the light standards as shown on the Plans. When installing lighting on a bridge, review the proposed bridge plans or the completed structure before ordering the standards.

1. **Bolt-Down Base Poles.** Set standards with bolt-down bases on foundations constructed as specified in **714.08.A.1**. Use metal shims supplied with the poles to plumb the pole, if the twin bracket arm type is

used; and, unless otherwise specified, to rake or lean the pole backward 4 inches, if the single bracket arm type is used.

2. **Prestressed Concrete Butt Base Poles.** Place prestressed concrete butt base lighting standards in the hole and on the layer of crushed stone prepared as specified in **714.08.A.2**. Position the pole in the center of the hole at grade and hold in place. Rake the lighting standards with single bracket arms as specified for poles with bolt-down bases in **714.08.B.1**. Set lighting standards with two bracket arms plumb. Fill the space surrounding the pole butt-base with crushed stone, applied in 6-inch layers. The crushed stone shall meet the same requirements specified for the stone foundation in **714.08.A.2**. Moisten the stone backfill material as necessary, and thoroughly compact each layer with mechanical tamping equipment. Continue the backfill with crushed stone to the depth of the bottom edge of the cable entrance in the butt-base. After completing the installation of the electrical cable, continue placing the crushed stone backfill in 6-inch layers, and compact to a depth of 1 foot below grade. Backfill the remaining 12 inches with soil in two equal layers, and thoroughly compact each layer.

3. **Wood Poles.** Place wood poles in holes excavated as specified in **714.08.A.2**. Set the pole in the center of the hole, with any vertical curvature of the pole located in the plane of the lines, and rake in a direction opposite that of the unbalanced stress where a guy or underbrace is specified. Backfill the hole with approved material applied in 6-inch layers, and thoroughly compact each layer with mechanical tamping equipment. Install cross arms and guying components, when specified, as shown on the Plans.

C. **Highmast Tower Installation**

Install standards with lowering devices on foundations constructed as shown on the Plans. Ensure that the standards are plumb. Assemble the shaft in the Engineer's presence. Do not perform any field welding between sections of the shaft. Erect the tower according to the manufacturer's recommended procedures and under the manufacturer's supervision. Make adjustments to align all parts and ensure operation. Arrange for the manufacturer or its representative to instruct the local utility in the proper operation of the lowering device.

714.09 Bracket Arms

Install, on the lighting standards, bracket arms of the specified type, design, kind, dimensions, and number as shown on the Plans.

714.10 Luminaires

Use the following luminaire types on the roads and bridges: High Intensity Discharge (HID) which includes High Pressure Sodium (HPS) and Metal Halide (MH); Fluorescent and Induction lamps; and Light Emitting Diode (LED).

Install luminaires of the design and size shown on the Plans, and level according to the manufacturer's recommendations, as shown on the Plans and as approved by the Engineer. Provide glare shields on luminaires when shown on the Plans.

Clamp the pole and bracket cable in the proper terminals on the terminal board in the luminaire, and then splice the cable to the proper phase and neutral conductors outside of the handhole in the pole base. After other required circuit splices are made outside of the handhole, place all of the wire inside the handhole.

Leave slack in all cables for future maintenance. Attach a suitable identification tag to each of the phase cables.

Clean luminaire reflector surfaces and glassware after installation. Perform cleaning, if required, according to the luminaire manufacturer's recommendations.

Ensure that luminaires for sign lighting are adjustable both horizontally and vertically.

High Intensity Discharge (HID)

High Intensity Discharge (HID) luminaires shall meet IES standards from LM-51-00 to LM-35-02. The HID luminaire shall be covered by a one-year written warranty starting from the system acceptance date. All of the other electrical and mechanical component parts of the HID shall be covered by a five-year written warranty starting from the system acceptance date. The signed warranty certificate shall be submitted prior to final payment.

Light Emitting Diode (LED)

Light Emitting Diode (LED) luminaires shall be manufactured in accordance with ANSI C136.37-2011 (or recent version). All testing and data sheets for proposed LEDs shall be included in the submittal package and shall include, but not limited to, the following: Illuminating Engineering Society of North America (IESNA): LM-79-08, LM-80-08, RP-8-14, TM-3-95 and TM-15-07 (all should be up-to-date versions). In addition to these requirements, the LEDs shall meet the following requirements:

1. Finished surface: Furnish luminaires with the color mentioned in the plans. The surface of luminaire housing shall meet UL-1598 listed for wet locations, ASTM B117 for salt chamber exposure, and ASTM D1654 for rust creepage.

2. Thermal Management: the luminaire shall start and operate in the ambient temperature range of -25C to +25C.

3. Optical Assembly: The LED optical assembly package shall have a minimum Ingress Protection rating of IP 66 according to ANSI/IEC 60529. The luminaire shall have a standardized refractor/reflector to meet the required optical distribution as required by the plans. The optical assembly shall utilize high brightness, long life, minimum 70 color rendering index (CRI), (3000 K-5700 K) color temperature (+/-300 K) LEDs binned according to ANSI C78.377. Lenses shall be UV-stabilized acrylic or glass. Provisions for house-side shielding shall be provided when specified.

4. Prevent the entrance of wildlife by limiting openings around the pipe tenon mounting area.

5. Electrical Parts (including Safety Testing) shall comply with an ANSI C136.41 with 7-pin receptacle that is fully pre-wire for LED driver's control.

6. Documents for the materials submitted need a certification from a National Voluntary Laboratory Accreditation Program (NVLAP) and that lab must be recognized by the U.S. Department of Energy.

LED Luminaire Warranty

The entire LED luminaire and all of its component parts shall be covered by a 10 year written warranty covering materials, fixture finish, and workmanship. Failure is when one or more of the following occur:

1. Negligible light output from more than 10 percent of the LED packages.

2. Condensed moisture inside the optical assembly.

3. Driver that continues to operate at a reduced output below 15 percent of the rated nominal output.The warranty period shall start from the system acceptance date. The signed warranty certificate shall be submitted prior to final payment.

714.11 Lamps

Install lamps of the design, type, and size, and at the locations shown on the Plans.

714.12 Installation of Overhead Wires

Install overhead wiring, when specified, as shown on the Plans.

714.13 Cable Markers

When shown on the Plans, place precast or cast-in-place concrete cable markers, of the dimensions indicated, at all locations where lighting cables make an abrupt change in direction. Construct the markers of Class A concrete meeting **604**. Imprint an arrow on each marker to indicate the direction of the cable run as it approaches and leaves the marker. Also imprint the circuit number on the marker.

Recess the markers into the ground approximately 3 inches, unless otherwise specified.

714.14 Control Center

Furnish and install a service pole or poles of the design, type, size, and class, and at the locations shown on the Plans. Install the service pole(s) as specified in **714.08** and as shown on the Plans. Set the service pole(s) plumb.

Notify the power company, at least 30 days before connection, of the need to furnish power to operate the lighting system.

Unless otherwise specified, furnish and install all the control center equipment and electrical supply facilities. The electrical supply facilities shall include the necessary service conduit from the control cabinet to the delivery point designated on the Plans.

Construct a concrete slab, of the dimensions and thickness indicated, around the service pole foundation. Construct the slab of Class A concrete meeting the requirements of **604**, and reinforce the slab, if specified, as shown on the Plans.

Construct a 6-foot chain-link fence and gate of the size specified around the control center as shown on the Plans and as specified in **707**.

714.15 Field Painting

After erection is completed, thoroughly clean steel standards that are not galvanized, and then apply two coats of inorganic zinc paint meeting the requirements of **910.03**. Perform painting as specified in **603**.

If the shop coat of prime paint is damaged, cover the damaged areas with a coat of the same type of paint as used for the original primer coat, and allow it to completely dry before applying the first coat of aluminum paint.

If the finish on galvanized steel materials is scratched, chipped, or otherwise damaged, the Engineer will reject the material, or may allow it to be repaired~~the Contractor to repair it~~ as specified in **713.04.B**.

714.16 Testing After Installation

Install all materials and equipment to form a complete installation ready for operation, unless otherwise specified.

After the installation is completed, test the lighting system in the presence of a Department representative and the Maintaining Agency. Tests shall include insulation resistance, voltage, current, and performance tests. Unless otherwise specified, perform the tests in accordance with the following:

D. **Voltage Tests**

Take a voltage reading at the control center at the load side of the circuit protection device and the last lighting standard served in each branch circuit. In cases where the circuit feeds in two or more directions, take the voltage reading at the light most remote from the control point or as directed by the Engineer. Unless otherwise specified, with the complete lighting system energized and all lamps operating, the voltage of this last standard shall not be less than 90% of the nominal rated voltage of the luminaire supply circuit, and the voltage at the last underpass luminaire in each branch circuit shall not be less than the minimum operating voltage recommended by the manufacturer of the luminaire ballast.

E. **Current Test**

Conduct current tests at each control center at the load side of each circuit protection device, using a clamp-on type ammeter. Current, in amperes, in each supply conductor shall not be greater than the rated current of a luminaire times the number of luminaires in the circuit.

F. **Grounding Resistance Test**

Conduct ground resistance tests with a “megger,” manufactured by the James H. Biddle Company, or a “vibraground” manufactured by Associated Research Incorporated or approved equal.

Adhere to the following when conducting this test:

1. Ensure that no equipment, such as ballast or oil switches, is connected at the time of the test.
2. Test only one conductor at a time.
3. Isolate the conductor being tested from ground.
4. Ensure that the other phase conductor and the neutral are grounded during each test.

G. **Performance Tests**

Prior to acceptance and after all faults have been corrected,~~ the Contractor shall~~ operate the lighting system, including automatic control equipment and other specified apparatus, for a continuous 48-hour period without interruption or failure attributable to poor workmanship or defective material. After the 48 hours

of continuous operation, the Engineer will inspect all lights and equipment for normal operation. Make all necessary repairs or replacements to the Engineer's satisfaction.

Make arrangements with the Servicing Agency to purchase the electric power necessary to conduct all tests.

Furnish the Engineer five copies of the test results, together with five copies of a statement from the Maintaining Agency that the system is acceptable to the Agency.

714.17 Repair of Seeded and Sodded Areas

If areas previously seeded or sodded are disturbed during the performance of the work described in this Section, reseed (with mulch) or re-sod such areas as specified in **801** or **803**, respectively. Perform these repairs as the work progresses to minimize erosion of disturbed areas.

H. **714.18 Disposal of Excess or Unsuitable Material**

Dispose of excess or unsuitable material as specified in **203.07**.

714.19 Final Cleanup

Perform final cleanup as specified in **104.10**. Remove existing foundations, designated for removal, to a minimum of 6 inches below grade. Before final inspection, touch-up finishes, clean surfaces including signs that are lighted, and perform such other work as directed by the Engineer to ensure the effectiveness and neat appearance of the work.

COMPENSATION

714.20 Method of Measurement

When the bid schedule contains an item for Roadway and Structure Lighting on a lump sum basis, measurement will be for the sum total of all items to be furnished and installed.

When the bid schedule contains items for various elements of Roadway and Structure Lighting, the Department will make measurement for payment as follows:

A. **Conduit**

The Department will measure:

1. Encased Conduit and Direct Burial Conduit by the linear foot of conduit for each kind, number, and size installed as indicated, and

2. Conduit (Structures) of the kind and size specified by the linear foot of each individual kind and size of conduit placed.

B. **Pull Boxes**

The Department will measure Pull Boxes by the unit, per each.

C. **Cable**

The Department will measure Cable of the type, and number and size of conductors specified, by the linear foot from the center to center of pull boxes, light standards, and similar features, for each type and number and size of conductors. No additional allowance will be made for slack length, length inside equipment or standards, and similar instances requiring additional length of wire.

D. **Preassembled Cable in Duct**

The Department will measure Preassembled Cable in Duct by the linear foot from the center to center of pull boxes, light standards, and similar features. No additional allowance will be made for slack length.

E. **Light Standards**

The Department will measure Light Standards of the kind and design specified by the unit, per each.

F. **Luminaires**

The Department will measure Luminaires of the size, type, and design specified by the unit, per each, regardless of their classifications (i.e. LED, HID).

G. **Overhead Conductors**

The Department will measure Overhead Conductors of the gauge, type, and kind specified by the linear foot between supports. No allowance will be made for slack length.

H. **Cable Markers**

The Department will measure Cable Markers by the unit, per each.

I. **Control Center**

The Department will measure the Control Center on a lump sum basis. Such measurement will be for the sum total of all items to be furnished and installed at the control center, except as specified in **714.20.J** and **714.20.K**.

J. **Class A Concrete**

The Department will measure Class A Concrete used to construct the concrete slab around the service pole at the control center by the volume in cubic yards, as determined from the specified thickness shown on the Plans and surface measurements for width and length. The Department will not measure reinforcement for the concrete slab for payment, but will consider the costs thereof as incidental to the item for Class A Concrete.

K. **Chain-Link Fence and Gate**

The Department will measure and pay for Fence and Gates in accordance with **707.08** and **707.09**, respectively.

L. **Navigational Lighting and Overhead Sign Lighting**

The Department will measure Navigational Lighting and Overhead Sign Lighting furnished and installed in accordance with the Plans on a lump sum basis.

M. **Incidental Items**

The Department will consider incidental, and will not directly measure, the following:

1. Excavation and backfilling performed in connection with this construction.

2. The removal and satisfactory disposal of existing pavement, surface, and base required to install conduit, and for restoring the base, pavement, and surface to their original condition.

3. Furnishing, installing, and subsequently removing sheeting, bracing, and supports needed to install conduit.

4. Labor, materials, equipment, electrical energy, and incidentals required to conduct the performance tests specified in **714.16.D**.

5. Reseeding, resodding, and otherwise restoring to their original condition areas that were disturbed during the performance of the work described in this Section.

714.21 Basis of Payment

When the bid schedule indicates payment will be made for Roadway and Structure Lighting on a lump sum basis, such payment is full compensation for all materials, labor, equipment, and incidentals necessary to produce a completely integrated, operative, and finished installation of a Roadway and Structure Lighting System, as shown on the Plans.

When the bid schedule contains items for various elements of Roadway and Structure Lighting, the Department will make payment as follows:

A. Conduit

1. **Encased Conduit.** The Department will pay for Encased Conduit at the contract unit price per linear foot, complete in place, for each kind, number, and size installed as indicated. Such payment is full compensation for all excavation, sheeting when required, backfilling, disposal of excess or unsuitable material, furnishing and placing or installing all materials and accessories, including grounding materials, concrete, and reinforcement when specified, all bends, joints, fittings and appurtenances, and installing the encased conduit complete.

2. **Direct Burial Conduit.** The Department will pay for Direct Burial Conduit of the kind, number, and size specified at the contract unit price per linear foot, complete in place. Such payment is full compensation for all excavation, sheeting when required, backfilling, jacking of conduit, disposal of excess or unsuitable material, furnishing and placing or installing all materials and accessories, including grounding materials, bedding materials when required, all bends, joints, fittings and appurtenances, and installing the conduit complete.

3. **Conduit (Structures).** The Department will pay for Conduit (Structures) of the kind and size specified at the contract unit price per linear foot, complete in place. Such payment is full compensation for furnishing

and installing all materials, including conduits, hangers, expansion fittings, grounding materials, and associated hardware and accessories, and installing the conduit complete.

B. Pull Boxes

The Department will pay for Pull Boxes at the unit price per each, complete in place. Such payment is full compensation for furnishing and installing or constructing pull boxes and for all excavation, backfilling, and other work connected therewith.

C. Cable

The Department will pay for Cable of the type, and number and size of conductors, as specified, at the contract unit price per linear foot, complete in place. Such payment is full compensation for furnishing and installing the cable and grounding materials, making splices, joints and connections, and for trenching, furnishing, and placing cushion and backfill material, and disposing of excess or unsuitable excavated material.

D. **Preassembled Cable in Duct**

Preassembled Cable in Duct of the kind and size specified will be paid for at the contract unit price per linear foot, complete in place. Such payment is full compensation for furnishing and installing the cable duct, grounding materials, making splices and connections, and for trenching, furnishing, and placing cushion and backfill material, and disposing of excess or unsuitable excavated material.

E. **Light Standards**

The Department will pay for Light Standards of the type specified at the contract unit price per each, complete in place. Such payment is full compensation for furnishing and installing the complete light standards, including the foundation, standard, bracket arm or arms, associated hardware and wiring, grounding materials, excavation, backfilling materials, and backfilling. The Department will measure foundations for high mast towers separately.

F. **Luminaires**

The Department will pay for Luminaires of the size and type specified at the contract unit price per each, regardless of their classifications (i.e. LED, HID), complete in place. Such payment is full compensation for furnishing and installing the complete luminaire, including the ballast(s), lamp(s), glare shields where required, and associated hardware and wiring.

G. **Overhead Conductors**

The Department will pay for Overhead Conductors of the gauge, type, and kind specified at the contract unit price per linear foot, complete in place.

H. **Cable Markers**

The Department will pay for Cable Markers of the design specified at the contract unit price per each, complete in place. Such payment is full compensation for furnishing and installing the marker complete, including the excavation, backfilling, and removal and disposal of excess or unsuitable excavated materials.

I. Control Center

The Department will pay for the Control Center at the contract unit price per lump sum, complete in place. Such payment is full compensation for furnishing and installing all equipment and materials, including service pole(s) when specified, and photoelectric relays, relay cabinets, multiple relays, lightning arrestors, fuse cutouts, and all other equipment, materials, associated hardware, and accessories, as shown on the Plans. Payment for the Control Center is full compensation for furnishing and installing all electrical supply facilities from the delivery point for electrical energy, as shown on the Plans, to the control center.

J. Class A Concrete

The Department will pay for Class A Concrete, measured as specified in **714.20.J**, at the contract unit price per cubic yard, complete in place.

K. Navigational Lighting and Overhead Structure Lighting

The Department will pay for Navigational Lighting and Overhead Structure Lighting by the lump sum complete in place including all materials and labor."

Subsection 730.11 (pg. 835), 6-27-16; Revise the title:

"AnchorRods"

Subsection 730.11 (pg. 835), 6-27-16; revise the first paragraph:

"Furnish, with anchor-base type poles, anchor rods meeting the requirements of ASTM F1554, Grade as required by design. Fit each anchor bolt with two heavy hex nuts. Hot-dip galvanize all nuts and not less than 10 inches of the threaded ends of anchor bolts according to ASTM A153. The anchor bolts shall be capable of resisting at yield strength stress the bending moment of the shaft at its yield strength stress."

Subsection 730 (pg. 828-880), 11-6-17; replace section with the following:

SECTION 730 – TRAFFIC SIGNALS

DESCRIPTION

730.01 Description of Work

This work consists of furnishing and installing all necessary materials and equipment to complete in-place traffic signal systems, modify existing systems, or both, all as shown on the Plans or the Standard or Special Details, and as specified in these Specifications. Unless otherwise shown on the Plans or specified in the Special Provisions, all materials shall be new.

Where existing systems are to be modified, incorporate the existing material into the revised system, salvage it, or abandon it as specified or as directed by the Engineer.

Furnish and install all incidental parts that are not shown on the Plans or specified herein, but that are necessary to complete the traffic signal or other electrical systems, or that are required for modifying existing systems, as though such parts were shown on the Plans or specified herein. Include the costs of such incidentals in bid price for other items. All systems shall be complete and in operation to the Engineer's satisfaction at the time of completion of the work.

GENERAL REQUIREMENTS

730.02 Regulations and Code

Ensure that all equipment provided conforms to NEMA Standards Publication, Traffic Control Systems, latest revision, or the Radio Manufacturers Association, whichever is applicable. In addition to the requirements of these Specifications, the Plans, and the Special Provisions, all material and work shall conform to the requirements of the NEC and the NESC; the Standards of ASTM, ANSI, ITE, and IMSA; the MUTCD; and other applicable local ordinances.

Wherever reference is made to the NEC, or the Standards mentioned above, consider the reference to mean the code or standard that is in effect on the date of advertising the bids or authorization for force account.

730.03 Submittal Data Requirements

Within 30 days after the issuance of the work order, submit to the Engineer, the Traffic Operations Division ~~of Materials and Tests~~, and the local entity (city or county engineer), one collated set of the manufacturer's descriptive literature and technical data that fully describes the types of signal equipment proposed for use. In the descriptive literature, identify the manufacturer and models and include sufficient information for the Engineer to determine if the equipment or material meets the requirements of the Plans and these Specifications. Include with these sets of submittal data a list of the materials submitted along with descriptive material for, but not limited to, the following items:

1. Controller
2. Cabinet and Exhaust Fan
3. Detectors
4. Signal Heads including Lamp Information and Mounting Hardware
5. Loop Wire and Loop Sealant
6. Shielded Detector Cable
7. Signal Cable
8. Cable for Span Wire, Guys, and similar features
9. Pull Boxes
10. Conduit
11. Coordination Equipment

Also include in the submittal sets detailed scale drawings of all non-standard or special equipment and of all proposed deviations from the Plans. Upon request, submit for approval sample articles of materials proposed for

use. The Department will not be liable for any materials purchased, labor performed, or delay to the Work prior to such approval.

In addition to the above, submit to the Engineer a notarized letter certifying that all traffic signal materials listed in the submittal conform to the Plans and Specifications along with a copy of a statement from the maintaining agency that the system is acceptable to the agency. Any material substitutions requested by the maintaining agency shall meet minimum Department standards and shall be approved by the Department in writing prior to purchase or installation. The Department will not be liable for any materials purchased; labor performed, or delay to the Work regarding such approval.

Submit ~~six prints~~an electronic copy in PDF format of "Design" or "Shop" drawings, indicating the proposed dimensions and material specification for each of the supports and mast arms involved, to the Division of Structures for approval purposes within 30 days after the work order is issued. The Department will review these drawings at the earliest possible date, and will return ~~two prints~~the electronic copy marked "Approved for Fabrication," or "Returned for Revisions as Noted." Respond by taking appropriate action to ensure the earliest possible correction of these items so as not to delay the installation.

730.04 Mill Test Reports and Certification

Provide Mill Test Reports (MTR) or Certifications of Conformance to the Specifications for Materials and Design for all materials incorporated into the Work. Supply the following prior to acceptance of the structures:

1. MTRs for MAJOR structural items only, as identified in Table 730.04-1, shall include both physical and chemical descriptions of the material as supplied to the fabricator. When physical properties are altered during the fabrication, supplement the MTR covering chemical composition with certified test reports indicating the physical properties of this material after fabrication.

2. Certifications of Conformance to the Specifications for all remaining material not covered by MTR as identified in Table 730.04-1.

3. Certification that all welding was performed by operators qualified as follows: Steel welders to AWS and aluminum welders to ASME.

4. Certification of Conformance to the Specification for the Design of all components not completely dimensioned and detailed on the Standard Drawing.

Table 730.04-1: Required Mill Test Reports and Certifications

Component Materials	MTR	Certification
Tubes for arms and poles	X	
Base Castings	X	
Anchor Bolts	X	
Pole tops, misc. fittings, and hardware		X
Fabricated or cast-type arm connections		X
Galvanizing		X

730.05 Working Drawings

Provide within the controller cabinet and to the local maintaining agency an electrical schematic diagram of the cabinet and system wiring. Submit manufacturer's instructions for installation, maintenance, and operation of all equipment to the local maintaining agency and also place a copy within the controller cabinet. Place all such materials inside a plastic envelope mounted in the cabinet.

730.06 Guarantee

Guarantee the Traffic Signal System(s) installed under these Specifications, including all equipment, parts, and appurtenances in connection therewith, to the City or County and State against defective workmanship and materials for a period of not less than 1 year following the date the signal system is installed and made operational, except in no case shall this guarantee expire prior to 3 months after the final acceptance of the Project. Upon completion of the Project, turn over to the government agency responsible for maintaining the signal installation all warranties or guarantees on equipment and materials that are offered by the manufacturers as normal trade practice ~~and that have not expired~~.

730.07 Training

Provide to the maintaining agency and/or the Department a training session on the controller and associated cabinet equipment to be supplied on the Project. The training session shall last for a minimum 4 hours unless the maintaining agency and/or the Department determines a lesser time is adequate. Train the user in the complete operation and programming features of all controllers. Provide this training prior to the acceptance of the Project at a facility agreed upon by the maintaining agency.

After the required training, certify to the Engineer that training has been completed.

This training requirement shall not apply if a training program meeting these criteria has been provided to the maintaining agency by this vendor and/or manufacturer on the equipment being bid within 18 months prior to the date of the invitation to bid. This requirement shall apply if the bidder is proposing new, upgraded, or modified equipment not covered in the previous training program.

MATERIALS AND INSTALLATION

730.08 Excavating and Backfilling

Perform excavation needed to install conduit, foundations, and other equipment, so as to cause the least possible damage to the streets, sidewalks, and other improvements. Excavate trenches no wider than necessary to properly install the electrical equipment and foundations. Do not begin excavating until immediately before installing conduit and other equipment. Place the material from the excavation where it will cause the least disruption and obstruction to vehicular and pedestrian traffic and the least interference with the surface drainage.

Backfill the excavations and compact to at least the density of the surrounding material. Remove all surplus excavation material and dispose of outside the highway right-of-way, in accordance with **203.07**, or as directed by the Engineer.

After backfilling, keep excavations well-filled, and maintain in a smooth and well-drained condition until permanent repairs can be made.

At the end of each day's work, and at all other times when construction operations are suspended, remove all equipment and other obstructions from that portion of the roadway used by public traffic, and park a minimum of 30 feet from the edge of pavement unless otherwise protected by guardrail, bridge rail, or barriers installed for other purposes.

Perform excavation in the street or highway so as to restrict no more than one traffic lane in either direction at any time. Do not obstruct traffic during hours of peak flow unless otherwise approved by the Engineer. Incorporate construction signing in accordance with the MUTCD.

730.09 Removing and Replacing Improvements

Replace or reconstruct, with the same kind of materials as found on the Work, improvements, such as sidewalks, curbs, gutters, Portland cement concrete and asphalt concrete pavement, bituminous surfacing, base material, and all other improvements removed, broken, or damaged by the Contractor.

Before removing the sidewalk and pavement material, use an abrasive type saw to cut, to a minimum depth of 2 inches, the outline of all areas to be removed in Portland cement concrete sidewalks and in all pavements. Use any method satisfactory to the Engineer to cut the remainder of the required depth. Make cuts neat and true with no shatter outside the removal area.

Whenever a part of a square or slab of existing concrete sidewalk or driveway is broken or damaged, remove the entire square or slab and reconstruct the concrete as specified above.

Perform all work in accordance with these Specifications, or the applicable local ordinance, whichever is of a higher standard. Consider this removal and replacement work to be incidental to other items.

730.10 Foundations

Construct foundations for posts, standards, and cabinets of Class A Portland cement concrete.

Pour foundations for posts, standards, and pedestals after the post, standard, pedestal, or anchor bolts or reinforcing steel is in proper position. Form the exposed portions to present a neat appearance. Rest the bottom of concrete foundations on firm undisturbed ground.

Construct forms to be true to line and grade. Finish tops of footings for posts and standards, except special foundations, to curb or sidewalk grade or as ordered by the Engineer. Use rigid forms, securely braced in place. Place conduit ends and anchor bolts by means of a template until the concrete sets. Moisten both the forms and the ground that will be in contact with the concrete before placing concrete. Do not remove forms until the concrete has cured for at least 12 hours and hardened sufficiently to allow form removal without causing damage to the concrete.

Apply an ordinary surface finish to exposed surfaces of concrete. Wherever the edge of a concrete foundation or sidewalk section is within 18 inches of any existing concrete improvement, extend the sidewalk section to meet the existing improvement.

Where obstructions prevent the construction of planned foundations, construct a foundation satisfactory to the Engineer.

730.11 Anchor Rods

Furnish, with anchor-base type rods, anchor bolts meeting the requirements of ASTM F1554, grade as required by design. Fit each anchor bolt with two heavy hex nuts. Hot-dip galvanize all nuts and not less than 10 inches of the threaded ends of anchor bolts according to ASTM A153. The anchor bolts shall be capable of resisting at yield strength stress the bending moment of the shaft at its yield strength stress.

Set standards, posts, and pedestals plumb by adjusting the nuts before the foundation is finished to final grade. Do not use shims or similar devices for plumbing or raking. After plumbing or raking has been completed, cut off anchor bolts 1/4 inch above the top nut, and paint the exposed surface with rust protective paint.

Furnish all anchor bolts and nuts required for relocating existing standards and posts.

730.12 Pull Boxes

Construct and install pull boxes as shown on the Plans and the Standard Drawings or as directed by the Engineer. Additional pull boxes may be required where conduit runs are more than 150 feet long. The maximum spacing

between pull boxes shall be 150 feet, unless otherwise directed by the Engineer. Install pull boxes wherever practicable out of the line of traffic. Set covers level with the pavement, or with the curb or sidewalk grade, or with the surrounding ground as required.

Place electrical conductors within pull boxes so as to be clear of the metal frame and cover.

Rest the bottom of the pull box firmly on a bed of crushed stone with a minimum depth of 12 inches below the bottom, and extending 6 inches beyond the outside edge of the pull box, unless otherwise directed by the Engineer.

A. Concrete Pull Boxes

Construct concrete pull boxes of a mixture of one part cement, two parts sand, and four parts gravel or 1-inch crushed stone with reinforcement placed as shown on the Standard Drawings. Reinforcement shall consist of welded wire reinforcement, 4 x 4 inches - No. 4/4 at 85 pounds per 100 square feet, meeting the requirements of **907.03**. Pull boxes may be poured in place or precast. The color of the pull box concrete material shall match the surrounding concrete color.

Install a cast iron frame and cover of the dimensions shown on the Drawings in each pull box. Provide castings of Class 30, meeting the requirements of **908.07**. The covers shall have a roughened top surface of 1/8 inch in relief. Provide notches for removing the cover. Inscribe the words "TRAFFIC SIGNALS" on top of the covers with letters 1-1/2 inches high and 1/8 inch in relief as shown on the Drawings.

The frame shall have a minimum weight of 42 pounds. The cover shall be of the "Extra Heavy" type with a minimum weight of 54 pounds.

B. Reinforced Plastic or Epoxy Mortar Pull Boxes

Ensure that pull boxes composed of reinforced plastic or epoxy mortar are designed and tested to temperatures of -50 °F and meet the requirements of the following: ASTM D543, ASTM D570, ASTM D790, and ASTM D635, and are based on a 30,000-pound single axle load over a 10 x 20 inch area. The top of the pull box shall consist of a concrete frame (ring) and cover. The color of the pull box concrete material shall match the surrounding concrete color. Inscribe the words "TRAFFIC SIGNALS~~Traffic Signals~~" on top of the covers.

730.13 Transformer Base

Fabricate the transformer base from steel plate and sheet, and design it to harmonize with the shaft. Provide each transformer base with:

1. One 7-1/2 x 9 inch minimum handhole, with a cover secured with stainless steel fastening screws;

2. Four galvanized steel bearing plates to fasten the base to the anchor bolts;

3. Four galvanized steel bolts, nuts, and washers to fasten base and standard; and

4. One 1/2-inch, 13 UNC grounding nut welded to the inside of the base opposite the handhole opening.

Ensure that the strength of the transformer base is comparable with that of the shaft.

When a transformer base is required, no handhole will be required in the shaft.

730.14 Conduit

Furnish and install plastic and steel conduit in accordance with these Specifications and close conformity with the lines shown on the Plans or as established by the Engineer.

Threads shall be clean cut, straight, and true and of sufficient length to allow proper coupling. Do not use long running threads on any part of the Work. Protect threads in transit and during installation, and provide conduit with proper supports and protection during construction to prevent damage. Properly thread, ream, and cap all ends of pipe installed for future connections to prevent water and foreign matter from entering the conduit system. Provide threaded ends with approved conduit bushings.

Signal conduit shall be a minimum 2 inches in diameter, and detector conduit a minimum 1 inch~~es~~ in diameter, unless otherwise specified or directed by the Engineer. Conduit for service connections shall be 1~~ 1/4~~ inch~~es~~ in diameter. Do not use conduits smaller than 1 inch in diameter unless otherwise specified, except grounding conductors at service points shall be enclosed in 3/4~~1/2~~-inch diameter conduit. Larger-sized conduit may be used,~~The Contractor may,~~ at no additional cost to the Department, ~~use larger size conduit,~~ in which case it shall be for the entire length of the run with no reducing couplings allowed.

A. Materials

Provide conduits and fittings of the type as shown in the construction plans or as directed by the Engineer and as follows:

1. Steel Conduit

a. Rigid conduit and fittings shall be heavy-wall, hot dipped galvanized steel conforming to Federal Specification WW-C-581-d(3) and ANSI C80.1. It shall be galvanized inside and out and shall meet the requirements of ASTM A53. Each length shall bear the label of Underwriters Laboratories, Inc.

b. Flexible conduit shall be galvanized flexible steel meeting Federal Specification WW-C-581-d(3), ANSI C80.1 and UL Standard 6 with a minimum 40-mil thickness of polyvinyl chloride (PVC) coating conforming to ASTM D746.

2. Plastic Conduit. For plastic conduit, provide high impact PVC, Schedule 40 or Schedule 80.

~~2.~~3. **High-Density Polyethylene (HDPE).** Materials used for the manufacture of HDPE conduit and fittings shall be per ASTM F2160 and consist of a Standard Dimension Ratio (SDR) 9-11. No other substitutions shall be allowed unless directed by the Engineer. HDPE conduit can be used with preassembled cable and rope-in-conduit.

B. Installation

All bends shall be in strict compliance with the NEC.

Lay conduits to a minimum depth of 6 inches below subgrade but not less than 24 inches below pavement grade except when approved by the Engineer; conduit may be laid at a depth of not less than 24 inches below top of curb when placed in back of the curb. Place conduit runs for detectors parallel to existing or proposed curbs and not more than 18 inches behind the curb face unless other specified. Place steel conduit or Schedule 80 PVC conduit under existing pavements by approved jacking or drilling methods. Do not disturb pavements without the Engineer's approval. Where trenching is allowed in a traffic bearing area, use PVC conduit (Schedule 40) encased in concrete.

Conduits shall be continuous and extend from end point (i.e. pull box, foundation signal pole, pedestal pole, etc.) to another end point, or as directed by the Engineer. Conduit splicing shall not be permitted between end points.

After completing the installation of the conduit, test all conduits installed under the Contract with a mandrel having a diameter 1/4-inch smaller than the conduit and a length of 2 inches. Repair, to the Engineer's satisfaction, all conduits that will not allow passage of the mandrel; if repairs cannot be accomplished, remove

and replace the conduit at no additional cost to the Department. After the mandrel test, scour all conduits with a stiff wire brush slightly larger in diameter than the conduit. Clear all conduits in the Engineer's presence.

Extend conduits terminating in anchor base standards and pedestals approximately 2 inches above the foundation and slope them toward the hand-hole opening. Conduits shall enter concrete pull boxes from the bottom and shall terminate not less than 2 inches nor more than 4 inches above the bottom of the box and near the box walls to leave the major portion of the box clear.

Clean existing underground conduit to be incorporated into a new system by blowing with compressed air, or by other means approved by the Engineer.

730.15 Conductors

Furnish and install conductors in accordance with these Specifications and close conformity as shown on the Plans, or as directed by the Engineer.

Traffic Control Conductors shall be rated at 600 volts. Run all conductors, except loop conductors and cables run along messengers, in conduit, except where run inside poles. Where signal conductors are run in lighting standards containing high voltage street lighting conductors, encase the signal conductors in flexible or rigid metal conduit. Where telephone circuits are introduced into controller foundations, encase the telephone conductors in flexible metal conduit and in conformance with the NEC.

Conductors for traffic loops shall be continuous AWG No. 14 XLP stranded wire to the detector terminals or spliced with shielded detector cable within a pull box, conduit, or pole base.

Detector cable shall be two conductor twisted pair shielded AWG No. 14 stranded meeting IMSA Specification No. ~~19~~50-2.

730.16 Cable

All signal cable shall conform to applicable IMSA Specification No. 19-1 or 20-1. Use stranded cable color coded AWG No. 14 for all signal and accessory circuits. Retain the same color identification for the entire length of a circuit run.

730.17 Wiring

1. Terminate all wiring to screw terminals using lugs.

2. Make all splices with solderless connectors, and insulate splices with weatherproof tape applied to a thickness equal to the original insulation.

3. Attach cables to messenger with non-corrosive lashing rods or stainless steel wire lashings.

4. All wiring within enclosed cabinets shall be neatly formed and harnessed and shall have sufficient length for access and servicing.

730.18 Service Connection

Coordinate service connection details and metering with the local utility as directed by the Engineer and in conformance with the City and County requirements. Obtain the necessary service for each installation.

730.19 Sealant

Provide sealant material selected from the Qualified Products List maintained by the Department's Material and Test Division for sealing saw-cuts. The sealant material shall resist the upward movement of loop and lead-in and shall

exhibit stable dielectric characteristics, including a low permitivity and high dielectric strength. It shall bond to the roadway paving material, preventing entry of moisture, and shall remain flexible without melting through the anticipated temperature and weather conditions.

730.20 Strand Cable

Span cable for suspending signal heads between pole supports shall be 7-strand, Class A, copper-covered steel wire strand or greater, meeting the requirements of ASTM A460, with a minimum breaking strength as noted on the Plans. An acceptable alternate is 7-strand steel wire with a Class A zinc coating meeting the requirements of ASTM A475, with a minimum breaking strength as shown on the Plans.

Strand cable for messenger wire (other than span wire as specified above) and pole guy cable use shall be of the diameter(s) shown on the Plans and shall meet the requirements of ASTM A475 for zinc-coated steel wire strand, 7-strand Siemens-Martin Grade with a Class A zinc coating or greater.

A Figure 8 cable combining the messenger cable and conductor cable in an insulated jacket is an acceptable alternate to conductor cable lashed to a messenger cable.

730.21 Bonding and Grounding

Make metallic cable sheaths, conduit, transformer bases, anchor bolts, and metal poles and pedestals mechanically and electrically secure to form a continuous system, and ensure they are effectively grounded. Bonding and grounding jumpers shall be copper wire or copper strap of not less than the same cross-sectional area as No. 6 AWG.

Furnish and install a ground electrode at each service point. Ground electrodes shall be one-piece lengths of copperweld ground rod not less than 8 feet in length and 1/2 inch in diameter, installed in accordance with the NEC. Ground the conduit and neutral as required under the NEC, except that grounding conductors shall be No. 6 AWG or approved equal, as a minimum. Enclose exposed ground conductors in 1/2-inch diameter conduit, and bond to the electrode with a copperweld ground clamp.

730.22 Field Test

Prior to completing the work, conduct the following tests on all traffic signal and lighting circuits in the Engineer's presence:

1. Test for ground in circuit.

2. Conduct a megger test on each circuit between the circuit and ground. The insulation resistance shall be not less than the values specified in Section 119 of the NEC.

3. Conduct a functional test to demonstrate that each part of the system functions as specified or intended herein.

4. Test all detector loops and leads before and after they are sealed in the pavement to ensure there are no shorts to ground in the system and to ensure that the loop plus lead-in inductance is within the operating range of the detector.

Replace or repair, in a manner approved by the Engineer, all faults in material or in the installation revealed by these tests. Repeat the applicable testing until no fault appears.

730.23 Inspection

After completion of the installation and before final acceptance of the Project, conduct a full operational check of the system under actual traffic conditions in the presence of the Engineer. The operational check shall cover a

minimum time period of 30 calendar days. During this period, perform all necessary adjustments and replace all malfunctioning parts of the equipment required to place the system in an acceptable operational condition at no additional cost to the Department. Perform all work and furnish all materials required under these Specifications subject to the direct supervision, inspection, and approval of the Engineer. Provide the Engineer and authorized representatives free access to the work, and to all plants, yards, shops, mills, and factories where, or in which, articles or materials to be used or furnished in connection with such work are being prepared, fabricated, or manufactured. Provide full and sufficient information to determine that the performance of the work, the character of materials, and the quality of workmanship and materials meets the intent of these Specifications.

Only perform work in the presence of the Engineer or the Inspector appointed by the Engineer, unless permission to do otherwise has first been obtained. The Engineer may reject any work that is performed or constructed in the absence of the Engineer or Inspector, without such permission having been granted, either expressly or by implication.

The inspection of the work shall not relieve the ~~Contractor of its~~ obligation to properly fulfill the Contract as specified. If the Engineer finds a part of the work, or the materials used in the work, to be defective or unsuitable at any time prior to final acceptance, repair or replace such defective or unsuitable work or material.

Request the presence of an Engineer or Inspector in connection with the work under these Specifications at least 24 hours before such services will be required.

SIGNAL HEADS

730.24 Signal Heads

Signal heads shall meet the latest requirements published in the Equipment and Materials Standards of the Institute of Transportation Engineers (ITE) for Adjustable Face Vehicle Traffic Control Signal Heads" and the National Electrical Code. The arrangement of traffic signal heads shall be mounted as shown on the Plans or as specified by the Engineer and be in accordance with the latest versions of the MUTCD and the TDOT Traffic Design Manual.

~~Each vehicle signal head shall:~~

~~1. Be of the adjustable, colored lens, vertical type with the number and type of lights detailed as specified herein and as shown on the Plans;~~

~~2. Provide a light indicator in one direction only;~~

~~3. Be capable of adjustment (without attachments) through 360 degrees about a vertical axis; and~~

~~4. Be mounted as shown on the Plans or as directed by the Engineer.~~

~~Arrange the lenses in the signal faces in accordance with Section 4B.9 of the MUTCD. All lenses shall be glass.~~ All circular indications shall use 12-inch lenses unless otherwise shown on the Plans. All arrow indications shall use 12-inch lenses. All new vehicle signal heads installed at any one intersection shall be of the same style and from the same manufacturer. ~~Apply one or more coats of primer to all signal heads, signal head mountings, and outside of hoods, followed by two coats of high quality synthetic resin enamel of Traffic Signal Yellow meeting or exceeding Federal Specifications TT-C-595 Gloss Yellow.~~ All exposed metal signal housings, doors, visors, backplates and framework parts shall be painted with a powder coated finish and be in accordance to the MUTCD specifications.

~~Apply one or more coats of primer to louvers as specified, signal hood interiors, and back plates, followed by two coats of Lusterless Black Enamel meeting or exceeding Master Painters Institute (MPI) Reference 94. Examine all factory enameled equipment and materials for damaged paint after installation, and repair such damaged surfaces to the Engineer's satisfaction. Factory applied enamel finish in good condition and of appropriate color will be acceptable.~~

Suspensions for span wire mounting of multi-faced signal heads and signal head clusters (such as a 5-section signal head) shall include an approved swivel type balance adjuster for proper vertical alignment.

~~Fabricate signal heads from die-cast bodies. Sand castings will not be acceptable.~~ Signal head housings shall be cast aluminum and all associated parts/hardware shall be of non-corrosive material.

~~Ensure that all signal heads meet the minimum Contract requirements for adjustable face vehicle traffic control signal heads.~~

In addition to these requirements, comply with the following:

A. Optical Units

~~Signal lamps for 8 inch lenses shall be clear, 595 rated initial lumen output, with a minimum life of 6,000 hours. Signal lamps for 12 inch lenses shall be clear, 1750 rated initial lumen output, with a minimum life of 6,000 hours.~~

Traffic signal indications shall be LED type and meet the Institute for Transportation Engineers (ITE) latest LED specifications. All LED indications shall have a five year warranty.

~~A.~~B. **Signal Head Mounting and Mounting Brackets**

Furnish signal heads that either have integral serrations or are equipped with positive lock rings and fittings designed to prevent heads from turning due to external forces. Lock ring and connecting fittings shall have serrated contacts. Provide signals with water-tight fittings. ~~using neoprene washers.~~

Support bracket-mounted signal heads, as shown on the Plans, by mounting brackets consisting of assemblies of 1-1/2 inch standard pipe size. Ensure that all members are either plumb or level, symmetrically arranged, and securely assembled. Conceal all conductors within poles and mounting assembly. Secure each slip fitter to the pole.

~~B.~~C. **Directional Louvers**

Where shown on the Plans, furnish and install louvers in the hoods of the signal head sections designated.

Directional louvers shall have a snug fit in the signal hoods. Construct the outside cylinder and vanes from a non-ferrous metal or galvanized sheet steel. ~~Paint louvers with two coats of black enamel as specified in **730.24.F**.~~ Louvers shall be painted with a powder coated finish.

~~C.~~D. **Back Plates**

Where shown on the Plans, furnish and attach back plates to the signal heads. All back plates shall be louvered and constructed of 3,003, half-hard, 0.051-inch minimum thickness aluminum sheet. Other materials such as plastic or fiberglass may be used where approved. In fabricating back plates, bend back the inside vertical edges, adjacent to the signal head, to form mounting brackets for attaching to the signal. Form back plates in two or more sections and bolt together, thus allowing for installation after signal heads are in place. Back plates shall have a dull black appearance in the front and back.

~~D.~~E. **Wiring**

Signal head leads shall be No. 18 AWG stranded with 221 °F thermoplastic insulation. Wire a separate white (common) lead to each socket shell; and wire a colored lead, corresponding to the color code shown on the Plans, to each socket terminal. Provide leads of sufficient length to allow connection to the terminal block

specified. Provide each complete signal head with a minimum 4-point terminal block, properly mounted in a signal section. Stud type terminal blocks shall have not less than 1/4-inch edge clearance to any portion of the stud. Exterior wiring shall have a 360-degree drip loop in advance of entering the head.

~~E.~~F. **Pedestrian Signals**

~~When shown on the Plans, provide pedestrian signals conforming to the following:~~

~~1. Pedestrian indications should attract the attention of and be readable to the pedestrian both day and night and at all distances from 10 feet to the full width of the area to be crossed.~~

~~2. All pedestrian indications shall be rectangular in shape and shall consist of the lettered messages WALK and DON'T WALK. For the purposes of these Specifications, interpret the messages WALK and DON'T WALK to be equivalent to the international symbols of a "Walking Figure" and "Upraised Hand," respectively.~~

~~3. When illuminated, the WALK indication shall be lunar white meeting ITE standards, with an opaque material obscuring all but the letters.~~

~~4. When illuminated, the DON'T WALK indication shall be Portland Orange meeting ITE standards, with an opaque material obscuring all but the letters.~~

~~5. When not illuminated, the WALK and DON'T WALK messages shall not be distinguishable by pedestrians at the far end of the crosswalk they control.~~

~~6. The letters shall be at least 3 inches high for crossing where the distance from the near curb to the pedestrian signal indication is 60 feet or less. For distances over 60 feet, the letters shall be at least 4 1/2 inches high.~~

~~7. Design and construct the light source so that in case of an electrical or mechanical failure of the word DON'T, the word WALK of the DON'T WALK message will also remain dark.~~

~~Provide each section with a visor encompassing the top and sides of the signal face of a size and shape adequate to shield the lens from external light sources. Provide lamps of the 69-watt traffic signal type.~~

Pedestrian signal heads shall meet the latest requirements published in the Equipment and Materials Standards of the Institute of Transportation Engineers (ITE) for Adjustable Face Pedestrian Signal Heads", the National Electrical Code and be compatible with NEMA standards. The arrangement of pedestrian signal heads shall be mounted as shown on the Plans or as specified by the Engineer and be in accordance with the latest versions of the MUTCD and the TDOT Traffic Design Manual. The pedestrian indications shall be LED symbols and in conformance with the Institute for Transportation Engineers (ITE) latest LED specifications. All LED indications shall have a five year warranty.

In addition, where pedestrian signal heads are provided, they shall:

1. include a pedestrian change interval countdown display where the calculated pedestrian change interval is more than 7 seconds;
2. include Accessible Pedestrian Signals and pedestrian pushbuttons complying with MUTCD Accessible Pedestrian Signals section;
3. incorporate a locator tone meeting the requirements of the MUTCD Accessible Pedestrian Signals;
4. include a pedestrian pushbutton with tactile vibrating arrow button and audible sound.

The pedestrian countdown display shall conform to the latest FCC regulation on Emission of Electronic Noise.

The manufacturer must supply certification, which includes a copy of the test report by an independent technical laboratory as to the compliance with ITE specifications (where it applies). The report shall also indicate that the tests were performed only after the modules received a thirty (30) minute operational warm-up period immediately preceding the tests.

The housing door, door latch, and hinges shall be of aluminum, or polycarbonate or approved equal. Hinge pins shall be stainless steel. Provide the door with a neoprene gasket capable of making a weather resistant, dust-proof seal when closed.

All pedestrian signal heads, mountings, outside of hoods, and pedestrian push button housings shall have have a powder coated finish (if aluminum) or colored resin (if polycarbonate) in accordance to MUTCD specifications. ~~one or more coats of primer followed by two coats of high quality synthetic resin enamel of Traffic Signal Yellow, meeting or exceeding Federal Specifications TT-C-595 Gloss Yellow. The interior of signal hoods shall have one or more coats of primer followed by two coats of Lusterless Black Enamel meeting or exceeding MPI Reference 94. Examine all factory enameled equipment and materials for damaged paint after installation, and repaint such damaged surfaces to the Engineer's satisfaction. Factory applied enamel finish in good condition and of appropriate color will be acceptable.~~

~~F.~~G. **Signal Head Installation**

Install signal heads and pedestrian signal heads with the faces completely covered until the entire installation is ready for operation.

CONTROLLERS – GENERAL

730.25 Controllers

~~A controller shall consist of the complete electrical mechanism for controlling the operations of traffic control signals, including the timing mechanism and necessary auxiliary equipment, mounted in a cabinet.~~

~~**A. Interval Sequence**~~

~~The color sequence of signal indications shall be green, yellow, and red. Overlaps, such as green and yellow indications showing at the same time, will not be permitted. During any interval there shall be no visual flicker of signal indications. Under no conditions shall controllers allow conflicting green signal indications to be displayed.~~

~~**B. Flashing Operations**~~

~~Equip controllers to allow any combination of flashing red or yellow lights. However, set the flashing operation for flashing yellow lights on the main street or highway unless otherwise specified in the Special Provisions, shown on the Plans, or directed by the Engineer. The flashing mechanism shall produce between 50 and 60 flashes per minute through two 120 volt, 15 ampere circuits. One illuminated period at each flash shall not be less than 1/2 and not more than 2/3 of the total cycle.~~

~~Pedestrian signals shall be dark during flashing operations. During normal operation, pedestrian signals shall flash DON'T WALK during the pedestrian clearance interval.~~

~~Use two circuit solid state flashers unless otherwise specified.~~

~~**C. Wiring Diagrams**~~

~~Submit a schematic wiring diagram of the controllers and auxiliary equipment at the time the controllers are delivered, or prior to ordering if requested by the Engineer. This diagram shall show in detail all circuits and parts. Identify such parts on the diagram by name or number and in such a manner as to be readily interpreted.~~

~~**D. Operating Line Voltage**~~

~~Provide equipment designed to operate from a 120 volt, 60 cycle AC supply. Operation shall be satisfactory at voltages from 105 to 130. All operating voltages into and out of the controller shall be NEMA level DC voltages, except for AC power (connector A, pin p and U).~~

Controller equipment shall be permanently marked with the manufacturer's name or trademark, part number, and serial number.
Controllers must meet the following applicable industry standards and amendments:
NEMA TS2 Controller ..... NEMA TS-2-2016
ATC Controller ..... AASHTO/ITE/NEMA ATC 5.2b
All NEMA TS2 and ATC controllers must provide functionality that meets or exceeds operational characteristics, including NTCIP support, as described in NEMA TS-2-2016.
NEMA TS2 Type 2 controllers shall be used when downward compatibility to existing TS1 cabinets is desired.
Except for replacing controllers in existing systems, all new installations must include controllers that capture high resolution event-based data elements to provide the automated traffic signal performance measures.

The manufacturer must supply certification of the conformance to the above requirements at the time of the bid.
In addition to the above requirements, the controller shall:

5. have all timing values entered via a front panel mounted keyboard. This keyboard shall be an integral part of the controller unit;
6. have an English language menu for programming or reading all controller features;
7. continue to operate the intersection as values are inspected or altered;

8. include the ability to upload and/or download the controller software operating system and user programmed database to or from external media (datakey, usb, sd card etc).
9. support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

Surge Protection Devices~~**Lightning Protectors and Interference Suppressors**~~

The cabinet shall have Surge Protective Devices (SPDs) for the main AC power input, all signal head field wiring terminals, interconnect cable terminals and loop lead-in cable terminals which are located in the cabinet. Furnish SPDs to provide effective defense against high transient voltages caused by lightning discharges or other sources. SPDs must be unobstructed and accessible from the front side of any panel used in the cabinet. The SPD for the main AC power input of the cabinet must be connected on the load side of the cabinet circuit breaker. SPDs must meet the following minimum requirements:

1. AC power SPD:

   a. Must be UL 1449 4th Edition Listed
   b. Parallel connected device
   c. UL Nominal Surge Rating (In): 20kA
   d. UL Short Circuit Current Rating (SCCR): 150kA minimum
   e. Surge current rating: 50kA per phase minimum

f. Visual status indication
g. Remote signalization contacts for monitoring purposes
h. 10 year manufacturer's warranty minimum

2. DC power SPD:

a. Must be UL 1449 4th Edition recognized
b. Parallel connected device
c. UL Nominal Surge Rating (In): 10kA minimum
d. Must provide protection between all +/-/Gnd connections
e. Surge current rating: 20kA per phase minimum
f. Visual status indication
g. Remote signalization contacts for monitoring purposes
h. 10 year manufacturer's warranty minimum

3. Data and communication SPD:

a. Must be UL 497B listed
b. 10 year manufacturer's warranty minimum

4. Signal and interconnect cable field wiring terminal SPD:

a. Clamp the surge voltage to a level no greater than twice the peak operating voltage of the circuit being protected
b. Withstand a surge current of 1000A with an 8 by 20 µs waveform six times (at 1 second intervals between surges) without damage to the suppressor
c. 10 year manufacturer's warranty minimum

5. Loop lead-in cable field wiring terminal SPD:

a. Protect the detector unit loop inputs against differential (between the loop lead) surges, and against common mode (between loop leads and ground) surges
b. Clamp the surge voltage to 25 V or less when subjected to repetitive 300A surges
c. Withstand repetitive 400A surges with an 8 by 20 µs waveform without damage
d. 10 year manufacturer's warranty minimum

All SPDs must be installed according to the SPD manufacturer's instructions and not affect the operation of equipment. SPD leads must be kept as short and straight as possible.

~~Furnish ample lightning protectors to provide effective defense against high transient voltages caused by lightning discharges or other sources. Furnish each controller cabinet with the following surge protection devices:~~

~~1. Provide main power suppressor, for all but flasher or remote detector cabinets, having the following characteristics:~~

~~a. Peak Surge Current: 20,000 amperes~~
~~b. Clamp Voltage: 250 volts~~
~~c. Response Time: Voltage NEVER exceeds 250 volts~~
~~d. Continuous Current: 10 amperes at 120 volts AC~~

~~2. For controller flasher, flashing beacon, and remote detector cabinets, provide a power protector having the following characteristics:~~

~~a. Peak Current 15,000 amperes~~
~~b. Power Dissipation 15 watts~~
~~c. Peak Voltage 212 volts~~

~~3. Provide loop detector input terminals with the following:~~
~~a. Peak Surge Current 400 amps Differential Mode~~
~~1,000 amps Common Mode~~
~~b. Response Time 40 nanoseconds~~
~~c. Input Capacitance 35 picofarads typical~~
~~d. Clamp Voltage 30 volts max (either mode)~~

~~4. Provide auxiliary relays and fan with a resistor/capacitor circuit to suppress generated noise.~~

~~5. Provide an RF Filter in controller cabinets capable of filtering of RF noise over the range of 60 hertz through 20 Megahertz. The RF filter may be incorporated as part of the Main Power Suppressor.~~

CABINETS – GENERAL

730.26 ~~Controller~~ Cabinets

Cabinets must be permanently marked with a label including the manufacturer's name or trademark, model/part number, and the year and month of manufacture. The label should be placed on the inside of the main door using a water resistant method. The label must be visible after installation.
Cabinets shall be provided as a complete unit and have all terminals and facilities necessary for traffic signal control as shown on the plans and shall meet at a minimum, the following requirement:
NEMA TS2 Controller Cabinet ..... NEMA TS 2 2016
The manufacturer must supply certification of the conformance to the above requirements at the time of the bid.
Cabinets shall also be in accordance with the latest version of the TDOT Traffic Design Manual.
Two paper copies of the cabinet wiring diagram shall be provided with each cabinet. The nomenclature of signal heads, vehicular movements and pedestrian movements on the wiring diagram must be in accordance with the signal operating plan. Documentation must include a list identifying the termination points of cables used for vehicular and pedestrian signal heads, detector loop lead-ins, and pedestrian pushbutton wires. A heavy duty, resealable plastic bag must be mounted on the backside of main cabinet door for storing cabinet documentation.

House the controller in a rigid, weatherproof cabinet, constructed, finished, and equipped as follows, and as shown on the Standard Details:

1. **Material.** Provide weather-tight cabinets fabricated from aluminum sheet or cast aluminum alloy with a minimum 0.125-inch thickness. All welds on fabricated cabinets shall be internal and continuous; spot

welding is not acceptable. Painting of cabinets is only required if the final finish presents an unsightly appearance.

2. **Doors.** Type III, IV, and V cabinets shall have a hinged front opening door that shall include substantially the full area of the front of the cabinet. Equip the door with a positive hold fast device to secure the door in at least two open positions: one position at approximately 90 degrees and the other at 120 degrees or more. The holdfast device shall be easily secured and released without the use of tools. Equip doors for Type II, III, IV, and V cabinets with a switch compartment, and provide the manual switches, specified in **730.2~~6~~5.~~F~~.6.jk**, with a hinged front opening auxiliary door. Each door shall have a gasket to provide a weatherproof seal when closed.

   Provide the main door with a No. 2 pin-tumbler cylinder lock, and the auxiliary door with a standard police sub-treasury lock. Provide four keys for each lock.

   Provide a switch which is to be tied to the cabinet light so that cabinet light will be on when the door is open and off when the door is closed.

3. **Cabinet Mounting.** Mount cabinets as shown on the Plans or Standard Details.

4. **Ventilation.** Unless otherwise specified, provide ventilation as follows:

   a. On all cabinets housing controllers, mount a screened, rain-tight vent, 1-1/2 inches in diameter or larger, on the cabinet top.

   b. Provide screened or filtered inlet ventilation openings, equal to or greater in area than top vents, located in the bottom or lower back side of Type I and II cabinets or around the lower 8 inches portion of Type III cabinets.

   c. Construct the vents so as to project within the cabinet no more than necessary to provide for lock nuts and gaskets to retain the vent.

   d. Locate vents so as to not interfere with the mounting of controller equipment.

5. **Cabinets with Exhaust Fans.** Exhaust fans shall consist of an electric fan with ball or roller bearings and a capacity of at least 100 cubic feet per minute. Mount the fan in a rain-tight housing attached to the top of the controller cabinet.

   The fan shall be controlled by a thermostat having a temperature differential between turn-on and turn-off of 15 °F (-0, +5 °F), adjustable for turn-on through a minimum calibrated range of from 100 °F to 150 °F.

   Whenever a fan is to be installed, provide the air inlet filter and filter holder shown in the Standard Details, or approved equal. Internally seal other air inlets. Provide exhaust fans in all cabinets that house controllers, with the exception of flasher controllers.

6. **Auxiliary Equipment.** With the exception of cabinets used in special applications (Type I and II), provide all cabinets with the following:

   a. Substantial shelves or brackets to support controller and auxiliary equipment.

   b. Panel for terminals arranged for adequate electrical clearance. Panels should be located in the cabinet as described below:

- Detectors Lower left wall
- AC power Lower right wall

- Auxiliary/police switches Door
- Load switch bay Back wall

c. The cabinet shall include an LED light and GFI duplex receptacle which can be used when the main circuit breaker is off.

d. Control panel assembly consisting of:

1. Power supply connections made to a 30-ampere circuit breaker mounted on the cabinet separate from the signal terminal panel. The circuit breaker shall be a magnetic trip type, having an interrupting capacity of at least 2,000 amperes at 125 volts AC. The circuit shall trip between 101% and 125% of rated load, with an inverse time delay characteristic provided. Instantaneous tripping shall occur at ten times the nominal rating. All controllers shall be internally fused.

2. Service line surge protection.

3. Electrical service termination point sized to accept No. 4 AWG copper wire.

4. Ground fault receptacle.

5. Porcelain lamp receptacle to accept a standard traffic signal lamp. If LED lenses are utilized, the shall be dimmable and switchable to reduce glare at night time. ~~(if necessary).~~

6. Circuit breakers in accordance to the National Electric Code for:
   (a) Main power input to provide all power associated with normal operation.
   (b) Flasher power input to provide all power associated with flash operation.
   (c) Service power to provide power for the lamp and duplex receptacle and cabinet light.

7. Copper ground bus (minimum of 12 positions).

e~~d~~. Flasher mechanism independent of controller. The cabinet shall be wired for and include a NEMA flasher mounted on the back panel. All cabinets shall have a two-circuit flasher. The flasher shall have output indicators mounted on the front of the flasher case and shall be rated at a minimum of 15 amperes.

f~~e~~. General purpose relays, where required to perform specified functions. All relays external to the controller or appurtenances shall meet NEMA standards. In addition:
- Flash transfer relays shall be of heavy-duty type and have a minimum contact rating of 10 amperes. Contacts shall be of silver material to reduce contact pitting.
- Unless otherwise specified, each cabinet shall include six (6) flash transfer relays.
- Flash transfer relays shall support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

g~~f~~. Type II, III, IV, and V cabinets, when specified as housing for traffic actuated controllers, with two or more insulated terminal blocks mounted within the housing, one or more for terminating each field wire.

h~~g~~. A minimum of 12 available bare ground positions tied to AC Common Return.

~~h~~i. Earth (driven) ground tie point to terminate a single No. 4 AWG copper ground.

~~i~~j. A tie point to tie all ground systems within the cabinet to a single reference point. All grounds (AC - return, Chassis, and Logic Ground) must be referenced to a single ground point at the electric service.

~~j~~k. A panel (police subpanel) ~~behind the auxiliary door~~ shall contain the following ~~switches~~:

1. A main power switch, which shall be wired to remove all cabinet power when in the Off position

2. An Automatic Flash switch, which shall be wired as follows:

   (a) The Flash position shall cause the cabinet to provide Flash Operation. The controller shall continue to operate, and Stop Time shall be applied to the controller.
   (b) Auto/Manual switch to activate Manual Control Enable.
   (c) Manual control pushbutton switch with self-coiling cord. Cord shall attach to a 2 position terminal strip via fork type connector

   (~~b~~d) Upon return from Flashing to Automatic, the controller shall initialize in the Start-Up Display condition as programmed in the controller, typically major road phases. ~~This display, unless noted otherwise, shall be Green for the Artery phase(s).~~

3. A panel mounted inside the main door shall contain the following switches:

   (a) A technician Stop-Time switch to apply Stop Time to each controller ring.

   (b) An Interval Advance switch, enabled only by the Stop Time switch, to be momentary pushbutton switch to apply Interval advance to the timer.

   (c) A Signal On-Off switch, which shall remove the AC power applied to the signal heads for normal operation while the controller continues to operate.

   (d) Individual phase vehicle and pedestrian detector test switches to be miniature toggle of the On-Off Momentary type to place:
      i. No Call - Call provided by detectors
      ii. Locked detector call
      iii. Momentary detector call

   Insulate or shield switch terminals on back of main cabinet door so that no live parts are exposed.

   Leads from the terminal block to the auxiliary door switches shall be no less than No. 18 AWG stranded, with TW plasticized polyvinyl chloride or nylon insulation enclosed in an insulating loom, and shall be of sufficient length to allow full opening of the main cabinet door.

~~k~~l. ~~Wire the cabinet according to the following:~~

~~1. Wire four phase controllers for four vehicle phases, two pedestrian phases, and two overlaps. Include eight NEMA load switch bases per cabinet.~~

~~2. Wire eight phase controllers for eight vehicle movements, four pedestrian phases, and four overlaps. Provide twelve NEMA load switch bases.~~

The cabinet shall be wired with the appropriate number of load switches to accommodate vehicular and pedestrian phasing according to plans. At a minimum cabinets shall include 16 load switch bases. The load switch wiring shall support Flashing Yellow Arrow for Permissive Left-turn Movement applications.

m. All cabinet wiring shall be neatly routed and labeled, laced and permanently secured. All cable shall be secured to the panel, where practical. There shall be no holes drilled through the cabinet walls to mount panels or secure cables.

n. All terminals in the cabinet shall be of the barrier type. The following field connector terminals shall be provided:

- Four (4) signal output positions per load switch bay (R-Y-G-FL).
- Ten (10) positions per phase for vehicle loop detector harness.
- One position per phase for pedestrian detector inputs.

o. Cabinets shall have SDLC communication between the controller, MMU, Detector Rack, Radar Detector (if applicable) and Video Detection (if applicable).

p. Cabinets should have an electrical outlet (Non GFI) that has 120 VAC from the OUTPUT side of the Main Power Surge unit.

q. Cabinets shall support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

r. All cabinets shall be supplied with a Malfunction Management Unit (MMU) and shall meet at a minimum, the following requirement:

NEMA TS2 Malfunction Management Unit ..... NEMA TS 2 2016

The manufacturer must supply certification of the conformance to the above requirements at the time of the bid.

According to NEMA TS2 the MMU shall be able to detect the presence of voltage on conflicting on conflicting field connection terminals, the absence of proper voltages on all the signal field connection terminals of a channel, and shall be capable of monitoring for the presence of satisfactory operating voltages within the Controller Unit (CU) and the MMU itself. The MMU shall be able to operate as a Type 16 with sixteen channels or as a Type 12 with twelve channels (compatible with NEMA TS1 cabinets.

The MMU should have an Ethernet port.

~~l. Supply all cabinets with a Signal Conflict Monitor (SCM) that meets the NEMA standards. The SCM for all controller cabinets with three or more phases shall be the 12 channel type, and shall have the following features:~~

~~1. Liquid Crystal Display to show all data in English language format.~~

~~2. Capability to monitor all Green/Yellow/Red/Walk field display outputs.~~

~~3. Capability to monitor the Controller 24 VDC output and be user programmable to have this monitor function Latch On.~~

~~4. Capability to monitor the Controller Voltage Monitor output, and be user programmable to have this monitor function Latch On.~~

~~5. Per Channel monitoring of Phase Yellow Clearance Interval, and shall cause flash operation if Yellow Clearance is less than the SCM programmed time (2.7 - 9 seconds).~~

~~6. Front panel mounted over current protection (no internally mounted fuses are acceptable).~~

~~7. Front panel mounted reset switch.~~

8. Fault logging features - the SCM shall log all faults as to the:

(a) Date of fault

(b) Time of fault

(c) Fault condition

(d) Power failure

and store these fault conditions in no volatile memory for user retrieval. The monitor shall be able to store at least ten such faults. The internal time clock shall automatically adjust for Daylight Savings Time changes. There shall be a keyboard method for the user to display and clear the stored event log.

9. There shall be an RS-232 port on the SCM to allow the user to print all data stored in the SCM. The printer shall interface with the SCM via a standard RS-232 cable. Printer to be supplied by others.

10. The SCM shall detect the following conditions and place the cabinet in the flash mode by De-energizing the Flash Transfer Relays:

(a) Absence of an active AC input on a channel

(b) Green/Yellow both active on a channel

(c) Yellow/Red both active on a channel

(d) Green/Red both active on a channel

(e) Green/Green active on conflicting channels

(f) Green/Yellow active on conflicting channels

(g) Green/Walk active on conflicting channels

(h) Low 24 VDC sample

(i) Controller Voltage Monitor active

(j) Clearance time less than programmed

11. On circuits where all field outputs are not used (such as left turn phases), unused circuits shall be terminated at a load resistor and the monitor plus features shall function.

12. No functional field display shall be permitted unless monitored by the SCM.

13. Terminate the SCM sampling inputs at the closest tie point to the field termination.

Enhanced Operational Features. When shown on the Plans, or specified in the Special Provisions, supply certain enhanced operational features of controllers. When required, these inputs and outputs shall be accessed to the controller by a dedicated fourth (or "D" Connector). Provide a connector of a type as determined by the manufacturer, and that meets the following requirements:

a. This connector shall not be mateable to any other connector in the cabinet.

b. All operating voltages in this connector shall be NEMA DC level voltages.

c. No special operating features shall enter or exit the controller on any NEMA pin designated as "Spare" or "Future."

d. When the "D" connector is not connected to the controller, the cabinet facility shall operate as a standard NEMA cabinet facility with no operational loss of standard NEMA features.

e. If the "D" connector is used as the input source for Pre Emption operation, wire the cabinet facility so that the cabinet facility will NOT perform any operation other than FLASH unless the "D" connector is terminated at the correct termination point and all cabinet features including Pre Emption are operational.

TRAFFIC ACTUATED CONTROLLERS

730.26 Traffic Actuated Controllers

The controller mechanism shall meet or exceed the current NEMA Traffic Signal Systems Standard. Provide Standard A, B, and C Connectors. Submit private laboratory certification that the proposed unit is in complete compliance with the NEMA standards in effect at the time of the advertisement for bids.

The controller shall have all timing values entered via a front panel mounted keyboard. This keyboard shall be an integral part of the controller unit.

Each controller shall have all operating timing parameters as specified in NEMA on a per phase basis, including all Volume/Density features. Each phase shall have a defeatable Last Car Passage feature wherein the last vehicle receiving the Phase Green shall receive at least one full Passage Time increment.

The controller shall have all of the following keyboard entered values or parameters:

1. Start on condition of the controller where the user can select via the keyboard the following:
a. Phases to start in
b. Phase display to be on
c. Overlap display start on condition
d. Normal start up display shall be mainstreet green phase(s), with concurrent overlaps green

2. Phase recall functions:
a. Non lock detector
b. Lock detector call
c. Minimum recall
d. Maximum recall
e. Pedestrian recall
f. Non actuated phase
g. Phase not active, phase omitted
h. Pedestrian phase omitted

3. All phase interval timing values except the Phase Yellow Clearance shall be as per NEMA. Each controller phase Yellow Clearance Interval is 3 seconds as a minimum.

The controller shall have a back lit liquid crystal display for each ring of the controller to provide an English language menu for programming with displays for programming or reading all controller features. The dynamic displays for real time operation shall be able to display the following values for each ring or phase(s) concurrently:

1. Per Phase Display:
a. Phase Vehicle Call

~~b. Phase Pedestrian Call~~
~~c. Phase is Next In Service~~
~~d. Phase is In Service~~
~~e. Phase Pedestrian Intervals in Service~~

~~2. Per Ring Display:~~
~~a. Ring Gapped Out~~
~~b. Ring Maximum Green Termination~~
~~c. Ring was Force Off Terminated~~
~~d. Ring Maximum Green II in effect~~
~~e. Ring Phase in Service Operating:~~
~~i. Lock Call~~
~~ii. Non-Lock Call~~
~~iii. Minimum Recall~~
~~iv. Maximum Recall~~
~~v. Pedestrian Recall~~
~~vi. Non-Actuated Mode~~

~~3. Per Ring Display of Timing Values (Real Time). The following values shall be selectively displayed and shall display the current value in a real time mode.~~
~~a. Minimum Green Interval~~
~~b. Passage Timer~~
~~c. Pedestrian Interval Timing~~
~~d. Maximum Green Timer~~
~~e. Time Before Reduction Timer~~
~~f. Time to Reduce Timer~~

~~It shall be possible to inspect and alter any currently programmed value while the controller is in operation without affecting the field operation. The controller shall continue to operate the intersection as values are inspected or altered.~~

~~The controller shall store all operator entered data in EEPROM devices that require no battery to support value storage. No internal components of circuitry shall require battery support.~~

~~The timer shall have a front panel mounted RS-232 connector to allow the user to print a hard copy of all programmed data to a standard serial printer. The printer shall use a standard RS-232 connecting cable. Printer to be supplied by others.~~

730.27 Auxiliary Equipment for Traffic ~~Actuated~~ Signal Controllers

Furnish and install the following auxiliary equipment in each cabinet for traffic actuated controllers.

A. Load Switches

Provide each cabinet complete, with the necessary number of NEMA load switches and Flash Transfer relays necessary to effect the specified signal sequence and phasing. Load switches shall:

1. Meet NEMA standards.

2. Have front-face mounted LED indicators to indicate the “On” condition of both the Input and Output circuits.

3. Use replaceable “cube” type circuitry or encapsulated discrete component construction. No unencapsulated discrete component construction are acceptable.

B. Time Clock Switches

Where shown on the Plans, provide time clock switches of solid state circuitry, continuous duty, with a 7-day cycle clock operating from the 120-volt AC service line. Provide switching for a minimum of one independent output and ensure the time of day selection is adjustable to within 1 minute of the desired time. Provide a battery backup system that can maintain time keeping and memory a minimum of 24 hours after power interruption. Furnish an omitting device as an integral part of the time switch to allow the switching operation to be skipped for any preselected day or days of the week. The time clock shall automatically compensate for daylight savings time changes. When the time clock is supplied as an internal component of the controller, supply the clock feature to provide for the selection of Maximum Green II on time of day, day of week, week of year basis. Time clocks shall meet NEMA environmental specifications.

When required in the traffic signal plans, the auxiliary equipment listed below shall meet the following requirements:

A. Uninterruptable Power Supply (UPS) – An UPS shall power the traffic signal cabinet in the event of a power failure for a minimum of 3 hours.

UPS assemblies should include off-the-shelf deepcycle AGM batteries.

Loss of utility power, transfer from utility power to battery power, and transfer back to utility power must not interfere with normal operation of connected equipment. In the event of UPS failure or battery depletion, connected equipment must be energized automatically upon restoration of utility power.

Removal and replacement of the UPS must not disrupt the operation of the equipment being protected.

All harnesses necessary to connect and operate the system must be included. All connectors must be keyed to prevent improper connection.

UPS assemblies shall be installed in accordance with the manufacturer's recommendations.

An UPS operation and maintenance manual shall be provided in the cabinet where the UPS is installed with cabinet wiring schematics, electrical interconnection drawings, parts layout and parts lists.

The UPS shall include a manufacturer's warranty covering defects for a minimum of three years (5 years for the external batteries) from the date of final equipment acceptance. The warranty must include provisions for providing a replacement UPS within 10 calendar days of notification for any UPS found to be defective during the warranty period at no cost to the maintaining agency.

B. Communications - Wireless - consist of installing a Wireless Network Communications Link with all necessary hardware in accordance with the plans and standard drawings to provide a data link between field devices (i.e. Traffic Signal Controllers).

Each link shall consist of Master ODU (Out Door Unit, Antenna) connected to a data switch within one of the signal cabinets and a Slave ODU connected to a data switch within the other signal cabinet. Each ODU is aligned to face the opposing ODU. The cable length between the ODU and its associated data switch may not exceed 300 feet.

The Wireless Network Communications Link components at each of the linked traffic signal cabinets shall include an ODU, a LPU (Lightning Protection Unit), power supply mounting hardware, and CAT 5e cabling. The ODU is pole mounted per manufacturer's specifications. The LPU and power supply are mounted within the traffic signal cabinet. CAT 5e cable is installed between the ODU and LPU.

For the applicable frequency spectrum of the radios being deployed, perform a spectrum analysis to ensure no competing equipment in the area. Ensure the radio path site survey test is performed using the supplied brand of radio equipment to be deployed. Typically, if the ODUs can be mounted with clear line of sight between them, this is sufficient to ensure proper operation. If this is not possible, it may be determined that a repeater station is necessary to complete the intended link. Provide the test results to the ENGINEER for review and approval. Submit copies of the test results and colored copies of the frequency spectrum scan along with an electronic copy of this information. The ENGINEER will approve final locations of the ODUs and any necessary repeater stations.

Install each ODU in such a manner that avoids conflicts with other utilities (separation distances in accordance with the guidelines of the NESC) and as specified in the ODU manufacturer's recommendations. Secure the ODU mounting hardware to the pole and route the CAT 5E cable such that no strain is placed on the RJ-45 connectors. Align each antenna/radio to be perpendicular to the ground (using bubble level) and to face the opposing radio.

C. Fiber optic cables - Multi-mode type fiber optic cable shall be 50 µm core diameter, with at least 12 fibers per cable unless otherwise specified in the plans. Single-mode type cable shall be between 8-9 µm core diameter, with at least 12 fibers per cable unless otherwise specified. A fiber optic drop cable shall be a minimum of 6 fibers (each type) and be spliced into the trunkline in a splice enclosure either aerially or in a pull box. ~~Contractor shall provide~~ 50ft. of slack shall be provided, either lashed to a span aerially, or coiled in a pull box for underground installations. Termination panels shall be provided with sufficient size to provide for a neat installation, and enough panel space to accommodate the specified number of fibers for termination. ST connectors shall be used unless otherwise specified. A~~Contractor shall provide a~~ny necessary jumpers shall be provided for installed equipment.

MISCELLANEOUS TRAFFIC~~FLASHING SCHOOL~~ SIGNALS

730.28A Flashing School Signals

When shown on the Plans, provide flashing school signals that conform to the following:

1. The signal shall produce two alternate flashing lights within the marginal limits of a school speed limit sign. Details of the sign construction shall be as shown on the Plans. Sign colors shall conform to the MUTCD and be constructed of materials complying with these specifications.

2. The two LED lenses shall be yellow in color and a minimum of 8 inches in diameter. The LED lenses shall be part of a weather-proof and water-tight optical unit. The LED lenses shall meet the same requirements for vehicular signal head LED lenses. Mount the lenses in the sign using a molded endless rubber gasket with the sign being mounted to the signal case. ~~The reflector for the round lens shall be glass and firmly mounted between the lens assembly and the case so as to produce a weather proof and water tight optical unit.~~

3. Provide a two circuit type flasher unit to provide alternating equal on-off operation. The flashing mechanism shall produce between 50 and 60 flashes per minute through two 120-volt, 60-cycle AC, 15-ampere circuits. The flasher shall be of solid state construction.

4. Wire the unit for external circuits.

5. The signal shall be actuated by time switch meeting **730.27**. Locate the timing device in a remote mounted control cabinet.

6. Where an illuminated speed limit indication is shown on the Plans, the numeral message shall be illuminated in Portland Orange in a rectangular lens and illuminated only during the period when the signal produces two alternately flashing amber lights.

In addition, the Time Clock Unit/Switch used for Flashing School Signals shall be a programmable module that allows a user to define the time and day that the school speed zone flasher assembly will initiate and terminate flashing operation. The module shall be installed within the pole-mounted signal cabinet provided as part of project. The time clock shall be compatible with the cabinet's wiring relays and termination panels and the battery power supply system. The time clock switch provided shall also have the following features/capabilities outlined below:

1. Daylight Savings Time shall be a user-programmable setting, in addition to having automated compensation per TDOT specifications.

2. The unit shall provide a minimum 12-character, multi-line alpha-numeric LCD back-lit display capable of displaying all programming parameters.

3. The unit shall be capable of being programmed manually (using an integral keyboard pad) or programmed externally using an optional software program via a laptop computer and cable connection (compatible software program is a separate and distinct item from the time switch unit, and if required, will be separately specified and noted in list of estimated project quantities).

4. Unit shall provide automatic Leap Year compensation.

5. The time clock switch shall be capable of up to minimum 24-hours of capacitive back-up operation, 48 hours desirable, in the event of power interruption.

6. Unit shall be compatible with the supplied solar powered power system / battery unit

7. Time clock switch shall be capable of being programmed for one (1) Normal / Main program, and an additional minimum of 12 Exception periods /programs allowing holiday, vacation and custom skip plans. The exception programs will allow for the Normal / Main program to be skipped or allow for flasher operation on alternative schedules (i.e. early release days, summer school, etc).

8. Unit shall conform to TDOT standard specification subsection 730.27 – Auxiliary Equipment for Traffic Actuated Controller – Time Clock Switches except as superseded herein.

9. Unit shall have non-volatile program memory to allow retention during power loss.

~~730.28B Solar Power Flashers~~

730.28B-Solar Power Flashers. When required, the solar power flasher equipment listed below shall meet the following requirements:

1. Solar panel and mounting equipment shall be installed on cantilever pole shaft as illustrated on layout detail sheet and as directed by manufacturer instructions.

2. Solar power unit assembly shall include all required mounting equipment, wiring/cables, battery supply, battery charging unit and other ancillary equipment necessary to operate the solar panel and properly charge the battery. The photovoltaic array shall include mounting bracket assembly to permit adjustment of the array to optimal sun exposure. The photovoltaic module shall be mounted and aligned per manufacturer recommendations to maximize solar exposure.

3. Battery unit shall meet manufacturer specifications required to operate and power L.E.D. signal displays and continuous time clock switch operation. Battery shall be compatible with cabinet equipment, including the time clock switch and the flasher signal displays. Battery unit shall meet minimum environmental and performance specifications required for system operation as recommended by solar panel and time clock switch manufacturers.

4. Solar panel and battery supply shall be of a size and power rating necessary to provide required power to time switch clock and flasher signal displays. O~~The contractor shall o~~btain the power load requirements from the solar power equipment manufacturer and provide as required. On a typical school day, it should be expected that the flasher system will operate up to four (4) hours per day with the time clock continuously operating to maintain its clock timer. P~~Contractor shall p~~rovide a solar system sizing report from the manufacturer indicating the power supply requirements of the proposed system required to meet the expected power demand.

5. The photovoltaic modules shall be warranted for a minimum of five (5) years from date of installation.

6. The battery system shall be a gelled-electrolyte type battery with capacity to provide a minimum of five (5) days continuous operation of the flasher assembly without charging. Batteries shall be field replaceable. Batteries shall have prorated warranty of a minimum of five (5) years from date of installation.

730.28C Portable Traffic Signals

Portable Traffic Signals (PTS) consists of furnishing, installing and configuring a complete PTS system that may be used in construction zones or in other temporary signal locations. The work will be at various sites throughout the state of Tennessee and will consist of providing all labor, materials, equipment and incidentals necessary to make functional the PTS in accordance with these specifications.

The PTS shall be trailer or cart mounted units that provide for easy transportation and quick setup and deployment. There shall be 2 unit options and each unit shall be self-contained.

1. Type 1 units are typically used for long term projects (i.e. projects 5 days or longer in duration) and shall include 2 signal heads per trailer with an upper signal head mounted on an overhead mast arm that can be extended over the travel lane, and a lower signal head mounted on the vertical upright of the trailer.

2. Type 2 units are typically used for short term projects (i.e. projects 4 days or shorter in duration) and shall include 1 signal head that is mounted on the vertical upright of the trailer or cart. Cart-mounted units shall be successfully crash tested to NCHRP 350 TL-3, or equivalent MASH standards. If the project duration is extended beyond 4 days, then Type 1 units should be substituted in lieu of the Type 2 units for all PTS within the signal system.

The PTS shall be MUTCD Compliant and utilize standard ITE signal heads, and adhere to the ITE Specifications and Standards for Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Circular Signal Supplement. The unit shall be solar powered and communicate via a wireless or hardwire connection. The unit shall include all the major components listed below or be able to perform the functions of these components. The major components of the unit shall include but are not limited to the trailer or cart, telescoping mast arm (on Type 1 units only), signal head(s) and back plates, traffic signal controller with operating software, solar charging system with batteries, input and output devices, flasher units, conflict monitor, relays, communications system and other equipment required for the safe operation and installation of the unit.

The PTS signal heads and all applicable components of the PTS shall meet the physical display and operational requirements of conventional traffic signals as specific in the MUTCD.

1. For Type 1 units, each unit shall contain 2 signal heads with an upper signal head mounted on an overhead mast arm that can be extended over the travel lane with a minimum clearance of 17 feet measured from the bottom of the signal head unit to the road surface. The lower signal head shall be mounted to the vertical upright of the trailer at a minimum height of 8 feet from the bottom of the signal head unit to the road surface. The signal heads shall also include black back plates that can be easily removed. The signal heads shall have the ability to be rotated 180 degrees to face in the opposite direction and shall have the ability to rotate and lock in approximately 10 degree increments to position the signal head for the optimum visibility to motorists.

2. For Type 2 units, the signal head of the unit shall be mounted to the vertical upright at a minimum height of 8 feet from the bottom of the signal head unit to the road surface. The signal head shall also include black back plate that can be easily removed. The PTS shall be easily rotated to position the signal head for optimum visibility to motorists.

The PTS shall include a solid-state controller with operating temperature range of -40ºF to +180ºF and compliance with NEMA TS-5 Performance Standard. The controller or programming module shall have an easy to read front panel indicator display. The display shall be backlit and have the capability to facilitate programming and display the currently operating program for each vehicular approach. The controller shall be capable of operating the PTS

system in a fixed time, traffic actuated, or manual control mode. Each PTS in a connected system shall have the capability to serve as either the master or slave signal. Each PTS shall include a Conflict Monitor Unit (CMU), or Malfunction Management System (MMS) to ensure phase conflicts do not exist during operation.

1. A minimum of 5 automatic time-of-day timing plans within a 24-hour period should be available in fixed time mode. The operating system should have the ability to control a minimum of 4 traffic phases with programmable cycle time adjustments and user adjustable red, amber, minimum green and maximum green times. The operating system shall also have the capability of facilitating standby modes of red, red flash and yellow flash.

2. The system shall also have the ability to operate in vehicle actuation mode when vehicle detection detectors are used. The operating system shall have the capability to allow the PTS to be connected to and controlled by a standard NEMA controller.

3. The system shall have the capability to be configured and controlled remotely using a handheld wireless remote control with the capability of being operated at a distance up to ¼ mile from the master.

4. The system shall have the capability of remote monitoring for reporting, at a minimum, signal location and status, battery voltage and system defaults. The remote monitoring shall have capability to alert designated individuals if a fault condition occurs.

5. The operating system shall include password protection to prevent unauthorized programming.

The PTS shall communicate with all other PTS within the signal system via license-free wireless 900 MHZ radio link communications. The radio units shall maintain communications at a minimum distance of 1 mile. The radio system shall conform to the applicable Federal Communications Commission (FCC) requirements, including FCC 90.17, and all applicable state and local requirements. The PTS shall be in direct communication at all times either by wireless or hardwire connection to provide for the required conflict monitor.

The system shall also have the ability to operate in vehicle actuation mode when vehicle detection detectors are used. For Type 1 units, the PTS detector shall be a high-definition, multi-beam, microwave radar stop bar detector for each vehicular approach. The Type 1 radar detector shall have a minimum range of 140 feet and shall be mounted at a minimum height of 17 feet measured from the top of the road surface. For Type 2 units, the PTS detector shall be a radar detector for each vehicular approach. The Type 2 radar detector shall have a minimum range of 140 feet and shall be mounted and have complete radar detection functionality at a minimum height of 8 feet measured from the top of the road surface.

The PTS shall be equipped with a solar power array, charging unit and battery system. For Type 1 units, the number and size of batteries shall be sufficient to operate the signal for a minimum of 21 days at 70 degrees without additional charging or assist from the solar array. An on-board battery charger shall be compatible with both the solar array and with a 120V AC power source. The solar panel array shall provide for a minimum of 440 watts of solar collection capability. For Type 2 units, the PTS shall have batteries sufficient to operate the signal for a minimum of 5 days at 70 degrees without additional charging or assist from a solar array. All instrumentation for the electrical system and battery compartment shall be mounted in a lockable weatherproof enclosure. Solar panels shall be secured to the mounting brackets for theft prevention. All wiring for the unit shall be protected against weather and damage.

The trailer or cart, and all mounted components, shall conform to the wind loading requirements (90 mph minimum) as described in the AASHTO Standard Specifications for Highway Signs, Luminaries and Traffic Signals. The wind load calculations shall be completed by an independent third-party contractor, and stamped by a U.S. Registered Professional Engineer. The trailer or cart shall be made of structural steel and shall include 4 leveling/stabilizer jacks capable of lifting the trailer or cart a minimum of 6 inches. The trailer or cart shall be equipped with a hydraulic or electric lift system sufficient for 1 person to be able to raise and lower the vertical upright and/or horizontal mast arm to and from the operating position. For Type 1 or 2 units, the trailer or cart shall be equipped to provide legal and safe transport on the public highway system at speeds up to 55 mph. All exterior metal surfaces,

except signal heads and back plates, shall be powder-coat painted highway safety orange.

The PTS work shall meet the following general contractor requirements:

1. Be responsible for locating the PTS in the appropriate location based on MUTCD and ITE standards for visibility to motorists and for safe operation.

2. Be responsible for providing all hardware, software, communications equipment and licenses to operate a complete PTS system.

3. Be responsible that all PTS equipment is installed according to the manufacturer's recommendations including wireless or hardwire connections.

4. Be responsible for transport, setup, configuration, operation and monitoring of the PTS throughout the entire project. The Engineer shall approve all timing and settings that are used for operation of the signal.

5. As directed by the Engineer, it may be necessary to relocate the PTS during the project. The cost of the relocation shall be included in the PTS price bid.

DETECTORS

730.29 Detectors

Provide detectors, of the type shown on the Plans, to actuate signal phases of traffic actuated controllers. Provide ample lightning protection to provide effective defense against high transient voltages caused by lightning discharges or from other sources. The lightning protection unit must withstand repeated 400-ampere surges on a 9 x 20 microsecond waveform. Also, the unit must be a two-stage device capable of clamping a minimum of one hundred 300-ampere surges to 25 volts within 40 nanoseconds for surge applied across the two detector leads.

A. Inductive Loop Detection~~ors~~ System

~~Loop amplifiers shall be of the single-channel, totally self-contained type, using a standard 10-pin MS connector (MS3102A 18P) and designed to operate within the NEMA environmental standards. All loop amplifiers shall be of the type to provide both "Extended" and "Delayed" outputs.~~ Inductive loop detector units (loop amplifiers) shall meet at a minimum, the following requirement:

NEMA TS2 Inductive Loop Detector Units ..... NEMA TS 2 2016

Loop amplifiers may be single or multi-channel and shall be of the totally self-contained type.

All loop amplifiers shall be of the type to provide both "Extended" and "Delayed" outputs.

The loop detector amplifier shall be full automatic, requiring no adjustments to effect operational ability other than setting of the operating frequency and sensitivity. The amplifier shall:

1. Sense any legal motor vehicle traveling at speeds up to 65 miles per hour.

2. Have both a "Pulse" and "Presence" Output:
   a. Pulse output shall generate an output of 125 ±25 millisecond output for each vehicle entry.
   b. Presence output shall provide a continuous output for up to 60 minutes as long as a vehicle is within the detection zone.

3. Provide at least four user selectable sensitivity ranges.

4. Be supplied with at least three frequency ranges for crosstalk minimization.

5. Have a front-face mounted indicator to indicate active output of the internal relay. This indicator shall indicate the presence of:
   a. Normal Output
   b. Delayed Output
   c. Extended Output

6. Have a front-panel mounted "Reset" switch that when pressed shall cause the unit to completely re-tune itself.

7. Have Delayed or Extended timing features with the following ranges:
   a. Delayed output of 0 to 30 seconds in 1-second increments.
   b. Extended output of 0 to 10 seconds in 1/4-second increments.

8. Have internal diagnostics to determine the operational ability of the loop. These diagnostics shall determine if a loop is opened or shorted, and shall provide a visible indication of such condition. Additionally, if such a condition occurs, the amplifier unit shall default to a "constant" output.

9. Provide output by a mechanical relay, which shall be "off" to provide an output.

10. Have all delay functions wired to the associated plan phase green to inhibit that function during controller phase green.

11. Be able to operate with loop lead-in lengths of at least 2,000 feet.

Comply with the details of the detector loop installation as shown on the Plans or Standard Drawings.

B. Video Detection System (VDS)– when specified in the plans, the equipment shall consist of all items necessary to provide a complete functional video detection system that process images and provide detection outputs to the traffic signal controller.

VDS shall be capable of NEMA TS2 operation.

VDS shall be waterproof and weather resistant.
VDS shall provide user-defined detection zone programming via a graphical user interface (GUI) and any necessary equipment for future programming. The configuration database shall have the ability to be stored on a removable data storage external to the video card,
VDS shall display programmable detection zones and detection activations overlaid on live video inputs. It shall detect vehicles in real time as they travel across each detection zone.
VDS shall have a minimum of 24 programmable detection zones per camera.
VDS shall be capable of:

1. shadow rejection without special hardware;
2. non-impaired operation under light intensity changes;
3. maintained operation during various weather conditions (e.g. rain, fog, snow)
4. anti-vibration, 5% rejection based on image change;
5. ability to select direction of flow parameters;
~~1.~~6. ability to properly detect directionally;
~~2.~~7. ability to configure presence, pulse, extend and delay outputs;
~~3.~~8. ability to set up a minimum of six detection zones per camera view to count the number of vehicles detected and store the information for retrieval;
~~4.~~9. variable focus providing a minimum of 4 to at least 40 degree horizontal field of view;
~~5.~~10. store detection zones in non-volatile memory;

VDS shall have no splices between the processors and the cameras.
VDS shall provide LED indicators to show active detection.
VDS camera shall have an internal heater to assure proper operation of the equipment during low temperatures.
VDS shall have surge ratings as set forth in NEMA specifications.
VDS shall have a two-year warranty and updates of all software shall be available without charge during the warranty period.

C. Radar Vehicle Detection System (RVDS) – when specified in the plans, the equipment shall consist of all items necessary to provide a complete functional RVDS~~radar vehicle detection system (RVDS)~~ that process high-definition, multi-beam radar electromagnetic waves and provide detection outputs to the traffic signal controller.

RVDS shall be capable of NEMA TS2 operation.
An RVDS ~~RVSD~~ shall consist of the following components: Radar sensor (1), detector rack interface module (1) power and surge protection panel or module (1) (cabinet interface devices that combine one or more of the above components shall be acceptable as well), and all associated equipment required to setup and operate in a field environment including software, serial and ethernet communication ports, cabling, electrical connectors and mounting hardware.
The RVDS~~RVSD~~ shall be able to operate in all types of weather conditions including: rain, snow, sleet, ice, fog and windblown dust.
Lightning and surge protection will be provided for power connections and communications links to the radar RVDS~~RVSD~~.
The RVDS~~RVSD~~ shall provide a "fail safe" operation that triggers when communication between the radar vehicle sensor and the interface module is broken. Contact closure from the interface module will occur on all programmed detector channels associated with the affected radar sensor when the fail safe is triggered and will remain in this state until communication is re-established between the interface module and the radar vehicle sensor.
The RVDS~~RVSD~~ shall comply with all applicable Federal Communications Commission (FCC) requirements. The manufacturer will provide documentation of compliance with FCC specifications.
The RVDS~~RVSD~~ shall maintain frequency stability without the use of manual tuning elements by the user.
The RVDS as a minimum must provide a minimum of 4 separate RF channels selectable by the user to avoid interference with other devices working on the same frequency.
The communication port(s) shall support a communication speed that will not introduce excessive latency between when a vehicle is detected and the contact closure in the traffic signal cabinet.
RVDS~~RVSD~~ interface modules that utilize the detector rack must operate at 12V or 24V DC. Shelf mounted interface modules must operate within a range of 89V to 135V AC, 60 Hz single phase. Power to the RVDS~~RVSD~~ radar sensor must be from the transient protected side of the AC power distribution system in the traffic control cabinet in which the RVDS~~RVSD~~ is installed.
RVDS~~RVSD~~ documentation shall include a comprehensive user guide as well as quick reference guide(s).
RVDS~~RVSD~~ shall have the ability to configure presence, pulse, extend and delay outputs.

D. Wireless Magnetometer Detection System (WMDS) - when specified in the plans, the equipment shall consist of all items necessary to provide a complete functional wireless magnetometer detection system that process changes to earth magnetic field and provide detection outputs to the traffic signal controller.

WMDS shall be capable of NEMA TS2 operation.
The WM~~V~~DS shall consist of the following components: In-pavement sensors, all wireless communication equipment needed to establish communication links to the controller cabinet, interface modules compatible with NEMA TS-2 V2.06b cabinet detector rack, surge protection for the WM~~V~~DS and system software for set-up and monitoring of the WM~~V~~DS.
The WM~~V~~DS must be capable of detecting a variety of vehicle types including motorcycles, automobiles and large trucks. The system must allow the user to select sensitivity levels that adjust the amount of hysteresis to the magnetic field needed to achieve contact closure to the assigned detector channel. Magnetometer sensitivity level adjustments must allow for different levels of vehicle detection.
WM~~V~~DS shall have the ability to configure presence, pulse, extend and delay outputs.

WM~~V~~DS equipment failure such as: the sensor, communications link, access point radio, repeater radio (if used) or interface module, shall result in constant vehicle call "fault state" on the affected detector channel to the traffic controller.
WM~~V~~DS detection accuracy must be comparable to properly operating inductive loops.
The WM~~V~~DS shall provide real-time vehicle detection (within 150 milliseconds (ms) of vehicle arrival). Once detection is achieved by the sensor, the traffic controller must receive contact closure to the assigned detector channel within the 150 ms time frame.
The WM~~V~~DS in-pavement sensor must operate on batteries without the need for underground power or communication cable connections to the unit.
The average operating life span of the sensor under battery power must be a minimum of 10 years.
The interface module must provide 2 or 4 detector channels. Sensors must be assignable to the available detector channels on the interface module using software provided with the WM~~V~~DS.
The front face of the module shall identify detector channel 1 and detector channel 2. Each must use an LED to indicate contact closure on the channel. When vehicle detection is achieved, the LED will be on and contact closure applied to the detector channel. During periods of no vehicle detection the LEDs will be in an off state and no contact closure will be applied to the detector channel.
The interface module will use an LED indication to indicate a "fault state" with the WM~~V~~DS. When the fault state is active contact closure will be applied to the appropriate detector channel.

~~B.~~E. Pedestrian Push Buttons

Where shown on the Plans, furnish and install pedestrian push buttons of substantial tamper-proof construction. They shall consist of a direct push type button and single momentary contact switch in a cast metal housing. Operating voltage for pedestrian push buttons shall not exceed 24 volts.

Provide a weatherproof assembly, constructed to prevent electrical shocks under any weather condition.

Where a pedestrian push button is attached to a pole, the housing shall be shaped to fit the curvature of the standard or post to which it is attached to provide a rigid installation.

Unless otherwise specified, install the push button and sign on the crosswalk side of the pole.

Pedestrian push buttons shall have a transient protection that meets NEMA specifications.

~~Magnetometer Detectors~~

~~Provide magnetometer detectors capable of being activated by a change in the magnetic field caused by the presence or passage of a vehicle within the lane of required detection at any speed from 0 to 80 miles per hour. The term "magnetometer detector" applies to a complete installation consisting of a sensing element or group of sensing elements installed in the roadway as shown on the Plans, lead in cable, and a control unit with power supply installed in a traffic signal controller cabinet or special cabinet as shown on the Plans.~~

~~The sensing elements shall be no larger than 2 inches in diameter by 4 inches high and shall contain no moving parts or transistors.~~

~~The control unit shall be an electronic device capable of providing closure of an output circuit when a vehicle stands over or passes through the magnetic field of the sensing elements connected to the input circuitry of the control unit. The output shall be electrically insulated from the sensing element and the electronic circuitry.~~

~~Each detector shall operate from a 120-volt, 60 hertz, AC supply. Operation shall be satisfactory at voltages from 110 to 130. In addition, the unit shall not be affected by normal powerline transients or by powerline voltage variations of plus/minus 10%.~~

~~The control unit for the magnetometer detector shall be designed for (1) permanent presence, (2) pulse presence, (3) presence counting of vehicles, or combinations thereof.~~

~~The permanent presence control unit shall signal continually the presence of any vehicle until the vehicle leaves the area of detection, where upon the vehicle signal shall immediately drop.~~

~~The pulse presence control unit shall provide one x 30 millisecond, plus/minus 10%, pulse for every vehicle entering the area of detection.~~

~~The presence counting control unit signal shall provide separate detection of each distinct traffic lane.~~

~~Each control unit shall have solid state circuitry, except for the output relay. House each unit in a control box. Furnish each control unit with an integral power supply. Each control unit shall be designed to provide ease of maintenance. All electronic components shall be easily accessible.~~

~~Calibrate the control unit with tuning controls.~~

~~Each detector shall provide positive vehicle detection without readjustment from -20 °F to +160 °F.~~

~~Mount all controls, pilot lights, meters, fuse holders, and connectors on the front panel of the control unit or the control power source assembly. Input power shall be fused.~~

~~When control unit and power supply components are mounted on insulating boards, printed circuit wiring may be used. Provide printed circuit boards designed to facilitate identification of components; provide either part identification markings or a pictorial diagram showing the physical location and identification of each component.~~

~~Place the sensing elements in holes cut in the roadway at the locations shown on the Plans. Make each hole large enough to accept a 2 inch diameter sensing element and to be 8 ± 2 inches deep. Make the holes vertical, regardless of the slope or grade of the pavement surface.~~

730.30 (Reserved)

730.31 (Reserved)

~~COORDINATION~~

~~730.30 Coordination~~

~~The following are the minimum design and operating requirements for all types of local coordinating units. The general design requirements apply to master coordinating units and secondary coordinating units; as a separate unit or internal to the controller; both dial electro mechanical, and digital full solid state. Local coordinating units provided for an interconnected signal system shall be completely compatible with the master controller and all local controllers in that system.~~

~~Use the coordinating units described herein in conjunction with solid state traffic actuated signal controllers and traffic adjusted master controllers. The coordinators shall inhibit the external extension limit in the local controllers and provide external maximum control. Background cycle lengths, splits, system offsets, and other coordination functions as required shall be called in by a master controller or coordinator. These functions may also be called in by local or master override or time switches.~~

~~Furnish coordinating units capable of at least the following:~~

~~1. Three background time cycles.~~

2. Three splits per cycle.

3. Three offsets per cycle.

4. Multiple and adjustable permissive periods for yielding to non-coordinated phases.

5. Force off capability for all non-coordinated phases.

6. Capability of generating as a minimum cycle lengths of 50, 60, 70, 80, 90, 100, and 120 seconds.

7. Master intersection control and supervision of other coordinating units as required.

8. Free operation when called for by the system master, time switch, or manual override.

It shall be possible to set offset splits and all synchronization functions from the front of the coordinating unit, and to make these settings in at least 1% steps to any percentage of the associated cycle length.

Absence or conflict of offset or cycle information on the interconnect shall place the coordinating unit in cycle number 1 (average offset) or a preset standby cycle.

730.31 Time Based Coordination Units

This Subsection covers traffic signal system time based coordination units of solid state design. Time based coordination units are used to control the timed relationship between intersections to maintain a system interconnect plan without the use of interconnect cable.

Background Cycle

Provide time based coordination units with at least three independently programmable background cycles. The background cycles shall be in fixed increments, not exceeding 1 second.

Offsets

Provide time based coordination units with at least three independently programmable offsets per background cycle.

Splits

Each split shall have at least six independently programmable force off points, one for each non coordinated phase. Provide two splits per background cycle.

Timing Requirements

Provide color or function coded time controls for programming the background cycle, offsets, force off points, and permissive periods. Timing of all functions shall be digital, with an accuracy of ±100 milliseconds from the programmed value.

Ensure that the minimum timing ranges and maximum increments of adjustment for the various timing functions meet Table 730.31-1.

~~Table 730.31-1: Timing Requirements~~

~~Function~~	~~Minimum Timing Range~~	~~Maximum Increment of Adjustment~~
~~Background Cycle~~	~~30 to 255 seconds~~	~~1 second~~
~~Offset~~	~~0 to 255 seconds~~	~~1 second~~
~~Force-off Points and Permissive Periods~~	~~0 to 99% of cycle~~	~~1% of cycle~~

~~The clock circuit of time based coordination units may use either the 60 hertz AC power source or a crystal oscillator as the timing reference. If a crystal oscillator is used as the timing reference, the frequency tolerance of the clock circuit shall be ±0.005%. The clock circuit of the time based coordination unit shall allow for setting to the nearest second.~~

~~Provide the time based coordination unit with a programmable feature that automatically changes from standard time to daylight savings time and vice versa.~~

~~**Battery Power**~~

~~Provide time based coordination units with a battery to power the clock circuit and memory for a minimum of 100 hours when the 120 volt AC power source is disconnected.~~

~~**Manual Override**~~

~~Time based coordination units shall be designed so that the programmed time of day function can be manually overridden to select a different function, such as cycle, offset, or splits.~~

~~**Indicator Requirements**~~

~~Time based coordination units shall provide the following minimum indications:~~
~~1. Time of day (hours, minutes, and seconds)~~
~~2. Day of week or calendar date~~
~~3. Outputs controlled by day program~~
~~4. Cycle count - indicates time in background cycle~~
~~5. Day program in effect~~
~~6. Week program in effect~~
~~7. Battery status~~

~~**Construction**~~

~~Time based coordination units shall be a built-in component to the controller.~~

~~**Data Transfer**~~

~~Time based coordination units shall provide transferring of all programmed data from unit to unit by using a data transfer cable. Supply a cable with each unit.~~

TRAFFIC SIGNAL SUPPORTS

730.32 Cantilever Signal Supports

This Subsection applies to the manufacture of steel poles and mast arms for the support of traffic signals. The height of poles, shaft dimensions and wall thickness shall meet the design requirements and mounting height of traffic signals as set forth in these Specifications and shown on the Plans. The Plans indicate bracket arm lengths.

Furnish poles consisting of a straight or uniformly tapered shaft, cylindrical or octagonal in cross-section, having a base welded to the lower end and complete with anchor bolts. All castings shall be clean and smooth with all details well defined and true to pattern. Steel castings shall conform to ASTM A27, Grade 65-35. Gray iron castings shall conform to ASTM A126, Class A.

All mast arms shall be compatible with the poles in material, strength, shape, and size.

A. Anchor Base

Secure an anchor base of one-piece cast steel or steel plate of adequate strength, shape, and size to the lower end of the shaft. Place the base so as to telescope the shaft, and weld at the top and bottom faces with continuous fillet welds so that the welded connection develops the full strength of the adjacent shaft section to resist bending action. Provide each base with a minimum of four holes to receive the anchor bolts. Provide cast steel bases with removable cast iron covers for anchor bolts and tapped holes for attaching covers with hex head cap screws.

Provide a welded frame handhole, 5 x 8 inches minimum and located with a clear distance above the base of no less than the pole diameter, "D". Weld a 1/2-inch 13 UNC grounding nut to the inside of the pole at a point readily accessible for wiring.

B. Shaft

Fabricate shafts from the best, hot-rolled basic open hearth steel. The shaft shall have only one longitudinal electrically welded joint and may have electrically welded intermediate transverse full penetration circumferential joints, at intervals of not less than 10 feet. The shaft shall be longitudinally cold-rolled to flatten the weld and increase the physical characteristics so that the metal will have a minimum yield strength of 48,000 pounds per square inch. Where transverse full penetration circumferential welds are used, the shaft fabricator shall furnish to the Engineer certification that: (1) all such welds have been radiographed and ultrasonically tested by an independent testing laboratory using a qualified Nondestructive Testing (NDT) technician and (2) the NDT equipment has been calibrated annually.

Fit the shaft with a removable pole cap, a J-hook wire support welded inside near the top, and a flange plate assembly to match that welded to the butt end of the mast arm.

C. Mast Arms

Provide mast arms fabricated and certified in the same manner as the upright shafts and that have the same physical characteristics.

The mast arms shall meet the design requirements necessary to support rigidly mounted traffic signals as shown on the Plans. All arms shall include a removable cap at the tip, grommeted wire outlets, and signal hanger assemblies of the type and number shown on the Plans, and a flange plate welded to the butt end to provide a rigid connection to the mast. The assembly shall be constructed so that all wiring can be concealed internally.

Connect mast arms to the upright pole at a height necessary to provide a minimum clearance of 16 feet 6 inches and a maximum clearance of 19 feet under the traffic signal heads. Install separate signal heads to provide the same clearance.

D. Finish

Galvanize steel poles, mast arms, and hardware in accordance with ASTM A123.

Galvanize all steel and cast iron components, hardware, and threaded fasteners, except anchor bolts, after fabrication in accordance with ASTM A123, or A153 or A385, as applicable.

730.33 Steel Strain Poles

Provide steel strain poles consisting of a uniformly tapered or equivalent upright shaft fitted with a removable pole top, J-hook wire support and 45-degree wire inlet near the top, a span wire clamp, a 5 x 8 inch handhole with reinforced frame and cover, bent anchor bolts, and all other accessories needed to make a complete installation. The pole and all of its component parts shall be designed to support tethered traffic signals of the type and number shown on the Plans, suspended from a span wire assembly. Fabricate and certify the poles as specified for the upright shafts in **730.32**.

Determine the shaft length required to meet field conditions and vertical clearances of signal heads over the roadway. The signal head clearance shall be a minimum of 16 feet 6 inches and a maximum of 19 feet. Fasten the span wire no closer than 1 foot 6 inches from the top of the pole.

Unless otherwise specified, provide all strain pole traffic signal supports with a one-piece anchor type base, fabricated from drop forged or cast steel of sufficient cross-section to fully develop the ultimate strength of the poles. Fasten the base to the pole with a welded connection that develops the full strength of the pole. Provide the base with a minimum of four holes of sufficient size to accommodate the proper size anchor bolts that are capable of resisting at yield strength stress, the bending moment of the shaft at its yield strength stress. Provide removable cast iron covers for the anchor bolts.

The shaft shall be fabricated from material providing a minimum yield strength of 48,000 pounds per square inch after fabrication.

Galvanize the steel poles and hardware in accordance with ASTM A123.

Galvanize all steel and cast iron components, hardware, and threaded fasteners, except anchor bolts, after fabrication in accordance with ASTM A123, or A153 or A385, as applicable.

730.34 Pedestal Support Signal Poles

Provide pedestal poles consisting of one upright pole with suitable base and other accessories or hardware as required to make a complete installation.

All poles shall be made of one continuous piece from top of base connection for the entire height of the pole. The cross-section shall be either cylindrical or octagonal and may or may not be uniformly tapered from butt to tip.

The cross-section at the tip shall have a 4-1/2 inch outside diameter.

A. Type "A" Pedestal (Aluminum)

Pedestals shall be of uniform octagonal or cylindrical cross-section of the tubular tapered type fabricated of one full length sheet.

Bases shall be octagonal or square in shape, of the ornamental type fabricated of cast material. Provide a handhole in each base.

Caps shall be of the nipple or tenon type mounting fabricated of cast material.

Furnish bases with four steel anchor bolts of sufficient size and length to securely anchor the base to the concrete footing. Weld the shaft to the cast metal base. Refer to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (current edition).

Type A pedestal shaft shall be fabricated from aluminum tubing 6063-T4 heat treated to T-6 temper after fabrication, and meeting ASTM B221.

Type A anchor base shall be made of sand-cast aluminum alloy 356-T6 meeting ASTM B26 - SF 70A-T5 specifications.

B. Type "B" Pedestal (Steel)

Pedestals shall be fabricated from a 4-1/2 inch (outside diameter) seamless steel pipe.

Bases shall be octagonal in shape of the ornamental type fabricated of cast or malleable iron and shall have minimum height of 12 inches. The top opening of the base shall be threaded to receive the shaft. Provide a handhole in each base.

Furnish bases with four steel anchor bolts of sufficient length to securely anchor the base to the concrete footing.

730.35 Wooden Pole Signal Supports

A. General

Provide wooden poles of the class and length shown on the Plans and that meet **917.11**. Set poles to the depth shown on the Plans, and fit them with all the necessary hardware to make the installation complete.

The signal head clearance shall be 16 feet 6 inches minimum and 19 feet maximum. Fasten the span wire at least 2 feet below the top of the pole.

B. Guying Components

Guy clamps shall be steel, 3-bolt type, 6 inches in length, and of the proper strand size to fit the wire used. The clamp bolts shall have upset shoulders fitting into the clamp plate. Substitution of the cable grip is subject to the Engineer's approval.

Attach guy wire to the pole with a 5/8-inch diameter x 12-inch length single strand angle-type eye bolt with 2 x 2 inch square cut washers, lock washer, and square nut.

Instead of the eye bolt specified above, an angle single strand eye of drop forged steel may be used, fastened on threaded end of span wire eye bolt.

Sidewalk guy fittings shall consist of 2-inch inside diameter standard galvanized steel pipe of required length with malleable iron pole plate and guy clamp. Fasten the pole plate to the pole with a 3/8-inch thru bolt and 1/2-inch lag screws.

All guying components and hardware shall be galvanized in accordance with ASTM A123 or A153.

Anchors for guys shall be of the pressed steel four-way expanding fluke type or of the steel or malleable iron sliding plate type. The minimum unexpanded diameter shall be 8 inches, and the minimum expanded area shall be 110 square feet. Coat anchors with a black asphaltic paint.

Guy anchor rods shall be drop-forged steel, 3/4-inch diameter and 7-foot minimum length, threaded, of the single thimble eye type, with a square anchor bolt nut.

730.36 Pole Location

Install all signal support poles at the locations shown on the Plans or where directed by the Engineer.

COMPENSATION

730.37 Method of Measurement

Measurement for traffic signals will be on a per item basis for each item to be furnished and installed, as specified herein and shown on the Plans.

With regard to items for signal head assemblies, each item to be furnished, installed, or both furnished and installed shall be distinguished with a code number as follows:

1. The first digit is the number of faces per assembly.

2. The second digit will indicate the number of 12-inch lenses per assembly (including arrow lenses).

3. The third digit is the quantity of 8-inch lenses per assembly.

4. The letter "A" indicates an arrow lens and the digit following the "A" indicates the number of 12-inch arrow lenses per assembly.

5. The letter "H" or "V" indicates the arrangement of arrow signal lenses to be horizontal or vertical with respect to solid ball indications.
   EXAMPLE:
   1 5 0 A 2 H
   Digits indicate the following:
   1 = one face
   5 = five 12-inch lenses
   0 = zero 8-inch lenses
   A2 = two 12-inch arrow lenses
   H = Arrow lenses placed horizontally with respect to circular indications

A. Removal of Signal Equipment

The Department will measure items of equipment or material designated or required for removal on a per each intersection basis. Removal and salvage of all signal heads, poles, control equipment, cabinets, span wire, cable, and similar features to be performed at an intersection shall be included as a unit cost per each intersection. This includes the cost of stockpiling salvable equipment for pick-up by the appropriate agency, as noted in the Plans.

Signal Head Assembly (includes Pedestrian Signal Heads)

The Department will measure signal heads of the type shown on the Plans by the individual assembly complete in place, per each. This item shall include the signal heads, terminals, lamps, attachment hardware, cable connection, and testing.

Pull Box

The Department will measure each pull box of the type required as one complete unit, installed, per each. This item includes the pull box, excavation, backfilling, crushed stone base, and other incidental items as called for in the Plans or Standard Drawings.

Electrical Service Connection

The Department will measure Electrical Service Connections on a per each signal installation basis. This item includes the electrical service supplied to the weatherhead by the local utility, all necessary materials and labor

for connection of the electrical service from the controller to the weatherhead, the wiring of the controller and detectors, and all incidentals necessary to render a complete and operable system.

Signal Cable

The Department will measure the length of Signal Cable of each size (number of conductors) installed in linear feet to the nearest foot from point to point along the routing for each cable.

The Department will make horizontal measurements by center to center measurement from:

1. Pole to pole
2. Pole to signal head (when terminating in a signal head)
3. Pull box to pull box
4. Pull box to pole
5. Pull box to pole-mounted or base-mounted controller

For cable inside mastarms, the Department will measure from center of vertical support to signal head where cable terminates.

The Department will make vertical measurement by one of the following:

1. For cable inside poles or conduit risers, the distance from ground level to the point of attachment of the span wire.

2. For cable inside mast arm supports, the distance from ground level to the mast arm connection.

3. For cable to pole-mounted controller,
   a. From ground level to bottom of controller.
   b. From bottom of controller to point of attachment of span wire.
4. For cable to pole-mounted signal head or pushbutton,
   a. From ground level to bottom of signal head or pushbutton
   b. From bottom of signal head or pushbutton to point of attachment of span wire.

The Department will make no additional allowance for slack length, length inside equipment or supports (except as noted), length for the required 360-degree drip loop, and similar instances requiring additional length of cable.

Span Wire

The Department will measure Span Wire Assembly, Tether Wire Assembly, and Messenger Cable by type in linear feet to the nearest foot. The measurement will be made from center to center of poles. These items include attachment hardware, strain insulators, and other hardware shown in the Plans as part of the assembly. The Department will make no additional allowance for slack length and other instances requiring additional length of wire.

Steel Conduit Riser Assembly

The Department will measure conduit riser assemblies per each for each size conduit riser installed on the outside of a pole, as shown on the Plans. This item includes conduit, weatherhead, condulet, fittings, nuts, washers, banding, clamps, grounding, and other items necessary for installation.

Conduit

The Department will measure conduit in linear feet to the nearest foot for each size and type of conduit installed.

The Department will measure underground conduit along the conduit by one of the following:

1. From the face of curb to the center of a pull box, pole or controller foundation,
2. From center to center of pull boxes,
3. From center to center of a pull box and a pole or controller foundation, or
4. From center to center of pole foundations or pole foundation and controller foundation.

The Department will add:

1. 1 foot to the above measurements for each entry to a pull box or pole foundation and each exit of a pull box or pole foundation.
2. 3 feet to the measurement for each capped extra entry (conduit stub) or exit to a pull box or pole foundation installed, as shown on the Plans.
3. 3 feet to the measurement for each connection between underground conduit and above ground riser.
4. 3 feet to the measurement for each entry or exit to a foundation for a base-mounted controller.

This item includes trenching, backfilling, sealing, capping, fittings, bushings, banding, grounding, and other accessories and hardware required for installation of the conduit system.

Vehicle Loop Detector (Amplifier)

The Department will measure vehicle detector loop amplifier per each unit, including the cable and associated hardware necessary to electrically connect the amplifier to the controller and loop lead in.

The Department will measure two and four channel card rack type amplifiers per each unit, including the cable, card rack(s), and associated hardware necessary to electrically connect the amplifiers to the controller and loop lead-ins.

Shielded Detector Cable

The Department will measure the two-conductor shielded detector cable installed between the controller cabinet and the loop detector wires in linear feet to the nearest foot.

The Department will make horizontal measurements (overhead and underground) by one of the following:

1. From center to center of pull boxes,
2. From center to center of pull box and pole,
3. From center to center of poles, or
4. From center to center of pull box or pole and controller foundation.

The Department will make vertical measurements by one of the following:

1. From ground level to the point of attachment of span wire, inside pole or conduit riser,
2. From the bottom of controller cabinet to the point of attachment of span wire, or
3. From ground level to the bottom of controller.

The Department will make no additional allowance for slack length, length inside equipment or supports (except as noted), splices, and similar instances requiring additional length of cable.

Saw Slot

The Department will measure the length of saw slot for installation of detection loop and lead wiring in linear feet to the nearest foot. Measurement for detection loops in the traffic lanes will be made based on the loop size shown on the Plans (the nominal length plus the nominal width) times 2. The Department will make no additional allowance for saw overruns to obtain full depth of saw slot or diagonal cuts to prevent sharp bends in the loop wire. The Department will measure saw slot for detection loop leads from the conduit entry at the face of curb or edge of pavement and along the route of the lead-in to the detection loop.

This item includes backing rods, or polyethylene foam sealant, loop sealant, and all other incidentals necessary to render a complete and operable system.

Loop Wire

The Department will measure the length of loop wire for installation of detection loops and lead-ins in linear feet to the nearest foot. Measurement will be made from the pull box or pole to the detection loop, around the loop the required number of turns and back to the pull box, pole, or point of splice. The Department will make no additional allowance for slack length, length inside equipment or supports, splices, and similar instances requiring additional length of wire.

This item includes electrical connections, testing, and all other incidentals necessary to render a complete and operable system.

Controller

The Department will measure controllers as one complete unit, installed, per each. This item includes all auxiliary equipment shown the Plans to provide signalization control as shown on the Plans, and all hardware, including the cabinet (and cabinet foundation, if base-mounted), necessary for installation.

Wood Pole

The Department will measure Wood Poles, of the type and size shown on the Plans, per each, installed.

Guying Device

The Department will measure Guying Devices, of the type shown on the Plans, per each, installed. This item includes the guy wire, anchor, clamps, and all other components shown on the Plans necessary for installation.

Steel Strain Pole

The Department will measure Steel Strain Poles of the type and size shown on the Plans, per each, installed. This item includes the pole, foundation, anchor bolts, grounding, and all other hardware shown on the Plans necessary for a complete installation.

Cantilever Signal Support

The Department will measure Cantilever Signal Supports, of the type and size shown on the Plans, per each, installed. This item includes the vertical pole shaft, mast arm, foundation, anchor bolts, grounding, and all other hardware shown on the Plans necessary for a complete installation.

Service Cable

The Department will measure two conductor power service cable, of the type and size shown on the Plans, in linear feet to the nearest foot, installed. Horizontal runs will be measured center to center of poles. Vertical runs will be measured from the ground to the weatherhead inside a pole or conduit riser, or from the ground to the

bottom of the controller, or from the bottom of the controller to the weatherhead. This item includes all necessary attachment hardware. The Department will make no additional allowance for slack length or other instances requiring additional length of cable.

Pedestrian Pushbutton with Sign

The Department will measure Pedestrian Pushbutton with Sign as one complete unit, in place, per each. This item includes the pushbutton, sign, mounting hardware, wiring of pushbutton, testing, and all other incidentals necessary for a complete installation.

Pedestrian Signal Display with Pushbutton and Sign

The Department will measure Pedestrian Signal Display with Pushbutton and Sign as one complete unit, in place, per each. This item includes the signal heads, terminals, lamps, cable connections, pushbutton, sign, all attachment hardware, testing, and other incidentals necessary for a complete installation.

Portable Traffic Signal

The Department will measure Portable Traffic Signal, of the type shown on the Plans or as directed by the Engineer, per each, installed. This item includes the all of the software and hardware necessary for a complete installation.

730.38 Basis of Payment

The Department will pay for accepted quantities, complete in place, at the contract prices as follows:

Item	*Pay Unit*
Traffic Signal	Lump Sum
Removal of Signal Equipment	Each
Signal Head Assembly (Description)	Each
Install Pull Box (Description)	Each
Electrical Service Connection	Each
Signal Cable – (Description)	Linear Feet
Span Wire Assembly (___ pounds min. break strength)	Linear Feet
Tether Wire Assembly – __" Diameter	Linear Feet
Messenger Cable – __" Diameter	Linear Feet
Riser Assembly (Description)	Each
Conduit __" Diameter (Type)	Linear Feet
Vehicle Detector (Description)	Each
Shielded Detector Cable	Linear Feet
Saw Slot	Linear Feet
Loop Wire	Linear Feet
Controller (Description)	Each
Wood Pole (Description)	Each
Guying Device (Description)	Each
Steel Strain Pole (Description)	Each
Cantilever Signal Support (Description)	Each
Service Cable	Linear Feet
Pedestrian Pushbutton with Sign	Each
Pedestrian Signal Display with Pushbutton and Sign	Each
Portable Traffic Signal (Type)	Each

The unit price to be paid includes the cost of furnishing and installing, complete in place, each of the various types of equipment required by the Summary of Quantities shown on the Plans. Total payment is full compensation for all materials, labor, equipment, and incidentals necessary to produce a completely operative and finished installation of a traffic signal or traffic signal system as shown on the Plans and as specified herein, including restoration of pavements, sidewalks, and appurtenances damaged or destroyed during construction and tests. All additional materials and labor not specifically shown or called for, which are necessary to complete the traffic signal installation or traffic signal system described, will be considered incidental to the system and no additional allowance will be made.

Subsection 730.32.A. (pg. 868), 6-27-16; revise the last paragraph of subsection 730.32 A.:

> "Provide a welded frame handhole, 5 x 8 inches minimum and located with a clear distance above the base of no less than the pole diameter, "D"."

S T A T E **O F** **T E N N E S S E E**

(Rev. 5-18-15)
(Rev. 11-16-15)
(Rev. 6-27-16)
(Rev. 12-2-16)
(Rev. 5-15-17)
(Rev. 11-6-17)
(Rev. 5-14-18)

January 1, 2015

Supplemental Specifications - Section 900

of the

Standard Specifications for Road and Bridge Construction

January 1, 2015

Subsection 901.01 (pg. 918), 5-14-18; Add the following sentence as the second paragraph of the subsection:

Provide hydraulic cement, selected from the Department's QPL, which conforms to the following for the kind and type specified or allowed:

Portland cement.....AASHTO M 85
Portland blast-furnace slag cement (Type IS) AASHTO M 240
Portland-pozzolan cement (Type IP).....AASHTO M 240
Portland-limestone cement (Type IL) .....AASHTO M 240

The maximum allowable equivalent alkalies is 0.60% for all cements and blended cements used in concrete riding surfaces with aggregates meeting the requirements of 903.24. This includes Class CP, A Paving, and DS concrete mixtures.

Subsection 903.01 - Table 903.01-1 (pg. 920), 5-18-15; Replace Note (1) with the following:

"(1)If the fine aggregate is manufactured from crushed stone and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 5%.

Subsection 903.01 - Table 903.01-1, Table 903.01-2 (pg. 921), 5-15-17; replace Tables 903.01-1 and 903.01-2 with the following Tables:

Table 903.01-1: Limits of Deleterious Substances in Fine Aggregate for Concrete

Substance	Maximum Permissible Limits Percent by Weight
Clay Lumps	0.5
Coal and Lignite	0.5
Material Passing the No. 200 Sieve [(1)(3)]	3.0
Other deleterious substances (such as shale, alkali, mica, coated/grains, soft and flaky particles) [(1) (2)]	3.0

(1) If the fine aggregate is manufactured from crushed stone and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 10%.

(2) Determine other organic impurities according to AASHTO T 267.

(3) If the fine aggregate is manufactured from crushed gravel and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 3.5%.

Table 903.01-2: Gradation Requirements for Fine Aggregate

Sieve Size	Total Percent Passing by Weight
3/8 inch	100
No. 4	95-100
No. 16	50-90
No. 50	5-35
No. 100	0-20
No. 200 [(1)]	0-3

(1) If the fine aggregate is manufactured from crushed stone and if material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this limit may be increased to 10%.

Subsection 903.03 (pg. 922) 5-15-17; Coarse Aggregate for Concrete, add the following as the 4th paragraph:

"Coarse aggregate in two-lift composite pavements shall consist of Size No. 467 in the lower lift, graded as specified in 903.22. Coarse aggregate in the upper lift shall be Size No. 57 or 67 graded as specified in 903.22 and shall meet 903.24 riding surface requirements."

Subsection 903.03 (pg. 922-923) 11-16-15; Coarse Aggregate for Concrete, modify the 4th and 5th paragraphs, update Table 903.03-1: Coarse Aggregate Sizes to the following:

"Coarse aggregate in Portland cement concrete bridge decks and overlays on interstates and four or more lane highways consisting of Size No. 57 shall meet 903.24.

The coarse aggregates for travel lanes and bridge decks shall be crushed and consist of stone, slag, gravel, quartzite, gneiss, or combination thereof with an absorption of plus 4 material not to exceed 5%. Do not use uncrushed gravel, pea gravel, or any other uncrushed particles. Crushed gravel, if used, shall consist of siliceous washed particles after processing, of which at least 70% by count of the material retained on the No. 4 sieve contains a minimum of two fractured faces. One face shall be fractured for the approximate average diameter or thickness of the particle."

Table 903.03-1

Application	**Coarse Aggregate Size** [(1)]
Structural concrete	No. 57
Self-Consolidating concrete	Maximum-No.67
Prestressed concrete	No. 57 or 67
Precast concrete	Any size fraction
Concrete curbing placed by machine-extrusion methods	No. 7, 57, 67, or 78
Cement treated permeable base [(2)]	No. 57

(1) Gradation shall conform to **903.22**.

(2) Aggregate shall meet the quality requirements specified below.

Subsection 903.03-2 (pg. 924) 5-15-17; Revise Table 903.03-2: Limits of Deleterious Substances in Coarse Aggregate for Concrete, update Material passing No. 200 Sieve and Footnote 2:

Table 903.03-2: Limits of Deleterious Substances in Coarse Aggregate for Concrete

Substance	Maximum Percent by Weight
Soft or non-durable fragments (fragments that are structurally weak such as shale, soft sandstone, limonite concretions, gypsum, weathered schist, or cemented gravel), and organic impurities as determined by AASHTO T 267 (1)	3
Coal and lignite (1)	1
Clay lumps (1)	0.25
Material passing the No. 200 sieve (1) (2)	1.5
Thin or elongated pieces (length greater than 5 times average thickness)	10
Other local deleterious substances (1)	1

(1) The sum of the percentages of these materials (i.e., soft or non-durable fragments, coal and lignite, clay lumps, material passing the No. 200 sieve, and other local deleterious substances) shall not exceed 5.0.

(2) For crushed aggregate, if all the material finer than the No. 200 sieve, as determined in accordance with AASHTO T 11, consists of the dust of fracture, essentially free of clay or shale, this limit may be increased to 2.0.

Subsection 903.05 – B. Type B Aggregate (pg. 927), 5-18-15; Replace the 1st paragraph of subsection 3. With the following:

> **"3.** Do not use material having clay content greater than 12%, as determined by hydrometer analysis performed in accordance with AASHTO T 88. Material may be used having a clay content exceeding 12% if a plasticity index-fines product does not exceed 3 when calculated by the following formula"

Subsection 903.05 – Aggregate for Mineral Aggregate Base and Surface Courses (pg. 928) 5-15-17; add section C to the bottom:

> **C. Reclaimed Concrete Aggregate.** Provide material comprised of concrete reclaimed from the demolition of a concrete structure or pavement. Reclaimed Concrete Aggregate may only be used as a mineral aggregate base course, subbase or shoulder course. The material shall be free of any materials classified as Solid or Hazardous Waste, especially asbestos, lead and mercury, with test results submitted by the contractor to the Project Supervisor. These test results shall be certified and notarized. The percentage of wear as determined in accordance with AASHTO T 96 shall not exceed 50. Deleterious substances shall be kept to a minimum, and may not be higher than the amounts listed on Table 903.05-3.

Table 903.05-3: Deleterious Materials

Material	Maximum Permissible Limits Percent by Weight
Brick	5
Bituminous Concrete Materials	5
Weathered Rock	2
Wood	0.1
Metals	0.1

The gradations of the coarse and fine fractions of aggregate shall be such that, when combined in proper proportions, the resultant mixture will fall within the grading specified in Table 903.05-4.

Table 903.05-4: RCA Grading Tolerances

Sieve Size	Total Percent Passing per Weight
1 ½ inch	100
1 inch	85-100
¾ inch	60-95
3/8 inch	50-80
No. 4	40-65
No. 16	20-40
No. 100	5-18

Subsection 903.05 – Aggregate for Mineral Aggregate Base and Surface Courses (pg. 925) 5-15-17; add reference to subsection **903.05 C.** in the second paragraph of subsection A.:

"**903.05 Aggregate for Mineral Aggregate Base and Surface Courses**

Provide crushed stone, crushed slag, crushed or uncrushed gravel, or crushed or uncrushed chert that may be blended with crushed recycled concrete or screened reclaimed asphalt pavement (RAP), together with material such as manufactured sand or other fine materials that are either naturally contained or added as needed to conform to these Specifications.

Provide aggregate of Types A and B, as specified below.

A. Type A Aggregate

Provide hard, durable particles or fragments of stone, slag, gravel, or chert, and other finely divided mineral matter.

The Contractor may use recycled concrete aggregate per 903.05 C. or reclaimed asphalt pavement~~,~~ ~~–~~at a maximum rate of 25% by weight~~,~~ for Type A aggregate, provided the combined aggregate blend meets all the requirements specified below. Crush and screen the recycled concrete and asphalt to produce a uniform stockpile before blending it with the virgin material. Keep the recycled stockpiles free of bricks, steel, wood, and all other deleterious materials. "

Subsection 903.05 – Aggregate for Mineral Aggregate Base and Surface Courses (pg. 925-926) 5-15-17; add reference to subsection **903.05 C.** in the second paragraph of subsection B.:

"For Provide crushed or uncrushed gravel, crushed or uncrushed chert, crushed stone or crushed slag, and other finely divided particles.

The Contractor may use recycled concrete aggregate per 903.05 C. or reclaimed asphalt pavement~~,~~ at a maximum rate of 30% by weight~~,~~ for Type B aggregate, provided the combined aggregate blend meets all the requirements specified below. Crush and screen recycled concrete and asphalt to produce a uniform stockpile before blending it with the virgin material. Keep the recycled stockpiles free of bricks, steel, wood, and all other deleterious materials."

Subsection 903.06 - C. Combined Aggregate Grading (pg. 930) 11-16-15; add the following sentence at the end of the first paragraph:

"For mixtures including recycled asphalt pavement, RAP, and/or recycled asphalt shingles, RAS, stockpiles will not be considered as contributing to the required minimum of three stockpile sizes."

Subsection 903.11 - Aggregate for Asphaltic Concrete Surface Coarses (Hot Mix) (pg. 934) 11-16-15; add the following sentence at the end of the first paragraph:

"For mixtures including recycled asphalt pavement, RAP, and/or recycled asphalt shingles, RAS, stockpiles will not be considered as contributing to the required minimum of three stockpile sizes."

Subsection 903.11 (pg. 934) 11-16-15; A. Coarse Aggregate (retained on a No. 4 sieve), revise the 1st paragraph and subsection 3:

"Provide aggregate, consisting of crushed stone, crushed slag, crushed gravel, crushed granite, crushed quartzite, crushed gneiss, or natural combinations of these materials.",

"3. Combined aggregate shall consist of siliceous particles processed from washed material, of which at least 70% by count of the material retained on the No. 4 sieve shall have a minimum of two fractured faces, one of which must be fractured for the approximate average diameter or thickness of the particle. Do not add pea gravel or uncrushed particles. The absorption of the crushed aggregate retained on the No. 4 sieve shall not exceed 5% when tested in accordance with AASHTO T 85."

Subsection 903.11 - A. Coarse Aggregate (retained on a No. 4 sieve) (pg. 934), 5-18-15; revise subsection 2. as follows:

"2. Material retained on the No. 4 sieve shall contain a maximum of 10% elongated pieces (length greater than five times the average thickness)"

Subsection 903.11 C.3. (pg. 938), 6-27-16; revise the 1st paragraph of subsection C.3 to the following:

> "**3. Grading OGFC.** A minimum of 75% of the aggregate shall meet the requirements specified in 903.24 for Surface Mixtures (Non-Skid Aggregates). The coarse aggregate shall have at least 90% crushed aggregate with two fractured faces and 100% with one fractured face as determined in accordance with ASTM D5821. The coarse aggregate shall have a LA Abrasion value of less than 40% and a maximum absorption of 3.0%."

Subsection 903.11 (pg. 938), 12-2-16; Add the following to C. as subsection 5.:

> "**5. Grading C, CS, CW.** The mixture shall meet all requirements of **903.06.** When using Grading C, CS, or CW as a final riding surface for traffic lanes and the design ADT is greater than 1000, a minimum of 75% of the aggregate shall meet the requirements specified in **903.24** for Surface Mixtures (Polish-Resistant Aggregate) for the appropriate levels."

Subsection 903.12 (pg. 938) 11-16-15; A. Aggregate for Slurry Seal, revise the 1st paragraph a A. as shown; delete the 2nd paragraph:

> "The aggregate shall be crushed slag, crushed granite, or crushed stone (crushed stone as specified in 903.24), meeting the requirements of ASTM D692, except the gradation shall be as specified in Table 903.12-1. The aggregate shall have a minimum sand equivalent, as determined in accordance with AASHTO T 176, of 45.

Subsection 903.12 (pg. 939) 11-16-15; B. Aggregate for Micro-Surface: modify the first paragraph, delete the second paragraph:

> "The aggregate shall be crushed slag, crushed granite, or crushed stone (crushed stone as specified in **903.24**) meeting the gradation limits specified in Table 903.12-2 and the physical properties of ASTM D692, except the percent of fractured pieces shall be 100. The aggregate shall have a minimum sand equivalent, as determined in accordance with AASHTO T 176, of 65. Polish-resistant aggregates will not be required for leveling courses, provided they will be covered with riding surface mixtures.

Subsection 903.12 (pg. 939) 5-15-17; B. Aggregate for Micro-Surface: Add the following as the 2nd paragraph:

> "If blending aggregates from more than one source, use automated proportioning and blending equipment which has individual bins for each aggregate source used to produce a stockpile meeting the job mix formula gradation. Proportion and blending equipment shall be calibrated at the beginning of production. All aggregate sources shall meet the requirements of **Table 903.24-1**. Do not blend aggregates with a front end loader. Proportion the aggregate to produce a uniform gradation meeting the requirements specified in Table 903.12-2. The contractor shall provide a Type A laboratory as defined by **106.06** capable of verifying gradation at the location where blending occurs."

Subsection 903.13 (pg. 940), 12-2-16; modify the last sentence of the 1st paragraph:

"Provide aggregate consisting of crushed stone, crushed slag, or crushed gravel, meeting the quality requirements of ASTM D692, except that at least 50% by count of crushed gravel aggregates shall have at least one fractured face. Crushed slag aggregate retained on the No. 4 sieve shall contain no more than 20% by weight of glassy particles. Provide aggregates meeting the requirements of **903.24 except, if ADT is less than 1000**."

Subsection 903.15 (pg. 941), 5-15-17; revise the 3rd paragraph:

"The Contractor may use recycled concrete aggregate per 903.05 C. or reclaimed asphalt pavement (RAP), at a maximum rate of 25% by weight~~,~~ provided the combined aggregate blend meets all the requirements specified above. If blending, crush and screen the recycled concrete and/or asphalt to produce a uniform stockpile before blending it with the virgin material. Keep the reclaimed asphalt pavement stockpiles free of bricks, steel, wood, and all other deleterious materials. The virgin and reclaimed pavement blend shall meet the quality requirements specified in Table **903.05-1**."

Subsection 903.24 (pg. 946), 5-18-15; Modify the 1st paragraph to the following:

"Provide coarse aggregate consisting of crushed gravel, crushed granite, crushed slag, crushed quartzite, crushed gneiss, or crushed sandstone. Other crushed aggregate may be used provided it has the chemical, physical, and performance characteristics specified in Table 903.24-1."

Subsection 904.01 (pg. 948) 11-16-15; Asphalt Cements, add the following between the 4th and 5th paragraphs:

"Polyphosphoric acid may be used as a modified not exceeding 0.5% by weight of asphalt binder and may only be used when the primary modifier is one of the styrene-based products listed above."

Subsection 904.01 (pg. 948) 11-6-17; Asphalt Cements, modify the fourth paragraph with the following:

"To modify the asphalt, properly blend one or more modifier(s) consisting of styrene butadiene (SB), styrene butadiene styrene (SBS), or styrene butadiene rubber (SBR), or Ground Tire Rubber (GTR) to a PG 64-22 or PG 67-22 base asphalt.

GTR used to modify asphalt shall meet the requirements of 921.17. Blending of GTR into asphalt cement shall occur only at the asphalt terminal. "

Subsection 904.01 (pg. 948), 11-6-17; Asphalt Cements, add the following paragraph as the next to last paragraph:

"In addition to the above, asphalt cement modified with GTR shall meet the following requirement. The temperature difference determined by the Separation Test shall not exceed 15 °F. The separation test shall consist of taking the difference in softening point,

as determined by the Ring and Ball Test (AASHTO T53), between the top and bottom thirds of a specimen prepared per ASTM D7173."

Subsection 904.01 (pg. 949), 12-2-16; Modify Table 904.01-1:

"**Table 904.01-1: Requirements for Asphalt Cement**

Property*	PG 64-22, PG 67-22	PG 70-22	PG 76-22	PG 82-22
Non-recoverable creep compliance at 3.2kPa, Jnr(3.2), kPa^{-1} at 64°C, Max	4.5	1.0	0.5	0.5
% Difference in Non-Recoverable Creep Compliance, Jnr(diff) at 64°C, %, Max	75	75**	n/a	n/a

* Tested in accordance with AASHTO T350.
** Shall be waived if Jnr(3.2) is equal to or less than 0.5

PG76-22 and PG82-22 grade asphalts shall meet the requirements for Indication of Elastic response as defined in Appendix X1 of AASHTO M332. PG70-22 grade asphalts shall have a minimum percent recovery at 3.2 kPa of 29%."

Subsection 904.01 (pg. 948-950) 5-18-15; revise the 1st paragraph to add the word cement, add sentence to the end of the 2nd paragraph, add "cement high-temperature grade properties to the 4th paragraph, remove the grades of asphalts and add asphalt cements to the 5th paragraph, update Table 904-01-1 to remove "Ring and Ball" and" Elastic Recovery", add "Non-recoverable creep compliance" requirements to Table 904-01-1, add footnote to Table, add a 6th paragraph, remove A. Test Procedures and Table 904.01-2, remove Materials Certification header, remove 8th paragraph, and revise the 9th paragraph:

"Only obtain asphalt cement for use on Department projects from Certified Asphalt Cement Suppliers that have an approved Quality Control Plan in accordance with the Department's Standard Operating Procedures.

Asphalt cement shall conform to AASHTO M 320 and Department procedures. Direct Tension testing is not required.

Instead of PG 64-22, the Contractor may use asphalt cement graded to PG 67-22. PG 67-22 shall conform to the requirements of AASHTO M 320 when the applicable tests are conducted at 67 °C and -12 °C, and the dynamic shear of the rolling thin film, pressure aged vessel sample is tested at 26.5 °C.

To modify the asphalt cement high-temperature grade properties, properly blend styrene butadiene (SB), styrene butadiene styrene (SBS), or styrene butadiene rubber (SBR) to a PG 64-22 or PG 67-22 base asphalt.

In addition to the above requirements, asphalt cements shall meet the requirements specified in Table 904.01-1.

Table 904.01-1: Requirements for Asphalt Cement

Property*	**PG 64-22, PG 67-22**	**PG 70-22**	**PG 76-22**	**PG 82-22**
Non-recoverable creep compliance at 3.2kPa, Jnr(3.2), kPa^{-1} at 64°C, Max	4.5	1.0	0.5	0.5
% Difference in Non-Recoverable Creep Compliance, Jnr(diff) at 64°C, %, Max	75	75	75	75

* Tested in accordance with AASHTO T350.

All modified grades shall meet the requirements for Indication of Elastic response as defined in Appendix X1 of AASHTO M332.

Furnish a certification to the Engineer on each project stating that the asphalt cement provided meets the Department's specification. Ensure that quality control and compliance testing are completed in accordance with the asphalt supplier's approved quality control plan and Department procedures.

In addition, the asphalt cement supplier shall provide a temperature-viscosity curve for PG 64-22 and PG 67-22 asphalt cements with a recommended mixing temperature range. In order to develop a temperature-viscosity curve, it may be necessary to run the viscosity test at a higher temperature, based on the softening point of the modified asphalt cement."

Subsection 904.01(pg. 949), 6-27-16; Modify Table 904.01-1:

Table 904.01-1: Requirements for Asphalt Cement

Property	PG64-22 PG67-22	PG70-22	PG76-22	PG82-22
Non-recoverable creep compliance at 3.2kPa, Jnr(3.2), kPa^{-1} at 64°C, Max	4.5	1.0	0.5	0.5
% Difference in Non-Recoverable Creep Compliance, Jnr(diff) at 64°C, %, Max	75	75	75	n/a

Subsection 904.01 B. (pg. 949) 11-6-17; Asphaltic Cements, B. Materials Certification, add the following as the last sentence of the first paragraph:

> "Furnish a certification to the Engineer on each project stating that the asphalt cement provided meets the Department's specification. Ensure that quality control and compliance testing are completed in accordance with the asphalt supplier's approved quality control plan and Department procedures. Identify on the certification, the type(s) of modifier used."

Subsection 904.03 (pg. 951) 11-16-15; Emulsified Asphalts, Add "TTT-3" to 904.03-1 with the following requirements:

Saybolt-Furol Viscosity @ 77 °F, seconds	10-100
Particle Charge	Positive
Sieve Test, %	0.1 Max
Residue by	Distillation(1)
Residue, %	50 Min
Demulsibility, %	65 Min
Penetration	40-90

[1]-Distill at 350°F

Subsection 904.03 (pg. 954), 12-2-16; Revise Table 904.03-1(c) to remove TTT-1, TTT-2, and TTT-3:

Table 904.03-1(c): Test Requirements for Emulsified Asphalt

Practices	**AASHTO Test Method**	**CRS-2P**	**RS-2**	**RS-1**
Saybolt-Furol Viscosity @ 77 °F, seconds	T59	n/a	n/a	20-100
Saybolt-Furol Viscosity @ 122 °F, seconds	T59	100-400	75-400	n/a
Storage Stability Test, 24- h, %	T59	1 Max	1 Max	1 Max
5-day Settlement, %	T59	n/a	n/a	n/a
Particle Charge	T59	Positive	n/a	n/a
Sieve Test, %	T59	0.1 Max	0.1 Max	0.1 Max
Residue by	T59	*Evaporation*	Distillation	Distillation
Residue, %	T59	65 Min	63 Min	55 Min
Demulsibility, %	T59	40 Min	60 Min	60 Min
Distillate, %	T59	n/a	n/a	n/a
Oil Test, %	T59	n/a	n/a	n/a
Stone Coating	T59	n/a	n/a	n/a
Float Test, seconds	T50	n/a	n/a	n/a
Penetration	T49	75-175	100-200	100-200

Practices	AASHTO Test Method	CRS-2P	RS-2	RS-1
Elastic Recovery, % (2)	T301	50 Min	n/a	n/a
Ductility @ 77 °F, cm	T51	40 Min	40 Min	40 Min
Ductility @ 40 °F, cm	T51	n/a	n/a	n/a
R&B Softening Point, °F	T53	125 Min	n/a	n/a
Original G*/sind @ 82 °C	T315	n/a	n/a	n/a

Subsection 904.03 (pg.954), 5-18-15; Replace with the following:

Subsection 904.03, Table 904.03-1(c). Modify as follows for TTT-1, TTT-2:

Table 904.03-1(c): Test Requirements for Emulsified Asphalt

Practices	AASHTO Test Method	CRS-2P	RS-2	RS-1	TTT-1	TTT-2
Saybolt-Furol Viscosity @ 77 °F, seconds	T59	n/a	n/a	20-100	20-100	10-100
Saybolt-Furol Viscosity @ 122 °F, seconds	T59	100-400	75-400	n/a	n/a	n/a
Storage Stability Test, 24- h, %	T59	1 Max	1 Max	1 Max	1 Max	1 Max
5-day Settlement,	T59	n/a	n/a	n/a	n/a	n/a

Practices	**AASHTO Test Method**	**CRS-2P**	**RS-2**	**RS-1**	**TTT-1**	**TTT-2**
%						
Particle Charge	T59	Positive	n/a	n/a	n/a	Positive
Sieve Test, %	T59	0.1 Max	0.1 Max	0.1 Max	0.1 Max	0.1 Max
Residue by	T59	*Evaporation*	Distillation	Distillation	Distillation	Distillation [(1)]
Residue, %	T59	65 Min	63 Min	55 Min	50 Min	50 Min
Demulsibility, %	T59	40 Min	60 Min	60 Min	n/a	n/a
Distillate, %	T59	n/a	n/a	n/a	n/a	n/a
Oil Test, %	T59	n/a	n/a	n/a	n/a	n/a
Stone Coating	T59	n/a	n/a	n/a	n/a	n/a
Float Test, seconds	T50	n/a	n/a	n/a	n/a	n/a
Penetration	T49	75-175	100-200	100-200	0-20	40-90
Elastic Recovery, % [(2)]	T301	50 Min	n/a	n/a	n/a	n/a
Ductility @ 77 °F, cm	T51	40 Min	40 Min	40 Min	n/a	n/a
Ductility @ 40 °F, cm	T51	n/a	n/a	n/a	n/a	n/a
R&B Softening Point, °F	T53	125 Min	n/a	n/a	60-75	n/a
Original G*/sind @ 82 °C	T315	n/a	n/a	n/a	1.0 Min	n/a

[(1)] Distill at 350 °F

[(2)] Straight-sided mold, 20-cm elongation, 5min hold, 25 °C

Subsection 905.01 (pg. 956) 5-14-18, Revise subsection, add part C. Polypropylene Foam Type:

"**905.01 Preformed Joint Fillers (Non-Extruding and Resilient Types)**

Provide preformed joint fillers ~~of the bituminous type unless otherwise~~as shown on the Plans. When designated, punch holes in preformed joint filler to admit the dowels.

Furnish the filler for each joint in a single piece for the full depth and width required for the joint unless otherwise directed by the Engineer. If the Engineer approves the use of more than one piece for a joint, fasten the abutting ends securely, and hold to shape by stapling or using other positive means of fastening satisfactory to the Engineer.

A. Bituminous Type

Provide bituminous type preformed joint fillers conforming to AASHTO M 213.

B. Non-Bituminous Types

Provide non-bituminous types of preformed joint filler conforming to AASHTO M 153, Type I, II, or III, as specified.

~~Furnish the filler for each joint in a single piece for the full depth and width required for the joint unless otherwise directed by the Engineer. If the Engineer approves the use of more than one piece for a joint, fasten the abutting ends securely, and hold to shape by stapling or using other positive means of fastening satisfactory to the Engineer.~~

C. Polypropylene Foam Type

Provide semi-rigid, closed-cell, polypropylene foam, preformed expansion joint filler conforming to ASTM D8139. ~~when shown on the plans or pre-approved by the Engineer as an alternate to the (A.) Bituminous Type or (B.) Non-Bituminous Types.~~"

Subsection 908.04 (pg. 968), 5-18-15, High Strength Bolts, A. Specifications; Add the following to the first paragraph:

"Unless otherwise shown on the Plans, mechanically galvanize all bolts, nuts and washers in accordance with ASTM B695 Class 50."

Subsection 908.04 (pg. 968), 12-2-16, High Strength Bolts, A. Specifications; revise the first paragraph:

"Unless otherwise shown on the Plans, all bolts, nuts and washers shall be coated with acceptable coating in accordance with ASTM F3125 for the respective grade."

Subsection 908.04 (pg. 968) 12-2-16; revise A. Specifications, 1.:

"A. Specifications: 1. Bolts. ASTM F3125, Grade 325 and Grade 490 - High Strength Bolts for Structural Joints"

Subsection 908.04 (pg. 970) 12-2-16; Revise C. Testing, 3. Assemblies, subsection f., update Table 908-04-2:

C. Testing, 3. Assemblies, f. Table 908.04-2 The minimum rotation, from a snug tight condition (10% of the specified proof load), shall be as specified in Table 908.04-2.

Table 908.04-2: Rotation from Snug Tight Condition

Bolt Length	Minimum Rotation from Snug
Up to and including 4 diameters	240 degrees (2/3 turn)
Over 4 diameters, but not exceeding 8 diameters	360 degrees (1 turn)
Over 8 diameters	480 degrees (1-1/3 turn)

(Note: These values differ from those shown in ASTM F3125.)

Subsection 908.07 (pg. 973), 5-14-18; Add the following as the last sentence in the subsection:

"Furnish the Engineer a certification from the manufacturer identifying each heat number and certifying that the requirements from AASHTO M 105 and the above additions have been met."

Subsection 909.02(pg. 977), 12-2-16; Remove the 4th paragraph referencing a tolerance of 5% from B. Steel Posts and Braces.

Subsection 909.02 (pg. 980-981), 12-2-16; Remove the word minimum from Table 909.02-1:

Table 909.02-1: Post and Braces

Application	Material	ASTM Specification	Nominal Diameter (inches)	Outside Diameter (inches)
Line Posts	Galvanized steel pipe	F1083	1.5	1.900
	Aluminum alloy	B429, Alloy 6063,	1.5	1.900

Application	Material	ASTM Specification	Nominal Diameter (inches)	Outside Diameter (inches)
	standard (ANSI Schedule 40) pipe	Temper T6		
	Triple coated steel pipe with a 0.120-inch wall thickness	F1043, Group I-C	1.5	1.900

Application	Material	ASTM Specification	Nominal Diameter (inches)	Outside Diameter (inches)
End, Corner, and Pull Posts	Galvanized standard steel pipe	F1083	2.0	2.375
	Aluminum alloy standard (ANSI Schedule 40) pipe	B429, Alloy 6063, Temper T6	2.0	2.375
	Triple coated steel pipe with a 0.130-inch wall thickness	F1043, Group I-C	2.0	2.375
End and Corner Braces	Galvanized standard steel pipe	F1083	1.25	1.660
	Aluminum alloy standard (ANSI Schedule 40) pipe	B429, Alloy 6063, Temper T6 (for corner posts: B241)	1.25	1.660
	Triple coated steel pipe with a 0.111-inch wall thickness	F1043, Group I-C	1.25	1.660

Subsection 909.03 (pg. 983), 12-2-16; Remove the last paragraph of the subsection.

Subsection 912.05 (pg. 1001), 6-27-16; Add subsection 912.05 – Brick Paving Units:

"912.05 Brick Paving Units

Provide brick of the kind and grade specified.

A. Masonry Brick

1. Sidewalk: ASTM C902, Class SX, Type 1
2. Crosswalks and Roadway: ASTM C1272, Type R

B. Concrete Brick and Truncated Dome Concrete Brick

Provide brick conforming to ASTM C936

C. Truncated Dome Brick

Provide brick conforming to ASTM C902, Class SX, Type 1"

Subsection 915.02 (pg. 1007), 6-27-16; modify the description of 915.03, remove zinc coated, iron from 915.02 A. update the first paragraph of 915.02 A., Remove subsection B. Aluminum Coated Steel Pipe, Revise C. to become B., revise D to become C, Remove 1st and 2nd paragraphs of D now C, revise E to become D, update 915.03 to match index title: :

"SECTION 915 – METALLIC PIPE

915.01 Ductile Iron or Cast Iron Pipe 1007
915.02 Corrugated Metal Pipe Culverts, Pipe Arches, and Underdrains…… 1007
915.03 Polymer Pre-coated, Corrugated Steel Pipe, Culverts, and Underdrains.... 1008

915.01 Ductile Iron or Cast Iron Pipe
Provide ductile iron pipe conforming to ASTM A716 for the specified diameters and strength classes. Unless otherwise specified, either smooth, corrugated, or ribbed pipe may be furnished. For pipe diameters in excess of 48 inches, conform to ANSI Standard for Cast Iron Pit Cast Pipe, or as otherwise specified in the Contract, for the specified diameter and strength class.
Provide cast iron drain pipe conforming to ASTM A74. Unless otherwise specified, provide ductile iron pressure pipe for water lines or sewer construction conforming to the requirements of ASTM A377 for the diameters and working pressures specified.

915.02 Corrugated Metal Pipe Culverts, Pipe Arches, and Underdrains
A. Corrugated Steel Pipe, Pipe Arches, and Underdrains
Provide corrugated steel pipe, pipe arches, or underdrains, including special sections, such as elbows and flared ends, that conform to AASHTO M 36, aluminum-coated Type 2 meeting AASHTO M274. Special Sections shall be the same thickness as the pipe, arch, or underdrain to which they are joined. Furnish shop-formed elliptical pipe and shop-strutted pipe only where shown on the Plans.

B. Corrugated Aluminum Pipe, Pipe Arches, and Underdrains

When using corrugated aluminum pipe, pipe arches, or underdrains, conform to the applicable requirements of AASHTO M 196. Use special sections, such as elbows and flared end sections that conform to the applicable requirements of AASHTO M 196 and that are of the same gauge as the conduit to which they are joined.

C. Structural Plate Corrugated Steel and Aluminum Structures

Corrugated aluminum alloy structural plate for pipe, pipe arches, and arches shall conform to the requirements of AASHTO M 219.

D. Bituminous Coating
When material supplied for any of the items specified above are to be bituminous-coated, ensure that the metal to be coated is free of grease, dirt, and other contaminants. Bituminous coating and paving shall conform to the requirements of AASHTO M 190. Apply the coating in accordance with the manufacturer's recommended procedures and as directed by the Department."

915.03 Polymer Pre-coated, Corrugated Steel Pipe, Culverts and Underdrains
Provide polymer pre-coated corrugated steel pipe conforming to AASHTO M 245, Grade250/250, unless otherwise specified."

Subsection 916.05 E. (pg. 1012); 12-2-16, Add sentence to first paragraph:

"Fabricators must be AISC certified as specified in **602.04 A.4**."

Subsection 917.02.A.6. (pg. 1023), 6-27-16; Revise the following:

"**6. Anchor Bolts.** Use anchor rods of high strength steel meeting the requirements of ASTM F 1554, Grade to be determined by design. Fit each anchor bolt with a hex nut and lock-washer."

Subsection 918.01 (pg. 1033-1035), 5-14-18; Revise the 1st paragraph and 3rd paragraph of A. General, Revise Table 918.01-1, Table 918.01-2, Table 918.01-4, Table 918.01-5, Revise the last paragraph of B. Seed Groups, Revise Table 918.01-6 Temporary Seeding:

A. General

Provide seed meeting the rules and requirements of the Tennessee Department of Agriculture~~. The Engineer will accept no "Below Standard" seed.~~ Chapter 0080-05-06.

Pack grass seed in new bags or bags that are sound and not mended.

The vendor shall notify the Department before making shipments to allow the Department to arrange for inspection and testing of stock.

The vendor shall furnish the Department a certified laboratory report from a~~n~~ Society of Commercial Seed Technologists accredited commercial seed laboratory or from a State seed laboratory showing the analysis of the seed to be furnished. The report from an accredited

commercial seed laboratory shall be signed by a Registered Member of the Society of Commercial Seed Technologists. The Department may take samples of the seed to check against the certified laboratory report. Sampling and testing will be in accordance with the requirements of the Tennessee Department of Agriculture.

Use commercial grade 10-10-10 fertilizer or equivalent.

B. Seed Groups

When a seed group is used, provide mixtures meeting the requirements specified in Tables 918.01-1 through 918.01-5, unless otherwise specified.

Table 918.01-1: Group A (February 1-July 1)

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	80
Korean Lespedeza	15
~~English~~ Annual Rye Grass	5

Table 918.01-2: Group B (June 1-August 15)

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	5575
~~English Rye~~	~~20~~
Korean Lespedeza	15
German Millet	10

Table 918.01-3: Group B1 (April 15 - August 15)

Kind of Seed	Quantity, Percent by Weight
Bermudagrass (hulled)	70
Annual Lespedeza	30

Table 918.01-4: Group C (August 1-December 1)

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	70
E~~nglish~~ Annual Rye Grass	20
White Clover	10

Table 918.01-5: Group C1 (February 1-December 1)

Kind of Seed	Quantity, Percent by Weight

~~Crown Vetch~~	~~25~~
Kentucky 31 Fescue	70
~~English~~ Annual Rye Grass	5

Uniformly mix seed when forming Groups. Do not mix Group seed until each type seed that is used to form the Group has been tested ~~and inspected~~ separately and ~~approved~~ meets DOA requirements for purity and germination ~~by the Department~~. ~~Seed mixed before tests and inspection are made will not be accepted.~~

C. Over-Seeding

Groups A, B, and C, when sown on slopes 3:1 and steeper, shall be over seeded with Sericea Lespedeza at the rate of 15 pounds per acre. When over-seeding is performed between February 1 and July 1, use Scarified Sericea Lespedeza with an additional 2 pounds per acre of Weeping Lovegrass. Between July 1 and December, use unhulled Sericea Lespedeza. Only use Group C1 when shown on the Plans.

D. Temporary Seeding

For temporary seeding, use seed groups and approved varieties as specified in Table 918.01-6.

Table 918.01-6: Temporary Seeding

Seed Group (Season)	Kind of Seed	Percent by Weight
Group D (January 1 – May 1)	It~~alian~~ Annual Rye Grass	33-1/3%
	Korean Lespedeza	33-1/3%
	S~~ummer~~ Spring Oats	33-1/3%
Group E (May 1 – July 15)	S~~udan Sorghum~~Sorghum-Sudan Crosses (1)	100%
	or	
	St~~arr~~ German Millet (2)	100%
Group F July 15 – January 1	B~~alboa~~ Cereal Rye	66-2/3%
	It~~alian~~ Annual Rye Grass	33-1/3%

~~(1) Dekalb Sudan SX11, Lindsey 77F, TN Farmer's Co-op GHS-1 or GHS-2A.~~

~~(2) Starr Millet, GaHi-1~~

Subsection 918.04 (pg. 1036), 12-2-16; add as a 2nd paragraph:

"For small quantities less than 100 units of seeding or sod, bagged pelletized or agricultural limestone meeting the Department of Agriculture Tennessee Liming Materials Act may be utilized."

Subsection 921 (pg. 1049), 11-6-17, Section 921 – Miscellaneous Materials, add Ground Tire Rubber to the Index:

"921.17 Ground Tire Rubber ……..1060"

Subsection 921.01 (pg. 1049), 5-18-15, Water; Replace subsection with the following:

"For mixing concrete, use water that is reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter, and other substances injurious to the finished product. Water provided by a municipal utility may be used without testing.

All other water shall have quality results submitted in accordance with the frequency listed in Table 921.01-01. All water quality results shall adhere to Table 921.01-2.

Table 921.01-1 Testing Frequency for Mixing Water

Water Source	**Testing Frequency**(1)
Municipal	NA
Non-Municipal	Every 3 months; tested annually after 4 consecutive passing tests

(1) The frequency may vary at the discretion of the Department.

Table 921.01-2 Quality Requirements for Mixing Water

Maximum Concentration in Mixing Water	**Limits**	**ASTM Test Method** (1)
Chloride Ion Content, ppm	500	C114
Alkalies as (NaO2 + 0.658 K2O), ppm	600	C114
Sulfates as SO4, ppm	3000	C114
Total Solids by mass, ppm	50000	C1603
pH	4.5-8.5	(2)
Resistivity, Minimum, kohm-cm	0.500	D1125
Soluble Carbon Dioxide, ppm	600	D513
Calcium and Magnesium, ppm	400	D511
Iron, ppm	20	(2)
Phosphate, ppm	100	D4327

(1) Other methods (EPA or those used by water testing companies) are generally acceptable.
(2) No ASTM method available.

Subsection 921.01 (pg. 1049), 5-14-18, Water; Remove Resistivity, Soluble Carbon Dioxide, Calcium and Magnesium, Iron, and Phosphate from Table 921.01-2 Quality Requirements for Mixing Water:

Table 921.01-2 Quality Requirements for Mixing Water

Maximum Concentration in Mixing Water	Limits	ASTM Test Method [1]
Chloride Ion Content, ppm	500	C114
Alkalies as (NaO2 + 0.658 K2O), ppm	600	C114
Sulfates as SO4, ppm	3000	C114
Total Solids by mass, ppm	50000	C1603
pH	4.5-8.5	[2]
~~Resistivity, Minimum, kohm-cm~~	~~0.500~~	~~D1125~~
~~Soluble Carbon Dioxide, ppm~~	~~600~~	~~D513~~
~~Calcium and Magnesium, ppm~~	~~400~~	~~D511~~
~~Iron, ppm~~	~~20~~	~~(2)~~
~~Phosphate, ppm~~	~~100~~	~~D4327~~

(1) Other methods (EPA or those used by water testing companies) are generally acceptable.
(2) No ASTM method available.

Subsection 921.06 (pg.1051) 11-16-15; B. Bituminous Additives - 1. Anti-Stripping Additive, replace the ASTM C977 reference with AASHTO M 303.

> "Use hydrated lime conforming to AASHTO M 303or other heat-stable asphalt anti-stripping additive containing no ingredient harmful to the bituminous material or the workmen and that does not appreciably alter the specified characteristics of the bituminous material when added in the recommended proportions."

Subsection 921.06 B. Bituminous Additives (pg.1052) 10-10-16; revise the 3rd paragraph to the following:

> "When using an anti-stripping additive other than hydrated lime, use a dosage rate of 0.3%, unless either gravel is used as a coarse aggregate or test results indicate moisture susceptibility, in which case mix at a dosage rate of 0.5%.

Subsection 921.06 B. 2. (pg. 1052) 11-6-17; B. Bituminous Additives, 2. Silicone Additives, Remove description and add the following sentence:

> "2. Silicone Additives. The amount of silicone added to asphalt cement shall not exceed 2 oz. of silicone per 5500 gallons asphalt cement."

Subsection 921.17 (pg. 1060) 11-6-17; Ground Tire Rubber, add the following subsection:

“921.17 Ground Tire Rubber

Provide Class 30-1 Ground Tire Rubber (GTR) as defined by ASTM D5630 except for as noted in table 921.17-1. The material shall also be certified to meet the requirements of Table 921.17-01. Include certification of the GTR with the bill of lading for the modified asphalt cement.

Table 921.17-1: Requirements for Ground Tire Rubber

Property	Specification
Specific Gravity	1.15 +/- 0.05
Moisture Content	0.75% Max
Ferrous Metal Content	0.01% Max
Fiber Content	0.5% Max
Ash (ASTM E1131)	10% Max

APPENDIX B

SPECIAL PROVISIONS

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MOWING PAYMENT ADJUSTMENT FOR FUEL	109MA
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S T A T E **OF** **T E N N E S S E E**
Rev: October 10, 2016 January 1, 2015

SPECIAL PROVISION

REGARDING

EMPLOYING AND CONTRACTING WITH ILLEGAL IMMIGRANTS

The State shall endeavor to do business only with those contractors and subcontractors that are in compliance with the Federal Immigration and Nationality Act. This policy shall apply to all State Contractors including subcontractors. This policy statement is issued to establish implementation guidance to procuring state agencies and contractors reflecting the requirements of *Tennessee Code Annotated* §12-3-309 regarding the employment of illegal immigrants in the performance of state contracts.

1. The Contractor hereby attests, certifies, warrants, and assures that the Contractor shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor who will utilize the services of an illegal immigrant in the performance of this Contract. The Contractor shall reaffirm this attestation, in writing, by submitting to the State a completed and signed copy of the "Attestation form" provided by the Department, semi-annually during the period of this Contract.

2. Prior to the use of any subcontractor in the performance of this Contract, and semi-annually thereafter, during the period of this Contract, the Contractor shall obtain and retain a current, written attestation that the subcontractor shall not knowingly utilize the services of an illegal immigrant to perform work relative to this Contract and shall not knowingly utilize the services of any subcontractor who will utilize the services of an illegal immigrant to perform work relative to this Contract.

3. The Contractor shall maintain records for its employees used in the performance of this Contract. Said records shall include a completed federal Department of Homeland Security Form I-9, *Employment Eligibility Verification*, for each employee and shall be subject to review and random inspection at any reasonable time upon reasonable notice by the State.

The Contractor understands and agrees that failure to comply with this section will be subject to the sanctions of *Tennessee Code Annotated* § 12-3-309 for acts or omissions occurring after January 1, 2007. This law requires the Chief Procurement Officer, Department of General Services, to prohibit a contractor from contracting with, or submitting an offer, proposal, or bid to contract with the State of Tennessee to supply goods or services for a period of one year after a

contractor is discovered to have knowingly used the services of illegal immigrants during the performance of this contract.

For the Purposes of this policy, “illegal immigrant” shall be defined as a non-citizen who has entered the United State of America without federal government permission or stayed in this country beyond the period allowed by a federal government-issued visa authorizing the non-citizen to enter the country for specific purposes and a particular time period.

S T A T E **OF** **T E N N E S S E E**

January 1, 2015

(Rev. 03-30-15)

SPECIAL PROVISION

REGARDING

TENNESSEE DEPARTMENT OF TRANSPORTATION STANDARD

SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

DESCRIPTION

Any and all references concerning the March 1, 2006 Standard Specifications for Road and Bridge Construction shall be interpreted as the January 1, 2015 Standard Specifications for Road and Bridge Construction.

The following Special Provisions have been incorporated into the January 1, 2015 Standard Specifications for Road and Bridge Construction:

- 107SHP
- 407G
- 411TL
- 411TLD
- 411OGFC
- 716ST

Any reference to these Special Provisions shall refer to the January 1, 2015 Standard Specifications for Road and Bridge Construction.

S T A T E O F T E N N E S S E E

(Rev. 6-19-95) January 1, 2015
(Rev. 6-1-04)
(Rev. 06-20-2011)

SPECIAL PROVISION

REGARDING

BUY AMERICA REQUIREMENTS

All manufacturing processes for iron and steel products, and coatings applied thereon, used in this project shall occur in the United States except that if the proposal has bid items for furnishing domestic and foreign iron and steel, the bidder will have the option of (1) submitting a bid for furnishing domestic iron and steel, or (2) submitting a bid for furnishing domestic iron and steel and a bid for furnishing foreign iron and steel. If option (2) is chosen the bid will be tabulated on the basis of (a) the total bid price using the bid price for furnishing domestic iron and steel and, (b) the total bid price using the bid price for furnishing foreign iron and steel.

For the total bid based on furnishing foreign iron and steel to be considered for award, the lowest total bid based on furnishing domestic iron and steel must exceed the lowest total bid based on furnishing foreign iron and steel by more than 25 percent. The 25 percent differential applies to the total bid for the entire project, not just the bid prices for the steel or iron products.

Iron and steel products are defined as products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed from iron and steel made in the United States. Iron products are included, however, pig iron and processed, pelletized, and reduced iron ore may be purchased outside the United States.

Manufacturing begins with initial melting and continues through the coating stage. Any process which modifies chemical content, physical size or shape, or the final finish is considered a manufacturing process. Coatings include epoxy, galvanizing, painting or any other surface protection that enhances the value and/or durability of a material.

The contractor shall provide a certification to the Engineer with each shipment of iron and steel products to the project site that the manufacturing processes for the iron and steel products occurred in the United States. No steel shall be placed until the contractor ensures the requirements of this Special Provision are met.

The above requirements do not prevent a minimal use of foreign materials, if the cost of such materials used does not exceed 0.1 percent of the total contract cost or $2,500.00, whichever is greater. If steel

not meeting the requirements of this Special Provision is used, the contractor shall provide a written statement to the Department prior to its use indicating where the steel will be incorporated in the work, the value of the steel, the percentage of the contract amount, and the appropriate invoices shall be submitted as documentation.

The contractor shall be responsible for all cost associated with any steel that is permanently incorporated into the project that does not meet the requirements of this Special Provision without prior written approval from the Department, up to and including removal and replacement.

S T A T E **O F** **T E N N E S S E E**

Rev. 9-03-2013 January 1, 2015

SPECIAL PROVISION

REGARDING

AIR QUALITY FOR MOWING

Description. The contractor will be required, absent an immediate safety issue determined by the Engineer, to cease mowing operations in the non-attainment counties listed below on Air Quality Action or Alert days within those counties. The appropriate TDOT representative will direct the contractor to suspend mowing operations upon the notification that an Action/Alert day forecast has been issued. Forecasts are issued by AIRNOW the day before the Action/Alert Day in the afternoons at the following web address:

http://airnow.gov/index.cfm?action=airnow.fcsummary&stateid=50

This will be the only authority for notifications used by TDOT. TDOT notification to the contractor will be made by the Close of Business (COB) the day prior to the Action/Alert Day.

The cessation of mowing operations will apply to any Action/Alert day forecast notification. The cessation of mowing operations shall remain in place until the Action/Alert day forecast is terminated. On these days, the contractor may mow outside of the non-attainment counties if the contract includes mowing in additional counties not listed below. Also, no trimming operations with weed trimmers will be allowed during these Action/Alert days. All working days that the contractor must cease mowing operations shall be added to the total number of days the contractor has to complete the disrupted mowing cycle.

Basis of Payment. All costs associated with the cessation of work caused by an Air Quality Action or Alert days will be compensated, on a per day basis, at the unit price bid for Item Number 717-10.01, INVOLUNTARY WORK SUSPENSION.

Payment will be made only when the contractor is actively mowing in one of the listed counties when an Air Quality Action/Alert day in that county has been declared and he is directed to cease mowing operations.

No payment will be made for any Air Quality Action/Alert day that occurs after mowing operations have been completed for a cycle. In addition, no payment will be made if after mobilizing for a mowing cycle an Air Quality Action/Alert day is declared before the contractor commences mowing operations.

Non-Attainment Area **Counties**
CHATTANOOGA REGION
Hamilton
CLARKSVILLE REGION
Montgomery
NASHVILLE REGION
Davidson
Rutherford
Sumner
Wilson
Williamson
KNOXVILLE REGION
Anderson
Jefferson
Knox
Loudon
Roane (only areas around TVA Plant)
MEMPHIS REGION
Shelby
GREAT SMOKY MTNS.
Blount
Cocke (only areas within Park)
Sevier

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

Rev. 12-22-14
Rev. 2-13-17
Rev. 6-26-17

SPECIAL PROVISION

REGARDING

WATER QUALITY AND STORM WATER PERMITS

Scope

The conditions of this Special Provision apply to all construction on this project pursuant to the following:

1. Section 404 of the Federal Clean Water Act (33 U.S.C. §1344), and all implementing regulations, including without limitation regulations of the U.S. Army Corps of Engineers governing permits for discharges of dredged or fill material into waters of the United States in 33 CFR Part 323; and
2. The Tennessee Water Quality Control Act (T.C.A. §69-3-101, et seq.) and all implementing regulations, including without limitation the Rules of the Tennessee Department of Environment and Conservation governing NPDES permits in Chapter 1200-4-10, and Aquatic Resource Alteration permits in Chapter 1200-4-7; and
3. Section 26a of the TVA Act of 1933 as amended (49 Stat. 1079, 16 U. S. C. sec. 831y1.) and all implementing regulations, including without limitation the regulations of the Tennessee Valley Authority governing construction in the Tennessee River System in 18 C.F.R., Part 1304; and
4. The Tennessee Wildlife Resources Agency Reelfoot Lake Watershed Management permit program (T.C.A. section 70-5-1,), and all implementing regulations, including without limitation regulations authorizing any activity, practice, or project which has or is likely to have the effect of diverting surface or subsurface water from the Lake or have the effect of draining or otherwise removing water from Reelfoot Lake; and
5. Coast Guard Bridge Permit (USCG) (Section 9 of the Rivers and Harbors Appropriation Act of 1899) and all implementing regulations, including but not without limitation for projects which impact streams deemed navigable by the U.S. Coast Guard.

Responsibility

It is understood and agreed that the Contractor assumes all responsibilities of the permittee as indicated in the permit that relates to protection of the "waters of the United States" and/or "waters of the State of Tennessee."

It is also understood and agreed that the Contractor shall be responsible for obtaining any additional permits required by the Contractor’s method of construction, including without

limitation haul roads, temporary channels or temporary ditches, or off-site waste and/or borrow areas.

It is also understood that the Contractor shall be responsible for implementing the provisions of the Water Quality (including, but not limited to, TDEC ARAP, USACE 404, TVA Section 26a, Coast Guard, TWRA) and Storm Water [including, but not limited to, National Pollution Discharge Elimination System (NPDES), Statewide Stormwater Management Plan (SSWMP)] Permits and requirements that pertain to construction activities.

The Contractor by signing this contract is indicating that the Contractor has reviewed a copy of the permit provisions, including NPDES Permit provisions at http://www.tdot.state.tn.us/construction/permits/npdes.pdf, the site specific SWPPP, the contract plans, Standard Specifications and contract Special Provisions and finds the permit requirements and erosion prevention and sediment control (EPSC) procedures to be reasonable, workable, and binding.

It is also understood that the Contractor shall not be released from the project site responsibilities under the NPDES permit provisions until the Notice of Termination (NOT) is submitted to TDEC by the TDOT Regional Construction Supervisor. The NOT is a certification that the construction project site is permanently stabilized and that all construction related discharges have ceased. This means that the use of EPSC measures to alleviate concerns of surface erosion and transport of sediment to surface water conveyances or to waters of the state is no longer necessary. Furthermore, it means that permanent controls, hard surfaces and/or vegetation, employed at the site are deemed adequate to prevent erosion and sediment transport and no other potential sources of construction-related pollution are on the project.

It is also understood that the Contractor shall not be released from any warranty provided for EPSC plantings, including sod and trees. If the entire project is complete as outlined in **Subsection 105.15** of the **Standard Specifications,** the Contractor shall be required to supply a performance bond as outlined in **Subsection 802.15** of the **Standard Specifications** to cover any warranty for EPSC plantings.

NPDES Permit Required Action

The Contractor (or their representative) shall accompany the EPSC inspector (TDOT personnel or TDOT hired consultant) on all EPSC inspections of the entire construction project including permitted locations and potentially impacted streams as well as attend all QA/QC Project Assessments.

EPSC Inspections shall be conducted as required in the most current TN Construction General Permit.

EPSC inspections shall be performed on the schedule established in the TN Construction General Permit until the site is permanently stabilized to determine if the permit requirements are being met. Where sites or portion(s) of construction sites have been temporarily stabilized, or runoff is unlikely due to winter conditions (e.g. site covered with snow or ice), such inspection only has to be conducted once per month until thawing or precipitation results in runoff or construction activity resumes. Written notification of the intent to change the inspection frequency and the justification for such request must be submitted to the TDOT Project Supervisor and the TDEC Central Office before proceeding.

An individual representing the Contractor, who holds a current TDEC "*Fundamentals of Erosion Prevention and Sediment Control Level I"* certification shall accompany the EPSC inspector on all required EPSC inspections. The Contractors project supervisor(s) shall also hold

a current TDEC "*Fundamentals of Erosion Prevention and Sediment Control Level I"* certification. Proof of required personnel training for the individual(s) shall be provided to the TDOT Project Supervisor prior to beginning of construction.

The TDOT EPSC inspector shall document all deficiencies on the required TDOT EPSC Inspection Report form (provided in the SWPPP). The Contractor (or their representative) shall sign the TDOT EPSC Inspection Report form and any supporting documentation indicating that he is in agreement with the report, recommendations and repair schedule as stated within the documentation.

Additionally, the Contractor shall make necessary maintenance and repairs relative to deficiencies in these permit conditions or requirements within twenty-four (24) hours after an inspection identifies the maintenance or repair need, and/or when directed to do so by the TDOT Project Supervisor, unless conditions make a particular activity impracticable. Any such conditions that make immediate repairs impracticable shall be documented and provided to the TDOT Project Supervisor, via the inspection report, and be accompanied by an expected repair schedule based on forecasted weather conditions.

The Contractor further agrees that he will execute two (2) copies of the Notice of Intent (NOI) form of the permit (provided by the Department), indicating his acceptance of the stipulations contained therein. The Contractor further agrees, that should he fail to execute said copies and return them to the TDOT Construction Division within ten (10) calendar days after submittal of the contract proposal to him, that the Department may at its discretion cancel the award with the Contractor forfeiting his bid bond.

Further, the Contractor agrees to review the site specific Stormwater Pollution Prevention Plan (SWPPP) that will be made available prior to or at the pre-construction conference, for any additional EPSC requirements. The Contractor shall sign and submit two copies of the SWPPP signature page (provided by the Department within the site specific SWPPP). The Contractor may submit for review and approval changes/revisions to the SWPPP to better prevent erosion and sediment transport at any time after contract execution. Rejection of any submittals does not relieve the contractor of any liability for appropriate Best Management Practices (BMPs).

If at any time during this contract, the requirements for the Water Quality Permits and/or the Storm Water Permits for Construction Related Activities are changed/revised/updated, the Contractor shall be notified in writing by the Department of such requirements. The Contractor shall comply with the new requirements within thirty (30) days of the Department notification.

If at any time the Contractor becomes aware that sedimentation is occurring or has occurred in streams impacted by the specified project, the Contractor shall immediately notify the TDOT Project Supervisor to evaluate the EPSC measures employed. A determination of the cause for sedimentation will be made by the Department. The Contractor shall immediately repair or replace defective EPSC measures, and install, as applicable, additional or other EPSC measures with the goal of eliminating future sedimentation. Once a remediation plan is provided by the Department, the Contractor shall, within twenty-four (24) hours after notification, begin the remediation as required. Based on the cause of sedimentation, the Department will determine if the cost of remediation will be performed at the Contractor's expense.

Failure to Comply

In the event a Notice of Violation (NOV) or Order pursuant to the Tennessee Water Quality Control Act or the Federal Clean Water Act is issued on this project, any and all fines will be the

sole responsibility of the Contractor as outlined in **Subsection 107.01** of the **Standard Specifications for Road and Bridge Construction.**

Failure of the Contractor to comply with this Special Provision or take immediate corrective actions required within twenty-four (24) hours (unless documented conditions make a particular maintenance or repair activity impracticable immediately) shall be reason for the TDOT Project Supervisor to suspend all other work on the Project, except erosion prevention and sediment control (EPSC) and traffic control, applying non-refundable deductions of monies from the Contract per calendar day from monies due to the Contractor for any EPSC work on the Project. This deduction can be made for each location, as determined by the TDOT Project Supervisor, for each calendar day that the deficiency is allowed to remain and charged as item description *"Failure to Comply with Permit Deduction"*. A deduction shall be made from monies due the Contractor, not as a penalty, but as liquidated damages, as indicated in **Subsection 108.09** of the **Standard Specifications for Road and Bridge Construction January 1, 2015**, as amended.

If the Contractor does not make necessary corrections/adjustments in a timely manner as required above, the Department will implement the provisions of **Subsection 209.07 and Subsection 109.08** of the **Standard Specifications for Road and Bridge Construction** that provides for the Department making repairs and recovering the costs thereof from the Contractor.

The Department will not participate in any payment or reimbursement for fines and will not authorize time extensions due to delays in project progress for work stoppage, to remedy the violations stated within the NOV, required by the TDOT Project Supervisor as stated in **Subsection 105.01** of the **Standard Specifications for Road and Bridge Construction**.

Spill Prevention, Control, and Countermeasure

To help prevent the discharge of oil into navigable waters, the U.S. Environmental Protection Agency (EPA) developed the Spill Prevention, Control, and Countermeasure (SPCC) Program.The SPCC Program is under the authority of Section 311 (j)(1)(C) of the Federal Water Pollution Control Act (Clean Water Act) in 1974. The rule may be found at Title 40, Code of Federal Regulations (CFR), Part 112. Additional information regarding the preparation and requirements of a SPCC Plan can be found at: http://www.epa.gov/oem/content/spcc/.

If applicable based upon the total aggregate capacity of aboveground oil storage, the contractor shall develop a site specific SPCC Plan per EPA requirements. This plan shall be provided to the Project Supervisor as part of the required submittals during the project Pre-Construction Meeting or at which time the conditions on the project site meet the applicable criteria. The contractor shall be responsible for obtaining any other necessary local, state, and federal permits as applicable. The SPCC Plan and/or permits shall be kept on-site.

The contractor shall be responsible complying with all aspects of the site specific SPCC Plan including but not limited to: performing any required inspections as directed by the SPCC Plan as well as implementing material and spill management practices per the project's Stormwater Pollution Prevention Plan (SWPPP). In the event, where a release containing a hazardous substance in an amount equal to, or in excess of a reportable quantity established under either 40 CFR 117 or 40 CFR 302 occurs during a 24-hour period, the contractor shall immediately notify the Project Supervisor.

Rev. November 19, 2018 July 27, 2018

STATE OF TENNESSEE

I-75/I-24
Hamilton County
Contract #: DB1801

SPECIAL PROVISION

REGARDING

PROJECT COMPLETION AND LIQUIDATED DAMAGES

The project shall be completed in its entirety as set forth in the Contract.

Daytime lane closures shall not be allowed at any time, unless otherwise specified herein or as directed by the Engineer.

Temporary lane closures on I-24, I-75, and interstate-to-interstate ramps within the interchange will be allowed Sunday through Thursday between 9:00 P.M. and 6:00 A.M as described in RFP Book 3. Construction, Maintenance of Traffic. For each hour, or portion thereof, in which the temporary lane closure is not completed and open to traffic, the sum of **$6,000** per hour per lane shall be deducted from the monies due the Design-Builder, not as a penalty, but as liquidated damages.

Temporary lane closures on local streets will be allowed Sunday through Thursday between 9:00 P.M. and 6:00 A.M. For each hour, or portion thereof, in which the temporary lane closure is not completed and open to traffic, the sum of **$1,800** per hour per lane shall be deducted from the monies due the Design- Builder, not as a penalty, but as liquidated damages.

In addition to temporary lane closures, the Design-Builder will be allowed up to four (4) total weekend closures of Interstate 75-to-Interstate 24 ramps and Interstate 24-to-Interstate 75 ramps within the interchange. The Design-Builder shall not have more than one interstate-to-interstate ramp closed at any time. The Design-Builder will be allowed up to six (6) weekend closures of the Spring Creek Road over I-24 bridges. A weekend is defined as between Friday at 9:00 P.M. and Monday at 5:00 A.M. outside of the holidays, and major events discussed in RFP Book 3.

For each hour, or portion thereof, in which a full weekend closure on the interstate-to-interstate ramps described in the previous paragraph is not completed and open to traffic, the sum of **$6,000** per hour per lane shall be deducted from the monies due the Design-Builder, not as a penalty, but as liquidated damages. For each hour, or portion thereof, in which a full weekend closure on Spring Creek Road is not completed and open to traffic, the sum of $1,800 per hour per lane shall be deducted from the monies due the Design-Builder, not as a penalty, but as liquidated damages.

Rolling roadblocks are permitted during blasting operations, the erection/construction of overhead signs and setting of bridge beams. These roadblocks shall be conducted by law enforcement agencies specified in Special Provision 712PO – DB. Rolling roadblocks for operations specified above other than blasting, will only be allowed between 9:00 P.M. and 6:00 A.M. with a maximum duration of 30 minutes. For each 15-minute period, or portion thereof, in excess of the allotted 30-minute period that any traffic lane remains closed, the sum of $3,000 per lane shall be deducted from the monies due the Design-Builder, not as a penalty, but as liquidated damages.

Blasting within the project limits shall not occur on a Sunday. Blasting shall be permitted between 9:00 A.M. and 2:00 P.M. If necessary for the public's protection from blasting, the Design-Builder may close traffic lanes in the vicinity of blasting site up to 15 minutes in any one-hour period. For each **15-minute** period, or portion thereof, in excess of the allotted 15-minute period that any traffic lane remains closed, the sum of **$3,000** per lane shall be deducted from the monies due the Design-Builder, not as a penalty,

but as liquidated damages.

The table below summarizes the liquidated damages referenced above.

Route Name/Type	Temporary Lane Closures Liquidated Damages	Full Weekend Closure Liquidated Damages	Rolling Roadblock/Blasting Liquidated Damages
I-24, I-75	$6,000 per hour per lane	N/A	$3,000 per 15 min. per lane
Interchange Ramps	$6,000 per hour per lane	$6,000 per hour per lane	$3,000 per 15 min. per lane
Spring Creek Road	$1,800 per hour per lane	$1,800 per hour per lane	N/A
Local Streets including State Routes	$1,800 per hour per lane	N/A	N/A

Welcome Center

The Design-Builder shall minimize disruptions to the normal operations of the Welcome Center located on I-75 north of the Ringgold Road interchange. The Design-Builder will be allowed to close the Welcome Center as detailed in RFP Book 3. Failure to restore full access to and normal operations of the Welcome Center within the allowed times will result in liquidated damages of $1,200 per calendar day until full access and normal operations are restored. Additionally, RFP Book 3 contains additional information regarding mandatory advance notice.

Noise Barriers

The Design-Builder shall complete construction of the new noise barrier east of Spring Creek Road prior to any work on the I-75 to I-24 ramps. Once work begins, the noise barrier shall be completed within 90 days. Failure to complete construction within the allowed 90 calendar days will result in liquidated damages of **$1,000** per day until noise barrier construction is complete. Noise barrier construction and/or repairs shall only be conducted during daytime hours not earlier than 8:00 A.M. and no later than 7:00 P.M. For each hour, or portion thereof, in which the noise barrier construction and/or repairs continue (outside the daytime hours allotted), the sum of **$500** per hour per noise barrier shall be deducted from the monies due the Design-Builder, not as a penalty, but as liquidated damages.

Potholes

The Design-Builder shall mitigate potholes greater than or equal to 1 square foot and 1.25 inches deep or an equivalent volume of size, shape and location that presents a hazard to the traveling public within 24 hours of discovery or notification. Failure to complete pothole mitigation within the 24-hour period will result in the sum of **$1,000** per occurrence per day (or portion thereof) until pothole mitigation is complete. These deductions are not penalties but are liquidated damages.

The following sections summarize the liquidated damages associated with ITS field device and supporting infrastructure downtime.

Fiber Network

The Design-Builder shall ensure continuous operation of the fiber optic lines within construction limits.

Temporary disconnect of communication shall not exceed forty-eight hours. Failure to restore communication within the allowed forty-eight hours will result in liquidated damages of **$500** per hour until communication is restored.

Dynamic Message Signs (DMS)

The Design-Builder shall ensure continuous operation of the dynamic message signs (DMS) within construction limits. Temporary loss of DMS operation during construction activities shall not exceed thirty calendar days. Failure to restore full operation within the allowed thirty calendar days will result in liquidated damages of **$500** per day/per DMS until full operation of the DMS is restored. Full operation is defined as the DMS being installed, integrated with TMC software, and accessible/controllable by TMC personnel.

CCTV Cameras

The Design-Builder shall ensure continuous operation of the all CCTV cameras affected by construction activities. Temporary loss of CCTV camera operation during construction activities shall not exceed forty-eight hours. Failure to restore full operation within the allowed forty-eight hours will result in liquidated damages of **$500** per hour/per CCTV camera until full operation of the camera is restored. Full operation is defined as the CCTV camera being installed, integrated with TMC software, and accessible/controllable by TMC personnel.

Radar Detection System (RDS)

The Design-Builder shall ensure continuous operation of the radar detection systems (RDS) within the construction limits. Temporary loss of RDS operation during construction activities shall not exceed fourteen calendar days. Failure to restore full operation within the allowed fourteen (14) calendar days will result in liquidated damages of **$500** per day/per RDS until full operation of the RDS is restored. Full operation is defined as the RDS being installed, integrated with TMC software, and accessible/controllable by TMC personnel.

The table below summarizes the liquidated ITS-related damages referenced above.

ITS Device Type	Allowable Down Time	Liquidated Damages
Fiber Network	48-Hours	$500 per hour
DMS	30 Calendar Days	$500 per day per DMS
CCTV	48-Hours	$500 per hour per CCTV
RDS	14 Calendar Days	$500 per day per RDS

Project Completion Date

The Design-Builder shall complete all work to be done under the Contract on or before the Design-Builder's completion date, set forth in RFP Book 2 Section D.3. If the Design-Builder fails to complete all work specified in the Contract, except for plant/vegetation establishment and punch list items (as defined in TDOT's *Design-Build Standard Guidance)*, on or before the Design-Builder's completion date, a sum of money equal to **$30,000** per Calendar Day, for the first 30 calendar days after the Design-Builder's completion date, shall be deducted from monies due to the Design- Builder, not as penalty, but as liquidated damages. For each calendar day thereafter, a sum of money equal to **$100,000** shall be deducted from monies due to the Design-Builder, not as a penalty, but

as liquidated damages.

Where provisions of this Special Provision conflict with Subsection 108.09 of the Standard Specifications, as amended, this Special Provision prevails. Additionally, RFP Book 3 contains additional information regarding mandatory closure concurrence and advance notice.

S T A T E **OF** **T E N N E S S E E**

(Rev. 10-01-06) January 1, 2015
(Rev. 11-03-08)
(Rev. 01-03-13)

SPECIAL PROVISION
REGARDING
PAYMENT ADJUSTMENT FOR FUEL

This special provision covers the method of payment adjustment for fuel price increases or decreases. Payment adjustments will be made in monthly increments based on the estimated fuel consumed on major items of work, the estimated price per gallon of fuel at the time of letting, and the percentage change of the Producer Price Index for Light fuel oils, Series ID Number WPU0573, published by the U.S. Department of Labor, Bureau of Labor Statistics.

The estimated price per gallon of fuel for this contract is $ **2.48**

The September 2018 Price Index (Ib) for light fuel oils shall be used for this contract. Adjustments will be based on the price index in effect for the month in which the item was installed.

Fuel consumption for payment adjustment shall be based on the following:

Item Number	Description of Work	Gallons per unit	Unit of measure
203	Any Road and Drainage Excavation	0.25	Cubic Yard
203	Any Borrow Excavation (Rock)	0.36	Cubic Yard
203	Any Borrow Excavation (Other than Solid Rock)	0.25	Cubic Yard
203	Any Borrow Excavation (Rock)	0.16	Ton
203	Any Borrow Excavation (Other than Solid Rock)	0.11	Ton
203-05	Undercutting	0.25	Cubic Yard
203	Any Embankment (in-place)	0.25	Cubic Yard
303, 309, 312	Any Aggregate Base	0.79	Ton
313, 501	Treated Permeable Base or Lean Concrete Base	0.10	Square Yard
307	Any Bituminous Plant Mix Base (HM)	2.98	Ton
411	Any Bituminous Concrete Surface (HM)	2.98	Ton
501	Any Portland Cement Concrete Pavement		
	≤ 10 in. thickness	0.25	Square Yard
	> 10 in. thickness	0.30	Square Yard

No payment adjustment for fuel shall be made on any item of work which is not listed above.

No payment adjustment for fuel shall be made unless the price index varies 5% or more from the index indicated in this Special Provision.

Where the price index varies 5% or more, the payment adjustment will be made as follows:

$PA = [(Ic \div Ib) - 1] \times Fe \times Fp$

Where:

PA =Payment Adjustment (may be plus or minus)
Ic =Index for Current Month
Ib =Index for Bidding
Fe =Estimated Fuel in Gallons used based on above table and work paid for during adjustment month. [$\sum$ (Pay quantity x Gallons per unit)= Fe]
Fp = Fuel Price for Bidding

The Project Engineer will compute the payment adjustment for fuel on work sheets similar to the one attached and will furnish a copy of the calculations upon request to the prime contractor and approved subcontractors.

Upon the expiration of the allocated working time, as set forth in the original contract or as extended by Change Order, payment adjustments for fuel will continue to be made only when the "Index for Current Month" is **less** than the "Index for Bidding" and varies 5% or more.

Payment adjustment, for fuel provided after the expiration of the allocated working time and where the “Index for Current Month” **exceeds** the “Index for Bidding”, will **not** be made until after the contract records have been approved by Final Records (FR)/Materials & Tests (MT) and a Final Estimate is ready to be processed. Upon contract record approval by FR/MT, fuel payment adjustments shall be calculated for each month where the allocated working time has expired, the “Index for Current Month” **exceeds** the “Index for Bidding”, and the indices vary 5% or more. The calculation of the fuel payment adjustment shall be made using the “Index for Current Month” or the “Index for Contract Completion Date” in accordance with the following formulas:

The “Index for Contract Completion Date” is the fuel index in effect on the allocated Contract Completion date or the completion date as extended by Change Order.

“Index for Current Month” is **less** than “Index for Contract Completion Date”

$PA = [(Ic \div Ib) - 1] \times Fe \times Fp$

“Index for Current Month” is **greater** than “Index for Contract Completion Date”

$PA = [(Icd \div Ib) - 1] \times Fe \times Fp$

Where:

PA = Payment Adjustment (may be plus or minus)

Ic = Index for Current Month
Ib = Index for Bidding
Icd= Index for Contract Completion Date (or as extended by Change Order)
Fe = Estimated Fuel in Gallons used based on above table and work paid for during adjustment month. [∑ (Pay quantity x Gallons per unit)= Fe]
Fp = Fuel Price for Bidding

Payment Adjustment for fuel will be made under:

Item No.	Description	Pay Unit
109-01.01	Payment Adjustment for Fuel	Dollar

Monthly Payment Adjustment for Fuel Worksheet

Project No._____ Contract No._____

County_____

Fuel Price (Fp)_____Price Index Bidding (Ib)_____Current Price Index (Ic) _____

Index for Contract Completion Date (or as extended by Change Order) (Icd)_____

Estimate Period: Work Performed_____Adjustment Paid_____
(Month/Yr)

Item	Unit	Quantity		Fuel Factor		Total Fuel
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____

Total Fuel for Month (Fe)_____

$PA = [(Ic \div Ib) - 1] \times Fe \times Fp$
$PA = [(Icd \div Ib) - 1] \times Fe \times Fp$

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

(Rev. 08-01-00)
(Rev. 08-02-00)
(Rev. 01-07-13)
(Rev. 05-16-16)

SPECIAL PROVISION

REGARDING

PAYMENT ADJUSTMENT FOR BITUMINOUS MATERIAL

This Special Provision covers the method of payment adjustment for bituminous materials.

100% Virgin Bituminous Material

A payment adjustment will be made to compensate for increases and decreases of 5% or more in the contractor's bituminous material cost. The normal bid items in the contract covering the bituminous material shall not be changed. Payment adjustments (+/-) shall be paid under "Payment Adjustment for Bituminous Material" and calculated as described herein:

A "Basic Bituminous Material Index" will be established by the Tennessee Department of Transportation prior to the time the bids are opened. This "Basic Bituminous Material Index" is the average of the current quotations on P.G. 64-22 from suppliers furnishing asphalt cement to contractors in the State of Tennessee. These quotations are the cost per ton f.o.b. supplier's terminal.

The "Basic Bituminous Material Index" for this project is **$543.75** per ton.

The "Monthly Bituminous Material Index" is also established on the first day of each month by the same method. A payment adjustment shall be made provided the "Monthly Bituminous Material Index" varies 5% or more (+/-) from the "Basic Bituminous Material Index".

Where the price index varies 5% or more, the payment adjustment will be made as follows:

$$PA = [Ic - Ib] \times T$$

Where:

PA =	Price Adjustment for Adjustment Month
Ib =	Basic Bituminous Material Index
Ic =	Monthly Bituminous Material Index
T =	Tons bituminous material for Adjustment Month

Payment adjustment will be applied to all asphalt cement, asphalt emulsion, or bituminous material used for paving on this project.

Upon the expiration of the allocated working time, as set forth in the original contract or as extended by Change Order, payment adjustments for bituminous material will continue to be made only when the "Monthly Bituminous Material Index" is **less** than the "Basic Bituminous Material Index" and varies 5% or more.

Payment adjustment, for bituminous material used after the expiration of the allocated working time and where the "Monthly Bituminous Material Index" **exceeds** the "Basic Bituminous Material Index", will **not** be made until after the contract records have been approved by Final Records (FR)/Materials & Tests (MT) and a Final Estimate is ready to be processed. Upon contract record approval by FR/MT, payment adjustments for bituminous material shall be calculated for each month where the allocated working time has expired, the "Monthly Bituminous Material Index" **exceeds** the "Basic Bituminous Material Index", and the indices vary 5% or more. The calculation of the bituminous payment adjustment shall be made using the "Monthly Bituminous Material Index" or the "Bituminous Material Index for Contract Completion Date" in accordance with the following formulas:

The "Bituminous Material Index for Contract Completion Date" is the Monthly Bituminous Material Index in effect on the allocated Contract Completion Date or on the completion date as extended by Change Order.

The "Monthly Bituminous Material Index" is **less** than the "Bituminous Material Index for Contract Completion Date".

PA = [Ic - Ib] x T

The "Monthly Bituminous Material Index" is **greater** than the "Bituminous Material Index for Contract Completion Date".

PA = [Icd - Ib] x T

Where:

PA =	Price Adjustment for Adjustment Month
Ib =	Basic Bituminous Material Index
Ic =	Monthly Bituminous Material Index
Icd =	Bituminous Material Index for Contract Completion Date (or as extended by Change Order)
T =	Tons

FOR REFERENCE ONLY

SiteManager calculates the price adjustement based on the actual amount of asphalt cement (residue) in the emulsion using the following percentages:

-tack coats and shoulder sealants (e.g. SS-1, SS-1h, CSS-1, Css-1h)	63% residue
-prime coats (e.g. AE-P)	54% residue
-microsurfacing (e.g. CQS-1HP)	65% residue
-chip seals (e.g. CRS-2, CRS-2P)	69% residue

Mixes Containing Recycled Bituminous Material

The quantity of virgin asphalt cement in tons subject to payment adjustment in recycled mixes shall be the product of the total tons of each mix multiplied by the difference between (1) the percent of asphalt cement specified for bidding purposes and (2) the percent of asphalt cement obtained from the recycled asphaltic material (RAP) used in each mix. No payment adjustment under this special provision for increases and decreases in the contractor's cost for virgin asphalt cement in recycled mixes will be allowed for asphalt cement content in excess of the percent specified for bidding purposes, as all payment adjustments for asphalt cement in the mix design of recycled mixes in excess of the percent of asphalt cement specified for bidding purposes will be made in accordance with the Standard Specifications.

No payment adjustment for bituminous material containing RAP shall be made unless the "Monthly Bituminous Material Index" varies 5% or more from the "Basic Bituminous Material Index" indicated in this Special Provision.

Where the price index varies 5% or more, the payment adjustment will be made as follows:

$$PA = [Ic - Ib] \times \frac{[BA - RA]}{100} \times Tm$$

PA = Price Adjustment for Adjustment Month
Ib = Basic Bituminous Material Index
Ic = Monthly Bituminous Material Index
BA = Percent asphalt specified for bidding purposes
RA = Percent asphalt obtained from recycled asphaltic material used in each mix
Tm = Tons asphalt mix for adjustment month

Upon the expiration of the allocated working time, as set forth in the original contract or as extended by Change Order, payment adjustments for bituminous material containing RAP will continue to be made only when the "Monthly Bituminous Material Index" is **less** than the "Basic Bituminous Material Index" and varies 5% or more.

Payment adjustment, for bituminous material containing RAP provided after the expiration of the allocated working time and where the "Monthly Bituminous Material Index" **exceeds** the "Basic Bituminous Material Index", shall **not** be made until after the contract records have been approved by Final Records (FR)/Materials & Tests (MT) and a Final Estimate is ready to be processed. Upon contract record approval by FR/MT, payment adjustments for bituminous material containing RAP shall be calculated for each month where the allocated working time has expired, the "Monthly Bituminous Material Index" **exceeds** the "Basic Bituminous Material Index", and the indices vary 5% or more. The calculation of the bituminous payment adjustment shall be made using the "Monthly Bituminous Material Index" or the "Bituminous Material Index for Contract Completion Date" in accordance with the following formulas:

The "Bituminous Material Index for Contract Completion Date" is the Monthly Bituminous Material Index in effect on the allocated Contract Completion Date or on the completion date as extended by Change Order.

The "Monthly Bituminous Material Index" is **less** than the "Bituminous Material Index for Contract Completion Date".

$$PA = [Icd - Ib] \times \frac{[BA - RA]}{100} \times Tm$$

The "Monthly Bituminous Material Index" is **greater** than the "Bituminous Material Index for Contract Completion Date".

$$PA = [Ic - Ib] \times \frac{[BA - RA]}{100} \times Tm$$

Where:

PA =	Price Adjustment for Adjustment Month
Ib =	Basic Bituminous Material Index
Ic =	Monthly Bituminous Material Index
Icd =	Bituminous Material Index for Contract Completion Date (or as extended by Change Order)
BA =	Percent asphalt specified for bidding purposes
RA =	Percent asphalt obtained from recycled asphaltic material used in each mix
Tm =	Tons asphalt mix for adjustment month

S T A T E **OF** **T E N N E S S E E**

(Rev. 10-29-04) January 1, 2015
(Rev. 10-17-06)
(Rev. 11-03-08)

SPECIAL PROVISION
REGARDING
MOWING
PAYMENT ADJUSTMENT FOR FUEL

This special provision covers the method of payment adjustment for fuel price increases or decreases. Payment adjustments will be made in monthly increments based on the estimated fuel consumed on major items of work, the estimated price per gallon of fuel at the time of letting, and the percentage change of the Producer Price Index for Light fuel oils, Table 6, published by the U.S. Department of Labor, Bureau of Labor Statistics.

The estimated price per gallon of fuel for this contract is $2.48 .

The September, 2018 Price Index (Ib) for light fuel oils shall be used for this contract. Adjustments will be based on the price index in effect for the month in which the item of work was done.

Fuel consumption for payment adjustment shall be based on the following:

Item No.	Description	Gallons/Pay Unit
806-01	Mowing	2.00/Acre

No payment adjustment for fuel shall be made on any item of work which is not listed above.

No payment adjustment for fuel shall be made unless the price index varies five percent or more from the index indicated in this Special Provision.

Where the price index varies five percent or more, the payment adjustment will be made as follows:

$$PA = [(Ic \div Ib) - 1] \times Fe \times Fp$$

Where:

PA =Payment Adjustment (may be plus or minus)
Ic =Index for Current Month
Ib =Index for Bidding
Fe =Estimated Fuel in Gallons used based on above table and work paid for during adjustment month. [Pay quantity x Gallons]
Fp = Fuel Price for Bidding

Payment adjustment errors on items of work which have occurred because of quantity errors in previous months for which the time period in which the work was performed cannot be established will be rectified on a subsequent estimate according to the following formula:

$Fa = [(Fq \div Pq) \times Ea] - Ea$

Where,

Fa = Final Adjustment (Item of work)
Fq = Final Quantity of work
Pq = Total Quantity of work on previous estimates
Ea = Total amount paid on previous estimates for Fuel Adjustment for this Item of work

The Project Engineer will compute the payment adjustment for fuel on work sheets similar to the ones attached and will furnish a copy of the calculations upon request to the prime contractor and approved subcontractors.

Upon the expiration of the allocated working time, as set forth in the original contract or as extended by Supplemental Agreement, all payment adjustments for fuel will discontinue, except that when the current price indexes are less than the price index for bidding, payment adjustments will continue to be made.

Payment Adjustment for fuel will be made under:

Item No.	Description	Pay Unit
109-01.01	Payment Adjustment for Fuel	Dollar

Monthly Payment Adjustment for Fuel Worksheet

Project No._____ Contract No._____

County_____

Fuel Price_____Price Index Bidding_____Current Price Index_____

Estimate Period: Work Performed_____Adjustment Paid_____
(Month/Year)

Item	Unit	Quantity		Fuel Factor		Total Fuel
_____	____	_____	x	_____	=	_____
_____	____	_____	x	_____	=	_____

Total Fuel for Month (Fe) = _____

$PA = [(Ic \div Ib) - 1] \times Fe \times Fp$

Final Payment Adjustment for Fuel Worksheet

Project No._____ Contract No._____

County_____

Item	Final Quantity of Work (Fq) for Specified Item	Total Quantity on Monthly Estimates (Pq) for Specified Item	Total Previous Adjustments (Ea) for Specified Item	Final Adjustment (FA) for Specified Item
_____	[(_____ ÷	_____) x	_____] -_____ =	_____
_____	[(_____ ÷	_____) x	_____] -_____ =	_____

Total Final Adjustment (Fa) = _____

$Fa = \sum [(Fq \div Pq) \times Ea] - Ea$

S T A T E **O F** **T E N N E S S E E**
(Rev. 5-15-17) January 1, 2015

SPECIAL PROVISION

REGARDING

BITUMINOUS PLANT MIX PAVEMENTS (HOT MIX)

ROADWAY DENSITY

Description: This specification covers the requirements for acceptance of asphalt roadway density by use of core samples. This provision also includes language for testing and acceptance of asphalt longitudinal joint density.

All sections of Section 407 of the Standard Specification, and Supplemental Specifications are applicable except as modified herein.

Section 407.03(D)2.h.- Contractor Quality Control System- Add the following between the second and third paragraphs:

The Contractor will be required to conduct quality control testing of surface and binder mixes for roadway density throughout placement to verify that the mixture being placed meets specified density requirements. A Quality Control Plan (QCP) for this density testing is required. Acceptable methods of quality control testing include coring, nuclear gauge testing, and non-nuclear gauge testing.

Section 407.07- Rollers. Replace the entire section with the following:

The Contractor shall use a sufficient number and type of rollers to obtain proper compaction and obtain the specified densities.

Section 407.15- Compaction. – **Replace** the entire section with the following:

A. General

After the bituminous mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly compacted. The method employed must be determined by the contractor and be capable of compacting the mixture to the specified density while it is in a workable condition. Rollers shall not park on the bituminous pavement nor shall rollers be refueled on the bituminous pavements.

B. Density Requirements

- Mix Types: A, B, BM, BM-2, D, E
- All levels of ADT
- %Gmm values specified here are for lot averages.

Travel Lane Density		
% Gmm		% Pay
Min	Max	
99.0	100	90
98.0	<99	94
97.0	<98	98
96.0	<97	100
95.0	<96	101
94.0	<95	102
93.0	<94	101
92.0	<93	100
91.0	<92	98
90.0	<91	94
89.0	<90	90
88.0	<89	86
	<88	*

Table 407DEN-1

Joint Density Incentive/Disincentive		
%Gmm		
Min	Max	$/L.F./Lot
98.0	100	*
97.0	<98	-0.70
96.0	<97	-0.42
95.0	<96	0.00
94.0	<95	0.00
93.0	<94	0.07
92.0	<93	0.14
91.0	<92	0.07
90.0	<91	0.00
89.0	<90	-0.14
88.0	<89	-0.42
87.0	<88	-0.70
86.0	<87	-0.98
	<86	*

Table 407DEN-2

*Shall be removed and replaced at the contractors expense or as directed by the engineer.

% Pay for travel lanes shall be applied to the theoretical quantity of the mix on the travel lanes only, even when the shoulder and travel lane are placed concurrently. No incentive shall be paid for the second travel lane mat unless the joint for that lot is a minimum of 90.0%.

Any lot of joint density tests averaging below 87% shall be sealed at the Contractor's expense. Approved sealers are listed on the TDOT Qualified Products List (QPL), Listing #40 for Pavement Sealers. Sealing of deficient longitudinal joint lots will only be required for surface mixes.

- Mix Types: All shoulder mixes
- All levels of ADT
- %Gmm values specified here are for lot averages.

Shoulder Density		
% Gmm		% Pay
Min	Max	
98.01	100	*
97.01	<98	96
96.01	<97	98
95.01	**<96**	**100**
94.01	**<95**	**100**
93.01	**<94**	**100**
92.01	**<93**	**100**
91.01	**<92**	**100**
90.01	**<91**	**100**
89.01	**<90**	**100**
88.01	**<89**	**100**
87.01	<88	98
86.01	<87	94
85.01	<86	90
<85	<85	*

Table 407DEN-3

*Unacceptable or as directed by the engineer.

% Pay for shoulders shall be applied to the theoretical quantity of mix on the shoulder even when the travel lane and shoulder are place concurrently.

Section 407.20.B.5 - Acceptance of the Mixture –Replace the entire subsection with the following:

5. Acceptance for Mix Density on the Roadway:

a. General. The Department will apply a deduction in payment, not as a penalty but as liquidated damages, for failure to meet the density requirements as outlined within this provision in Subsection 407.15.B. As soon as practical after the final rolling is completed on each lot, 5 density tests (1 per sublot) shall be performed by the Department at random locations determined by the Engineer, and an average of all such tests shall be computed. Any deduction for failure to meet density requirements

or incentive for exceeding density requirements shall be computed to the nearest 0.1% as a percentage of the total payment otherwise due for each lot. Although, compaction after the acceptance test is acceptable, the Department will use the original test result to determine lot density

b. Mat (Travel Lane, Turning Lane, Ramp or Shoulder) Density for density acceptance purposes, the pavement shall be divided into lots of 1,000 tons for each mix type and divided into 5 sublots. One core will be tested in each sublot and the average for the entire lot shall be compared with the requirements in Tables 407DEN-1 for travel lanes or 407DEN3 for shoulders. Control strips shall not be included as part of acceptance lots. At the beginning of the project, the first lot will begin immediately after the end of the control strip. When possible, attention should be provided to avoid cutting cores in areas where signal/loop wire may be affected. If test location selections indicate testing locations in these areas, a new random number should be selected. At the beginning of a project or at any time advisable, the Department may consider smaller lots to evaluate compaction methods or for other reasons as approved or directed by the Engineer.

c. Joint Density, for density acceptance purposes, joints shall use the same length lot as the last adjoining mat to be paved and then divided into 5 sublots. One core will be tested in each sublot from the joint and the average for the entire lot shall be compared with the requirements in Table 407DEN-2. Joints adjacent to the control strip shall not be included as part of the acceptance lots. At the beginning of a project or at any time advisable, the Department may consider smaller lots to evaluate compaction methods or for other reasons as approved or directed by the Engineer.

d. **Test Method**. Five randomly selected cores (4" min./ 6" max. diameter), from each lot, will be tested to determine density compliance and acceptance. The density (bulk specific gravity) determination for a compacted asphalt mixture shall be performed in accordance with AASHTO T-166, Method A only.

All core samples shall be COMPLETELY DRY before testing. Air drying is permitted provided core samples are weighed at 2-hour intervals until dry in accordance with AASHTO T166, Section 6.1. Cores may also be dried in accordance with ASTM D 7227.

The Bulk Specific Gravity (G_{mb}) of the cores shall be averaged for each lot.

For **mats** the maximum theoretical gravity (G_{mm}) from acceptance testing for that shift's production will be averaged and the percent density will be determined for compliance by dividing the G_{mb} average for each lot by the G_{mm} daily average.
For **joints** the maximum theoretical gravity (G_{mm}) from acceptance testing for both adjoining mat shall be averaged and the percent density will be determined for compliance by dividing the G_{mb} average for each lot by the G_{mm} daily average.

The Contractor will be responsible for obtaining the cores at the locations randomly selected by TDOT. Cores shall be tested by TDOT, by a certified plant technician.

If a lot is split between two days, determine the percent density of each individual core using the daily G_{mm} average from the day the sublot (represented by the core being tested) was paved.

After obtaining the cores, all core holes shall be properly filled and compacted in kind with hot mix asphalt. There will be no additional compensation to comply with this section.

Cores shall be clearly labeled in a discrete, sequential manner (i.e. – M1, M2,...,M30; J1, J2,...,J15) throughout the course of the project. After testing, cores shall be retained along with copies of test results and will be periodically obtained by the regional materials office for spot-check verification testing.

e. **Incentive/Disincentive Payment** shall be in accordance with tables shown in Subsection 407.15.B, "Density Requirements" above**.** Any deduction in monies due the Contractor for failure to meet the Density Requirements shall be made under the item for Density Deduction. Any incentive payment due the contractor shall be under item Density Incentive.

STATE OF TENNESSEE

August 14, 2017 January 1, 2015

SPECIAL PROVISION

REGARDING

INTELLIGENT COMPACTION (IC) FOR HOT MIX ASPHALT (HMA)

This specification covers the requirements for modification of standard HMA compaction equipment for the purpose of tracking and documenting location, and temperature. Compaction equipment and procedures shall meet all requirements listed in Standard Specifications sections **407.07** and **407.15** except as modified herein.

Global Positioning System (GPS) Requirements

Breakdown and intermediate rollers shall be equipped with GPS radio and receiver units to monitor the equipment locations and track the number of roller passes utilizing the same reference system. Reference system may be a ground-based base station or network-RTK. Network-RTK may be a third party subscription service or the contractor may subscribe at cost to the Department's GNSS Reference Network. If a Network-RTK is proposed, verify coverage inside the project limits prior to beginning work; if coverage cannot be achieved, provide a ground-based base station.

GPS receivers shall utilize the Universal Transverse Mercator (UTM) or Tennessee State Plane coordinate system. Once declared, the coordinate system utilized shall be the same for both rollers for the entire project.

GPS data shall be in the following format:

- Time: Military, local time zone, hhmmss.ss
- GPS: Latitude/Longitude, degrees/minutes ddmm.mmmmmmmm or decimal degrees dd.dddddddd
- Grid: Meters, 0.001 m

Temperature Measurement

Breakdown and intermediate rollers shall be equipped with non-contact temperature sensors for measuring pavement surface temperatures.

Integrated On-Board Documentation System

An on-board documentation system that is capable of displaying real-time color-coded maps of IC measurement values including the, location of the roller, number of roller passes, pavement surface temperatures, and roller speeds. The Intelligent Compaction System shall be

capable of transferring the data by means of a USB port or cellular upload to cloud storage at the end of each day's production. Data files shall be compatible with IC data analysis software Veta Version 4.2 or later, available at www.intelligentcompaction.com. At the end of the project, turnover a copy of the complete data set in digital format to the Department. Provide the Department access to the data on request from the beginning of the project until final delivery of the data.

System Failure

In the event that the intelligent compaction system does not work due to mechanical failure of the system, work may continue for the day's production. The Intelligent Compaction system must be operational prior to starting the next day's production.

File Name

Name Veta project files (*.VETAPROJ) using filenames CNXXXX_ROUTE_IC standardized format where XXXX is replaced by the contract number (e.g. Z999) and ROUTE is replaced with the five character State Route or Interstate designation (e.g. SR001 or I0040).

Basis of Payment

All costs of equipment and related additional expenses shall be bid under the following lump sum item:

Item	Description	Unit
407-07.01	INTELLIGENT COMPACTION EQUIPMENT	LS

S T A T E **O F** **T E N N E S S E E**

(Rev. 12-01-02) January 1, 2015
(Rev. 02-01-07)
(Rev. 10-20-07)
(Rev. 05-11-2010)

SPECIAL PROVISION

REGARDING

SECTION 411 – ASPHALTIC CONCRETE SURFACE (HOT MIX)

This provision sets up pavement smoothness requirements and how testing procedures, acceptance, and payment practices, will be handled by the Department.

Completed pavement surfaces of traffic lanes, including those on bridge deck surfaces on both the mainline and ramps between freeways that do not have stop or yield conditions shall be tested for smoothness with the Road Profiler in accordance with Department procedures.

For projects on all interstates and controlled access freeways that require the placement of BM or BM2 as a binder layer, the binder layer shall be tested for smoothness as soon as practicable after placement of the binder layer but prior to the placement of the final wearing surface. The binder layer shall have a maximum HCIRI of 60 in./mi. Any lot, or fraction thereof, of the binder layer that is greater than 60 in./mi. shall be corrected prior to placement of the final surface mix. Ramps with posted speeds less than 45 MPH shall be excluded. All corrective action shall be approved by the Engineer and shall be completed at the Contractors expense including, but not limited to, grinding and asphalt leveling.

The Contractor shall be paid monies due for items in the surface mix based on the payment table below. Any lot (one mile or fraction thereof) of pavement where the Road Profiler's Half Car International Roughness Index value exceeds 70 inches per mile, as shown in the payment table below, will require corrective action. Any unacceptable lot(s) will be divided into 0.1-mile sub-lots for closer evaluation. The Contractor, at his discretion, shall choose those sub-lots, within the unacceptable lot, to correct in order to bring the overall lot into the acceptable smoothness range. However, the Contractor may not choose more than 3 sub-lots for repair, unless they are adjacent to each other and there are no more than 6 transverse joints. Otherwise, the entire lot will require corrective action. The minimum corrective action shall be the length of the entire sub-lot of 0.1 mile. The only acceptable corrective action is mill and inlay. Payment for the corrected one mile lot(s) will be based on the Road Profiler's Half Car International Roughness Index after corrective action has been taken.

Each lot of pavement will be tested by one pass of the Road Profiler. If corrective action is required, a second pass will then be made to determine the payment for the corrected lot(s).

Payment table for smoothness based on Road Profiler Half Car International Roughness Index values

SPECIFICATION 411B			
Road Profiler Value Half Car IRI (IN/MI)	Percentage paid on bid price of surface items	Road Profiler Value Half Car IRI (IN/MI)	Percentage paid on bid price of surface items
Less than 25	110%	48	97%
25	110%	49	96%
26	109%	50	95%
27	108%	51	94%
28	107%	52	93%
29	106%	53	92%
30	105%	54	91%
31	104%	55	90%
32	103%	56	88%
33	102%	57	86%
34	101%	58	84%
35	100%	59	82%
36	100%	60	80%
37	100%	61	77%
38	100%	62	74%
39	100%	63	71%
40	100%	64	68%
41	100%	65	65%
42	100%	66	61%
43	100%	67	57%
44	100%	68	53%
45	100%	69	49%
46	99%	70	45%
47	98%	Greater than 70	Mill and Inlay*

* The mill and inlay shall be the thickness as specified on the plans for the surface layer.

S T A T E **O F** **T E N N E S S E E**

(Rev. 02-03-15) January 1, 2015
(Rev. 10-19-15)

SPECIAL PROVISION

REGARDING

FULL DEPTH AND PARTIAL DEPTH CONCRETE PAVEMENT REPAIR

Description. This work shall consist of performing full depth or partial depth concrete pavement repair in accordance with this Special Provision and in reasonably close conformity with the design set out on the plans or established by the Engineer. The provisions of **Section 501** of the **Standard Specifications for Road and Bridge Construction** shall apply except as herein revised.

Materials. Coarse aggregate shall be crushed stone, crushed slag, or washed gravel meeting the requirements of 903.03 and the grading requirements of Subsection 903.22 for size #57 aggregate; all other materials shall conform to **Subsection 501.02** of the **Standard Specifications for Road and Bridge Construction.**

Chemical admixtures shall meet the requirements of Subsection 921.06 and be approved by the Department.

Partial Depth patching material shall be a concrete mixture meeting the requirements below or an approved non-shrink grout or epoxy concrete.

Dowel bars and tie bars shall be epoxy coated in accordance with ASTM D 3963 and **Subsection 907.02**. The bar sizes shall be determined from the Standard Drawings. Epoxy used to adhere dowel and tie bars shall be approved by the Department.

Proportioning. A workable concrete mix utilizing size Type I cement, #57 aggregate and natural sand conforming to Subsection 501.02, and having a slump not greater than 63 mm (2 1/2 inches) shall be required. The slump may be increased to a maximum of 150 mm (6 inches) when using an approved high range admixture. The mixture shall have a minimum compressive strength of 13.8 MPa (2000 psi) within 8 hours. The mixture shall have a maximum water to cement ratio of 0.40 including admixtures. The percentage of air entrained in the mix shall be five percent, with a tolerance of plus three or minus two percentage points.

Equipment. Equipment and tools necessary for handling materials and performing all parts of the work shall conform to **Subsection 501.04**.

Construction Requirements. The construction shall conform to the requirements of Section 501 in so far as the requirements do not conflict with the requirements herein specified or unless otherwise directed by the Engineer.

Full depth and partial depth concrete pavement repair shall be performed as shown on the plans. If the depth of the partial depth concrete pavement repair (Spall Repair) exceeds 100 mm (4 inches), the pavement area to be repaired shall be removed and replaced full depth, to the dimensions shown on the plans for Concrete Pavement Replacement, or as directed by the Engineer.

The slabs shall be removed by lifting, unless the slab is deteriorated such that lifting is not possible. An adequate lifting machine will be required to minimize damage to the sub-base. Any soft base material shall be removed and replaced. All loose base material shall be compacted. The method of removal shall not spall or damage any existing concrete pavement.

The area adjacent to the spall area shall be sounded to determine the limits of partial depth repair. The hammer for chipping will be a maximum of 14 kg (30 lbs).

Patching material for partial depth repairs may be mixed on site in small mobile drum or paddle mixers.

Joints. Joints shall be constructed for full depth repair and shall conform to Subsection 501.15. Dowel and tie bar holes shall be drilled in the locations shown on the Plans. After drilling, the hole shall be cleaned either pneumatically or with a wire brush. A sufficient amount of epoxy shall be inserted at the back of the drill hole and the bar inserted with a twisting motion to assure uniform distribution of epoxy. Excess epoxy shall be removed.

Finishing and Curing. After properly vibrating the concrete in place, the patch shall be finished using a vibratory screed parallel to the centerline such that it meets the existing grade and profile. Curing shall be completed in accordance with Subsection 501.18 (c).

Partial depth repairs shall be finished from the center outwards to the edges.

Opening to Traffic. Traffic shall not be allowed on the newly placed concrete until a test cylinder break of at least 13.8 MPa (2000 psi) is attained.

Sampling and Testing. The concrete shall be tested in accordance with Section 501. The Engineer also will perform tests for slump and air content as often as deemed necessary to maintain uniform, quality concrete. In addition, prior to the start of the project and before any concrete is placed, the contractor shall batch, and mix a one-cubic meter (yard) trial batch of mix. The trial batch shall be made using the same equipment and procedures as is to be used on the project. Slump and air content shall be taken on the trial batch and test cylinders shall be made. A minimum strength of psi13.8 MPa (2000) in 8 hours shall be required on the test cylinders. If the trial batch does not produce the required results, adjustments shall be made by the Engineer and a new trial batch shall be required. During the progress of the job, if the Engineer deems necessary additional trial batches may be required. No direct payment will be made for the trial batching.

Unsatisfactory Work. Repaired areas which do not produce a relatively smooth riding surface, show excessive shrinkage, cracking, or do not produce an adequate bond to the adjacent slab shall be removed and replaced at the contractor's expense.

Method of Measurement. Full Depth Portland Cement Concrete Pavement Repair shall be measured by the cubic yard in accordance with Section 109.

Partial Depth Portland Cement Concrete Pavement Repair (Spall Repair) which becomes full depth repair because the depth of repair exceeds (4 inches) shall be measured by the square yard as FULL DEPTH PCC PAVEMENT REPAIR .

Sawing Concrete Pavement (Full Depth) will be measured by the linear meter (foot). The Load Transfer Dowels and the Transverse Tie Bars will be measured by the unit, per each.

No measurement for payment will be made for removing and disposing of the existing portland cement concrete pavement, drilling holes, grouting, joint materials, etc., required in conjunction with the specified concrete pavement repair; and the cost for this work shall be included in the price bid for other items.

Basis of Payment. The accepted quantities will be paid per unit of measurement, respectively, for each of the pay items shown below and on the bid schedule. The price shall be full compensation for performing all operations incidental thereto; and for furnishing all materials, equipment, tools, labor, and incidentals necessary to complete the work.

502-03.20	FULL DEPTH PCC PAVEMENT REPAIR	C.Y.
502-03.21	PARTIAL DEPTH PCC PAVEMENT REPAIR	S.Y.
502-04.01	SAWING CONCRETE PAVEMENT (FULL DEPTH)	L.F.
502-04.02	LOAD TRANSFER DOWELS	EACH
502-04.03	TRANSVERSE DOWEL BARS	EACH

STATE OF TENNESSEE

(Rev. 09-30-2015) January 1, 2015
(Rev. 10-19-2015)

SPECIAL PROVISION

REGARDING

FULL DEPTH AND PARTIAL DEPTH CONCRETE PAVEMENT REPAIR

(HIGH EARLY STRENGTH)

Description. This work shall consist of performing full depth or partial depth concrete pavement repair in accordance with this Special Provision and in reasonably close conformity with the design set out on the plans or established by the Engineer. The provisions of Section 501 of the **Standard Specifications for Road and Bridge Construction** shall apply except as herein revised.

Materials. Coarse aggregate shall be crushed stone, crushed slag, or crushed gravel meeting the requirements of 903.03 and the grading requirements of Subsection 903.22 for size #57 aggregate; all other materials shall conform to Subsection 501.02 of the Standard Specifications for Road and Bridge Construction.

The cement used in this construction shall be a Type I, Type III, or a rapid setting cement listed on TDOT's Qualified Products List (QPL).

Chemical admixtures shall meet the requirements of Subsection 921.06(A) and be approved by the Department.

Partial Depth patching material shall be a concrete mixture meeting the requirements below or an approved non-shrink grout or epoxy concrete from the QPL.

Dowel bars and tie bars shall be epoxy coated in accordance with ASTM D 3963, TDOT Standard Section 907.02, and listed on the QPL. The bar sizes shall be determined from the Standard Drawings.

Proportioning. A workable concrete mix utilizing an approved cement, #57 aggregate and natural sand conforming to Subsection 501.02, and having a slump not greater than 2 inches shall be required. The slump may be increased to a maximum of 6 inches when using an approved high range admixture. The mixture shall have a maximum water to cement ratio of 0.40 including admixtures. The percentage of air entrained in the mix shall be five percent, with a tolerance of plus three or minus two percentage points.

The mixture shall have a minimum compressive strength of 2500 psi within 6 hours. However, the time frame of 6 hours may be reduced depending on the Contractor's mode of

operation. The Contractor shall submit to the Engineer in writing the time frame in which the minimum compressive strength will be attained. The Contractor shall be responsible for attaining the minimum compressive strength prior to opening the pavement to traffic.

Sampling and Testing. Prior to the start of the project and before any concrete is placed, the contractor shall batch, and mix a one-cubic yard trial batch of mix. The trial batch shall be made using the same equipment and procedures as is to be used on the project. An approved TDOT representative will test the trial batch for slump and air content and test cylinders shall be made. A minimum strength of 2500 psi within the designated time frame shall be required on the test cylinders. If the trial batch does not produce the required results, adjustments shall be made by the Engineer and a new trial batch shall be required. During the progress of the job, if the Engineer deems necessary, additional trial batches may be required. No direct payment will be made for the trial batching.

Acceptance. The concrete shall be tested and accepted in accordance with Section 501 and Standard Operating Procedure 1-1. The Contractor also will perform quality control tests for slump and air content as often as deemed necessary to maintain uniform, quality concrete.

Equipment. Equipment and tools necessary for handling materials and performing all parts of the work shall conform to Subsection 501.04.

Construction Requirements. The construction shall conform to the requirements of Section 501 in so far as the requirements do not conflict with the requirements herein specified unless otherwise directed by the Engineer.

Full depth and partial depth concrete pavement repair shall be performed as shown on the plans. If the depth of partial depth concrete pavement repair (Spall Repair) exceeds 4 inches, the pavement area to be repaired shall be removed and replaced full depth, to the dimensions shown on the plans for Concrete Pavement Replacement, or as directed by the Engineer.

The slabs shall be removed by lifting, unless the slab is deteriorated such that lifting is not possible. An adequate lifting machine will be required to minimize damage to the sub-base. Any soft base material shall be removed and replaced. All loose base material shall be compacted. The method of removal shall not spall or damage any existing concrete pavement.

The area adjacent to the spall area shall be sounded to determine the limits of partial depth repair. The hammer for chipping shall be a minimum of 30 lbs.

Patching material for partial depth repairs may be mixed on site in small mobile drums or paddle mixers.

Joints. Joints shall be constructed for full depth repair and shall conform to subsection 501.15. Dowel and tie bar holes shall be drilled in the locations shown on the Plans or reference drawings. After drilling, the hole shall be cleaned either pneumatically or with a wire brush. A sufficient amount of epoxy shall be inserted at the back of the drill hole and the bar inserted with a twisting motion to assure uniform distribution of epoxy. Excess epoxy shall be removed.

Finishing and Curing. After properly vibrating the concrete in place, the patch shall be finished using a vibratory screed parallel to the centerline such that it meets the existing grade and profile. Curing shall be completed in accordance with Subsection 501.18(c).

Partial depth repairs shall be finished from the center outwards to the edges.

Opening to Traffic. Traffic shall not be allowed on the newly placed concrete until a test cylinder break of at least 2500 psi is attained.

Unsatisfactory Work. Repaired areas which do not produce a relatively smooth riding surface, show excessive shrinkage, cracking, or do not produce an adequate bond to the adjacent slab shall be removed and replaced at the contractor's expense.

Method of Measurement. Full depth Portland Cement Concrete Pavement Repair shall be measured by the cubic yard in accordance with Section 109.

Partial Depth Portland Cement Concrete Pavement Repair(Spall Repair) shall be measured by the square yard in accordance with Section 109. Spall Repair which becomes full depth repair because the depth of repair exceeds 4 inches shall be measured by the cubic yard as FULL DEPTH PCC PAVEMENT REPAIR full and partial depth Portland cement concrete pavement repair.

Sawing Concrete Pavement (Full Depth) will be measured by the linear foot. The Load Transfer Dowels and the Transverse Tie Bars will be measured by the unit, per each.

No measurement for payment will be made for removing and disposing of the existing Portland cement concrete pavement, drilling holes, grouting, joint materials, etc., required in conjunction with the specified concrete pavement repair; and the cost for this work shall be included in the price bid for other items.

Basis of Payment. The accepted quantities will be paid for per unit of measurement for each of the pay items shown below andon the bid schedule. The price shall be full compensation for performing all operations incidental thereto and for furnishing all materials, equipment, tools, labor and incidentals necessary to complete the work.

502-03.25	FULL DEPTH PCC PAVEMENT REPAIR HIGH EARLY	C.Y.
502-03.26	PARTIAL DEPTH PCC PAVEMENT REPAIR HIGH EARLY	S.Y.
502-04.01	SAWING CONCRETE PAVEMENT (FULL DEPTH)	L.F.
502-04.02	LOAD TRANSFER DOWELS	EACH
502-04.03	TRANSVERSE DOWEL BARS	EACH

S T A T E **O F** **T E N N E S S E E**

(Rev. 5-1-95) January 1, 2015
(Rev. 12-1-01)

SPECIAL PROVISION

REGARDING

CLEANING AND RESEALING TRANSVERSE AND

LONGITUDINAL JOINTS AND RANDOM CRACKS

Description. This work shall consist of cleaning and resealing existing transverse and longitudinal joints and random cracks in portland cement concrete pavement, and joints between portland cement concrete pavement and asphaltic concrete pavement.

Materials. Material used to seal joints shall conform to the requirements of Subsection 905.05.

Equipment. All equipment necessary for the satisfactory performance of this construction shall be on the job and approved by the Engineer before work will be permitted to begin.

Joint Sealants shall be placed with equipment recommended by the sealant manufacturer. The equipment shall be capable of maintaining a uniform, homogeneous, mixture throughout the sealing operation.

Construction Requirements. Unless otherwise specified on the Plans, the longitudinal joints between Portland cement pavement and asphaltic pavement shall be prepared by sawing, or other approved method, so that an opening one inch wide by one inch deep measured from the lowest elevation is formed. Shoulder joints shall be filled full depth.

Pavement joints shall be re-sawed to the dimensions shown on the plans or as directed by the Engineer. Both sides of the joint shall be sawed in order to be thoroughly cleaned of all oil, grease, old sealant and all other foreign material. The faces of all sawed joints shall be sandblasted so that the sealant will adhere to the side of the joint. The sand shall be clean, sharp and have 100 percent passing the 2.0 millimeter (No. 10) sieve. The nozzle pressure shall be such that the joints will be cleaned out and the edges will have etched surfaces. Sandblasting and cleaning shall be done immediately prior to sealing, to assure proper preparation. Joints shall be dry before sealing.

Random Cracks shall be routed or chipped to the dimensions shown on the plans or as directed by the Engineer and shall be cleaned of all foreign material as specified above for joints.

The sealant shall be applied so that it flows into the joint without overlapping onto the concrete pavement. All sealant which overlaps onto the concrete pavement shall be removed by the contractor at his expense.

Hot poured sealant applied at other than the shoulder joint shall be placed to a depth as shown on plans after the bond breaker media has been placed to provide the proper shape factor. The sealant shall be applied in accordance with the manufacturer's recommendations and a primer shall be furnished and applied prior to sealing if so indicated in the recommendation. Any sealant spilled on the concrete shall be promptly removed.

The silicone sealant and backer rod shall be applied as shown on the plans and in accordance with the manufacturer's recommendations except as modified hereafter. The thickness of the silicone material measured from the highest point of the backer rod to the lowest point in the trough formed by the silicone material shall be as dimensioned on the plans within a tolerance of plus or minus 2 millimeters (1/16 inch). The application of primer shall be required if it is included in the manufacturer's recommendations.

Method of Measurement. Resealing Joints and Resealing Random Cracks will be measured by the meter (linear foot) along the surface of the joint or crack. No measurement of width or depth will be made.

Basis of Payment. Payment for Resealing Joints and Resealing Cracks shall be full compensation for the item complete in place, including sawing, cleaning, furnishing and installing all materials and all incidentals of the work. No additional payment will be made for irregular joint and crack widths or depths.

S T A T E **O F** **T E N N E S S E E**

REV. 10-22-01 January 1, 2015

SPECIAL PROVISION

REGARDING

GRINDING CONCRETE PAVEMENT

Description. The work shall consist of grinding Portland Cement Concrete Pavement to substantially eliminate joint faulting and/or to restore proper drainage, riding characteristics and skid resistance to the pavement surface. The work shall be accomplished in accordance with these Specifications and in reasonably close conformity to the details on the Plans.

Equipment. The grinding equipment shall be a power driven, self-propelled machine that is specifically designed to smooth and texture Portland Cement Concrete Pavement with diamond blades. The effective wheel base of the machine shall not be less than 12.0 feet. It shall have a set of pivoting tandem bogey wheels at the front of the machine and the rear wheels shall be arranged to travel in the track of the fresh cut pavement. The center of the grinding head shall be no further than 3.0 feet forward from the center of the back wheels.

The equipment shall be of a size that will cut or plane at least 3.0 feet wide. It shall also be of a shape and dimension that does not encroach on traffic movement outside of the Work area. The equipment shall be capable of grinding the surface without causing spalls at cracks, joints, or other locations.

Equipment other than that specified above may be used when permission to do so is requested by the Contractor and granted by the Engineer in accordance with Subsection 105.17.

Construction. The Plans will designate the areas of pavement surfaces to be ground. Grinding of bridge decks and roadway shoulders will not be required unless indicated on the Plans or required to improve drainage.

The construction operation shall be scheduled and proceed in a manner that produces a uniform finished surface. Grinding will be accomplished in a manner that eliminates joint or crack faults while providing positive lateral drainage by maintaining a constant cross-slope between grinding extremities in each lane. Auxiliary or ramp lane grinding shall transition as required from the mainline edge to provide positive drainage and acceptable riding surface. The entire area designated on the Plans shall be ground until the pavement surfaces of adjacent sides of transverse joints and cracks are in the same plane. The operation shall result in pavement that conforms to the typical cross-section and requirements specified herein. It is the intention of this Specification that the faulting at joints and cracks be eliminated, that the overall riding

characteristics be within the limits specified, and that substantially all of the pavement surface be textured except that extra depth grinding to eliminate minor depressions in order to provide texturing for 100 percent of the pavement surface will not be required.

The Contractor shall establish positive means for removal of grinding and/or grooving residue. Solid residue shall be removed from pavement surfaces before being blown by traffic action or wind. Residue shall not be permitted to flow across lanes used by public traffic or into gutters or drainage facilities. Residue shall be disposed of in a manner that will prevent residue, whether in solid or slurry form, from reaching any waterway in a concentrated state.

Residue may be continuously discharged on adjacent roadway slopes or ditches if the Engineer determines that there is sufficient vegetative cover to adequately filter the residue. However, if the Engineer determines that there is not sufficient vegetative cover on the adjacent roadway slopes and ditches to adequately filter the residue, then the residue shall be collected in approved storage tanks and deposited in settling basins, spread over flat vegetated areas, or filtered by other means approved by the Engineer.

Final Surface Finish. The grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. The line type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy type appearance. The peaks of the ridges shall be approximately 1/16 inch higher than the bottoms of the grooves with approximately 50 to 52 evenly spaced grooves per foot for pavements constructed with limestone coarse aggregate and 53 to 57 evenly spaced grooves for pavements constructed with aggregate other than limestone. Grinding chip thickness shall be a minimum of 0.100 inches thick for pavements constructed with limestone coarse aggregate and a minimum of 0.080 inches thick for pavements constructed with coarse aggregate other than limestone.

The finished pavement surface shall be measured for riding quality. The grinding shall produce a riding surface, which does not exceed the specified requirements indicated below.

Ground pavement surfaces on mainline traffic lanes, auxiliary lanes, ramps, acceleration lanes and deceleration lanes shall be tested with the Rainhart Profilograph using a 2.5 millimeter (0.1 inch) blanking band.

Any area 0.1 mile in length with a Rainhart Profilometer roughness index value in excess of the applicable values specified below shall be reground for profile with equipment approved by the Engineer:

1. Mainline traffic lanes and auxiliary lanes more than one half mile in length - 0.7 inch.

2. Auxiliary lanes one half mile in length or less, ramps, acceleration lanes and deceleration lanes - 1 inch.

Grinding along the inside edge of the existing pavement shall conform to the straightedge requirements.

Transverse joints and random cracks shall be visually inspected to insure that adjacent surfaces are in the same plane. Misalignment of the planes of the surfaces on adjacent sides of the joints or cracks which is in excess of 1/16 shall be ground until the surfaces are flush.

The transverse slope of the pavement shall be uniform to a degree that no depressions or misalignment of slope greater than 1/4 inch in 12 feet are present when tested with a straightedge placed perpendicular to the centerline. Straightedge requirements do not apply across longitudinal joints or outside of areas ground.

Measurement. Grinding Concrete Pavements will be measured by the square yard. The quantity of pavement grinding will be determined by multiplying the finished ground width by the total length ground.

Basis of Payment. The Contract Price per square yard for grinding concrete pavement shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all work involved in grinding the existing surface, removing residue and cleaning the pavement in accordance with these Specifications and as shown on the Plans.

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

SPECIAL PROVISION

REGARDING

DOWEL BAR RETROFITTING

DESCRIPTION

The work consists of installing epoxy coated 1-1/2 inch diameter by 18 inch long plain round dowel bars into existing concrete pavement. The existing Portland Cement Concrete pavement shall be slotted and the dowel bars shall be retrofit across pavement cracks and/or joints.

MATERIALS (See Standard Specifications for other details)

Dowel bars, including the ends, shall be epoxy coated. The dowel bars shall also be further coated prior to installation with a bond breaking compound. The bond breaking coating shall be one of the approved products appearing on the Department's Qualified Products List.

The dowel bars shall have tight fitting end caps made of nonmetallic material that allows for 1/4 inch bar movement at each end of the bar. The Contractor shall submit an end cap sample to the Engineer for approval prior to installation.

Chair devices for supporting and holding the dowel bar in place during placement of the patching material shall be completely epoxy coated and made of nonmetallic material. The Contractor shall submit a chair sample to the Engineer for approval prior to installation.

The foam core board filler material shall be 1/4 inch thick, constructed of closed cell foam and faced with poster board material on each side. The foam core board is to be used when existing transverse joints are being retrofitted.

The caulk for sealing the existing crack/joint at the bottom and sides of the slot shall be a commercial grade of silicone caulk containing a minimum of 50 percent silicone.

The Portland cement concrete pavement that is removed to install the dowel bars shall be replaced with one of the following approved patching products: Patchroc 1060, Five Star Highway Patch, Burke 928 Fast Patch, or an approved equal. The use of Set 45 will not be allowed.

The patching material may be extended with aggregate meeting the manufacturer's recommendations. The Contractor shall provide a concrete mix design, including all additives, to meet a minimum compressive strength of 4,000 psi in 6 hours.

The Contractor shall verify the results of the mix design prior to beginning work. If the mix design is not satisfactory, the Contractor shall provide the Department with a mix design that meets the requirement

prior to the beginning of work.

CONSTRUCTION REQUIREMENTS

The Contractor shall install the dowel bars in the existing Portland cement concrete pavement as shown in the plans and according to the following requirements:

1. Diamond saw cut the pavement to place the center of the dowel bar at mid-depth in the pavement. Multiple saw cuts parallel to the center line may be required to properly remove the waste material from the slot. The saw cuts for the six slots at each transverse crack/joint shall be made such that the dowel bars are placed within the following tolerances:

   Centerline of individual dowel bars shall be parallel to the top of pavement, parallel to the ether dowel bars, and parallel to the roadway centerline within + or - 1/4 inch in 18 inches.

2. Any jackhammers used to break loose the concrete shall net be larger than the 30 pound class. If the pavement is damaged by the 30 pound jackhammer, the engineer will require the Contractor to use a 15 pound hammer.

3. All surfaces exposed and cracks in the slot shall be sand blasted and cleaned prior to bar installation.

4. The crack/joint on the bottom and the sides of the slot shall be filled with silicone caulk.

5. The dowel bars shall be lightly coated with the bond breaking compound prior to placement. The bar chairs shall provide a minimum of 1/2 inch clearance between the bottom of the dowel bar and the bottom of the slot. The dowel bar shall be placed to the depth shown on the plans, parallel to centerline and the top of the roadway surface, and at the middle of the slot, all within the specified tolerances. The chairs shall hold the dowel bar securely in place during placement of the patching mix.

   Longitudinal dowel bar placement for skewed joints or cracks shall be within + or - 2 inches. Longitudinal dowel bar placement for perpendicular joints shall be within + or - 1 inch.

6. The 1/4 inch thick foam core board shall be placed at the middle of the dowel bar to maintain a transverse contraction joint. The existing joint sealant may need to be cut or removed to accommodate the 1/4 inch thick foam core board with 1/2 inch by 1 inch tabs. The tabs are required to stabilize the foam core board during patching material placement. The foam core board shall fit tightly around the dowel bar and to the bottom and edges of the slot. The top of the foam core board shall be flush with the top surface of the concrete pavement.

   The Contractor may need to increase the width of the foam core board for pavements with skewed joints. The skew angle may vary for different pavement sections.

   The Contractor shall caulk the transverse joint crack at the bottom and the sides of the slot on both sides of the 1/4 inch thick foam core board. The foam core board shall be capable of remaining in a vertical position and tight to all edges during the placement of the patching material.

If for any reason the foam core board shifts during the placement of the patching material, the work shall be rejected and replaced at the Contractor's expense.

7. The Contractor shall thoroughly moisten all surfaces on the sawed slot immediately prier to filling with patching compound. Care shall be taken to prevent standing water in the slot. All excess water shall be removed with compressed air.

   The Contractor shall fill the slot (with the installed dowel bar, chairs, foam core board where used, and silicone in place) with an approved patching material. The patching material shall be vibrated with a small hand held vibrator capable of thoroughly consolidating the patching material into the slot and around the dowel bar. The top surface of the filled slot shall be trowel finished and cured immediately after each group of three dowels are installed. The curing compound shall meet the requirements of the Standard Specifications.

   The patching material shall be mixed with a hand mixer. The Engineer will test the patching material once every four hours of production. The patching material shall have a minimum compressive strength of 4,000 psi in 6 hours. Department compression testing may be performed up to 24 hours after the cylinders are made. If the compressive strengths are not being met, production shall cease and the Contractor shall resubmit a concrete mix design correcting the strength problems.

8. The transverse contraction joints shall be sawed and sealed as required in the Standard Drawings within 24 hours after placement of the patching material.

9. Any damage to the pavement due to the Contractor's operation shall be repaired or replaced at the expense of the Contractor.

MEASUREMENT

Dowel bar retrofit will be measured by each dowel bar installed and accepted.

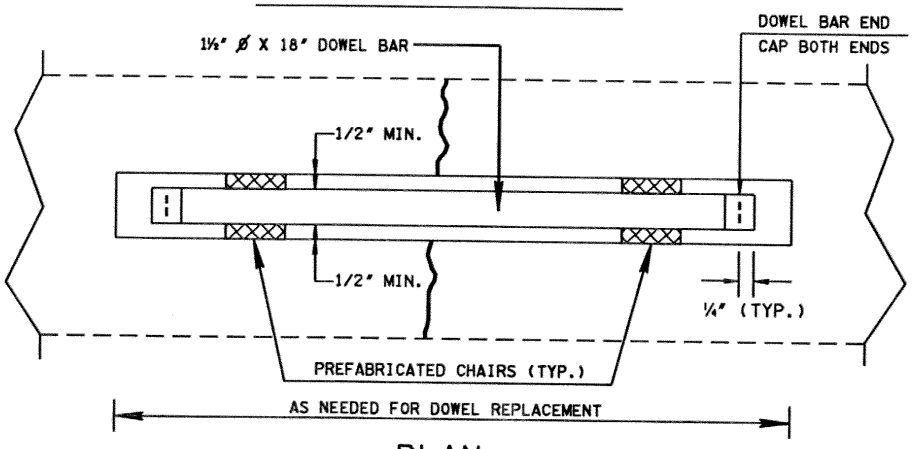
PAYMENT

Dowel bar retrofit will be paid at the contract unit price bid per each dowel bar. Payment shall be full compensation for equipment, materials, labor, and all incidentals required.

SP503DB

DOWEL BAR RETROFIT DETAILS

SP503DB



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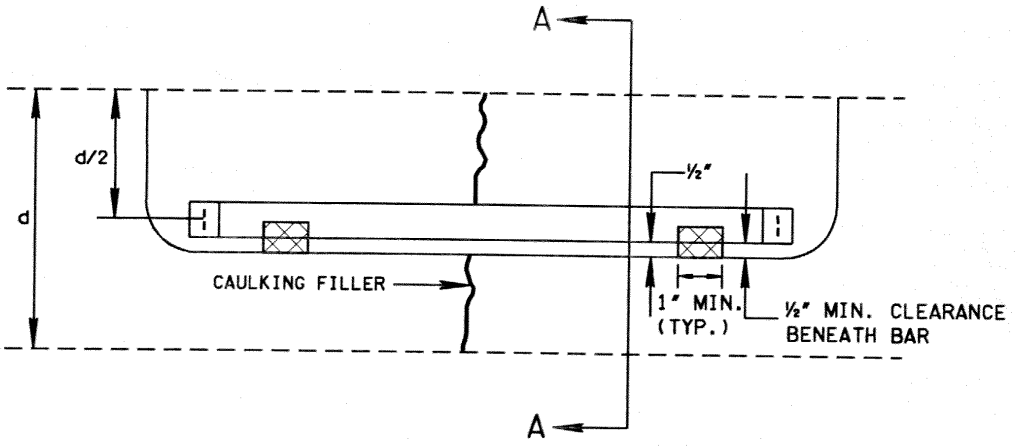

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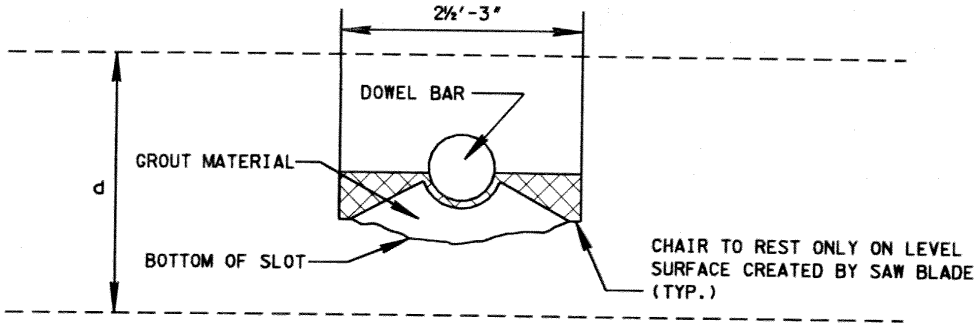
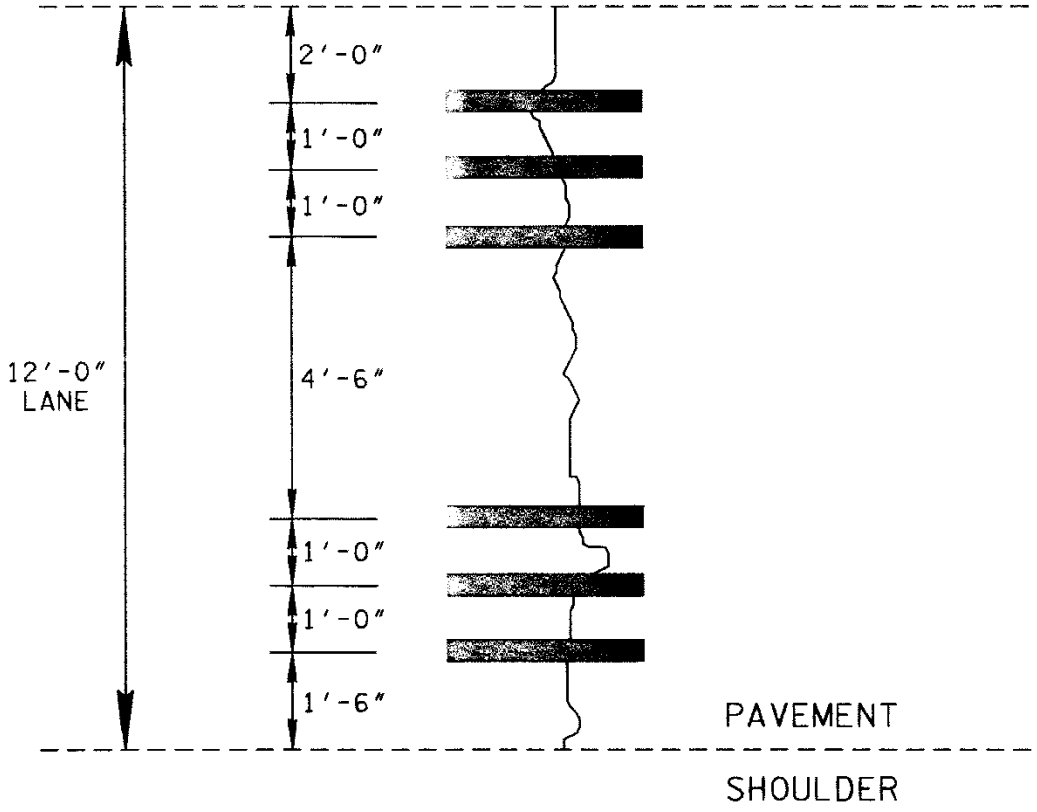


SECTION A-A

SP503DB SP503DB



DOWEL BAR PLACEMENT

S T A T E **O F** **T E N N E S S E E**

(Rev. 3-18-96)
(Rev. 4-01-05)
(Rev. 7-15-05)

March 1, 2006

SPECIAL PROVISION

REGARDING

SECTION 602 STEEL STRUCTURES

The cost of structural steel inspection (QA), limited to the rates established below, will be paid by the Department:

Steel Structures (Weight Range)	**Inspection Cost**
Up to 833,000 pounds (First 377,850 Kgs.)	$25,000.00 L.S. ($25,000 L.S)
If Total Structural weight is between 833,000 and 2,500,000 pounds (Kgs. Between 377,850 and 1,134,000)	$0.03 per pound ($0.065 per Kg.)
If Total Structural weight is greater than 2,500,000 pound (Kgs. Over 1,134,000)*	$75,000 L.S. plus $0.01 per pound greater than 2,500,000 pounds ($0.022 per Kg.)

*For Complex Structures (Trusses, Box Member Bridges when box members are over fifty percent of the structure) and projects with more than five steel bridges:

If Total Structural weight is greater than 2,500,000 pound (Kgs. Over 1,134,000)	$75,000 L.S. plus $0.02 per pound greater than 2,500,000 pounds ($0.044 per Kg.)

The above rates shall be applied as specified in **Subsection 602.04** of the Standard Specifications.

S T A T E **O F** **T E N N E S S E E**

(Rev. 2-19-96) January 1, 2015

SPECIAL PROVISION

REGARDING

REPAIR OF BRIDGE DECK CRACKS

Description. This work shall consist of the cleaning and repairing of all visible bridge deck cracks in accordance with these specifications, the Standard Specifications, the contract plans or as directed by the Engineer. Cracks shall be repaired using a High Molecular Weight Methacrylate (HMWM).

Materials. The material used for treating cracks shall be a low viscosity, non-fuming, high molecular weight methacrylate resin listed on the Department's approved products list and conforming to the following:

Physical Property	Requirement
Viscosity	25 cps, maximum (Brookfield RVT with UL adaptor, 50 RPM at 25°C (77°F))
Density	0.9 kg/L (7.5 lbs/gal), minimum, at 25°C (77°F)
Flash Point	82°C (180°F), minimum
Vapor Pressure	1.0 mm Hg, maximum at 25°C (77°F)
Gel Time	20 minutes minimum at application temperature
Tack Free Time	6 hours maximum
Bond Strength	10.3 MPa (1500 psi) minimum (ASTM C 882)

The contractor shall have a qualified representative on site to provide expert assistance to the Contractor on storage, mixing, application, clean-up and disposal of materials.

The promoter and initiator, if supplied separately, shall not contact each other directly. Containers of promoters and initiators shall not be stored together in a manner that will allow leakage or spillage from one to contact the containers or material of the other.

The quantity of resin mixed with promoter and initiator shall be limited to 20 liters (5 gallons) at a time for manual application. A significant increase in viscosity shall be cause for rejection. The mixed resin shall be applied within 10 minutes after complete mixing.

A Material Safety Data Sheet (MSDS) shall be furnished for the HMWM resin promoter and initiator to be used. A certification showing conformance to these specifications shall be provided with each batch of resin.

Aggregate materials shall consist of clean, dry, fine grained sand as per resin manufacturer specifications.

Surface Preparation. Preparation of the concrete bridge deck surface shall consist of air blasting all visible cracks with oil free compressed air using sufficient air pressure to remove all loose or objectionable material from the cracks and bridge deck surface as approved by the Engineer The surface cracks shall be visually dry before treatment with HMWM is allowed to begin.

Application of HMWM. The contractor shall plan and prosecute his operations in such a manner as to protect persons and vehicles from injury or damage.

The concrete surface temperature shall not be less than 10°C (50° F) and not more than 38°C (100° F) at the time of resin application.

In applying to individual cracks on a linear foot basis the resin shall be applied at an average rate of one liter per 16 linear meters (one (1) gallon per 200 linear feet) or as directed by the Engineer. Large cracks (wider than 0.75 mm (0.03 inches)) should be pre-filled with sand before applying resin. Each crack shall be treated with resin by ponding the resin over the crack and allowing gravity to feed the material into the crack. The resin shall be ponded over each crack for 5-10 minutes. The ponding procedure shall be repeated until each crack is sealed.

If applying to the total deck surface on a square meter (square yard) basis, the deck surface shall be flooded with resin, allowing penetration into the concrete and filling of all cracks. The rate of application of promoted/initiated resin shall be approximately 2.2 square meters per liter (10 square yards per gallon), the exact rate shall be determined by the Engineer. Excess material shall be redistributed by squeegee or brooms within 10 minutes after application. The entire treated area of the bridge deck shall have sand broadcast by mechanical means to effect a uniform coverage of 0.14 to 0.16 kilograms per square meter (0.25 to 0.30 pounds per square yard).

Traffic shall not be permitted on the treated bridge deck until the treated cracks are tack free (non-oily).

Measurement and Payment. Bridge Deck Sealing shall be measured and paid for at the contract unit price per square meter (square yard) which price shall be full compensation for all labor, materials (except sealant), equipment, surface preparation and incidentals required for the satisfactory completion of the work.

Bridge Deck Crack Sealing shall be measured and paid for at the contract unit price per linear meter (linear foot) which price shall be full compensation for all labor, materials (except sealant), equipment, surface preparation and incidentals required for the satisfactory completion of the work.

Sealant shall be measured and paid for at the contract unit price per liter (gallon) which price shall be full compensation for furnishing the sealant material for individual crack sealing or sealing of areas by flooding.

S T A T E **O F** **T E N N E S S E E**

(Rev. 3-30-15) January 1, 2015

SPECIAL PROVISION

REGARDING

BRIDGE DECK PREPARATION USING HYDRODEMOLITION

Description: This work shall consist of the removal of bridge deck concrete using hydrodemolition equipment as preparation for bridge deck repairs or overlay. All work shall be performed in accordance with the details shown on the plans or as directed by the Engineer.

Equipment and Materials. The hydrodemolition equipment shall be a self-propelled machine that utilizes a high pressure water jet stream capable of removing concrete to the depths shown on the plans or as directed by the Engineer and be capable of removing rust and concrete particles from reinforcing steel. Pneumatic hammers, 35 pound class maximum, may be used in areas that are inaccessible or inconvenient to the self-propelled machine such as, but not limited to, areas not to exceed one foot away from curbs or parapets.

Construction Requirements. Prior to the commencement of the removal operation, the hydrodemolition equipment shall be calibrated on an area of sound concrete approximately 2 ft. x 5 ft. as directed by the Engineer. The cost of the calibration procedure shall be included in the unit price bid for hydrodemolition. The Engineer shall verify the following settings:

1. Water pressure.
2. Machine staging control (step).
3. Nozzle size.
4. Nozzle speed (travel).

During the calibration, any or all of the above settings may be adjusted in order to achieve removal in accordance with the requirements of the plans. When the designated depth of removal is attained, the settings shall be recorded and maintained throughout the removal operation unless otherwise directed by the Engineer. The depth of removal shall be verified periodically and, if necessary, the equipment re-calibrated to insure the plans depth of removal.

After the hydrodemolition is completed, the deck shall be inspected (by sounding) to insure that all partial depth deteriorated concrete has been removed. Should deteriorated concrete be found, the Contractor shall remove the areas of deteriorated concrete by additional passes of the hydrodemolition equipment or jackhammers. No additional payment will be made for removal of these areas. The Contractor shall provide shielding, as necessary, to insure containment of all dislodged concrete within the removal area in order to protect the traveling public from flying debris both on and under the work site.

Waste water from the hydrodemolition process shall be controlled and filtered to produce a visibly clear water prior to releasing it to the surrounding environment. Sediment basins at the end of or outside of the structure shall be used if further filtration is required to produce visibly clear water. Bridge deck drains shall be plugged during the hydrodemolition process. The release of wastewater and solids generated by full depth hydrodemolition shall be minimized.

Cleaning of the bridge deck shall be performed with a vacuum system capable of removing wet debris and water. The deck shall then be blown dry with air to remove excess water and residual debris. Cleaning shall be done before debris and water are allowed to dry on the deck surface. All exposed reinforcing steel which is left unsupported by the hydrodemolition process shall be adequately supported and protected from bending by vacuum trucks or any other equipment. All reinforcing steel damaged or dislodged by these operations shall be replaced with epoxy coated bars of the same size at the expense of the Contractor.

When full depth repair is specified on plans, only those areas marked in the field by the Engineer as full depth repair will be paid for as full depth repair. Other areas where hydrodemolition equipment blows through the deck shall be the responsibility of the Contractor and will not be paid for as full depth repair.

Method of Measurement. Hydrodemolition shall be measured by the square yard of the total deck area regardless of depth.

Basis of Payment. The accepted quantity of hydrodemolition will be paid for at the contract unit price per square yard, which price will be full compensation for all materials, equipment and labor necessary to remove and dispose of all concrete and other debris to the depth shown on the plans or as directed by the Engineer. This item shall also include all rotomilling, vacuuming, shielding, containment and filtration of waste water, additional jackhammering and all other aspects of work necessary to remove bridge deck concrete by hydrodemolition.

Payment will be made under:

Item No.	Description	Unit
604-10.20	Hydrodemolition	S. Y.

Rev. 8-27-04
REV 1/31/06

SPECIAL PROVISION

REGARDING

BRIDGE DECK PREPARATION, REPAIR, AND CONCRETE OVERLAY

USING HYDRODEMOLITION

Description: This work shall consist of the removal of bridge deck concrete using hydrodemolition equipment as preparation for bridge deck repairs and concrete overlay. Rotomilling of the existing concrete deck prior to hydrodemolition will be allowed to a depth specified on the Plans. All work shall be performed in accordance with the details shown on the plans or as directed by the Engineer.

Equipment and Materials. The hydrodemolition equipment shall be a self-propelled machine that utilizes a high pressure water jet stream capable of removing concrete to the depths shown on the plans or as directed by the Engineer and be capable of removing rust and concrete particles from reinforcing steel. Pneumatic hammers, 35 pound class maximum, may be used in areas that are inaccessible or inconvenient to the self-propelled machine such as, but not limited to, areas not to exceed one foot away from curbs or parapets.

The concrete used to perform the deck repairs and overlay shall meet the requirements of the Standard Specifications for Class “D” concrete.

Construction Requirements. Prior to the commencement of the removal operation, the hydrodemolition equipment shall be calibrated on an area of sound concrete approximately (2 ft x 5 ft) as directed by the Engineer. The cost of the calibration procedure shall be included in the unit price bid for hydrodemolition. The Engineer shall verify the following settings:

1. Water pressure.
2. Machine staging control (step).
3. Nozzle size.
4. Nozzle speed (travel).

During the calibration, any or all of the above settings may be adjusted in order to achieve removal in accordance with the requirements of the plans. When the designated depth of removal is attained, the settings shall be recorded and maintained throughout the removal operation unless otherwise directed by the Engineer. The depth of removal shall be verified periodically and, if necessary, the equipment re-calibrated to insure the plans depth of removal.

After the hydrodemolition is completed, the deck shall be inspected (by sounding) to insure that all partial depth deteriorated concrete has been removed. Should deteriorated concrete be found, the Contractor shall remove the areas of deteriorated concrete by additional passes of the hydrodemolition equipment or jackhammers. No additional payment will be made for removal of these areas.

The Contractor shall provide shielding, as necessary, to insure containment of all dislodged concrete within the removal area in order to protect the traveling public from flying debris both on and under the work site.

Waste water from the hydrodemolition process shall be controlled and filtered to produce visibly clear water prior to releasing it to the surrounding environment. Sediment basins at the end of or outside of the structure shall be used if further filtration is required to produce visibly clear water. Bridge deck drains shall be plugged during the hydrodemolition process. The release of wastewater and solids generated by full depth hydrodemolition shall be minimized.

Cleaning of the bridge deck shall be performed with a vacuum system capable of removing wet debris and water. The deck shall then be blown dry with air to remove excess water and residual debris. Cleaning shall be done before debris and water are allowed to dry on the deck surface. All exposed reinforcing steel which is left unsupported by the hydrodemolition process shall be adequately supported and protected from bending by vacuum trucks or any other equipment. All reinforcing steel damaged or dislodged by these operations shall be replaced with epoxy coated bars of the same size at the expense of the Contractor.

When full depth repair is specified on plans, only those areas marked in the field by the Engineer as full depth repair will be paid for as full depth repair. Other areas where hydrodemolition equipment blows through the deck shall be the responsibility of the Contractor and will not be paid for as full depth repair.

Bridge deck repairs and concrete overlay shall be made as soon as practicable following removal by hydrodemolition and the subsequent cleaning of the deck as mentioned above. Traffic shall not be permitted on the bridge deck until curing time has elapsed in accordance with the Standard Specifications.

Method of Measurement. Hydrodemolition shall be measured by the square yard of the total deck area regardless of depth.

Full depth repair shall be measured by the square yards of deck surface area repaired.

Class D Concrete (Repair) shall be measured by the cubic yard. The number of cubic yards will be determined by deducting the theoretical quantity of class D concrete (overlay) from the number of cubic yards actually used as determined from invoices or conversion from batch weights then multiplying by a factor of 0.96 to allow for waste.

Class D Concrete (Overlay) shall be measured by the cubic yard based on the theoretical quantity required for the overlay shown in the plans.

Basis of Payment. The accepted quantity of hydrodemolition will be paid for at the contract unit price per square yard, which price will be full compensation for all materials, equipment and labor necessary to remove and dispose of all concrete and other debris to the depth shown on the plans or as directed by the Engineer. This item shall also include all rotomilling, vacuuming, shielding, containment and filtration of waste water, additional jackhammering and all other aspects of work necessary to prepare the deck for repair and concrete overlay.

The accepted quantity of Bridge Deck Repairs (Full Depth) will be paid for at the contract unit price per square yard, which price will be full compensation for full depth concrete removal including all materials, equipment and labor necessary to remove and dispose of all concrete and other debris as directed by the Engineer. This item shall also include any rotomilling, hydrodemolition, vacuuming, shielding, containment, additional jackhammering and all other aspects of work including forming and form removal necessary to prepare the deck for repair. Only those areas marked in the field by the Bridge Inspection and Repair Office as full depth repair will be paid under item 604-10.30.

The accepted quantity of Class D Concrete (Overlay) will be paid for at the contract unit price per cubic yard, which price will be full compensation for the placement and finishing of the concrete in accordance with the Standard Specifications and for any tools, labor, equipment or incidentals necessary for such placement.

The accepted quantity of Class D Concrete (Repair) will be paid for at the invoice price (including sales tax) of the concrete per cubic yard plus 15%.

Payment will be made under:

Item No.	Pay Item	Pay Unit
604-10.20	Hydrodemolition	Square Yard
604-10.30	Bridge Deck Repairs (Full Depth)	Square Yard
604-10.85	Class D Concrete (Overlay)	Cubic Yard
604-10.86	Class D Concrete (Repairs)	Cubic Yard

S T A T E **O F** **T E N N E S S E E**

Rev. 03-17-15 January 1, 2015
Rev. 08-27-15
Rev. 12-7-15
Rev. 5-16-16
Rev. 5-14-18

SPECIAL PROVISION

REGARDING

RETAINING WALLS

General Description

This Special Provision covers the design requirements, submittal of wall design drawings and supporting calculations, materials, construction, measurement, and payment for earth retaining walls. The scope of work for retaining wall construction includes, but is not limited to, the following as required:

1. All grading necessary for wall construction,
2. Undercutting and backfilling of weak surficial zones, and or ground improvement as required by plans
3. Temporary Shoring/Wall
4. Compaction of wall foundations
5. General and local dewatering as required for proper execution of the work
6. Construction of leveling pads
7. Formwork, placement of reinforcing steel, placement and curing of concrete
8. Texture coating or architectural treatment
9. Placement of drainage materials
10. Installation of piling
11. Placement of soil reinforcing devices
12. Placement and compaction of backfill
13. Preparation and erection of wall units
14. Construction of any required caps, copings, or end sections

All items included in the construction of the retaining wall shall conform to this Special Provision, the *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction,* henceforth referred to as the Standard Specifications, American Society for Testing Materials Standards (ASTM), Federal Highway Administration (FHWA) Technical Publications, the current edition of the *AASHTO LRFD Bridge Construction Specifications*, and the current *AASHTO LRFD Bridge Design Specifications* with interims, henceforth referred to as the AASHTO LRFD. The architectural treatment and/or texture finish of the walls shall be in accordance with the contract plans.

Design Criteria

The design of all types of earth retaining walls shall be in accordance with this Special Provision and the following Specifications as required:

1. AASHTO *LRFD Bridge Design Specifications* with interims
2. Publication no. FHWA-NHI-10-024, *Mechanically Stabilized Earth Walls and Reinforced Soil Slopes*
3. (FHWA Report No. FHWA-SA-99-018, 1999)*Geotechnical Engineering Circular No. 4, Ground Anchors and Anchored Systems*

The soil and/or rock properties and specific design values required for wall design are provided in the contract plans.

Submittal Requirements for Contractor/Supplier Prepared Design Plans

The Contractor shall utilize the information contained on the Retaining Wall Conceptual drawing as well as information shown elsewhere in the plans (i.e. utility sheets or traffic control/phasing sheets) to prepare his bid for the wall during the project bidding process and to prepare wall design plans during the construction of the project. The final design shall be submitted subsequent to contract award and a minimum of sixty (60) days prior to start of wall construction and shall include detailed design computations and all details, dimensions, quantities and cross sections necessary to construct the wall. Acceptable wall types will be identified on the concept drawing. Specific wall systems for the Acceptable Wall Types shall be selected from the Department's Qualified Products List (QPL 38) in effect at time of bid letting. In certain circumstances for a particular project, TDOT may elect to provide a complete, detailed wall design in the contract plans. The Contractor shall not bid for nor shall the Contractor submit plans for wall types and/or specific wall systems not listed as an Acceptable Wall Type on the Retaining Wall Conceptual Drawing and related drawings. If a specific wall design is provided for in the contract plans, the Contractor shall not bid for or submit plans for other wall types or design. (See Section 8 for the limited conditions under which other wall types or designs may be considered).

The plans shall be prepared to include but not be limited to the following items:

1. A plan and elevation sheet or sheets for each wall containing the following:

    a. An elevation view of the wall showing grades at the top of the wall, every 50 feet along the wall and at all horizontal and vertical break points. Elevations at the top of leveling pads and footings, the distance along the face of the wall to all steps in the footings, and leveling pads, the designation as to the type of panel or module, the length, size and number of tiebacks, nails, mesh or strips and all the distances along the face of the wall to where changes in length of the reinforcing elements occur and the location of the original and final ground line should be shown. The Contractor shall be responsible for field verifying original ground elevations.

b. A plan view of the wall shall indicate the offset from the construction centerline to the face of the wall at all changes in horizontal alignment, the limit of the widest module, tiebacks, nails, mesh or strip and the centerline of any drainage pipe which is behind, under, in front of or passes through the wall.
c. Any general or special notes, standard or special drawings, or other unique provisions required for construction of the wall.
d. All horizontal and vertical curve data affecting wall construction.
e. Cross sections showing limits of construction and in fill sections, limits and extent of select granular backfill material placed above original ground.
f. Limits and extent of reinforced soil volume
g. Limits and extent of any ground improvements as required by the contract plans.
h. Limits and extent of temporary shoring/retaining walls.

2. Details

a. All structural details including reinforcing bar bending details. Bar bending details shall be in accordance with CRSI standards.
b. All details for foundations and leveling pads, including details for steps in the footings or leveling pads.
c. Wall Elevation drawings shall delineate the changes in wall design height with corresponding changes in reinforcement type and/or lengths for the design section.
d. For each delineated wall design segment the Applied Factored Bearing Load at both the Service and Strength Limit States shall be shown.
e. All modules and facing elements shall be detailed. The details shall show all dimensions necessary to construct the elements, all reinforcing steel in the element, and the location of reinforcement element attachment devices embedded in the facing.
f. All details for construction of the wall around drainage facilities, overhead sign footings, abutment piles or other obstructions shall be clearly shown.
g. All details for connections to traffic barriers, coping, parapets, noise walls and attached lighting shall be shown.
h. All details for drainage behind wall or reinforced soil volume.
i. If vehicular impact protection is required due to the wall system not satisfying the minimal design requirements of Section 5.0, details of the barrier wall and end terminals shall be shown on the Contractor/Supplier Design plans for the proposed wall.

3. Detailed design computations which clearly demonstrate compliance with design requirements provided in this specification.

4. Limits of design responsibility, if any.

5. Each design submittal shall include a detailed list of quantities for each wall unit. The quantities shall include but not be limited to: concrete cast in-place, pre-cast concrete, select backfill material, backfill material, reinforcing steel,

geomembrane/geogrid reinforcement, modular blocks, structural steel, pre-stressing steel, etc. If known, all materials sources shall be identified so acceptance and verification sampling and testing can be conducted. All quantities listed are for informational purposes only and do not necessarily constitute a pay item or quantity . All retaining walls shall only be paid for under the respective retaining wall bid item measured and described herein.

6. The Contractor's wall plans shall be signed, stamped and dated by a qualified registered Professional Engineer licensed in the State of Tennessee.

7. Submittals and Approval

Four sets of design drawings and detail design computations shall be submitted to the Structures Division. The computations shall include a detailed explanation of any symbols and computer programs used in the design of walls. . Structures Division will submit two of their four copies to the Division of Materials and Tests.

Each design drawing shall contain in the title block the project number, county, structure name, structure number, station and contract number. Design drawings shall be submitted in sets with the drawing numbers running consecutively in each set, and if more than five (5) sheets in a set, shall be appropriately bound.

All designs and construction details will be checked by the Structures Division and the Materials and Tests Division against the pre- approved design drawings and procedures for that particular system. Review of the wall submittal will occur within 30 days of receipt. If there are design or plans issues requiring revisions then the Structures Division will inform the appropriate TDOT Construction Office and provide a listing of the required revisions. Depending on the required revisions the 30 day review timeframe may be extended. Approval of the detailed design and plans shall be made by the Structures Division and Materials and Tests Division. Notification to proceed shall be made by the Structures Division.

After approval, the Contractor shall submit additional sets of the design drawings (full size and half size) as determined by the Structures Division for Departmental distribution. Also, an electronic copy of the design drawings and detail design computations shall be submitted to the Structures Division and the Materials and Tests Division upon completion of the project.

8. Other Submission Requirements

As discussed in the previous sections, the Contractor shall bid for and, subsequently, (for the Contractor for which the project was awarded) prepare plans for and be prepared to construct the wall type(s) given on the Retaining Wall Conceptual Drawing or, under special circumstances, the specific wall type and design as provided by in the Contract Plans. The Contractor awarded the project may only under the circumstances discussed below request that a

wall type, wall system, or associated construction for a wall (i.e., foundation improvement requirements, construction sequence requirements, etc.) be changed, altered, or eliminated from those requirements set forth in the plans.

The Contractor may request the Department consider a change in the wall type, specific system, and associated construction through the submission of a Value Engineering Change Proposal (VECP) unless the contract prohibits submission of a VECP. Furthermore, any conditions of a VECP, such as a minimum cost savings required by the contract must be followed. The Department's agreement to review a VECP for a retaining wall shall in no way imply subsequent acceptance of the VECP or any part thereof. Any costs associated with preparation and submittal of a VECP shall be borne by the Contractor and no construction scheduling changes or time delays shall be caused by the Contractor's submission of the VECP and the Department's review of the VECP. If the proposed change involves a wall system not on the Approved Wall System list, then the contractor must coordinate with the system supplier to gain approval of the system and shall be aware of the approval requirements and time considerations for this approval process.

The Contractor may request the Department consider a change in the wall type, specific system, and/or associated construction if the Contractor determines that project conditions exist that substantially differ from those conditions upon which the decision to specify in the plans a particular wall type(s), wall system, or associated construction was made. An example of this would be where a soldier pile-lagging wall is specified as the only wall type due to right-of-way constraints not allowing for a typical wall type to be built, then subsequently it is determined TDOT can acquire or has sufficient right- of-way available to make another wall type feasible.

The request for consideration of changing of a wall type, system, or associated construction shall be made in writing and be submitted to the Construction Engineer. The Construction Engineer will distribute the request to the Regional Construction Engineer, Structures Division, Geotechnical Engineering Section, Design Division, and Right-of-Way Division, if applicable. The parties will review the request and provide recommended action (approval, rejection, alterations) to the Construction Engineer. If necessary, a plans revision will be made. Note that the Contractor's submission of a request does not imply acceptance by the Department and that the request process shall not be justification for a project schedule change or time extension. The Department reserves the right to require the Contractor to construct the wall as shown in the plans if there are no conditions that exist which render the contract plan wall requirement not constructible.

The Contractor must provide documentation in the request to demonstrate that the proposed change does not in any way cause additional cost to the wall and associated construction or to other aspects of the project. If the Contractor judges that a change involving wall construction must be made due to differing site conditions, the Contractor must follow procedures given in Sections 104.02 and 104.03 of TDOT Standard Specifications for Road and

Bridge Construction.

Requirements for retaining wall protection provided by the retaining wall system

When noted on the plans that a retaining wall is located in a hazard zone subject to vehicular impact, the Contractor shall be aware that retaining wall protection against vehicular collision for the wall may be required. If the retaining wall facing meets any one of the following criteria, an independent barrier wall shall be provided in front of the wall and included in the square foot cost of the wall:

1. Any retaining wall facing that is constructed of non-reinforced concrete (cast-in-place concrete gravity walls are exempt from this requirement and do not require protection.
2. Any dimension of a retaining wall facial panel that is less than 5'0" x 5'0" x 6" thick reinforced panel.
3. Any type of crib retaining walls.
4. A cast in place reinforced facing that has a thickness less than 6 inches.

Materials Approval

The materials used in the construction of the earth retaining walls shall conform to this Special Provision and/or the Standard Specifications. Prior to delivery of any material used in the retaining wall construction, the materials must be accepted in conformance with the specifications associated with the wall type being constructed.

Materials

Unless other otherwise stated in specific retaining wall specifications, the materials used in the construction of earth retaining walls shall conform to the following specifications:

1. Concrete Class "A" shall be in accordance with Section 604 of the Standard Specifications.
2. Concrete Class "D" Shall be in accordance with Section 604 of the Standard Specifications.
3. Reinforcing steel shall conform to ASTM A 615, Grade 60.
4. The sources for all backfill material shall be approved in conformance with the Standard Specifications before the material is delivered to the job site. Any select backfill material must be approved or tested for compliance prior to construction.
5. Lifting hooks and threaded inserts shall be of the size indicated on the working drawings.
6. When required, imbedded items must be galvanized in accordance with AASHTO M 232 or ASTM A 153.
7. Acceptance of materials furnished for work will be in accordance with the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1) and certified test reports as specified in Section 106 – Control of Materials supplemented by routine tests run by the Department as defined in the various applicable sections of the Standard

Specifications.

8. Clearing and grubbing, removal of structures and obstructions, and excavation and undercutting shall be performed in accordance with the provisions of Sections 201, 202, and 203, respectively, of the Standard Specifications. Cost of these items, however, shall be included in the square foot price bid for retaining walls as shown in contract plans.
9. Reinforced Concrete Facing Panels - The panels shall be fabricated in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels."
10. Stone masonry shall be in accordance with Section 612 of the Standard Specifications.
11. All fabricated or precast retaining wall assemblies shall be selected from the TDOT's Qualified Products List.

All concrete, reinforcing steel, and backfill materials shall be tested at the specified frequencies in accordance with the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

Method of Measurement

The method of measurement shall be square foot area of the wall face, measured from the top of footing (or bottom of wall for walls without footings) to the top of the wall excluding any appurtenances in accordance with drawing number W-MSE-1 (in this document). Appurtenances are defined herein as barriers, fences, sign supports, noise wall support posts, and other fixtures. Coping, caps, end sections and moment slabs will **not** be considered appurtenances and are to be considered as part of the wall face.

Basis of Payment

The earth retaining wall, complete in place and accepted, shall be paid for at the contract square foot bid price. The bid price for walls shall include as required: grading and compaction of the wall foundation, undercutting and backfilling of weak surficial zones, installation of ground improvement, footing excavation, presplitting, sheeting, shoring, drilling, piles, lagging, grouting, concrete, reinforcing steel, reinforcement strips or mesh, tie strips or rods, fasteners, connectors, wire mesh baskets, prefabricated modular components, post tensioning, performance testing and evaluation, architectural treatment and/or texture finish, drainage system, water-stops and joint sealing material, coping, caps, end sections, moment slabs, and all miscellaneous material and labor for the complete installation of the wall. If the contractor's design requires the use of select granular backfill, the unit price bid for the wall shall be full compensation for any additional backfill costs due to the use of select backfill material.

If required for retaining wall protection against vehicle impact, the cost of the barrier wall and end terminals shall be included in the square foot cost of the wall.

Additional area of wall required due to unforeseen foundation conditions or other reasons and approved by the Engineer will be paid for on the basis of the unit price bid except as noted below.

The mechanically stabilized earth wall, complete in place and accepted as noted above, shall be paid for at the contract square foot bid price. No increase in unit price will be

paid for increases in wall height less than or equal to 10 feet as compared to the contract plans and wall heights. Wall height increases greater than 10 feet will be paid for by supplemental agreement.

The cast-in-place concrete cantilever or counterfort retaining wall, complete in place and accepted shall be paid for at the contract square foot bid price except as noted below.

If the actual driven quantity of concrete piles varies more than 10% from the estimated quantity based on the estimated lengths, an increase or decrease based on the contract bid price, or in the absence of a bid item, a price of twenty eight (28) dollars, per linear foot of additional or reduced pile length will be added or deducted accordingly from the price paid for the retaining wall. If the Engineer orders additional test piles, they will be paid for at the contract bid price, or in the absence of a bid item, a price of forty (40) dollars per linear foot. If the contractor changes friction pile types or sizes, additional load test(s) may be required at the Engineer's discretion and at the contractor's expense.

If the contractor uses a different type of pile than those that have estimated lengths shown on the contract plans, the price of the wall shall include all costs associated with piles and pile installation with no additional payment for any variation in pile lengths. All pile types and pile driving procedures, lengths, and bearings shall be in accordance with the Standard Specifications and shall be approved by the Engineer

The contractor shall show the estimated quantity of point bearing steel piles on the design drawings submitted for approval. If the actual quantity of steel piles driven differs more than 10% from this approved quantity because of variation in the rock line, the cost of the retaining wall will be increased or decreased accordingly based on the contract bid price, or in the absence of a bid item, a unit price of thirty five (35) dollars per linear foot, for the adjusted piling quantity.

If the Engineer orders changes in the work which alters the ~~exposed~~ surface area of the wall without increasing the height of the wall, payment will be increased or decreased accordingly based on the square foot bid price. If the Engineer orders changes in the work which increases the height of the wall, the unit price bid for the wall sections that were increased up to a maximum of 10 feet will be adjusted according the following tables. Adjustments exceeding 10 feet will be made by supplemental agreement.

RETAINING WALL COST ADJUSTMENT FACTORS
Level Backfill with Slope <= 3 : 1 (Run : Rise)

Original Height (ft.)	Height Increase (ft.)									
	1	2	3	4	5	6	7	8	9	10
1 - 10	1.01	1.02	1.04	1.06	1.08	1.10	1.13	1.16	1.20	1.24
11	1.01	1.03	1.05	1.07	1.09	1.12	1.15	1.19	1.22	1.26
12	1.02	1.03	1.06	1.08	1.11	1.14	1.17	1.21	1.25	1.29
13	1.02	1.04	1.06	1.09	1.12	1.15	1.19	1.23	1.27	1.31
14	1.02	1.04	1.07	1.10	1.13	1.17	1.21	1.25	1.29	1.34
15	1.02	1.05	1.08	1.11	1.14	1.18	1.22	1.26	1.31	1.36
16	1.03	1.05	1.08	1.12	1.15	1.19	1.24	1.28	1.33	1.38
17	1.03	1.06	1.09	1.13	1.16	1.21	1.25	1.29	1.34	1.40
18	1.03	1.06	1.10	1.13	1.17	1.22	1.26	1.31	1.36	1.41
19	1.03	1.06	1.10	1.14	1.18	1.22	1.27	1.32	1.37	1.42
20	1.03	1.07	1.11	1.15	1.19	1.23	1.28	1.33	1.38	1.44
21	1.03	1.07	1.11	1.15	1.19	1.24	1.29	1.34	1.39	1.45
22	1.04	1.07	1.11	1.15	1.20	1.25	1.29	1.35	1.40	1.45
23	1.04	1.07	1.12	1.16	1.20	1.25	1.30	1.35	1.41	1.46
24	1.04	1.08	1.12	1.16	1.21	1.25	1.30	1.36	1.41	1.47
25	1.04	1.08	1.12	1.16	1.21	1.26	1.31	1.36	1.41	1.47
26	1.04	1.08	1.12	1.17	1.21	1.26	1.31	1.36	1.42	1.47
27	1.04	1.08	1.12	1.17	1.21	1.26	1.31	1.37	1.42	1.48
28	1.04	1.08	1.12	1.17	1.22	1.26	1.31	1.37	1.42	1.48
29	1.04	1.08	1.12	1.17	1.22	1.26	1.31	1.37	1.42	1.48
30	1.04	1.08	1.12	1.17	1.22	1.26	1.31	1.37	1.42	1.48
31	1.04	1.08	1.12	1.17	1.22	1.26	1.31	1.37	1.42	
32	1.04	1.08	1.12	1.17	1.22	1.26	1.31	1.36		
33	1.04	1.08	1.12	1.17	1.22	1.26	1.31			
34	1.04	1.08	1.12	1.17	1.21	1.26				
35	1.04	1.08	1.12	1.17	1.21					
36	1.04	1.08	1.12	1.17						
37	1.04	1.08	1.12							
38	1.04	1.08								
39	1.04									

RETAINING WALL COST ADJUSTMENT FACTORS
Level Backfill with Slope > 3 : 1 (Run : Rise)

Original Height (ft.)	Height Increase (ft.)									
	1	2	3	4	5	6	7	8	9	10
1 - 10	1.03	1.07	1.11	1.16	1.22	1.28	1.35	1.43	1.51	1.60
11	1.04	1.08	1.13	1.18	1.25	1.31	1.39	1.47	1.56	1.65
12	1.04	1.09	1.14	1.20	1.27	1.34	1.42	1.50	1.59	1.69
13	1.05	1.10	1.15	1.22	1.29	1.36	1.44	1.53	1.62	1.72
14	1.05	1.10	1.16	1.23	1.30	1.38	1.46	1.55	1.65	1.75
15	1.05	1.11	1.17	1.24	1.32	1.40	1.48	1.57	1.67	1.77
16	1.05	1.12	1.18	1.25	1.33	1.41	1.49	1.59	1.68	1.78
17	1.06	1.12	1.19	1.26	1.33	1.42	1.50	1.59	1.69	1.79
18	1.06	1.12	1.19	1.26	1.34	1.42	1.51	1.60	1.70	1.80
19	1.06	1.12	1.19	1.27	1.34	1.42	1.51	1.60	1.70	1.80
20	1.06	1.13	1.19	1.27	1.34	1.43	1.51	1.60	1.69	1.79
21	1.06	1.13	1.19	1.27	1.34	1.42	1.51	1.60	1.69	1.79
22	1.06	1.13	1.19	1.27	1.34	1.42	1.51	1.59	1.68	1.78
23	1.06	1.13	1.19	1.27	1.34	1.42	1.50	1.59	1.68	1.77
24	1.06	1.13	1.19	1.26	1.34	1.41	1.50	1.58	1.67	1.76
25	1.06	1.12	1.19	1.26	1.33	1.41	1.49	1.57	1.66	1.74
26	1.06	1.12	1.19	1.26	1.33	1.40	1.48	1.56	1.64	1.73
27	1.06	1.12	1.19	1.25	1.32	1.40	1.47	1.55	1.63	1.72
28	1.06	1.12	1.18	1.25	1.32	1.39	1.46	1.54	1.62	1.70
29	1.06	1.12	1.18	1.25	1.31	1.38	1.46	1.53	1.61	1.69
30	1.06	1.12	1.18	1.24	1.31	1.38	1.45	1.52	1.60	1.67
31	1.06	1.11	1.17	1.24	1.30	1.37	1.44	1.51	1.58	
32	1.06	1.11	1.17	1.23	1.30	1.36	1.43	1.50		
33	1.05	1.11	1.17	1.23	1.29	1.36	1.42			
34	1.05	1.11	1.17	1.22	1.29	1.35				
35	1.05	1.11	1.16	1.22	1.28					
36	1.05	1.10	1.16	1.22						
37	1.05	1.10	1.16							
38	1.05	1.10								
39	1.05									

Specific Wall Construction and Materials Requirements

A. Cast-in-Place (CIP) Concrete Gravity Retaining Walls

1. Construction

The construction of the wall shall be in accordance with this Special Provision and the Standard Specifications.

B. Cast-In-Place (CIP) Concrete Cantilever And Counterfort Retaining Walls

1. Construction

The construction of the wall shall be in accordance with this Special Provision and the Standard Specifications. If the use of piles is anticipated, the foundation information shown on the contract plans shall include the skin friction (Fs) and end bearing (Qb) values, or the location of the rock line. Based on this information, estimated pile lengths shall be shown on the contract plans for fifty (50) and one hundred (100) tons ultimate bearing capacity for Size 1 concrete friction piles. The contractor shall estimate point bearing steel pile refusal lengths based on the given rock line information.

Concrete friction piles shall be installed to provide a minimum factor of safety of 2.0 if a load test is used and a minimum factor of safety of 3.0 if a load test is not used. Pile types, load test procedures, and driving equipment shall be in accordance with the Standard Specifications and shall be approved by the Engineer. The number and location of test piles and load tests shall be approved by the Engineer. Test pile lengths shall be ten (10) feet longer than the estimated pile lengths. Test piles shall be driven in accordance with the Standard Specifications, and shall be required at least every fifty (50) feet along the wall, unless otherwise approved by the Engineer. No pile shall be any farther than five hundred (500) feet from a load test, if a load test is used, unless otherwise approved by the Engineer. The length of production piles to be driven and the required bearing based on the driving equation shall be determined by the Engineer based on the required design bearing, the results of the test piles and load tests (if used), and applicable safety factors. Driven pile lengths and final bearings shall be approved by the Engineer.

Point Bearing Steel Piles shall be driven to refusal. Pile tips shall be used when indicated on the contract plans.

All reinforcing steel projecting from footing into the wall in the back face (fill side) shall be epoxy coated.

C. Concrete Crib Walls (See QPL 38 for Approved Manufacturer/Supplier)

1. Materials

The following items are the construction materials requirements necessary for crib wall design fabrication. All materials shall be approved prior to use.

- Pre-Cast Concrete Crib Units

  The pre-cast crib units are to be made of Class D Portland cement concrete conforming to Section 604 of the Standard Specifications.

- Crib Backfill

  All backfill material shall be tested prior to use and at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

  - The crib backfill material shall consist of an AASHTO classified A-1-a, A-1-b, or A-3 soil with the additional requirement no more than ten percent by weight pass the #200 sieve.
  - The unit weight of the crib fill should be a minimum 115 lb. per cubic foot.
  - Filter protection (geotextile) may be required.

- Backfill Behind the Crib Type Structure

  All backfill material shall be tested prior to use and at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

  - If a filter blanket is placed behind the wall, native soil may be used as backfill behind the structure.
  - Select fill, as defined in 4.2.1 of this document, can be used as backfill behind the structure. The backfill unit weight must be a minimum of 115 pcf. An internal angle of friction can be assumed equal to 35 degrees.

2. Fabrication of Precast Concrete Crib Units

- All pre-cast concrete shall be produced in an approved plant in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels".

  Out-of-state producers shall provide documentation of material quality before the manufacture of any pre-cast products (i.e. aggregate quality reports, cement/steel mill test reports, etc.)

  The fabricator shall provide two precast modular units to the Engineer for approval.

  - These approved precast modular units will serve as standard models. The finished exposed faces of the production precast modular units should be similar to the exposed faces of the model precast modular units.
  - One of the model precast modular units should be kept at the production plant for relative comparison to future modular units. The other model should be kept on the construction site for comparison to the other delivered units.

- To assure uniform unit production steel forms must be used.
- The placement of reinforcing steel within the precast units should conform to the design placement shown in the shop drawings.

- Final acceptability of the precast units shall be determined on the basis of compression tests, production defects and tolerances, and visual inspection. The manufacturer shall furnish all sampling and testing facilities.
- Section 604 of the Standard Specifications states the units shall be steam or moist cured until developing the specified compressive strength set forth in the shop drawings. Any unit not developing the specified compressive strength shall be rejected.
- The precast units should not be delivered before samples have attained the required compressive strength of 4,000 psi (f'_c).
- Prior to shipment, the finished units are subject to visual inspection by the Engineer. Individual crib units may be rejected for any of the reasons listed below.
    i. Variations in the exposed face texture relative to the approved model face texture.
    ii. The length or height of the unit not satisfying the unit allowable tolerance limit of 3/16".
    iii. Honeycombed or open texture units which are not properly repaired.
    iv. Individual defects which could affect the structural integrity of the unitVariations in the exposed face texture relative to the approved model face texture.
- TDOT will verify products before shipment in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels". If products are manufactured out of state, TDOT may verify at the project site PRIOR to the placement of the units. The Contractor, or producer, shall notify the Regional Materials and Tests Division that products need to be verified.
- Upon delivery, the exposed surface of the precast units shall be examined. If the exposed faces of any of the units are below the standards of the approved model on site, the units shall be replaced or properly repaired until conforming to the appearance, strength, and durability of the approved model.
- The date of manufacture shall be clearly and permanently marked on one of the inside surfaces of each unit. Each shipment must be accompanied with a certification letter as stated in the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels.

3. Construction

- The Contractor should perform any soil improvement, such as undercutting and backfilling before foundation preparation.

- Compact the top 12" of soil on which the structure will rest to at least 95% of the maximum laboratory dry density as specified in AASHTO T-99.
- No Crib-type wall should be built upon frozen ground.
- Following excavation for the crib wall system, the Contractor shall notify the Engineer for approval of the footing depth and character of the foundation material. No crib wall system work shall proceed until approval has been granted.
- The correct batter of the wall shall not exceed ½" per 10 ft. of wall height.
- The crib backfill should be placed and compacted to at least 95% of the maximum laboratory dry density (AASHTO T-99) in layers no thicker than 12".
- Backfilling behind the crib system shall follow erection as closely as possible. The wall height should never be greater than three feet above the backfill.
- Any underdrain shall be placed in accordance with the details of the working plans.
- The Contractor shall furnish, install, operate, and maintain satisfactory dewatering systems as required to maintain the site in a dry and workable condition. These systems shall be continued as long as necessary. No separate measurement or payment will be made for dewatering.

D. Bin Wall (See QPL 38 for Approved Manufacturer/Supplier)

1. Materials

- Filler for horizontal joints between modular units shall be resin-bonded cork filler or closed cell foam, cross linked polyethylene polymer, conforming to test requirements of AASHTO M 153 or ASTM D 1752 (Type II) or equal. Filter fabric placed behind front vertical joints shall be at least 6" wide and conform to section 918.27 of the TDOT Standard Specifications).
- Backfill: All select granular material shall be free from shale and organic or otherwise deleterious material and conform to the following gradation limits:

Sieve Size	Percent Passing
6 inch	100
3 inch	75-100
No. 200	0-15

The Contractor, at his option, may produce the select granular material by processing the excavation from the project or from approved material from other sources. No direct payment will be made for producing the select granular material.

All backfill material shall be tested prior to use and at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

- Bearing pads shall be rubber of size, and manufacture shown on shop drawings, with the following properties perpendicular to the pad thickness:
    i. Compression- minimum ultimate strength 8000 psi
    ii. Initial Cracking Strain- 40% of thickness
    iii. Hardness (Shore A) – 75 +/- 5
    iv. Tensile Strength- ASTM D 412, die "C", 1000 psi +/- 100 psi
    v. Tear Strength- ASTM D 624, die "B" – 360 psi minimum
- Acceptance of materials furnished for work will be in accordance with the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1) and certified test reports as specified in Section 106 – Control of Materials supplemented by routine tests run by the Department as defined in the various applicable sections of the Standard Specifications.

2. Construction

- Bin Fabrication
    - All pre-cast concrete shall be produced in an approved plant in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels".

      Out-of-state producers shall provide documentation of material quality before the manufacture of any pre-cast products (i.e. aggregate quality reports, cement/steel mill test reports, etc.)

      Before proceeding with production, a model precast modular unit shall be provided by the fabricator for the Engineer's approval to establish a guide and standard for the type of finish to be furnished on the exposed face. This model shall be kept at the fabricator's plant to be used for comparison purposes during production. Formed surfaces other than the exposed face shall not require a special finish
    - Forms: Forms for the units shall be constructed of steel with dimensional tolerances that will assure the production of uniform units. Finish for the front face of the wall shall be in accordance with the finish specified on the contract plans.

    i. Mixing and Placing Concrete: The concrete mix as designed shall be proportioned and mixed in a batch mixer to produce a homogeneous concrete. The transporting, placement, and compaction of concrete shall be by methods that will prevent segregation of the concrete materials and the displacement of the reinforcement steel from its proper position in the form. Concrete shall be carefully placed in the forms and vibrated sufficiently to produce a surface free from imperfections such as honeycomb, segregation or cracking. Clear form oil of the same manufacture shall be used throughout the casting operation.

    ii. Reinforcing Steel: All reinforcing steel for the precast modules and other components shall be fabricated and placed in accordance with plans and Standard Specifications.

- Testing and Inspection: Acceptability of the precast units at the casting yard shall be determined on the basis of compression tests and visual inspection during casting. The manufacturer shall furnish such facilities and assistance as is required to carry on the sampling and testing in an expeditious and satisfactory manner. The manufacturer shall document and provide all test data and certify in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels".

iii. Curing: The units shall be steam or moist cured as specified in Section 604 of the Standard Specifications for a sufficient length of time so that the concrete will develop the specified compressive strength. Any panel which does not reach specified strength within 28 days shall be rejected.

- Compressive Strength: Compressive tests to determine the minimum strength requirements shall be made on cylinders. A minimum of six cylinders for determining when the units may be put into service will be made from each day's production and cured in accordance with AASHTO T 23 or ASTM C 31. The 28 day compressive strength shall be at least 5000 psi. Compressive strength tests shall be in accordance with AASHTO T 22 or ASTM C 39.

- Rejection: The quality of materials, the process of manufacture, and the finished units shall be subject to inspection by the Engineer prior to shipment. Precast units may be subject to rejection on account of failure to conform to the requirements set forth herein. Individual units may be rejected because of any of the following:

  - Variations in the exposed face that substantially deviate from the approved model as to texture in accordance with precast concrete industry standards.
  - Dimensions not conforming to the following tolerances:
    - Face of panel, length or height: plus/minus 3/16"
    - Deviation from square when measured on diagonal: 5/16" for modules up to 10' wide, 3/4" for larger units.
  - Honeycombed or open texture not properly repaired.
  - Defects which would affect the structural integrity of the unit.

- Shipment: The precast units shall not be shipped until they have achieved the required concrete strength (f'c) of 5000 psi. TDOT will verify products before shipment in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels". If products are manufactured out of state, TDOT may verify at the project site PRIOR to the placement of the units. The Contractor, or producer, shall notify the Regional Materials and Tests Division that products need to be verified

- Repairs at Plant: Before shipment, surfaces of all precast units shall be examined. If the exposed face of a unit is below the standard of the approved model then it shall be properly repaired to conform to the balance of the work with respect to appearance, strength and durability.
- Handling and Storage: Handling devices, as required, shall be provided in each precast modular unit for the purpose of handling and placing. Care shall be taken during storage, transporting, hoisting and handling of all units to prevent cracking or damage. Units damaged by improper storing, transporting or handling shall be replaced or repaired to the satisfaction of the Engineer.
- Marking: The date of manufacture and production lot number shall be clearly and permanently marked on the rear face of each unit.

• Erection:

i. Foundation Preparation: The foundation for the bin wall shall be graded to the elevations and dimensions shown on the contract plans. Prior to wall construction, the top 12 inches of the foundation shall be compacted to at least 95% of the maximum laboratory dry density as determined by AASHTO T 99. Any foundation soils found to be unsuitable or incapable of sustaining the required compaction shall be removed and replaced. After the excavation for each location of the bin wall has been performed, the Contractor shall notify the Engineer. No concrete leveling footing shall be placed until the depth of excavation and the character of the foundation material has been approved by the Geotechnical Engineering Section of the Division of Materials and Tests and permission has been given to proceed by the Engineer.

ii. At each unit foundation level, either a precast or cast-in-place footing and/or leveling pad shall be provided as shown on the shop drawings. The footings shall be given a wood float finish and shall reach the required compressive strength of 3000 psi, before placement of wall modules. The completed footing surface shall be constructed in accordance with grades and cross slopes shown on the shop drawings. When tested with a 10’ straight edge, the surface shall not vary more than 1/8” in 10’. Any additional depth of footing required to level the top surface and bear on approved foundations shall be at the Contractor’s expense.

iii. The modular units shall be installed in accordance with the manufacturer’s recommendations. Special care shall be taken in setting the bottom course of units to true line and grade. Joint filler and neoprene pads, when required, shall be installed in the horizontal joints. Joints at corners or angle points shall be closed as shown on the plans or in accordance with recommendation of the manufacturer.

iv. All units above the first course shall interlock with the lower courses. Vertical joints shall be staggered with each successive course, or as shown on shop drawings. The vertical joint opening on the front face of the wall shall not exceed 3/4".

v. The interior of each successive course of precast modular units shall be filled with select granular backfill. The maximum lift thickness shall be 2 feet, and shall then be thoroughly consolidated with a vibratory tamping device.

vi. Backfill behind the wall shall be compacted to at least 95 percent of the maximum laboratory dry density as defined in AASHTO T 99 to within one foot of the top of the wall. The top 12 inches shall be compacted to at least 100 percent of the maximum laboratory dry density.

vii. When erecting a battered wall, placement of backfill behind the wall shall closely follow erection of successive courses of units. At no time shall the difference in elevation between the backfill and the top of the last erected course exceed seven feet.

viii. The overall vertical tolerance of the wall shall not exceed 1/2 inch per 10 feet of wall as shown per plans.

ix. Underdrain, if required, shall be placed in accordance with the details shown on the plans or shop drawings.

x. Storm Drains: Where required, precast concrete wall units shall be provided with the appropriate storm drain openings cast into units at the appropriate elevation and locations indicated on drainage profiles. Catch basins shall be located so pipes will enter perpendicular (plan view) to the precast wall units or below the leveling footing as shown on the plans. Construction of catch basins and placement of storm drains must be coordinated with the bin wall construction.

xi. Cooperation between contractors: Contractors must coordinate all phases of the work to prevent delays and expedite construction.

xii. Dewatering: The Contractor shall furnish, install, operate, and maintain satisfactory dewatering systems as required to maintain the site in a dry and workable condition so as to permit grading and compaction of the wall foundation and proper erection and backfill of the wall. These systems shall include all equipment and materials, and shall be continued as long as necessary. No separate measurement or payment will be made for dewatering.

xiii. Technical Consultations: The fabricator will be required as a part of the contract to provide onsite technical expertise to the Contractor and/or the State upon request. Response to requests shall be required within five (5) days of the request. The cost of

furnishing such technical consultations shall be at no cost to the State.

- On Site Inspection
  The quality of materials, the process of manufacture, and the finished member shall be subject to inspection and approval by the Engineer. Any bin wall units damaged prior to acceptance shall be repaired or reconstructed as directed by the Engineer. All costs of repairs or reconstruction shall be at the Contractor's expense.

E. Gabion Wall (See QPL 38 for Approved Manufacturer/Supplier)

1. General:

This section covers the furnishing, assembling, filling with stone and tying open wire mesh rectangular compartmented gabions placed on filter cloth or filter stone as specified herein, and in reasonably close conformity with the lines, grades, dimensions, and cross-sections shown on the plans or as directed by the Engineer, and the design, working drawings, materials, construction, measurement and payment for gabions.

Included in the scope of this section are: grading and compaction of the wall foundation, general and local dewatering as required for proper execution of the work, installation of wall drainage systems as specified on the plans, erection of units, the placement of stone within the units and compaction of the soils behind the units as well as the construction of any required reinforced concrete appurtenances such as caps, copings, or end sections as specified on the plans. For the purposes of this section, the gabions foundation shall include all areas underlying the gabion wall. All other items included in the construction of the retaining wall not specifically mentioned herein this manual shall conform to the applicable sections of the *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, January 1, 2015* and the current *AASHTO LRFD Bridge Design Specifications* with interims. Future reference to the *Tennessee Department of Transportation Standard Specification For Road And Bridge Construction- January 1, 2015* will be made as Standard Specifications.

2. Design Criteria

The current AASHTO LRFD Bridge Design Specifications with interims shall be used as the basis for design for the Gabion Wall utilized as a gravity type retaining wall.

3. Submittals

Working drawings and design calculations shall be submitted to the Engineer for review and approval at least 60 days before wall construction is to begin. See Chapter I, Section 4.0 for contractor/supplier submittal responsibilities. The Contractor shall not start work on the bin wall until the working drawings have been approved by the Engineer. Approval of the Contractor's working drawings shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work.

4. Materials

- Gabion Wire Mesh

Gabion basket units shall be fabricated from either a double twisted hexagonal wire mesh (metallic or PVC coated as required in contract plans) or welded wire mesh (metallic or PVC coated as required in contract plans) that meets property requirements described in:

ASTM Designation: A974 − 97 (Reapproved 2011)
Standard Specification for
Welded Wire Fabric Gabions and Gabion Mattresses
(Metallic-Coated or Polyvinyl Chloride (PVC) Coated)

ASTM Designation: A975 − 11
Standard Specification for
Double–Twisted Hexagonal Mesh Gabions and Revet
Mattresses (Metallic-Coated Steel Wire or Metallic-Coated
Steel Wire With Poly(Vinyl Chloride) (PVC) Coating

All other components of the gabion construction such as selvedge wire, lacing wire, spiral connectors, clips, galvanization, PVC coating shall be in accordance with the above specifications.

- Stone Fill

  All stone fill shall be approved by the Engineer and shall be of suitable quality to ensure durability. When the stone is subjected to five alterations of sodium sulfate soundness testing, in accordance with AASHTO T-104, the weighted percentage of loss shall not be more than twelve percent. The inclusion of objectionable quantities of shale, dirt, sand, clay, rock fines, and other deleterious material will not be permitted. Stone fill shall be of well-graded mixture with sizes ranging between 4 inches and 10 inches in diameter, based on U.S. Standard square mesh sieves. No stone shall have minimum dimension less than 4 inches. Stone fill material selected for use in the gabions shall meet the minimum in-place density specified on the plans.

- Filter Cloth

  All filter cloth shall meet the applicable requirements of Section 918.27, Sub-Section 27, of the Standard Specifications.

- Filter Stone

  All filter stone shall meet the applicable requirements of Grading Size 68 or 57. See the Standard Specifications section 903.22.

5. Construction

- Clearing and Grubbing

  Clearing and grubbing, removal of structures and obstructions, and excavation and undercutting shall be performed in accordance with the provisions of Sections 201, 202, and 203, respectively, of the Standard Specifications. Cost of these items, however, shall be included in the square foot price bid retaining walls as shown in contract plans.

- Foundation Preparation

  Foundation preparation for the gabions shall be made to the required depth below the finished surface and to such a width as to permit the proper installation of the gabions. Prior to wall construction, the top 12 inches of the foundation shall be compacted to at least 95% of maximum laboratory dry density as specified in AASHTO T 99. All soft and unsuitable material shall be removed and replaced with suitable material, which shall then be compacted. The finished subgrade shall be smooth and uniform, with no protruding debris or rock formations. A Size 57 stone may be required to obtain the smooth uniform surface and shall be in reasonably close conformity with the dimensions and designs shown on the plans or established by the Engineer. No gabions shall be constructed upon frozen foundation material.

- Filter Cloth or Filter Stone

  Upon final foundation preparation and acceptance by the Engineer, the filter cloth or filter stone shall be placed directly on the foundation at those locations shown on the plans or as directed by the Engineer. All end and side laps shall be a minimum of 18 inches for the filter cloth.

- Assembly (Fabrication)

  Gabions shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into rectangular baskets. Gabions shall be of single unit construction, i.e., the base, lid, ends, and sides shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh. Gabion units shall be equally divided, by diaphragms of the same mesh and gauge as the body of the gabions, into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. All perimeter edges of the mesh forming the gabion shall be securely joined so that the joints formed by tying the selvedges or installation of spiral ties have at least the same strength as the body of the mesh. Lacing wire or connecting wire shall be supplied in sufficient quantity for securely fastening all diaphragms and edges of the gabion.

- Assembly (Field)

  i. Empty gabion units shall be placed on the filter blanket when required on contract drawings and shall be assembled individually to the lines and grades indicated on the Plans. Or as directed by the Engineer, with the sides, ends, and diaphragms erected in such a manner to ensure the correct position. All adjoining empty gabion units must be connected by tie wire lacing along the perimeter of their contact surfaces in order to obtain a monolithic structure. Lacing of adjoining basket units shall be accomplished by continuous stitching with alternating

single and double loops at intervals of not more than 5 inches. All lacing wire terminals shall be securely fastened. The use of expedient clip connections for this purpose or as final lid closing will not be permitted. After adjoining empty basket units are set to line and grade and common sides with adjacent units thoroughly laced, they shall be placed in tension and stretched to remove any kinks from the mesh and to a uniform alignment. The stretching of empty basket units shall be accomplished in such a manner as to prevent any possible unraveling and distortion.

ii. Stone filling operations shall carefully proceed with placement by hand or machine so as not to damage galvanized wire coating, to assure a minimum of voids between the stones, to prevent damage to the underlying filter blanket, and to ensure the maintenance of alignment throughout the filling process. The maximum height from which the stone may be dropped into the basket units shall be 36 inches. Along all exposed faces, the outer layer of stone shall be carefully placed and arranged by hand to ensure a neat and compact appearance. The last layer of stone shall be leveled with the top of the gabions to allow for the proper closing of the lid and to provide an even surface that is uniform in appearance.

iii. Lids shall be stretched tight over the stone fill using crowbars or lid closing tools until the lid meets the perimeter edges of the front and end panels. The lid shall then be tightly laced with tie wire along all edges, ends and internal cell diaphragms by continuous stitching with alternating single and double loops at intervals of not more than 5 inches. Special attention shall be given to see that all projections or wire ends are turned into the baskets. Where shown on the drawings or as directed by the Engineer, or where a complete gabion unit cannot be installed because of space limitations, the basket unit shall be cut, folded and wired together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh cut out completely or folded back and neatly wired to an adjacent gabion face. The assembling, installation, filling, lid closing, and lacing of the reshaped gabion units shall be carried out as specified above.

- Backfill

  Backfilling of the gabion wall shall follow erection as closely as possible and in no case should the height of the wall be greater than seven feet above the backfill. Underdrains, if required, shall be placed in accordance with the details shown on plans. Gabion walls backfill shall have a density of 100 pounds per cubic foot or as specified on contract plans and shall be compacted to at least 95 percent of the maximum laboratory dry density as defined in AASHTO T 99 to within one foot of the top of the wall. The top 12 inches shall be compacted to at least 100 percent of the maximum laboratory dry density. The backfill material shall consist of broken or crushed stone, gravel, sand, slag or other suitable coarse granular material to insure proper drainage. Shale, clay or cinders shall not be permitted as

backfill material. Prior to placement, the backfill material must be approved by the Engineer. The Contractor shall furnish, install, operate, and maintain satisfactory dewatering system as required to maintain the site in a dry and workable condition so as to permit grading and compaction of the wall foundation and proper erection and backfill of the wall. These systems shall include all equipment and materials, and shall be continued as long as necessary. No separate measurement or payment will be made for dewatering or dewatering systems.

All backfill material shall be tested prior to use and at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

- Vertical Wall Tolerance

  The overall vertical tolerance of the wall (plumbness from top to bottom) shall not deviate more than ½ inch per 10 feet of wall height from the contract drawings batter of the wall.

- On Site Inspection

  The quality of materials, the process of manufacture, and the finished members shall be subject to inspection and approval by the Engineer. Any gabions damaged prior to acceptance shall be repaired or reconstructed as directed by the Engineer. All costs of repairs or reconstruction shall be at the Contractor's expense.

F. Segmental, Precast Facing Mechanically Stabilized Earth (MSE) Wall (See QPL 38 for Approved Manufacturer/Supplier)

1. Materials

General - The Contractor shall make arrangements to purchase or manufacture the facing elements, reinforcing mesh or strips, attachment devices, joint filler, and all other necessary components. Materials not conforming to this section or the Standard Specifications or from sources not listed in the contract document shall not be used without written consent from the Engineer.
Out-of-state producers shall provide documentation of material quality before the manufacture of any pre-cast products (i.e. aggregate quality reports, cement/steel mill test reports, etc

- Reinforced Concrete Facing Panels - The panels shall be fabricated in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels."

  i. Acceptability of the precast units will be determined on the basis of compressive strength tests, production tolerances, and visual inspection. The Contractor, or the supplier, shall furnish facilities and perform all necessary sampling and testing in an expeditious and satisfactory manner as directed by the Engineer.

  ii. The Portland cement shall be types 1, 2, or 3 and shall conform to the requirements of AASHTO M 85 (ASTM C 150). Concrete for precast panels shall be Class D (4000 psi) as specified in Section 604 of the TDOT Standard Specifications. Admixtures containing chlorides shall not be used.

  iii. The panels shall be cast using steel forms. The front face of the

panel (face exposed to view when installed in the wall) shall be cast against a steel form or architectural form liner. The back face is to be float finished. The concrete in each panel shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by such hand tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pocket or cleavage planes. Clear form oil of the same type shall be used throughout the casting operation.

iv. Unless otherwise indicated on the plans or elsewhere in the Standard Specifications, the concrete surface for the front face shall have a Class 1 finish as defined by Section 8.12 of AASHTO, Division II, and for the rear face a uniform surface finish. The rear face of the panel shall be float finished sufficiently to eliminate open aggregate pockets and surface distortions in excess of 1/4 inch. The panels shall be cast on a flat area. The strips or other galvanized attachment devices shall not contact or be attached to the face panel reinforcement steel.

v. Curing and forms removal shall be in accordance with the requirements of Section 604.20 and 604.24 of the Standard Specifications, unless otherwise approved by the Engineer. The forms shall remain in place until they can be removed without damage to the panel.

vi. The units shall be fully supported until the concrete reaches a minimum compressive strength of 1000 psi. The units may be shipped after reaching a minimum specified compressive strength of 4000 psi. TDOT will verify products before shipment in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels and Retaining wall panels". If products are manufactured out of state, TDOT may verify at the project site PRIOR to the placement of the units. The Contractor, or producer, shall notify the Regional Materials and Tests Division that products need to be verified.

vii. Marking - The date of manufacture, the production lot number, and the piece mark shall be clearly scribed on an unexposed face of each panel.

viii. Handling, Storage, and Shipping - All units shall be handled, stored, and shipped in such a manner as to eliminate the dangers of chipping, discoloration, cracks, fractures, and excessive bending stresses. Panels damaged during handling or storage at the casting plant shall be repaired at the plant as directed by the Engineer. Any panels damaged during handling, storing, or shipping may be rejected upon delivery at the option of the Engineer. Panels in storage shall be supported in firm blocking located immediately adjacent to embedded connection devices to avoid bending the connection devices.

ix. Tolerances - All units shall be manufactured within the following tolerances:

- Panel Dimensions - Position panel connection devices within 1 inch, except for all other dimensions within 3/16 inch.
- Panel Squareness - Squareness as determined by the difference between the two diagonals shall not exceed 1/2 inch.
- Angular distortion with regard to the height of the panel shall not exceed 3/16 inch in 5 feet.
- Panel Surface Finish - Surface defects on smooth formed surfaces measured over a length of 5 feet shall not exceed 1/8 inch. Surface defects on the textured-finish surfaces measured over a length of 5 feet shall not exceed 5/16 inch.

x. Steel - In accordance with the Standard Specifications.

xi. Compressive Strength - Acceptance of the concrete panels, with respect to compressive strength, will be determined on the basis of production lots. A production lot is defined as a group of panels that will be represented by a single compressive strength sample and will consist of a single day's production as defined in the certify in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels".

xii. During the production of the concrete panels, the Engineer will sample the concrete in accordance with AASHTO T 141 (ASTM C 172). A single compressive strength sample, consisting of a minimum of six (6)cylinders, will be randomly selected for every production lot.

xiii. Cylinders for compressive strength tests shall be prepared in accordance with AASHTO T 23 (ASTM C 31) on 6" x 12" or 4" x 8" specimens. For every compressive strength sample, a minimum of two (2) cylinders will be cured in the same manner as the panels and tested for acceptance no later than twenty-eight (28) days. The average compressive strength of these two cylinders, when tested according with AASHTO T 22 (ASTM C 39), will determine the compressive strength of the production lot.

xiv. If the Contractor wishes to remove forms or ship the panels prior to 28 days, a minimum of two (2) additional cylinders will be cured in the same manner as the panels. The average compressive strength of these cylinders when tested in accordance with AASHTO T 22, will determine whether the forms can be removed and the panels are acceptable.

xv. Acceptance of a production lot will be made if the compressive strength test result is greater than or equal to 4,000 psi when tested for acceptance no later than 28 days.

xvi. In the event that a production lot fails to meet the specified compressive strength requirements, the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at their own expense, obtains and submits cores for testing and the results show that the strength and quality of the concrete placed within the panels of the production lot is acceptable. The cores shall be taken from the panels within the production lot and tested in accordance with the specifications of AASHTO T 24 (ASTM

C 42). Two cores per each cylinder that failed will be required. In addition, any or all of the following defects shall be sufficient cause for rejection:

- Defects that indicate imperfect molding.
- Defects indicating honeycombing or open texture concrete.
- Defects in the physical characteristics of the concrete such as cracked or severely chipped panels.
- Color variation on front face of panel due to excess form oil or other reasons.
- Damage due to handling, storing or shipping.

xvii. The Engineer shall determine whether spalled, honeycombed, chipped or otherwise defective concrete shall be repaired or rejected. Repair of concrete, if allowed, shall be done with a TDOT approved cementitious polymer patching mortar in a manner satisfactory to the Engineer. Repair to concrete surface which will be exposed to view after completion of construction must be approved by the Engineer.

- Soil Reinforcing and Attachment Devices - All reinforcing and attachment devices shall be shop fabricated and carefully inspected to ensure they are true to size and free from defects that may impair their strength and durability.

i. Reinforcing Strips - Reinforcing strips shall be hot rolled from bars to the required shape and dimensions. Their physical and mechanical properties shall conform to either AASHTO M 183 (ASTM A 36) or AASHTO M 223 (ASTM A 572) grade 65 or
equal. Galvanization shall conform to the minimum requirements or AASHTO M 111 (ASTM A 123).

ii. Tie Strips - The tie strips shall be shop- fabricated of hot rolled steel conforming to the minimum requirements of ASTM 570, Grade 50 or equivalent. Galvanization shall conform to AASHTO M 111 (ASTM A 123). Tie straps may be partially bent before shipment to the precast yard. Minimum bending radius shall be one inch. Final bending may be accomplished at the precast yard.

iii. Reinforcing Mesh - Reinforcing mesh shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of AASHTO M 32 (ASTM A 82) and shall be welded into the

finished mesh fabric in accordance with AASHTO M 55 (ASTM A 185). Galvanization shall be applied after the mesh is fabricated and conform to the minimum requirements of AASHTO M 111 (ASTM A 123).

iv. Fasteners - Fasteners shall be high strength hexagonal cap screw bolts and nuts conforming to AASHTO M 164 (ASTM A 325). Galvanizing fastener elements, including washers, shall be in accordance with AASHTO M 232 (ASTM A 153). Bolts and nuts nominal diameter will be shown in the plans and supplied in

accordance with the fasteners as specified previously.

v. Steel Strap Connections - The steel strap connection bar and plate shall meet the same requirements as the reinforcing and tie strips specified above. Bolts, nuts, and washers shall conform to the requirements for the fasteners specified above. Coatings for connecting devices shall be as specified below.

vi. Clevis Loop and Mesh Loop - Clevis loops and mesh loops shall be fabricated of cold drawn steel wire conforming to the requirements of AASHTO M 32 (ASTM A 82) and welded in accordance with AASHTO M 55 (ASTM A 185) and shall develop a minimum stress of 0.9 F_y.

vii. Connector Bar - Connector bar shall be fabricated of cold drawn steel wire conforming to the requirements of AASHTO M 32 (ASTM A 82).

viii. Holes for bolts shall be punched in the location shown. Surfaces resulting from punching holes for bolts shall be galvanized in accordance with AASHTO M 111 (ASTM A 123). Those parts of the connecting devices which are threaded shall be galvanized in accordance with AASHTO M 232 (ASTM A 153). Alignment pins are to be hot dip galvanized.

ix. All connecting devices shall be to the dimensions shown on the plans. Connecting members and soil reinforcement devices shall be assembled prior to galvanization. All connecting devices shall be true to size and free from defects that may impair their strength or durability.

x. Any damage sustained to any part of the connecting devices, bolts or reinforcing devices during any phase of fabrication, storage or erection shall be repaired to the satisfaction of the Engineer at no increase in contract cost.

- Geosynthetic Reinforcement Material- Where geosynthetic reinforcements are used for the construction of MSE walls the following requirements shall apply:

i. Geotextiles and Thread for Sewing - Woven or nonwoven geotextiles shall consist only of long chain polymeric filaments or yarns formed into a stable network such that the filaments or yarns retain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the long chain polymer shall be polyolefin or polyester. The material shall be free of defects and tears. The geotextile shall conform as a minimum to the properties indicated for Separation, Medium Survivability indicated under AASHTO T 288. The geotextile shall be free from any treatment or coating that might adversely alter its physical properties after installation.

ii. Geogrids - The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be

dimensionally stable and able to retain its geometry under manufacture, transport and installation.

iii. Required Properties - The specific geosynthetic material(s) shall be preapproved by the Department and shall have certified long-term strength (T_{al}) as determined by:

- Long-Term strength (T_{al}) based on $T_{al}= T_{ULT}/(RF_D)*(RF_{ID})*(RF_{CR})$ where RF_{CR} is developed from creep tests performed in accordance with ASTM D 5262, RF_{ID} obtained from site installation damage testing and RF_{ID} from hydrolysis or oxidative degradation testing extrapolated to 75 or 100 year design life.
- Ultimate Strength (TULT) based upon minimum average roll values (MARV) (lb/ft), ASTM D4595.
- Pullout Resistance Factor developed in accordance with Chapter 3 of chapter 3 of FHWA-SA-96-071.

iv. Certification - The Contractor shall submit a manufacturer's certification that the geosynthetics supplied meet the respective index criteria set when the geosynthetic was approved by the Department, measured in full accordance with all test methods and standards specified and as set forth in this document.

The manufacturer's certificate shall state that the furnished geosynthetic meets the requirements of this document as evaluated by the manufacturer's quality control program. The certificates shall be attested to by a person having legal authority to bond the manufacturer. In case of dispute over validity of value, the Engineer can require the Contractor to supply test data from a Department approved laboratory to support the certified values submitted.

v. Manufacturing Quality Control: The geosynthetic reinforcement shall be manufactured with a high degree of quality control. The manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of this document. The purpose of the QC testing program is to verify that the reinforcement geosynthetic being

supplied to the project is representative of the material used for performance testing and approval by the Department.

Conformance testing shall be performed as part of the manufacturing process and may vary for each type of product. As a minimum, the following index tests shall be considered as applicable for an acceptable QA/QC program:

Property	Test Procedure
Specific Gravity (HDPE only)	ASTM D 1505
Wide Width Tensile	ASTM D 4595; GRI:GG1
Melt Flow (HDPE and PP only)	ASTM D 1238
Intrinsic Viscosity (PET only)	ASTM D 4603
Carboxyl End Group (PET only)	ASTM D 2455

vi. Sampling, Testing, and Acceptance - Sampling and conformance testing shall be in accordance with ASTM D 4354. Conformance testing procedures shall be as established under 4.3.5. Geosynthetic product acceptance shall be based on ASTM D 4759.

The quality control certificate shall include:

- Roll numbers and identification
- Sampling procedures
- Result of quality control tests, including a description of test methods used

vii. Select Granular Backfill Material for use with Geosynthetic Reinforcement – The backfill material shall conform to the requirements as stated below in Select Granular Backfill Material ~~set forth in Section F.1.e~~. except that the maximum size of the backfill shall be 3/4 inch, unless full scale installation damage tests are conducted in accordance with ASTM D 5818.

- Joint Materials - Installed to the dimensions and thicknesses in accordance with the plans or approved shop drawings.

i. If required, provide flexible foam strips for filler for vertical joints between panels, and in horizontal joints where pads are used, where indicated on the plans.

ii. Provide in horizontal joints between panels preformed EPDM rubber pads conforming to ASTM D 2000 for 4AA, 812 rubbers, neoprene elastomeric pads having a Durometer Hardness of 55 ± 5, or high density polyethylene pads with a minimum density of 59 lb/ft^3 in accordance with ASTM D 1505.

iii. Cover all joints between panels on the back side of the wall with a geotextile meeting the minimum requirements for filtration applications as specified by AASHTO M 288. The minimum width and lap shall be 12 inches. Adhesive used to attach the filter fabric to the back of the panels shall be approved by the wall supplier.

- Select Granular Backfill Material - All backfill material used in the Mechanically Stabilized Earth structure volume, as shown on the plans, shall be reasonably free (maximum of 0.1%) from organic and otherwise deleterious materials, and it shall be approved by the Engineer prior to use. The material shall conform to the following gradation limits and be tested at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)". The Contractor shall also provide test data from an approved laboratory certifying that the material meets the following:

  i. Gradation as determined by AASHTO T 27.

Sieve Size	Percent Passing
4 inches	100
3/8 inch	0-75
No. 4	0-25
No. 8	0-10
No. 16	0-5

Note: Size Nos. 1 through 78 as listed in order of Table 1 Standard Sizes of Processed Aggregate in Section 903.22 of Standard Specifications meet the above gradation requirements.

ii. In addition, the backfill must conform to all of the following requirements:

- Soundness - The material shall be substantially free from shale or other soft, poor durability particles. The material shall have a sodium sulfate loss of less than 12 percent after five (5) cycles determined in accordance with AASHTO T 104.
- The material shall exhibit an angle of internal friction of not less than 34 degrees as determined by the standard direct shear test AASHTO T 236 on the portion finer than the No. 4 sieve, using a sample of the material compacted to 95 percent of AASHTO T 99. No testing is required for backfills where 80 percent of sizes are greater than 3/8 inch.
- Electrochemical requirements - The backfill shall meet the following criteria:

REQUIREMENTS	**TEST METHOD**
ph = 5-10	AASHTO T 289 – 91
Resistivity > 3000 ohm centimeters[1]	AASHTO T 288 – 91
Chlorides < 100 parts per million	AASHTO T 291 – 91
Sulfates < 200 parts per million	AASHTO T 290 – 91
Organic Content < 1 %	AASHTO T 267 – 86

1. If the resistivity is greater or equal to 5000 ohm centimeters the chloride and sulfates requirements may be waived.

- Unit weight- The unit weight of the backfill material (at optimum condition) shall meet the requirements of the approved shop drawings or plans.

- Concrete Leveling Pad, Traffic Barrier and Coping - The concrete shall conform to the requirements of the Standard Specifications for Class A concrete.
- Acceptance of Material - The Contractor shall furnish the Engineer a Certificate of Compliance certifying the above materials comply with the applicable contract specifications. A copy of all test results performed by the Contractor necessary to assure contract compliance shall be furnished to the Engineer.

  Acceptance will be based on the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

2. Construction

a. Foundation Preparation - The foundation for the MSE wall shall be graded level for a minimum width equal to the width of the reinforced volume and leveling pad plus one (1) foot, or as shown on the plans, using the top of the leveling pad as the grade elevation. Prior to wall construction, the foundation shall be compacted to 95 percent of optimum density, as directed by the Engineer. Any foundation soils found to be unsuitable shall be removed as directed by the Engineer and replaced with select granular backfill material compacted to 95 percent of AASHTO T 99. The contractor shall conduct any ground improvements required by the contract plans as part of foundation preparation.

   At each panel foundation level, a precast reinforced or a cast-in-place unreinforced concrete leveling pad of the type shown on the plans shall be provided. The concrete shall be Class "A" concrete with compressive strength of 3000 psi (28 day strength). The leveling pad shall be cured a minimum of 12 hours before placement of wall panels.

b. Wall Erection - Where a proprietary wall system is used, a field representative shall be available during the erection of the wall to assist the fabricator, Contractor, and Engineer. If there is more than one wall of the same type on the project, this requirement will apply to construction of the initial wall only. After construction of the initial wall, the representative will be available on an as-needed basis, as requested by the Engineer, during construction of the remainder of the walls. Wall erection shall be in conformance with the latest edition of the MSE wall construction manual as published by the wall supplier. For erection, panels are handled by means of a lifting device set into the upper edge of the panel. Precast concrete panels shall be placed such that a final vertical face will be obtained.

   It shall be the responsibility of the Contractor to consult with the designer/supplier and to utilize the proper methods necessary to achieve a vertical face for the final wall. Panels should be placed in successive horizontal lifts as backfill placement proceeds. As backfill material is placed behind the panels, the panels shall be maintained in position by

means of temporary wedges or bracing according to the wall supplier's recommendations. External bracing shall also be required for this initial lift. The wedges shall remain in place until the fourth layer of panels is placed, at which time the bottom layer of wedges shall be removed. Each succeeding layer of wedges shall be removed as the succeeding panel layers are placed. When the wall is completed, all wedges shall be removed. No wedges shall be used as a means of leveling panels on leveling pads. Wedges placed below the ground line on the front face of the wall shall be removed before this area is backfilled.

Tolerances and alignment shall be as follows:

i. Horizontal and vertical joint openings between panels shall be uniform. The maximum allowable offset in any panel joint shall be 3/4 inch.

ii. Vertical tolerance (plumbness) and horizontal alignment tolerances as the wall is constructed shall not exceed 3/4 inch when measured along a 10 foot straightedge.

The overall vertical tolerance of the wall (plumbness from top to bottom)

in its final position shall not exceed 3/4 inch per 10 feet of wall height.

Cast-in-place concrete shall be placed on top of wall panels to allow precast coping elements on top of the wall to be brought to proper grade.

Prior to placing any select backfill material on any soil reinforcement device, all connections to the panels shall be completed.

c. Backfill Placement - Backfill placement shall closely follow the erection of each lift of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials including panels, soil reinforcements, and connections, or misalignment of the facing panels or reinforcing elements. Any wall materials which may become damaged or disturbed during backfill placement, or due to wall settlement prior to completion of the project shall be either removed and replaced at the Contractor's expense or corrected, as directed by the Engineer. Any misalignment or distortion of the wall facing panels due to placement of backfill outside the limits of this section shall be corrected, as directed by the Engineer at the Contractor's expense. Backfill placement methods near the facing shall assure that no voids exist directly beneath the reinforcing elements.

Backfill shall be compacted to 95 percent of the maximum density as determined by AASHTO T 99. When the backfill supports a spread footing of a bridge or other structural load, the top 5 feet shall be compacted to 100 percent of the maximum density. For backfills containing more than 30 percent retained on the ¾ inch sieve, a method compaction consisting of a minimum of 2 passes of a steel drum roller or truck equipment equivalent or larger than a Caterpillar D-6 Bulldozer shall be used.

The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall be placed at a moisture content not more than 2 percentage points less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T 99.

At each soil reinforcement device level, backfill shall be compacted to the full length of reinforcement devices and be sloped to drain away from the wall before placing and attaching the next layer of reinforcement devices. The compacted backfill shall be level with the connecting device before the reinforcement device can be connected. Compaction within three feet of the back face of the wall facing panel shall be achieved with at least three (3) passes of a light weight mechanical tamper, roller, or vibratory system.

Unless otherwise indicated on the plans or directed by the Engineer, soil reinforcement devices shall be placed at 90 degrees to the face of the wall. The maximum lift thickness before compaction shall be ten (10) inches and shall closely follow panel erection. The Contractor shall decrease this

lift thickness, if required, to obtain the specified density.

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

G. Prefabricated Modular Block Facing Mechanically Stabilized Earth (MSE) Wall (See QPL 38 for Approved Manufacturer/Supplier)

1. Materials

General - The contractor shall make arrangements to purchase or manufacture the facing elements, reinforcing mesh or strips, attachment devices, joint filler, and all other necessary components. Materials not conforming to this section or from sources not listed in the contract document shall not be used without written consent from the Engineer.

- Concrete Modular Block Facing - The concrete modular blocks shall be either hollow or solid concrete structural retaining wall units, machine made from Portland cement, water, and mineral aggregates with or without the inclusion of other materials. The units are intended for use in the construction of mortarless, modular block retaining (MBW) walls.

  i. Cementious Materials - Materials shall conform to the following:

  - Portland Cement - AASHTO M 85 (ASTM C 150).
  - Blended Cements – Type IP -AASHTO M 240 (ASTM C 595).
  - Pozzolans – Class C or Class F fly ash -AASHTO M 295 Blast Furnace Slag Cement – grade 100 or 120- AASHTO M 302 (ASTM C 989).

  ii. Aggregates - Aggregates shall conform to the following specifications, except that grading requirements shall not necessarily apply:

  - Normal Weight Aggregates – TDOT Standard Specification sections 903.01 and 903.03.
  - Lightweight Aggregates - TDOT Standard Specification section 903.19.

  iii. Other Constituents - Air-entraining agents, coloring pigments, integral water repellants, finely ground silica, and other constituents shall be previously established as suitable for use in concrete MBW units and shall conform to applicable AASHTO Standards or, shall be shown by test or experience to be not detrimental to the durability of MBW units or any material customarily used in masonry construction.

  iv. Physical Requirements. Prior to delivery to the work site, the units shall conform to the following physical requirements:

  1. Minimum required compressive strength = 4,000 psi (Average 3 coupons)
  2. Minimum required compressive strength = 3,500 psi

(Individual coupon)

3. Maximum water absorption = 5%
4. Maximum number of blocks per lot = 2,000

Also, prior to delivery, TDOT will conduct verification testing on the modular blocks in accordance with the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)

If products are manufactured out of state, TDOT may verify at the project site PRIOR to the placement of the units. The Contractor, or producer, shall notify the Regional Materials and Tests Division that products need to be verified.

v. Tolerances. Blocks shall be manufactured within the following tolerances:

- The length and width of each individual block shall be within 1/8 inch of the specified dimension. Hollow units shall have a minimum wall thickness of 1-1/4 inch.
- The height of each individual block shall be within 1/16 inch of the specified dimension.
- When a broken face finish is required, the dimension of the front face shall be within 1 inch of the theoretical dimension of the unit.
- Finish and Appearance. All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction. Minor cracks (e.g. no greater than 1/32 inch in width and no longer than 25 % of the unit height) incidental to the usual method of manufacture or minor chipping resulting from shipment and delivery, are not grounds for rejection.

  The face or faces of units that are to be exposed shall be free of chips, cracks or other imperfections when viewed from a distance of 30 feet under diffused lighting. Up to five (5) percent of a shipment may contain slight cracks or small chips not larger than 1 inch.

  Color and finish shall be as shown on the plans and shall be erected with a running bond configuration.

- If pins are required to align MBW units, they shall consist of a non-degrading, polymer or galvanized steel and be made for the express use with the MBW units supplied.
- Cap units shall be cast to or attached to the top MBW units in strict accordance with the manufacturer's requirements and the adhesive manufacturer's recommended procedures. The Contractor shall provide a written 10 year warranty acceptable to the Department that the integrity of the materials used to

attach the cap blocks will preclude separation and displacement of the cap blocks for the warranty period.

vi. Sampling and Testing. Acceptance of the concrete block with respect to compressive strength and absorption will be determined on a lot basis. The lot will be randomly sampled in accordance with ASTM C 140. Compressive strength and absorption tests shall be performed by the manufacturer and submitted to the Department. Compressive strength test specimens shall be cored or shall conform to the saw-cut coupon provisions of section 6.2.4 of ASTM C 140. Blocks represented by test coupons that do not reach an average compressive strength of 4,000 psi or an individual strength of 3500 psi, or have less than 5 % absorption will be rejected.

vii. Rejection. Blocks shall be rejected because of failure to meet any of the requirements specified above. In addition, any or all of the following defects shall be sufficient cause for rejection.

- Defects that indicate imperfect molding.
- Defects indicating honeycomb or open texture concrete.
- Cracked or severely chipped blocks.
- Color variation on front face of block due to excess form oil or other reasons.

Blocks may also be rejected if TDOT verification test results do not comply with the requirements specified above.

- Unit Fill - The unit fill and drainage aggregate shall be a well graded crushed stone or granular fill meeting the following gradation:

U.S. Sieve Size	**Percent Passing**
1 inch	100-75
3/4 inch	50-75
No. 4	0-60
No. 40	0-50
No. 200	0-5

- Geosynthetic Reinforcement Material - The following requirements shall apply for geosynthetic reinforcement material:

i. Geotextiles and Thread for Sewing - Woven or nonwoven geotextiles shall consist only of long chain polymeric filaments or yarns formed into a stable network such that the filaments or yarns retain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the long chain polymer shall be polyolefin or polyester. The material shall be free of defects and tears. The

geotextile shall conform as a minimum to the properties indicated for Separation, Medium Survivability indicated under AASHTO T 288. The geotextile shall be free from any treatment or coating that might adversely alter its physical properties after installation.

ii. Geogrids - The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation.

iii. Required Properties - The specific geosynthetic material(s) shall be pre-approved by the Department and shall have certified long-term strength (T_{al}) as determined by:

- Long-Term strength (T_{al}) based on $T_{al} = T_{ult}/(RF_D)*(RF_{ID})*(RF_{CR})$ where RF_{CR} is developed from creep tests performed in accordance with ASTM D 5262, RF_{ID} obtained from site installation damage testing and RF_{ID} from hydrolysis or oxidative degradation testing extrapolated to 75 or 100 year design life.
- Ultimate Strength (T_{ULT}) based upon minimum average roll values (MARV) (lb/ft), ASTM D4595.
- Pullout Resistance Factor developed in accordance with chapter 3 of FHWA-SA-96-071.

iv. Certification - The Contractor shall submit a manufacturer's certification that the geosynthetics supplied meet the respective index criteria set when the geosynthetic was approved by the Department, measured in full accordance with all test methods and standards specified and as set forth in this section of the TDOT Earth Retaining Structures Manual. The manufacturer's certificate shall state that the furnished geosynthetic meets the requirements of this document as evaluated by the manufacturer's quality control program. The certificates shall be attested to by a person having legal authority to bond the manufacturer. In case of dispute over validity of values, the Engineer can require the Contractor to supply test data from a Department approved laboratory to support the certified values submitted.

v. Manufacturing Quality Control: The geosynthetic reinforcement shall be manufactured with a high degree of quality control. The manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of the TDOT Earth Retaining Structures Manual. The purpose of the QC testing program is to verify that the geosynthetic being supplied to the project is representative of the material used for performance testing and approval by the

Department.

Conformance testing shall be performed as part of the manufacturing process and may vary for each type of product. As a minimum the following index tests shall be considered as applicable for an acceptable QA/QC program:

Property	**Test Procedure**
Specific Gravity (HDPE only)	ASTM D 1505
Wide Width Tensile	ASTM D 4595; GRI:GG1
Melt Flow (HDPE and PP only)	ASTM D 1238
Intrinsic Viscosity (PET only)	ASTM D 4603
Carboxyl End Group (PET only)	ASTM D 2455

vi. Sampling, Testing, and Acceptance - Sampling and conformance testing shall be in accordance with ASTM D 4354. Conformance testing procedures shall be as established under section 4.3.5. Geosynthetic product acceptance shall be based on ASTM D 4759.

The quality control certificate shall include:

- Roll numbers and identification
- Sampling procedures
- Result of quality control tests, including a description of test methods used.

vii. Select Granular Backfill Material for use with Geosynthetic Reinforcement - The backfill material shall conform to the requirements as stated below in Select Granular Backfill Material ~~set forth in Section G. 1.c.~~ except that the maximum size of the backfill shall be 3/4 inch, unless full scale installation damage tests are conducted in accordance with ASTM D 5818.

All backfill material shall be tested prior to use and at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)".

- Soil Reinforcing and Attachment Devices - Where steel reinforcing and attachment devices are used in the construction of the MSE wall the following requirements shall apply.

i. Reinforcing Strips - Reinforcing strips shall be hot rolled from bars to the required shape and dimensions. Their physical and mechanical properties shall conform to either AASHTO M 183 (ASTM A 36) or AASHTO M 223 (ASTM A 572) grade 65 or
equal. Galvanization shall conform to the minimum requirements or AASHTO M 111 (ASTM A 123).

ii. Tie Strips - The tie strips shall be shop-fabricated of hot rolled

steel conforming to the minimum requirements of ASTM A 570, Grade 50 or equivalent. Galvanization shall conform to AASHTO M111. Tie straps may be partially bent before shipment to the precast yard. Minimum bending radius shall be one inch. Final bending may be accomplished at the precast yard.

iii. Reinforcing Mesh - Reinforcing mesh shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of AASHTO M 32 (ASTM A 82) and shall be welded into the finished mesh fabric in accordance with AASHTO M 55 (ASTM A 185). Galvanization shall be applied after the mesh is fabricated and conform to the minimum requirements of AASHTO M 111

iv. Fasteners - Fasteners shall be high strength hexagonal cap screw bolts and nuts conforming to AASHTO M 164 (ASTM A 325).Galvanizing fastener elements, including washers, shall be in accordance with AASHTO M 232 (ASTM A 153). Bolts and nuts nominal diameter will be shown in the plans and supplied in accordance with the fasteners as specified previously.

v. Steel Strap Connections - The steel strap connection bar and plate shall meet the same requirements as the reinforcing and tie strips specified above. Bolts, nuts, and washers shall conform to the requirements for the fasteners specified above. Coatings for connecting devices shall be as specified below.

vi. Clevis Loop and Mesh Loop - Clevis loops and mesh loops shall be fabricated of cold drawn steel wire conforming to the requirements of AASHTO M 32 and welded in accordance with AASHTO M 55 and shall develop a minimum stress of 0.9 F_y.

vii. Connector Bar - Connector bar shall be fabricated of cold drawn steel wire conforming to the requirements of AASHTO M 32.

Holes for bolts shall be punched in the location shown. Surfaces resulting from punching holes for bolts shall be galvanized in accordance with AASHTO M 111. Those parts of the connecting devices which are threaded shall be galvanized in accordance with AASHTO M 232. Alignment pins are to be hot dip galvanized.

All connecting devices shall be to the dimensions shown on the plans. Connecting members and soil reinforcement devices shall be assembled prior to galvanization. All connecting devices shall be true to size and free from defects that may impair their strength or durability.

Any damage sustained by any part of the connecting devices, bolts or reinforcing devices during any phase of fabrication, storage or erection shall be repaired to the satisfaction of the Engineer at no increase in contract cost.

Select Granular Backfill Material - All backfill material used in the Mechanically Stabilized Earth structure volume, as shown on the plans, shall be reasonably free (maximum of 0.1%) from organic and otherwise deleterious materials, and it shall be approved by the Engineer prior to use. The material shall conform to the following gradation limits and be tested

at the established frequencies in the TDOT "Procedures for the Sampling and Testing, and Acceptance of Materials and Products (SOP 1-1)". The Contractor shall also provide test data from an approved laboratory certifying that the material meets the following:

i. Gradation as determined by AASHTO T 27.

Sieve Size	Percent Passing
4 inches	100
3/8 inch	0-75
No. 4	0-25
No. 8	0-10
No. 16	0-5

Note: Size Nos. 1 through 78 as listed in order of Table 1 Standard Sizes of Processed Aggregate in Section 903.22 of Standard Specifications meet the above gradation requirements.

ii. In addition, the backfill must conform to all of the following requirements:

- Soundness - The material shall be substantially free from shale or other soft, poor durability particles. The material shall have a sodium sulfate loss of less than 12 percent after five (5) cycles determined in accordance with AASHTO T 104.
- The Plasticity Index (P.I.), as determined by AASHTO T 90, shall not exceed 6.
- The material shall exhibit an angle of internal friction of not less than 34 degrees as determined by the standard direct shear test AASHTO T 236 on the portion finer than the No. 4 sieve, using a sample of the material compacted to 95 percent of AASHTO T 99. No testing is required for backfills where 80 percent of sizes are greater than 3/8 inch.
- Electrochemical requirements - The backfill shall meet the following criteria:

REQUIREMENTS	**TEST METHOD**
ph= 5-10	AASHTO T 289 – 91
Resistivity > 3000 ohm centimeters[1]	AASHTO T 288 – 91
Chlorides < 100 parts per million	AASHTO T 291 – 91
Sulfates < 200 parts per million	AASHTO T 290 – 91
Organic Content < 1%	AASHTO T 267 – 86

1. If the resistivity is greater or equal to 5000 ohm centimeters the chloride and sulfates requirements may be waived.

- Unit weight- The unit weight of the backfill material (at optimum condition) shall meet the requirements of the approved shop drawings or plans.

- Concrete Leveling Pad, Traffic Barrier and Coping - The concrete shall conform to the requirements of the Standard Specifications for Class A concrete.

- Acceptance of Material - The contractor shall furnish the Engineer a Certificate of Compliance certifying the above materials comply with the applicable contract specifications. A copy of all test results performed by the Contractor necessary to assure contract compliance shall be furnished to the Engineer.

2. Construction

a. Wall Excavation - Unclassified excavation shall be in accordance with the requirements of the Standard Specifications and in reasonably close conformity with the limits and construction lines shown on the plans. Temporary excavation support as required shall be the responsibility of the Contractor.

b. Foundation Preparation - The foundation for the MSE wall shall be graded level for a minimum width equal to the width of the reinforced volume and leveling pad plus one (1) foot, or as shown on the plans, using the top of the leveling pad as the grade elevation. Prior to wall construction, the foundation shall be compacted to 95 percent of optimum density, as directed by the Engineer. Any foundation soils found to be unsuitable shall be removed as directed by the Engineer and replaced with select granular backfill material compacted to 95 percent of AASHTO T 99 methods. The contractor shall conduct any ground improvement required by the contract plans as part of foundation preparation.

At each block foundation level, a precast reinforced or a cast-in-place unreinforced concrete leveling pad of the type shown on the plans shall be provided. The concrete shall be Class A concrete with compressive strength of 3000 psi (28 day strength). The leveling pad shall be cured a minimum of 12 hours before placement of wall panels.

c. Wall Erection - Where a proprietary wall system is used, a field representative shall be available during the erection of the wall to assist the fabricator, Contractor, and Engineer. If there is more than one wall of the same type on the project, this requirement will apply to construction of the initial wall only. After the initial wall, the representative will be available on an as-needed basis, as requested by the Engineer, during construction of the remainder of the walls. Wall erection shall be in conformance with the latest edition of the MSE wall construction manual as published by the wall supplier.

It shall be the responsibility of the Contractor to consult with the designer/supplier and to utilize the proper methods necessary to achieve a vertical face for the final wall. Blocks should be placed in successive horizontal lifts as backfill placement proceeds per the manufacturer's recommendations.

Cast-in-place concrete shall be placed on top of wall panels to allow precast coping elements on top of the wall to be brought to proper grade.

Prior to placing any select backfill material on any soil reinforcement device, all connections to the blocks shall be completed.

d. Backfill Placement - Backfill placement shall closely follow the erection of each lift of blocks. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials including blocks, soil reinforcements, and connections, or misalignment of the facing blocks or reinforcing elements. Any wall materials which may become damaged or disturbed during backfill placement, or due to wall settlement prior to completion of the project shall be either removed and replaced at the Contractor's expense or corrected, as directed by the Engineer. Any misalignment or distortion of the wall facing blocks due to placement of backfill outside the limits of this section shall be corrected, as directed by the Engineer. Backfill placement methods near the facing shall assure that no voids exist directly beneath the reinforcing elements.

Backfill shall be compacted to 95 percent of the maximum density as determined by AASHTO T 99. When the backfill supports a spread footing of a bridge or other structural load, the top 5 feet shall be compacted to 100 percent of the maximum density. For backfills containing more than 30 percent retained on the ¾ inch sieve, a method compaction consisting of a minimum of 2 passes of a steel drum roller or tracked equipment equivalent or larger than a Caterpillar D-6 Dozer shall be used.

The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill materials shall have a placement moisture content less than or equal to the optimum moisture content. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T 99.

At each soil reinforcement device level, backfill shall be compacted to the full length of reinforcement devices and be sloped to drain away from the wall before placing and attaching the next layer of reinforcement devices. The compacted backfill shall be level with the connecting device before the reinforcement device can be connected. Compaction within three feet of the back of the wall facing shall be achieved with at least three (3) passes of a light weight mechanical tamper, roller, or vibratory system.

Unless otherwise indicated on the plans or directed by the Engineer, soil reinforcement devices shall be placed at 90 degrees to the face of the wall. The maximum lift thickness before compaction shall be ten (10) inches and shall closely follow modular block erection. The Contractor shall decrease this lift thickness, if required, to obtain the specified density.

At the end of each day's operation, the Contractor shall slope the last level

of backfill away from the wall facing to rapidly direct runoff or rainwater away from the wall face. In addition, the contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

H. Anchored Wall (See QPL 38 for Approved Manufacturer/Supplier)

Part A - Part A covers specifications for permanent ground anchor walls exclusive of the ground anchors.

1. Design Criteria

Unless otherwise directed the Contractor shall select the type of wall element to be used. The wall shall be designed for shear, moment, and lateral and axial capacity in accordance with AASHTO LRFD procedures. The Contractor shall be responsible for determining the length of the wall element and required section necessary to resist loadings due to earth, and water forces while controlling ground movements. Structure design life and corrosion protection requirements for sheet-piles and soldier beams will be provided on the contract drawings. Soil properties, safety factors, anchor tendon corrosion protection requirements, wall finish and color requirements, and appurtenance locations are given in the contract plans or specifications.

The Contractor shall be familiar with the requirements for ground anchors described in Part B, "Ground Anchors". The contractor shall incorporate all dimensional and location restrictions on ground anchor locations, spacing, and length of anchor bond length and unbonded length that may affect the design of the wall system covered by this section.

- The wall system shall be designed to resist maximum anticipated loadings calculated for the effects of any special loadings shown on the contract plans.
- The wall shall be designed to ensure stability against passive failure of the embedded portion of the vertical wall elements (below the base of excavation).
- The axial load carrying capacity of the embedded portion of the vertical wall elements (below the base of the excavation) shall be evaluated.. The wall shall be designed to resist vertical loads including vertical anchor forces and the weight of the lagging and the vertical wall elements. Relying on transfer of vertical load into the soil behind the wall by friction shall not be permitted, unless approved by the Engineer.
- Permanent facing shall be precast or cast-in-place reinforced concrete. Architectural facing treatments, if required, shall be as indicated on the contract drawings. The facing shall extend a minimum of 2.0ft below the gutter line or, if applicable, the ground line adjacent to the wall unless otherwise indicated on the contract drawings.
- The Contract Plans will provide minimum requirements of design elements in order to provide global stability requirement such as minimum embedment of vertical pile elements or minimum lengths of unbonded (free-length) zone for anchors. The wall design shall provide these minimum requirements.
- Wall Drainage. The wall drainage system shall operate by gravity and

shall be capable of relieving water pressures on the back face of the wall under anticipated worst case water pressure conditions. When drainage systems are incorporated into the specific design, hydrostatic head on the back of the wall shall not exceed 6 inches above the elevation of the drainage collection pipe.

2. Materials

The Contractor shall not deliver materials to the site until the Engineer has approved the submittals outlined in section 3.0. The Contractor shall protect the materials from the elements by appropriate means. Prestressing steel strands and bars shall be stored and handled in accordance with the manufacturer's recommendations and in such a manner that no damage to the component parts occurs. All steel components shall be stored under cover and protected against moisture.

- Soldier Beam and Structural Steels
  - i. Steel Soldier Beams - Steel soldier beams shall be of the type and weight indicated on the approved working drawings. Steel soldier beams shall conform to the requirements of AASHTO M 183 (ASTM A 36) or AASHTO M 223 (ASTM A 572) unless otherwise specified.
  - ii. Steel Sheet Piles - Steel sheet piles shall be of the type and weight indicated on the approved working drawings. Steel sheet piles shall conform to the requirements of AASHTO M 202 (ASTM A 328) or AASHTO M 270 (ASTM A 709) Grade 50.
  - iii. Steel Plate - Steel used to fabricate steel studs and other devices shall conform to the requirements of AASHTO M 169 (ASTM A 108)
  - iv. Steel Tube - Steel tube shall conform to the requirements of ASTM A 500.
  - v. Reinforcing Steel - Reinforcing steel shall conform to ASTM A 615. The required Grade of all reinforcing shall be shown on the plans.
- Concrete
  - i. Cement - Portland cement shall be Type I or II and shall conform to AASHTO M 85.
  - ii. Structural Concrete - Structural concrete shall conform to the requirements of Section 604 of the TDOT Standard Specifications Structural concrete shall be Class A with a minimum 28-day compressive strength of 3000 psi, unless otherwise noted on the contract drawings.
  - iii. Lean-Mix Concrete Backfill - Lean-mix concrete backfill shall consist of Type I or Type II Portland cement, fine aggregate and water. Each cubic yard of lean-mix concrete backfill shall consist of a minimum of one sack (94lbs) of Portland cement.

iv. Precast Concrete - Precast concrete elements such as panels shall be made by an approved plant in accordance with the TDOT Procedure for the "Manufacture and Acceptance of Pre-cast Concrete Drainage Structures, Noise Wall panels, and Retaining wall panels".

Out-of-state producers shall provide documentation of material quality before the manufacture of any pre-cast products (i.e. aggregate quality reports, cement/steel mill test reports, etc.)

Unless otherwise shown on the contract drawings, Portland cement concrete used in precast elements shall conform to Class D with a minimum 28-day compressive strength of 4000 psi

- Drainage Materials

i. Drainage Aggregate - Drainage aggregate to be used as a drainage medium shall conform to section 903.17 of the Standard Specifications.

ii. Preformed Permeable Geocomposite Drains – The preformed permeable geocomposite drains shall be continuous and a minimum of one (1) foot wide. The drains shall be placed in sections with a minimum overlap of one (1) foot and be spliced to assure continuous drainage.

iii. Pipe and Perforated Pipe - Pipe and perforated pipe shall conform to section 610 of the Standard Specifications.

- Lagging

i. Temporary Timber Lagging - Temporary timber lagging shall be construction grade rough cut and shall be a minimum of 3 inches thick. Where necessary, the Contractor shall provide certification that the timber conforms to the grade, species, and other specified requirements. If the timber is to be treated with a preservative, a certificate of compliance shall be furnished.

ii. Permanent Timber Lagging – Permanent timber lagging shall conform to all requirements of section 2.d.i. and shall be constructed from structural stress-graded lumber.

3. Construction

- General Considerations

i. Wall elements for anchored walls designed and constructed in accordance with this manual shall be either continuous interlocking sheet-piles or steel soldier beams that are either driven or placed in pre-drilled holes that are subsequently backfilled with lean mix or structural concrete.

- Excavation

i. Excavation below a level of anchors shall be limited to 2 feet below the anchor level and shall not commence below this level until anchors at that level have been installed, load tested, locked

off and accepted by the Department. Placement of timber lagging shall immediately follow excavation in the front of the wall.

- Driven Sheet Pile and Soldier Beam Installation.

  i. Driven sheet piles and soldier beams shall be driven to the specified minimum tip elevation shown on the approved working drawings. The Contractor shall select a sheet pile or soldier beam section that satisfies all design criteria. The Contractor shall select a driving method and pile driving and ancillary equipment consistent with the expected ground conditions at the site. The sheet-pile or soldier beam shall be driven to the specified minimum tip elevation or to the approved elevation based on bearing capacity without damaging the sheet pile or soldier beam. The interlocks between adjacent sheet piles shall not be damaged. Equipment shall be used to permit the impact energy to be distributed over the tops of the sheet pile or soldier beam.

- Soldier Beam Installation in Pre-drilled Holes

  i. Excavations required for soldier beam placement shall be performed to the dimensions and elevations on the approved working drawings. The methods and equipment used shall be selected by the Contractor.

  ii. The Contractor shall ensure that the sidewalls of the pre-drilled holes (i.e. shafts) do not collapse during drilling. Uncased shafts may be used where the sides and the bottom of the shaft are stable and may be visually inspected prior to placing the soldier beam and concrete. Casing or drilling muds shall be used where the sides of the shaft require additional support.

  iii. The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. The dimensions and alignment shall be determined by the Contractor but shall be observed by the Inspector. The Inspector will check the alignment of the drilling equipment at the beginning of shaft construction and periodically thereafter. Final shaft depth shall be measured after final cleaning by the Contractor.

  iv. Loose material shall be removed from the bottom of the shaft. No more than 2 feet of standing water shall be left in the bottom of the shaft prior to beginning soldier beam installation.

  v. The soldier beam shall be placed in the shaft without difficulty and aligned prior to general placement of concrete. The Contractor may place up to 2 feet of concrete at the bottom of the shaft to assist in aligning the soldier beam. The soldier beam shall be blocked or clamped in place at the ground surface, prior to placement of concrete.

  vi. For shafts constructed without casing or drilling muds, concrete (either structural or lean-mix backfill) may be placed by free-falling the concrete from the ground surface down the shaft and

around the soldier beam. If casing is used, the placement of concrete shall begin prior to casing removal. Remove the casing while the concrete remains workable. For shafts constructed using slurry, concrete shall be placed using the tremie method from the bottom of the shaft. The tremie pipe shall be withdrawn slowly as the level of the concrete rises in the shaft and the level of the tremie pipe outlet shall never exceed the height of the slurry.

- Wall Tolerances
  - i. Soldier beams shall be placed at the locations shown on the approved working drawings and shall not deviate by more than 1 foot along the horizontal alignment of the wall. The wall shall not deviate from the vertical alignment shown of the contract drawings by more than 4 inches in each plane.
  - ii. The soldier beam or sheet pile tip shall be installed to within 1 foot of the specified tip elevation shown on the approved working drawings.
  - iii. Whenever a soldier beam deviates in location or plumbness by more than the tolerance given in these guidelines, the Contractor, at his option, may provide corrective measures such as 1) rebuilding soldier beams; 2) redesigning soldier beam; 3) adjust soldier beam spacing by adding additional soldier beams; 4) redesigning concrete facing; 5) building up the soldier beam section, or 6) other methods.
- Welding and Splicing
  - i. Splicing of sheet piles or soldier beams shall not be permitted, unless approved by the Department. All structural welding of steel and steel reinforcement shall be performed by certified welders qualified to perform the type of welding shown on the shop drawings. All sheet piles or soldier beams shall be cutoff to a true plane at the elevations shown on the approved working drawings. All cutoff lengths shall remain the property of the Contractor and shall be properly disposed.
- Timber Lagging Installation
  - i. Timber lagging shall be placed from the top-down in sufficiently small lifts immediately after excavation to prevent erosion of materials into the excavation. Prior to lagging placement, the soil face shall be smoothed to create a contact surface for the lagging. Large gaps behind the lagging shall be backfilled and compacted prior to applying any loads to the ground anchors.
  - ii. A gap shall be maintained between each vertically adjacent lagging board for drainage between adjacent lagging sections. In no case shall lagging be placed in tight contact to adjacent lagging.
- Drainage System Installation
  - i. The Contractor shall handle preformed permeable geocomposite drains in such a manner as to ensure the geocomposite drain is not

damaged in any way. Care shall be taken during placement of the geocomposite drain not to entrap dirt or excessive dust in the geocomposite drain that could cause clogging of the drainage system. Delivery, storage, and handling of the geocomposite drains shall be as provided in the plans or based on manufacturer's recommendations.

ii. Drainage geocomposite strips shall be placed and secured tightly against the timber lagging with the fabric facing the lagging. A continuous sheet of drainage geocomposite that spans between adjacent soldier beams shall not be allowed. Seams and overlaps between adjacent composites shall be made according to the special provisions or manufacturer's recommendations and specifications. Repairs shall be performed at no additional cost to the Department and shall conform to the plans or manufacturer's recommendation.

iii. Where drainage aggregate is used to construct a vertical drain behind the permanent wall and in front of the lagging, the drainage aggregate shall be placed in horizontal lifts. The construction of the vertical drain should closely follow the construction of the precast facing elements. Care should be exercised to ensure that connection devices between wall elements and facing elements are not damaged during the placement of the drainage aggregate.

iv. Perforated collector pipe shall be placed within the permeable material to the flow line elevations and at the location shown on the approved working drawings. Outlet pipes shall be placed at the low end of the collector pipe and at other locations shown or specified in the approved working drawings.

- Concrete Facing Installation

  For permanent cast-in-place and precast concrete facings, concrete manufacture, handling, placement, and finishing shall conform to the requirements in Section 8 "Concrete Structures" of the AASHTO - *LRFD Bridge Construction Specifications with interims*. Connections used to secure the facing to wall elements shall conform to the details shown on the approved working drawings. The exposed surface of the concrete facing shall receive a Class I finish as specified in Section 8 "Concrete Structures," unless a special architectural treatment is specified.

Part B, Anchored Wall (See QPL 38 for Approved Manufacturer/Supplier) – Part B covers specifications for the design, construction and testing of Permanent Ground Anchors.

1. Description

The work covered under this section includes the furnishing of all materials, labor, tools, equipment, and other incidental items for the designing, detailing, and construction of permanent ground anchors. All other items included in the construction of the permanent ground anchors not specifically mentioned herein shall

conform to all applicable sections of the *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction*, henceforth referred to as the Standard Specifications, the current *AASHTO LRFD Bridge Design Specifications* with latest revisions, the current *AASHTO LRFD Bridge Construction Specifications* with interims, and the latest version of Post Tensioning Institute (PTI) Standards, including: 1. *PTI, "Post Tensioning Manual"*, 2. *PTI "Specification for Unbonded Single Strand Tendons"*, 3. *PTI "Recommendations for Prestressed Rock and Soil Anchors."*

Unless otherwise noted the Contractor shall select the ground anchor type, drilling method, grouting method, and grout pressures, determine the ground anchor capacity, bond length, free stressing (unbonded) length, and anchor diameter. The Contractor shall be responsible for installing ground anchors that will develop the load-carrying capacity indicated on the approved working drawings in accordance with the testing subsection of this section. The anchor tendon shall be protected from corrosion as shown on the approved working drawings and in accordance with the requirements of this specification.

2. Design Criteria

- Unless otherwise directed the Contractor shall select the type of tendon to be used. The tendon shall be sized so the design load does not exceed 60 percent of the specified minimum tensile strength of the prestressing steel. The lock-off load for the tendon shall be chosen based on anticipated time or activity dependent load changes, but shall not exceed 70 percent of the specified minimum tensile stress of the prestressing steel. The prestressing steel shall be sized so the maximum test load does not exceed 80 percent of the specified minimum tensile strength of the prestressing steel.

- The Contractor shall be responsible for determining the bond length necessary to develop the design load indicated on the approved working drawings. The minimum bond length shall be 15 feet for strand tendons in rock and 10 feet for bar tendons in rock. The minimum bond length shall be 15 feet for strand and bar tendons in soil. The minimum tendon bond length shall be 10 feet.

- The free stressing length (unbonded length) for rock and soil anchors shall not be less than 10 feet for bar tendons and 15 feet for strand tendons. The free stressing length shall extend at least 5 feet or 20 percent of the height of the wall, whichever is greater, behind the critical failure surface. The critical failure surface shall be evaluated using slope stability or similar procedures.

3. Submittals

Requirements for submittals are as outlined above and also include the following:

- Contractor qualifications as outlined in Part A, of these anchored wall design and construction requirements.
    - The working drawings and design submission shall include the following:
        a) A ground anchor schedule giving:
        - Ground anchor number

- Ground anchor design load
- Type and size of tendon
- Minimum total anchor length
- Minimum bond length
- Minimum tendon bond length
- Minimum unbonded length

b) A drawing of the ground anchor tendon and the corrosion protection system including details for the following:

- Spacers and their location
- Centralizers and their location
- Unbonded length corrosion protection system
- Bond length corrosion protection system
- Anchorage and trumpet
- Anchorage corrosion protection system

- Certificates of Compliance for the following materials , if used. The certificate shall state that the materials or assemblies to be provided will fully comply with the requirements of the contract.

a) Prestressing steel, strand or bar
b) Portland cement
c) Prestressing hardware
d) Bearing plates
e) Corrosion protection system

- The Contractor shall submit to the Engineer for review and approval or rejection mill test reports for the prestressing steel and the bearing plate steel. The Engineer may require the Contractor to provide samples of any ground anchor material intended for use on the project. The prestressing steel and bearing plates shall not be incorporated in the work without the Engineer's approval.

- The Contractor shall submit to the Engineer for review and approval or rejection calibration data for each test jack, load cell, primary pressure gauge and reference pressure gauge to be used. Testing cannot commence until the Engineer has approved these calibrations.

- The Contractor shall submit to the Engineer within twenty calendar days after the completion of the ground anchor work a report containing the following:

a) Prestressing steel manufacturer's mill test reports for the tendons incorporated in the installation
b) Grouting records indicating the cement type, quantity injected and the grout pressures
c) Ground anchor test results
d) As-built drawings showing the location and orientation of each ground anchor, anchor capacity, tendon type, total anchor length, bond length, unbonded length, and tendon bond length as installed

and locations of all instruments installed by the Department.

- Existing Conditions – Prior to beginning work, the Department shall provide utility location plans to the Contractor. The Contractor is responsible for contacting a utility location service to verify the location of underground utilities before starting work. The Contractor shall survey the condition of adjoining properties and make records and photographs of any evidence of settlement or cracking of any adjacent structures. The Contractor's report of this survey shall be delivered to the Department before work begins.

4. Materials

- General

  a) The Contractor shall not deliver materials to the site until the Engineer has approved the submittals outlined in Section 3.0.

  b) The Contractor shall protect all materials from theft, vandalism, and the elements by appropriate means. Prestressing steel strands and bars shall be stored and handled in accordance with the manufacturer's recommendations and in such a manner that no damage to the component parts occurs. All steel components shall be protected from the elements at all times. Cement and additives for grout shall be stored under cover and protected against moisture.

- Anchorage Devices

  a) Stressing anchorages shall be a combination of either steel bearing plate with wedge plate and wedges, or a steel bearing plate with a threaded anchor nut. The steel bearing and wedge plate may also be combined into a single element. Anchorage devices shall be capable of developing 95 percent of the specified minimum ultimate tensile strength of the prestressing steel tendon. The anchorage devices shall conform to the static strength requirements of Section 3.1.6 (1) and Section 3.1.8 (1) and (2) of the latest edition of the PTI *"Guide Specifications for Post-Tensioning Materials."*

  b) The bearing plate shall be fabricated from steel conforming to AASHTO M 183 or M 222 specifications, or equivalent, or may be

a ductile iron casting conforming to ASTM A 536.

c) The trumpet shall be fabricated from a steel pipe or tube or from PVC pipe. Steel pipe or tube shall conform to the requirements of ASTM A 53 for pipe or ASTM A 500 for tubing. Steel trumpets shall have a minimum wall thickness of 0.1 inch for diameters up to 4 inches and 0.2 inch for larger diameters. PVC pipe shall conform to ASTM A 1785, Schedule 40 minimum. PVC trumpets shall be positively sealed against the bearing plate and aligned with the tendon to prevent cracking during stressing.

d) Anchorage covers shall be fabricated from steel or plastic with a minimum thickness of 0.1 inch. The joint between the cover and the bearing plate shall be watertight.

e) Wedges shall be designed to preclude premature failure of the prestressing steel due to notch or pinching effects under static and dynamic strength requirements of Section 3.1.8 (1) and 3.1.8 (2) of the PTI *"Post Tensioning Manual."* Wedges shall not be reused.

f) Wedges for epoxy coated strand shall be designed to be capable of biting through the epoxy coating and into the strand. Removal of the epoxy coating from the strand to allow the use of standard wedges shall not be permitted. Anchor nuts and other threadable hardware for epoxy coated bars shall be designed to thread over the epoxy coated bar and still comply with the requirements for carrying capacity.

- Prestressing Steel

a) Ground anchor tendons shall be fabricated from single or multiple elements of one of the following prestressing steels:

- Steel bars conforming to AASHTO M 275
- Seven-wire, low relaxation strands conforming to AASHTO M 203
- Compact, seven-wire, low-relaxation strands conforming to ASTM A 779
- Epoxy coated strand conforming to ASTM A 882
- Epoxy coated reinforcing steel bars conforming to ASTM A 775

b) Centralizers shall be provided at maximum intervals of 10 feet with the deepest centralizer located 1 foot from the end of the anchor and the upper centralizer for the bond zone located no more than 5 feet from the top of the tendon bond length. Spacers shall be used to separate the steel strands of strand tendons. Spacers shall be provided at maximum intervals of 10 feet and may be combined with centralizers.

- Prestressing Steel Couplers

  Prestressing steel bar couplers shall be capable of developing 100 percent of the minimum specified ultimate tensile strength of the prestressing steel bar. Steel strands used for a soil or rock anchor shall be continuous with no splices, unless approved by the Engineer.

- Centralizers

  a) Centralizers shall be fabricated from plastic, steel or material, which is non-detrimental to the prestressing steel. Wood shall not be used. The centralizer shall be able to support the tendon in the drill hole and position the tendon so a minimum of 2 inches of grout cover is provided and shall permit grout to freely flow around the tendon and up the drill hole.

  b) Centralizers are not required on pressure injected anchors installed in coarse grained soils when the grouting pressure exceeds 145 psi or on hollow stem-augured anchors when they are grouted through the auger with grout having a slump of 9 inches or less.

- Spacers

  Spacers shall be used to separate elements of a multi-element tendon and shall permit grout to freely flow around the tendon and up the drill hole. Spacers shall be fabricated from plastic, steel or material, which is non-detrimental to the prestressing steel. Wood shall not be used. A combination centralizer-spacer may be used.

- Tendon Bond Length Encapsulations

  When the contract plans require the tendon bond length to be encapsulated to provide additional corrosion protection, the encapsulation shall be fabricated from one of the following:

  a) High density corrugated polyethylene tubing conforming to the requirements of AASHTO M 252 and having a minimum wall thickness of 0.06 inch except pre-grouted tendons, which may have a minimum wall thickness of 0.04 inch.
  b) Deformed steel tubing or pipes conforming to ASTM A 52 or A 500 with a minimum wall thickness of 0.2 inch.
  c) Corrugated, polyvinyl chloride tubes manufactured from rigid PVC compounds conforming to ASTM D 1784, Class 13464- B.
  d) Fusion-bonded epoxy conforming to the requirements of AASHTO M 284.

- Heat Shrinkable Sleeves

Heat shrinkable sleeves shall be fabricated from a radiation cross-linked polyolefin tube internally coated with an adhesive sealant. Prior to shrinking, the tube shall have a nominal wall thickness of 0.025 inch. The adhesive sealant inside the heat shrinkable tube shall have a nominal thickness of 0.02 inch.

- Sheath

  A sheath shall be used as part of the corrosion protection system for the unbonded length portion of the tendon. The sheath shall be fabricated from one of the following:

  a) A polyethylene tube pulled or pushed over the prestressing steel. The polyethylene shall be Type II, III or IV as defined by ASTM D 1248 (or approved equal). The tubing shall have a minimum wall thickness of 0.06 inch.

  b) A hot-melt extruded polypropylene tube. The polypropylene shall be cell classification B55542-11 as defined by ASTM D 4101 (or approved equal). The tubing shall have a minimum wall thickness of 0.06 inch.

  c) A hot-melt extruded polyethylene tube. The polyethylene shall be high density Type III as defined by ASTM D 1248 (or approved equal). The tubing shall have a minimum wall thickness of 0.06 inch.

  d) Steel tubing conforming to ASTM A 500. The tubing shall have a minimum wall thickness of 0.2 inch.

  e) Steel pipe conforming to ASTM A 53. The pipe shall have a minimum wall thickness of 0.2 inch.

  f) Plastic pipe or tube of PVC conforming to ASTM D 1784 Class 13464-B. The pipe or tube shall be Schedule 40 at a minimum.

  g) A corrugated tube conforming to the requirement of the tendon bond length encapsulation Subsection 4.g. above.

- Bondbreaker

  The bondbreaker shall be fabricated from a smooth plastic tube or pipe having the following properties: (1) resistant to chemical attack from aggressive environments, grout, or corrosion inhibiting compound; (2) resistant to aging by ultraviolet light; (3) fabricated from material non-detrimental to the tendon; (4) capable of withstanding abrasion, impact, and bending during handling and installation; (5) enable the tendon to elongate during testing and stressing; and (6) allow the tendon to remain unbonded after lockoff.

- Cement Grout

  Type I, II, III or V Portland cement conforming to AASHTO M 85 shall be used for grout. The grout shall be a pumpable neat mixture of cement and water and shall be stable (bleed less than 2 percent), fluid, and provide a minimum 28-day compressive strength of at least 3000 psi measured in accordance with ASTM C 109 at the time of stressing.

- Admixtures

  Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to the approval of the Engineer. Admixtures, if used, shall be compatible with the prestressing steels and mixed in accordance with the manufacturer's recommendation. Expansive admixtures may only be added to the grout used for filling sealed encapsulations, trumpets, and anchorage covers. Accelerators shall not be permitted.

- Water

  Water for mixing grout shall be potable, clean, and free of injurious quantities of substances known to be harmful to Portland cement or prestressing steel.

- Corrosion Inhibiting Compound

  The corrosion inhibiting compound placed in either the free length or the trumpet areas shall be an organic compound (i.e. grease or wax) with appropriate polar moisture displacing, corrosion inhibiting additives and self-healing properties. The compound shall permanently stay viscous and be chemically stable and nonreactive with the prestressing steel, the sheathing material, and anchor grout.

- Grout Tubes

  Grout tubes shall have an adequate inside diameter to enable the grout to be pumped to the bottom of the drill hole. Grout tubes shall be strong enough to withstand a minimum grouting pressure of 145 psi. Post-grout tubes shall be strong enough to withstand post-grouting pressures.

5. Construction

1. Tendon Storage and Handling

   - Tendons shall be handled and stored in such a manner as to avoid damage or corrosion. Damage to the prestressing steel, the corrosion protection, and/or the epoxy coating as a result of abrasions, cuts, nicks, welds or weld splatter will be cause for rejection by the Engineer. The prestressing steel shall be protected if welding is to be performed in the vicinity.

Grounding of welding leads to the prestressing steel is forbidden. Prestressing steel shall be protected from dirt, rust, or other deleterious substances. A light coating of rust on the steel is acceptable. If heavy corrosion or pitting is noted, the Engineer shall reject the affected tendons.

- The Contractor shall use care in handling and storing the tendons at the site. Prior to inserting a tendon in the drill hole, the Contractor and the Inspector shall examine the tendon for damage to the encapsulation and the sheathing. If, in the opinion of the Inspector, the encapsulation is damaged, the Contractor shall repair the encapsulation in accordance with the tendon supplier's recommendations. If, in the opinion of the inspector, the smooth sheathing has been damaged, the Contractor shall repair it with ultra-high molecular weight polyethylene tape. The tape should be spiral wound around the tendon to completely seal the damaged area. The pitch of the spiral shall ensure a double thickness at all points.

- Banding for fabricated tendons shall be padded to avoid damage to the tendon corrosion protection. Upon delivery, the fabricated anchors or the prestressing steel for fabrication of the tendons on site and all hardware shall be stored and handled in such a manner to avoid mechanical damage, corrosion, and contamination with dirt or deleterious substances.

- Lifting of the pre-grouted tendons shall not cause excessive bending, which can debond the prestressing steel from the surrounding grout.

- Prestressing steel shall not be exposed to excessive heat (i.e. more than 446° F).

b. Anchor Fabrication

- Anchors shall be either shop or field fabricated from material conforming to part 4 of this section and as shown in the approved working drawings and schedules.
- Prestressing steel shall be cut with an abrasive saw or, with the written approval of the prestressing steel supplier, an oxyacetylene torch.
- All of the tendon bond length, especially for strand, must be free of dirt, manufacturer's lubricants, corrosion-inhibitive coatings, or other deleterious substances that may significantly affect the grout- to-tendon bond or the service life of the tendon.
- Pre-grouting of encapsulated tendons shall be done on an

inclined, rigid frame or bed by injecting the grout from the low end of the tendon.

c. Drilling

- Drilling methods shall be left to the discretion of the Contractor, whenever possible. The Contractor shall be responsible for using a drilling method to establish a stable hole of adequate dimensions, within the tolerances specified. Drilling methods may involve, amongst others, rotary, percussion, rotary/percussive or auger drilling; or percussive or vibratory driven casing.

- Holes for anchors shall be drilled at the locations and to the length, inclination and diameter shown on the approved working drawings. The drill bit or casing crown shall not be more than 0.12 inch smaller than the specified hole diameter. At the ground surface the drill hole shall be located within 1 foot of the location shown on the approved working drawings. The drill hole shall be located so the longitudinal axis of the drill hole and the longitudinal axis of the tendon are parallel. In particular, the ground anchor hole shall not be drilled in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supported structure. At the point of entry the ground anchor shall be installed within plus/minus three (3) degrees of the inclination from horizontal shown on the approved working drawings. At the point of entry the horizontal angle made by the ground anchor and the structure shall be within plus/minus three (3) degrees of a line drawn perpendicular to the plane of the structure unless otherwise shown on the approved working drawings. The ground anchors shall not extend beyond the right of- way or easement limits shown on the contract drawings.

d. Tendon Insertion

- Tendons shall be placed in accordance with the approved working drawings and details and the recommendations of the tendon manufacturer or specialist anchor contractor. The tendon shall be inserted into the drill hole to the desired depth without difficulty.

Each anchor tendon shall be inspected by Department field personnel during installation into the drill hole or casing. Damage to the corrosion protection system shall be repaired, or the tendon replaced if not repairable. Loose spacers or centralizers shall be reconnected to prevent shifting during insertion. Damaged fusion bonded epoxy coatings shall be repaired in accordance with the

manufacturer's recommendations. If the patch is not allowed to cure prior to inserting the tendon in the drill hole, the patched area shall be protected by tape or other suitable means.

e) The rate of placement of the tendon into the hole shall be controlled such that the sheathing, coating, and grout tubes are not damaged during installation of the tendon. Anchor tendons shall not be subjected to sharp bends. The bottom end of the tendon may be fitted with a cap or bullnose to aid its insertion into the hole, casing or sheathing.

- Grouting

    - The Contractor shall use a neat cement grout or a sand-cement grout. The cement shall not contain lumps or other indications of hydration. Admixtures, if used, shall be mixed in accordance with the manufacturer's recommendation.

    - The grouting equipment shall produce a grout free of lumps and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge to monitor pressures. The pressure gauge shall be capable of measuring pressures of at least 145 psi or twice the actual grout pressure used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer should be capable of continuously agitating the grout.

    - The grout shall be injected from the lowest point of the drill hole. The grout may be pumped through grout tubes, casings, hollowstem-augers, or drill rods. The grout can be placed before or after insertion of the tendon. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave or

- After the tendon is installed, the drill hole may be filled in one continuous grouting operation except that pressure grouting shall not be used in the free length zone. The grout at the top of the drill hole shall not contact the back of the structure or the bottom of the trumpet.

- If the ground anchor is installed in a fine-grained soil using drill holes larger than 6 inches in diameter, then the grout above the top of the bond length shall be placed after the ground anchor has been tested and stressed. The Engineer will allow the Contractor to grout the entire drill hole at the same time if the Contractor can demonstrate that their particular ground anchor system does not derive a significant portion of its load-carrying capacity from the soil above the bond length portion of the ground anchor.

- If grout protected tendons are used for ground anchors anchored in rock, then pressure grouting techniques shall be utilized. Pressure grouting requires that the drill hole be sealed and that the grout be injected until a minimum 50 psi grout pressure (measured at the top of the drill hole) can be maintained on the grout for at least five (5) minutes.

- The grout tube may remain in the hole on completion of grouting if the tube is filled with grout.

- After grouting, the tendon shall not be loaded for a minimum of three (3) days.

f. Anchorage Installation

- The anchor bearing plate and the anchor head or nut shall be installed perpendicular to the tendon, within plus/minus three (3) degrees and centered on the bearing plate, without bending or kinking of the prestressing steel elements. Wedge holes and wedges shall be free of rust, grout and dirt.

- The stressing tail shall be cleaned and protected from damage until final testing and lock-off. After the anchor has been accepted by the Engineer, the stress tail shall be cut to its final length according to the tendon manufacturer's recommendations.

- The corrosion protection surrounding the unbonded length of the tendon shall extend up beyond the bottom seal of the trumpet or 4 inches into the trumpet if no trumpet seal is provided. If the protection does not extend beyond the seal or sufficiently far

enough into the trumpet, the Contractor shall extend the corrosion protection or lengthen the trumpet.

- The corrosion protection surrounding the unbonded length of the tendon shall not contact the bearing plate or the anchor head during testing and stressing. If the protection is too long, the Contractor shall trim the corrosion protection to prevent contact.

g. Corrosion Protection

- Protection Requirements

  Corrosion protection requirements shall be determined by the Department and shall be shown on the contract plans. The corrosion protection systems shall be designed and constructed to provide reliable ground anchors for temporary and permanent structures.

- Anchorage Protection

  - All stressing anchorages permanently exposed to the atmosphere shall receive a grout-filled cover, except, for restressable anchorages where a corrosion inhibiting compound must be used. Stressing anchorages encased in concrete at least 2 inches thick do not require a cover.

  - The trumpet shall be sealed to the bearing plate and shall overlap the unbonded length corrosion protection by at least 4 inches. The trumpet shall be long enough to accommodate movements of the structure and the tendon during testing and stressing. On strand tendons, the trumpet shall be long enough to enable the tendon to make a transition from the diameter of the tendon along the unbonded length to the diameter of the tendon at the wedge plate without damaging the encapsulation.

  - The trumpet shall be completely filled with grout, except re-stressable anchorages must use corrosion inhibiting compounds. Compounds may be placed any time during construction. Compound filled trumpets shall have a permanent seal between the trumpet and the unbonded length corrosion protection. Grout must be placed after the ground anchor has been tested and stressed to the lock-off load. Trumpets filled with grout shall have either a temporary seal between the trumpet and the unbonded length corrosion protection or the trumpet shall fit tightly over the unbonded length corrosion protection for a minimum of 4 inches.

- Unbonded Length Protection

  a) Corrosion protection of the unbonded length shall be provided by a combination of sheaths, sheath filled with a corrosion inhibiting compound or grout, or a heat shrinkable tube internally coated with a mastic compound, depending on the tendon class. The corrosion inhibiting compound shall completely coat the tendon elements, fill the void between them and the sheath, and fill the interstices between the wires of 7-wire strands. Provisions shall be made to retain the compound within the sheath.

  b) The corrosion protective sheath surrounding the unbonded length of the tendon shall be long enough to extend into the trumpet, but shall not come into contact with the stressing anchorage during testing. Any excessive protection length shall be trimmed off.

  c) For pre-grouted encapsulations and all Class I tendons, a separate bond breaker or common sheath shall be provided for supplemental corrosion protection or to prevent the tendon from bonding to the grout surrounding the unbonded length.

- Unbonded Length/Bond Length Transition

  The transition between the corrosion protection for the bonded and unbonded lengths shall be designed and fabricated to ensure continuous protection from corrosive attack.

- Tendon Bond Length Protection for Grout Protected Tendons (Class II)

  a) Cement grout can be used to protect the tendon bond length in non-aggressive ground when the installation methods ensure that the grout will remain fully around the tendon. The grout shall overlap the sheathing of the unbonded length by at least 1 inch.

  b) Centralizers or grouting techniques shall ensure a minimum of 0.5 inch of grout cover over the tendon bond length.

- Tendon Bond Length Protection for Encapsulated Tendons (Class I)

  a) A grout-filled, corrugated plastic encapsulation or a grout-filled, deformed steel tube shall be used. The prestressing steel can be grouted inside the encapsulation prior to being placed.

  b) Centralizers or grouting techniques shall ensure a minimum of 0.5 inch of grout cover over the encapsulation.

- Epoxy

  A fusion-bonded epoxy may be used to provide a layer of protection for the steel tendon in addition to the cement grout.

- Coupler Protection

  a) On encapsulated bar tendons (Class I), the coupler and any adjacent exposed bar sections shall be covered with a corrosion-proof compound or wax-impregnated cloth tape. The coupler area shall be covered by a smooth plastic tube, complying with the requirements set forth in 4.9, overlapping the adjacent sheathed tendon by at least 1 inch. The two joints shall be sealed each by a coated heat shrink sleeve of at least 6 inches in length, or approved equal. The corrosion-proof compound shall completely fill the space inside the cover tube.

  b) Corrosion protection details for strand couplers, if specifically permitted, shall be submitted for approval of the Engineer.

h. Stressing, Load Testing, and Acceptance

- General

  Each ground anchor shall be tested. No load greater than ten (10) percent of the design load can be applied to the ground anchor prior to testing. The maximum test load shall be no less than 1.33 times the design load and shall not exceed 80 percent of the specified minimum ultimate tensile strength of the prestressing steel of the tendon. The test load shall be simultaneously applied to the entire tendon. Stressing of single-element tendons shall not be permitted.

- Stressing Equipment

  a) The testing equipment shall consist of:

  a) A dial or vernier scale capable of measuring to the nearest .001 inch shall be used to measure the ground anchor movement. The movement measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum test load and it shall have adequate travel so the ground anchor movement can be measured without resetting the device at an interim point.

  b) A hydraulic jack and pump shall be used to apply the test load. The jack and a calibrated primary pressure gauge shall be used to measure the applied load. The jack and primary pressure gauge shall be calibrated by an independent firm as a unit. The calibration shall have been performed within forty-five (45) working days of

the date when the calibration submittals are provided to the Engineer. Testing cannot commence until the Engineer has approved the calibration. The primary pressure gauge shall be graduated in 100 psi increments or less. The ram travel shall be at least 6 inches and preferably not be less than the theoretical elongation of the tendon at the maximum test load. If elongations greater than 6 inches are required, re-stroking can be allowed.

c) A calibrated reference pressure gauge shall also be kept at the site to periodically check the production (i.e. primary pressure) gauge. The reference gauge shall be calibrated with the test jack and primary pressure gauge. The reference pressure gauge shall be stored indoors and not subjected to rough treatment.

d) The Contractor shall provide an electrical resistance load cell and readout to be used when performing an extended creep test.

e) The stressing equipment shall be placed over the ground anchor tendon in such a manner that the jack, bearing plates, load cells and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment.

f) The stressing equipment, the sequence of stressing and the procedure to be used for each stressing operation shall be determined at the planning stage of the project. The equipment shall be used strictly in accordance with the manufacturer's operating instructions.

g) Stressing equipment shall preferably be capable of stressing the whole tendon in one stroke to the specified test load and the equipment shall be capable of stressing the tendon to the maximum specified test load within 75 percent of the rated capacity. The pump shall be capable of applying each load increment in less than 60 seconds.

h) The equipment shall permit the tendon to be stressed in increments so that the load in the tendon can be raised or lowered in accordance with the test specifications, and allow the anchor to be lift-off tested to confirm the lock off load.

i) Stressing equipment shall have been calibrated, within an accuracy of plus or minus two (2) percent, a maximum of 45 days prior to use. The calibration certificate and graph shall be available on site at all times. The calibration shall be traceable to the National Institute of Standards and Technology (NIST).

- Load Test Setup

a) Dial gauges shall bear on the pulling head of the jack and their stems shall be coaxial with the tendon direction. The gauges shall be supported on an independent, fixed frame, such as a tripod, which will not move as a result of stressing or other construction activities during the operation.

b) Prior to setting the dial gauges, the Alignment Load (AL) shall be accurately placed on the tendon. The magnitude of the AL depends on the type and length of the tendon.

c) Re-gripping of strands, which would cause overlap wedge bites, or wedge bites on the tendon below the anchor head, shall be avoided.

d) Stressing and testing of multiple element tendons with single element jacks is not permitted.

e) Stressing shall not begin until the grout has reached adequate strength.

- Performance Tests

a) Five (5) percent of the ground anchors or a minimum of three (3) ground anchors, whichever is greater, shall be performance tested in accordance with the procedures described in this section. The Engineer shall select the ground anchors to be performance tested. The remaining ground anchors shall be tested in accordance with the proof test procedures as outlined in 5.h. below.

- The performance test shall be made by incrementally loading and unloading the ground anchor in accordance with the schedule provided in section 5.h. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest

0.001 inch with respect to an independent fixed reference point at the alignment load and at each increment of load. The load shall be monitored with the primary pressure gauge. The reference pressure gauge shall be placed in series with the primary pressure gauge during each performance test. If the load determined by the reference pressure gauge and the load determined by the primary pressure gauge differ by more than ten (10) percent, the jack, primary pressure gauge and reference pressure gauge shall be recalibrated at no expense to the Department. At load increments other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

- The maximum test load in a performance test shall be held for ten (10) minutes. A load cell shall be used to monitor small changes in load during constant load-hold periods.
- The jack shall be adjusted as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the ground anchor movement between one (1) minute and ten (10) minutes exceeds .04 inch, the maximum test load shall be held for an additional 50 minutes. If the load hold is extended, the ground anchor movement shall be recorded at 15, 20, 30, 40, 50 and 60 minutes.

- Steps for the Performance Test – The steps for the performance test are detailed in the table on the following page:

Step	Loading	Applied Load	Record and Plot Total Movement (d_{ti})	Record and Plot Residual Movement (d_{ri})	Calculate Elastic Movement (d_{ei})
1	Apply alightment load (AL)				
2	Cycle 1	0.25DL	$\mathbf{d_{t1}}$		$\mathbf{d_{t1} - d_{r1} = d_{e1}}$
		AL		$\mathbf{d_r}$	
3	Cycle 2	0.25AL	$\mathbf{d_2}$		$\mathbf{d_{t2} - d_{r2} = d_{e2}}$
		0.50DL	$\mathbf{d_{t2}}$		
		AL		$\mathbf{d_{r2}}$	
4	Cycle 3	0.25DL	$\mathbf{d_3}$		$\mathbf{d_{t3} - d_{r3} = d_{e3}}$
		0.50DL	$\mathbf{d_3}$		
		0.75FL	$\mathbf{d_3}$		
		AL		$\mathbf{d_{r3}}$	
5	Cycle 4	0.25DL	$\mathbf{d_4}$		$\mathbf{d_{t4} - d_{r4} = d_{e4}}$
		0.50DL	$\mathbf{d_4}$		
		0.75DL	$\mathbf{d_4}$		
		1.00DL	$\mathbf{d_{t4}}$		
		AL		$\mathbf{d_{r4}}$	
6	Cycle 5	0.25DL	$\mathbf{d_5}$		$\mathbf{d_{t5} - d_{r5} = d_{e5}}$
		0.50DL	$\mathbf{d_5}$		
		0.75DL	$\mathbf{d_5}$		
		1.00DL	$\mathbf{d_5}$		
		1.2DL	$\mathbf{d_5}$		
		AL		$\mathbf{d_{r5}}$	
7	Cycle 6	0.25DL	$\mathbf{d_6}$		
		0.50DL	$\mathbf{d_6}$		
		0.75DL	$\mathbf{d_6}$		
		1.00DL	$\mathbf{d_6}$		
		1.2DL	$\mathbf{d_6}$		
		1.33DL	$\mathbf{d_{t6}}$ **, zero reading for creep test**		
8	Hold load for 10 minutes while recording movement at specified times. If the total movement measured during the load hold exceeds the specified maximum value then the load hold should be extended to a total of 60 minutes.				
9	Cycle 6 cont=d	AL		$\mathbf{d_{r6}}$	Cycle 6: $\mathbf{d_m - d_{r6} = d_{e6}}$

Notes: AL = Alignment Load, DL = Design Load, d_i = total movement at a load other than maximum for cycle, i = number identifying a specific load cycle.

- Proof Tests

  The proof test shall be performed by incrementally loading the ground anchor in accordance with the following schedule. The load shall be raised from one increment to another immediately after recording the ground anchor movement. The ground anchor movement shall be measured and recorded to the nearest 0.001 inch with respect to an independent fixed reference point at the alignment load and at each increment load. The load shall be monitored with the primary pressure gauge. At load increment other than the maximum test load, the load shall be held just long enough to obtain the movement reading.

Proof Test Schedule

Step	Load
1	AL
2	0.25DL
3	0.50DL
4	0.75DL
5	1.00DL
6	1.20DL
7	1.33DL
8	Reduce to lock-off load
9	AL (optional)
10	Adjust to lock-off load

- The maximum test load in a proof test shall be held for (10) minutes. The jack shall be adjusted as necessary in order to maintain a constant load. The load-hold period shall start as soon as the maximum test load is applied and the ground anchor movement with respect to a fixed reference shall be measured and recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. If the ground anchor movement between one (1) minute and ten (10) minutes exceeds 0.04 inch, the maximum test load shall be held for an additional 50 minutes. If the load hold is extended, the ground anchor movements shall be recorded at 15, 20, 30, 40, 50, and 60 minutes.

- Extended Creep Tests

  a) The Department shall determine if extended creep testing is required and select those ground anchors that are to be creep tested. If creep tests are required, at least two (2) ground anchors shall be tested. The stressing equipment shall be capable of measuring and maintaining the hydraulic pressure within 50 psi.

  b) The extended creep test shall be made by incrementally loading and unloading the ground anchor in accordance with the performance test schedule provided in 5.8.5. At the end of each

loading cycle, the load shall be held constant for the observation period indicated in the creep test schedule below. The times for reading and recording the ground anchor movement during each observation period shall be 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210,

240, 270 and 300 minutes as appropriate for the load increment. Each load-hold period shall start as soon as the test load is applied. In a creep test, the primary pressure gauge and reference pressure gauge will be used to measure the applied load and the load cell will be used to monitor small changes in load during constant load-hold periods. The jack shall be adjusted as necessary in order to maintain a constant load.

c) The Contractor shall plot the ground anchor movement and the residual movement measured in an extended creep test. The Contractor shall also plot the creep movement for each load hold as a function of the logarithm of time.

Extended Creep Test Schedule

Load	**Observation period (min)**
AL	
0.25DL	10
0.50DL	30
0.75DL	30
1.00DL	45
1.20DL	60
1.33DL	300

- Ground Anchor Acceptance Criteria

A performance-tested or proof-tested ground anchor with a 10 minute load hold shall be acceptable if the: (1) ground anchor resists the maximum test load with less than 0.04 inch of movement between 1 minute and 10 minutes; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

a) A performance-tested or proof-tested ground anchor with a 60 minute load hold shall be acceptable if the: (1) ground anchor resists the maximum test load with a creep rate that does not exceed 0.08 inch in the last log cycle of time; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

b) A ground anchor subjected to extended creep testing is acceptable if the: (1) ground anchor resists the maximum test load with a creep rate that does not exceed 0.08 inch in the last log cycle of time; and (2) total elastic movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the unbonded length.

c) The initial lift-off reading shall be within plus or minus five (5) percent of the designated lock-off load. If this criterion is not met, then the tendon load shall be adjusted accordingly and the initial lift-off reading repeated.

- Procedures for Anchors Failing Acceptance Criteria

a) Anchors that do not satisfy the minimum apparent free length criteria shall be either rejected and replaced at no additional cost to the Department or locked off at no more than 50 percent of the maximum acceptable load attained. In this event, no further acceptance criteria are applied.

b) Re-groutable anchors which satisfy the minimum apparent free length criteria but which fail the extended creep test at the test load may be post grouted and subjected to an enhanced creep criterion. This enhance criterion requires a creep movement of not more than 0.04 inch between 1 and 60 minutes at test load. Anchors which satisfy the enhanced creep criterion shall be locked off at the design lock-off load. Anchors which cannot be post grouted or regroutable anchors that do not satisfy the enhanced creep criterion shall be either rejected or locked off at 50 % of the maximum acceptable test load attained. In this event, no further acceptance criteria are applied. The maximum acceptable test load with respect to creep shall correspond to that where acceptable creep movements are measured over the final log cycle of time.

c) In the event that the anchor fails, the Contractor shall modify the design and/or construction procedures. These modifications may include, but are not limited to, installing additional anchors, modifying the installation methods, reducing the anchor design load by increasing the number of anchors, increasing the anchor length, or changing the anchor type. Any modification of design or construction procedures shall be at no change in the contract price. A description of any proposed modifications must be submitted to the Engineer in writing. Proposed modifications shall not be implemented until the Contractor receives written approval from the Engineer.

- Anchor Lock-Off

a) After testing has been completed, the load in the tendon shall be such that after seating losses (i.e. wedge seating); the specified lock-off load has been applied to the anchor tendon.

b) The magnitude of the lock-off load shall be specified in the approved working drawings, or as determined by the designer.

c) The wedges shall be seated at a minimum load of 50% F_{pu}. If the lock-off load is less than 50% F_{pu}, shims shall be used under the wedge plate and the wedges seated at 50% F_{pu}. The shims shall then be removed to reduce the load in the tendon to

the desired lock-off load. Bar tendons may be locked off at any load less than 70% F_{pu}.

- Anchor Lift-Off Test

  After transferring the load to the anchorage, and prior to removing the jack, a lift-off test shall be conducted to confirm the magnitude of the load in the anchor tendon. This load is determined by reapplying load to the tendon to lift off the wedge plate (or anchor nut) without unseating the wedges (or turning the anchor nut). This moment represents zero time for any long time monitoring.

S T A T E **O F** **T E N N E S S E E**
Rev. 5/18/17 January 1, 2015

SPECIAL PROVISION
REGARDING
DRILLED SHAFT SPECIFICATIONS

625.01 Description. This work shall consist of constructing cast-in-place reinforced concrete drilled shafts and rock sockets, as required, to serve as a structural foundation. This work shall provide reinforced concrete shafts cast in cylindrically excavated holes extending sufficiently into soil or sound rock to adequately support the structure and all externally applied loads for which the shaft was designed. The drilled shaft foundation, including the rock socket, where required, shall be constructed in accordance with these Specifications, as shown on the Plans and in accordance with other Specifications included in the contract documents.

625.02 Qualifications of Drilled Shaft Contractor. The Contractor/Subcontractor performing the work described herein shall have staff on-site (driller and/or foreman or superintendent) experienced in the drilled shaft specialty and have installed drilled shafts of both diameter and length similar to those shown on the Plans. The Contractor shall have staff (as defined above) on site that has a minimum of three years of experience in the geologic conditions associated with the project site prior to the bid date for this project. This work shall be performed under the supervision of the Contractor's/Subcontractor's superintendent, who is knowledgeable and experienced in the method of constructing drilled shafts as required by the project. The Contractor's/Subcontractor's equipment shall have the capacity to undertake the work and shall be sufficient to complete the work within the specified contract time. The Contractor shall furnish evidence of experience and expertise that the Contractor/Subcontractor meets the following requirements:

The Contractor's/Subcontractor's ability to construct the drilled shafts for this project shall be supported by a list containing a description of at least five projects either on-going or completed in the last two years on which the Contractor's/Subcontractor's staff (driller, foreman or superintendent), responsible for the drilled shaft construction, have installed drilled shafts of similar size as shown in the Plans and with similar excavation techniques anticipated for this project. This list of projects shall contain a brief description of the project as well as names and phone numbers of the project owner's representatives who can verify the Contractor's/Subcontractor's staff participation on the project.

625.03 Drilled Shaft Work Plan. The Contractor shall develop a work plan for all the drilled shafts and submit the plan for review and acceptance by the Engineer 30 days prior to beginning construction of the drilled shafts. The Drilled Shaft Work Plan shall provide detailed project specific information, including the following:

1. Work experience in accordance with required qualifications mentioned in Subs**ection 625.02.**
2. List and size of proposed equipment including: cranes, kelly bars, drill rigs, vibratory hammers, augers, core barrels, cleanout buckets, airlifts and/or submersible pumps, tremies and/or concrete pumps, casing (diameters, thicknesses and lengths), etc.
3. Details of the sequence and proposed schedule of drilled shaft construction, including the anticipated order in which shafts will be constructed
4. Details of excavation methods
5. Details of proposed methods to clean the excavation bottom
6. Details of the method(s) to be used to ensure shaft stability (i.e., prevention of caving, bottom heave, etc. using temporary casing, slurry, or other means) during excavation and concrete placement. If appropriate, this shall include a review of method suitability to the anticipated site and subsurface geotechnical conditions
7. Details of reinforcement placement including support and method to center in the excavation
8. Details of concrete placement including proposed operational procedures for the concrete tremie or pump (if applicable); including initial placement, how the tremie or pump will be raised during concrete placement and what type of discharge control will be used to prevent concrete contamination when the tremie or pump is initially placed in the excavation.
9. If applicable, details of casing installation and temporary casing removal including order of telescoped casing removal and minimum concrete head in each casing during removal
10. Required submittals for concrete mix designs
11. Details on how drilling spoils will be handled including environmental control procedures used to prevent the loss of concrete and spoils
12. Detailed procedures for mixing, using, maintaining, and disposing of the slurry shall be provided. A detailed mix design (including all additives and their specific purpose in the slurry mix), and a discussion of its suitability to the anticipated subsurface geotechnical conditions, shall also be provided for the proposed slurry
13. Other information shown in the Plans or requested by the Engineer

The Engineer will review the Drilled Shaft Work Plan for conformance with the Plans and Specifications. Within 15 days of receiving the plan, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary to satisfy the Plans, Specifications and special provisions. Any part of the plan that is unsatisfactory will be rejected and the Contractor shall submit changes for re-evaluation. The Engineer will respond to the Contractor within 7 days after receiving the proposed changes.

Review of the Drilled Shaft Work Plan by the Engineer does not relieve the Contractor of the responsibility to perform the work in accordance with Plans and Specifications. The Drilled Shaft Work Plan is intended to provide an opportunity for the Contractor to explain his approach to the work and to allow the Engineer to comment on equipment and procedures before field operations begin.

625.04 Preconstruction Conference. After the Drilled Shaft Work Plan has been reviewed by the Project Supervisor, a drilled shaft preconstruction conference shall be scheduled with the Contractor/Drilling Subcontractor to discuss construction and inspection of the drilled shafts. At a minimum, the attendees should include the General Contractor's Superintendent, the Drilling Subcontractor's Superintendent, the State's representatives, the Geotechnical Engineer, the Structural Engineer and members of the Inspection Team. This conference shall be completed prior to beginning any drilled shaft work.

Construction Requirements

625.05 Material. All material shall be in accordance with the Plans and in accordance with other Specifications included in the contract document.

625.06 Self-Consolidating Concrete. Drilled shafts shall be constructed of the class concrete and concrete strength specified on Plans, and all material, proportioning, mixing and transporting of concrete shall be in accordance with *TDOT Standard Specifications for Road and Bridge Construction* except as modified below. The concrete mix for drilled shafts shall be dense, homogeneous, fluid and resistant to segregation, and shall consolidate under self-weight such that vibrating or rodding will not be required as specified in **604.03 1b.** Self-Consolidating Concrete (SCC) Design and Production Parameters. The concrete mix shall have a set time that ensures that fluidity is maintained throughout the shaft concrete placement and removal of temporary casing, if used.

625.07 Casing. When applicable, the Contractor shall select the rigid casing used to stabilize shaft during construction unless casing is specified on Plans. A casing with sufficient strength to safely resist all imposed loads, including those from the soil and ground water, shall be used. The Contractor must insure the stability of casing during all drilled shaft operations.

Shop Drawings. Shop drawings for permanent steel casings shall be submitted to and approved by the Engineer prior to installation of the casings.

Condition of Casings. Casings shall be smooth, clean and watertight. Out-of-round tolerance shall not exceed one inch at any portion of the casing. The Contractor shall demonstrate the casing is within tolerance after installation. Telescoping casing shall not be allowed in bridges located in Seismic Zones 3 or 4.

Extent of Casing Length. Permanent casings, if required, shall be continuous wherever possible or practical. The permanent casing shall terminate at the specified elevation. Where drilled shafts are located in open water areas, casings shall be extended at least 18 inches above the datum defined water elevation as shown on the plans. Contractor shall be responsible for casing adjustments at the time of installation due to water fluctuations.

Use of Teeth or Cutting Edge. The casing may be fabricated with teeth or a cutting edge to facilitate insertion into the rock.

Splices. Splicing of permanent casings is not desirable and will only be permitted when approved by the Engineer. If splices are required, the welding process shall be in accordance

with the requirements specified in subsection **602.19**. The Contractor shall be fully responsible for the adequacy of welds during driving.

Welding. Welding of casings shall be in accordance with the current edition of *AASHTO/AWS Bridge Welding Code* and *TDOT Standard Specification for Road and Bridge Construction* and as specified in Plans, except that shop welding of casings will not require radiographic inspection. Inspection of welds will be of a visual nature. If evidence indicating poor welding is found, the Engineer may require ultrasonic testing at the contractor's expense.

625.08 Slurry. Drilling slurry will be defined as mineral slurry, polymer slurry, natural slurry formed during the drilling process, water or other fluids used to maintain stability of the drilled shaft excavation to aid in the drilling process or to maintain the quality of the rock socket. In addition, the terms mineral slurry and polymer slurry, as used herein, will be defined as the final mixed composite of all additives, including manufactured mineral or polymer slurry additives required to produce the acceptable drilling slurry.

Slurry Usage. Drilling slurry shall be used if detailed in the approved installation plan, if in accordance with the contract documents or if approved in writing by the Engineer. Drilling slurry may be used at the Contractor's option if the slurry is not in accordance with the contract documents; however, any slurry shall be approved by the Engineer prior to use. Drilling slurry, when used, will be non-compensable and effect on time of performance due to the use of the slurry will be non-excusable.

General Properties. The material used to make the slurry shall not be detrimental to the concrete or surrounding ground strata. Mineral slurries shall have both a mineral grain size that remains in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Polymer slurries shall have sufficient viscosity and gel characteristics to transport excavated material to suitable screening systems or settling tanks. The percentage and specific gravity of the material used to make the slurry shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. If approved by the Engineer, the Contractor may use water and on-site soils as drilling slurry. In that case, the range of acceptable values for density, viscosity and pH, as shown in the following table for bentonite slurry, shall be met, except that maximum density (unit weight) shall not exceed 70 pounds/cubic foot. When water is used as the drilling fluid to construct rock sockets in limestone, dolomite, sandstone or other formations that are not erodible, the requirements for slurry testing will not apply.

Preparation. Prior to introduction into the shaft excavation, the manufactured mineral or polymer slurry admixture shall be pre-mixed thoroughly with clean, fresh water and for adequate time in accordance with the slurry admixture manufacturer's recommendations allotted for hydration. Potable water can be used for mixing although stream or river water may be used when approved by the engineer. Slurry tanks of adequate capacity will be required for slurry mixing, circulation, storage and treatment. No excavated slurry pits will be allowed in lieu of slurry tanks without written approval from the Engineer. Adequate de-sanding equipment will be required as necessary to control slurry properties during the drilled shaft excavation in accordance with the values provided in the table below. De-sanding will not be required for signposts or lighting mast foundations unless specified in the contract documents.

Control Tests. Control tests using a suitable apparatus shall be performed by the Contractor on the slurry to determine density, viscosity, sand content and pH of freshly mixed slurry, recycled slurry and slurry in the excavation. Tests of slurry samples from within one foot of the bottom and at mid-height of the shaft shall be conducted in each shaft excavation during the excavation process to establish a consistent working pattern. A minimum of four sets of tests shall be conducted during the first eight hours of slurry use on the project. When the results show consistent behavior, the testing frequency may be decreased to one set every four hours of slurry use, or as otherwise approved by the Engineer. Reports of all tests, signed by an authorized representative of the Contractor, shall be furnished to the Engineer on completion of each drilled shaft. An acceptance range of values for the physical properties will be as shown in the table below.

Sampling. When slurry samples are found to be unacceptable, the Contractor shall bring the slurry in the shaft excavation to within specification requirements. Concrete shall not be poured until re-sampling and testing results produce acceptable values. Prior to placing shaft concrete, the Contractor shall take slurry samples from within one foot of the bottom and at mid-height of the shaft. Any heavily contaminated slurry that has accumulated at the bottom of the shaft shall be removed. Disposal of all slurry shall be done in areas approved by the Engineer. The Contractor shall perform final shaft bottom cleaning after suspended solids have settled from the slurry mix.

Range of Acceptable Values for Mineral and Polymer Slurries in Fresh Water Without Additives					
Property	**Bentonite**	**Emulsified Polymer**	**Dry Polymer**	**Units**	**Test Method**
Density (Unit Weight)					
At Introduction	63.5- 66.8	< 63	< 63	lb/ft3	Density Balance
Prior to Concreting	63.5- 70.5	< 63	< 63		
Marsh Funnel Viscosity					
At Introduction	32 – 60	33 – 43 **b**	50 – 80 **b**	sec/qt	Marsh Funnel
Prior to Concreting	32 – 60	33 – 43 **b**	50 – 80 **b**		

pH					pH
At Introduction	8 – 10	8 – 11	7 – 11	--	Paper or
					pH
Prior to Concreting	8 – 10	8 – 11	7 – 11	--	Meter
Sand Content					API Sand
At Introduction	< 4	< 1	< 1	Percent by	Content
				Volume	Kit
Prior to Concreting	< 2	< 1	< 1		
Maximum Contact Time [a]	4	72	72	Hours	

a. Without agitation and sidewall cleaning.

b. Higher viscosities may be required to maintain excavation stability in loose or gravelly sand deposits.

625.09 Protection of Existing Structures. All precautions shall be taken to prevent damage to existing structures and utilities as stated in Standard Specifications for Road and Bridge Construction or plans general notes. These measures shall include, but are not limited to, monitoring and controlling the vibrations from the driving of casing or drilling of the shaft, and selecting construction methods and procedures that shall prevent excessive caving of the shaft excavation.

625.10 Technique Shafts. When required by the contract documents, the Contractor shall demonstrate the adequacy of methods and equipment used during construction of the first drilled shaft, which shall be an out of position technique shaft, constructed with reinforcement as identified for production shafts on the Plans. This technique shaft shall be drilled in the position as directed by the Engineer and drilled to the maximum depth for any production shaft shown on the Plans. If at any time the Contractor is unable to demonstrate, to the satisfaction of the Engineer, the adequacy of methods or equipment and alterations required, an additional technique shaft(s) may be required. Technique shafts shall be cut off three feet below ground line, buried or otherwise disposed of as specified in the contract documents or as directed by the Engineer. Once approval has been given to construct production shafts, no changes will be permitted in the methods of equipment used to construct the shaft without approval from the Engineer. When a technique shaft is not required, construction of the first production shaft will be used to determine if the methods and equipment used by the Contractor are acceptable. Failure at any time to demonstrate to the Engineer the adequacy of methods or equipment will be cause for the Engineer to require appropriate alterations in equipment or method by the Contractor to eliminate unsatisfactory results.

625.11 Construction Sequence. Where construction of a footing is applicable, excavation to footing elevation shall be completed before shaft construction begins, unless otherwise authorized by the Engineer. Any disturbance to the footing area caused by shaft installation shall be repaired by the Contractor prior to pouring the footing. When drilled shafts are to be installed

in conjunction with embankment placement, the Contractor shall construct drilled shafts after placement of fills. Drilled shafts constructed prior to the completion of fills shall not be capped until the fills have been placed as near to final grade as possible, leaving only the necessary work room for construction of the caps.

625.12 General Equipment and Methods. The Contractor shall perform excavations through whatever material is encountered to the dimensions and elevations shown on the Plans. The Contractor's methods and equipment shall be suitable for the intended purpose and for whatever material is encountered.

Equipment. The Contractor shall provide equipment capable of constructing shafts to a depth equal to the deepest shaft tip elevation shown on the Plans plus 15 feet, or as otherwise specified in the contract documents. When a rock socket is identified on the Plans at a shaft location, the definition of "shaft tip elevation", for the purposes of this subsection, shall be taken to refer to the bottom of the rock socket.

Excavation Methods. Excavations required for shafts and rock sockets shall be completed in a continuous operation. The Contractor shall be responsible for ensuring the stability of the shaft excavation and the surrounding soil. When obstructions, either expected or unexpected, are encountered, the Contractor shall notify the Engineer promptly. The dry method, wet method, temporary casing method, permanent casing method if specified, or combinations, as necessary, shall be used to produce sound, durable concrete drilled shafts free of defects. The permanent casing method shall be used only when required by the contract documents or approved by the Engineer. Blasting excavation methods will not be permitted. When a rock socket is required, the Engineer will be the sole judge as to what constitutes the top of sound rock. The Engineer may order in writing additional depths of rock socket below the top of sound rock as considered necessary to improve the foundation. If the top surface of the sound rock is found to be inclined across the width of the shaft, the Contractor shall immediately notify the Engineer. The Contractor shall use an airlift, or other method approved by the Engineer, to clean the bottom of the shaft excavation.

625.13 Dry Construction Method. The dry construction method shall be used only at sites where the groundwater table and site conditions, generally stiff to hard clays or rock above the water table, are suitable to permit construction of the shaft in a relatively dry excavation and where the sides and bottom of the shaft remain stable without any caving, sloughing or swelling and allow visual inspection prior to concrete placement. The dry method shall consist of drilling the shaft excavation, removing accumulated seepage water and loose material from the excavation and placing the shaft reinforcing and concrete in a relatively dry excavation. The dry construction method shall be used only when shaft excavations have 12 inches per hour or less of seepage and less than 3" of standing water.

625.14 Wet Construction Method. The wet construction method shall be used at sites where a dry excavation cannot be maintained for placement of the shaft concrete. This method shall consist of drilling the shaft excavation below the water table, keeping the shaft filled with water, natural slurry formed during the drilling process, mineral slurry or polymer slurry to control seepage, groundwater movement and stability of the hole perimeter until excavation to the final depth and placement of the reinforcing cage and concrete has been completed. This procedure

will require placing the shaft concrete with either a tremie or concrete pump beginning at the shaft bottom, and displacing the water or slurry as concrete is placed. Temporary partial depth casings near the ground surface shall be provided to aid shaft alignment and position and to prevent sloughing of the top of the shaft excavation. Where drilled shafts are located in open water areas, shafts shall be constructed by the wet method using casings extending from above the water elevation to the Plans casing tip elevation or top of rock socket to protect the shaft concrete from water action during placement and curing. The casing shall be installed in a manner that produces a positive seal at the bottom of the casing.

625.15 Temporary Casing Construction Method. The temporary casing construction method shall be used at all sites where the stability of the excavated hole, the effects of groundwater cannot be controlled by other means, or other conditions exist in which the Engineer deems it necessary. In this method, the hole shall be advanced through caving material by the wet method in accordance with Subs**ection 625.14**. When a formation is reached that is nearly impervious, a casing shall be placed in the hole and sealed. Drilling may proceed by the dry method to the projected depth. The placement of concrete shall proceed by the dry or wet method, except that the casing shall be withdrawn after the concrete is placed. In the event seepage conditions prevent use of the dry method, excavation shall be completed by the wet method. Before and during casing withdrawal, a 5-foot minimum head of fresh concrete above the bottom of the casing shall be maintained at such a level that fluid trapped behind the casing is displaced upward out of the shaft excavation without mixing with or displacing the shaft concrete. Casing extraction shall be at a slow, uniform rate with the pull in line with the axis of the shaft. Temporary casings shall be removed while the concrete is still workable and the slump of the concrete is between four and eight inches. Vibratory hammers shall not be used for casing installation or removal within 50 feet of other shafts that have been completed less than 24 hours earlier. The reinforcing cage shall not be damaged or displaced when withdrawing the temporary casing.

625.16 Permanent Casing Construction Method. The permanent casing construction method shall be used only when required by the contract documents or authorized by the Engineer. The casing shall be continuous between top and bottom elevations shown on the Plans. Vibratory hammers shall not be used for casing installation within 50 feet of shafts which have had concrete poured within the past 24 hours

625.17 Time Limitations. When bentonite slurry is used, the Contractor shall adjust construction operations such that the maximum time that slurry is in contact with the bottom five feet of the shaft, the time from the end of drilling to the beginning of concrete placement, does not exceed four hours without agitation. If the four-hour limit is exceeded, the bottom five feet of the shaft shall be over reamed prior to performing other operations in the shaft. For rock sockets constructed in shale using polymer slurry, concrete placement shall begin within 72 hours of starting the rock socket excavation to avoid degradation of the shaft sidewall. Before concrete placement begins, foundation inspection, when required, cleaning operations and reinforcing steel placement shall be completed and approved by the Engineer. These operations will be included in the 72 hour time limit. If concrete placement is not begun within the time limit, the Contractor shall take corrective measures to the satisfaction of the Engineer.

625.18 Level of Slurry. During construction, the level of slurry not be less than five feet above the water table and shall be maintained at a height sufficient to prevent caving of the excavation. If the Engineer determines that the slurry construction method is failing to produce the desired final results, the Contractor shall discontinue operations and propose an alternate method for approval from the Engineer. Correction for a failed slurry construction method will be non-compensable and any effect on time of performance non-excusable.

625.19 Slurry Manufacturer's Representative. When manufactured mineral or polymer slurry additives are to be incorporated into the drilling slurry mix, the Contractor shall provide the technical assistance of a representative of the mineral or polymer slurry additive manufacturer at the site prior to introduction of the slurry into the first shaft where slurry use will be required, and during drilling and completion of a minimum of one shaft to adjust the slurry mix to the specific site conditions.

625.20 Cleaning of Shaft or Casing Sidewalls. Cleaning of the shaft or casing sidewalls shall occur by a method approved by the Engineer as necessary to remove the depth of softening or to remove excessive slurry cake buildup.

625.21 General Excavation Considerations. The Plans will indicate the top of shaft elevations and the estimated bottom of shaft elevations between which the drilled shaft shall be constructed. Drilled shafts may be extended or shortened as approved by TDOT Soils and Geology and TDOT Structures if the foundation material encountered is unsuitable or better than anticipated, or based on the results of load tests.

625.22 Time Restrictions. Drilled shaft excavation shall begin only if the Contractor can complete the excavation, perform foundation inspection and testing, and place the reinforcement and concrete as a continuous daily operation. No two shaft within 50 feet of another shaft shall be excavated at the same time. Shafts shall not be constructed within 24 hours of the completion of an adjacent shaft if the center-to-center spacing is less than three shaft diameters.

625.23 Disposal of Excavated Material. Excavated material removed from the shaft and any drilling fluids used shall be disposed of in accordance with the contract documents, as directed by the Engineer, and in compliance with federal and state regulatory requirements

625.24 Worker Entry Into Shaft Excavation. The Contractor shall not allow workers to enter the shaft excavation for any reason, unless both a suitable casing has been installed and adequate safety equipment and procedures have been provided to workers entering the excavation.

625.25 Rock and Obstructions. Subsurface obstructions at drilled shaft locations shall be removed by the Contractor. The Contractor shall employ special procedures or tools when the hole cannot be advanced using conventional equipment. Blasting will not be permitted. Any man-made material that significantly limits excavation advancement such as concrete, steel, timber, etc. will be classified as an "obstruction". Drilling tools lost in the excavation will not be considered obstructions and shall be promptly removed by the Contractor. The presence of an obstruction for pay purposes must be verified by the Engineer or his representative. Removal of obstruction(s) will be paid at two times the unit price bid for Item Drilled Caisson (Rock) L.F.

for the shaft length from the first occurrence of the obstruction until such depth that the shaft is advanced to the point of removal of the obstruction and normal shaft excavation methods can resume. Boulders or rock layers of such size that do not allow the use of soil excavation tools as described above will not be considered an obstruction but will be considered Drilled Caisson Rock as described above.

625.26 Inspection Equipment. The Contractor shall maintain at the job at all times, all equipment suitable for use in the shaft inspection.

625.27 Removal of Excess Sediment. Final shaft depth shall be measured with approved methods after final cleaning by airlift, or other method approved by the Engineer. Unless otherwise stated in the contract documents, a minimum of 50 percent of the base of each shaft shall have less than ½ inch of sediment at the time of concrete placement. The maximum depth of sediment or any debris at any place on the base of the shaft shall not exceed 1 ½ inches. Shaft cleanliness will be verified by the Engineer for wet or dry shafts.

625.28 Inspection, Supervision, and Records. The Contractor shall provide aid to the Engineer in maintaining accurate records during all phases of the drilled shaft installation. The Contractor's supervisor shall provide the Engineer with any information required for the drilled shaft inspection reports. The Contractor shall provide bosun chairs, gas meters, safety equipment, lights, mirrors, weighted tape measures, steel probes, cameras, personnel and all assistance that may be required for the Engineer to inspect the drilled shaft excavations. Contractor shall perform any corrective work found necessary as a result of inspections. Necessary time shall be allowed for performance of these inspections.

625.29 Inspection for Side Walls. At the Engineer’s request, the Contractor will lower the Inspector to the level of the bottom of the casing and allow visual examination of the side walls of the rock socket to confirm the top of rock socket has been reached once the casing has been extended to the top of rock. Preferably, the sidewall inspection should not be performed until the drilled shaft excavation has extended to the anticipated base of rock socket and before any inner casing is set below the top of rock. Should the observed rock excavation reveal soil inclusions or voids, the drilled shaft excavation shall be extended as directed by the Engineer. Where groundwater cannot be controlled or other conditions prevent safe down-hole entry, side wall inspection will be performed using a camera. The camera should include any light source needed to allow for clear imaging. The Contractor will be responsible for providing sufficient proof that casing has been properly seated into rock and that side walls are free from soil inclusions or voids.

625.30 Inspection of Bottom of Shaft. Where groundwater can be effectively controlled (that is, less than one foot of standing water is maintained in excavation bottom) after reaching the anticipated base of rock socket, the Contractor will lower the Inspector to the level of the bottom of the socket and allow visual examination of the bottom of the shaft. Temporary casing should extend to the base of the rock socket to allow the Inspector to safely enter the excavation. Where groundwater cannot be controlled or other conditions prevent safe down-hole entry, bottom of shaft inspection will be performed using a camera. The camera should include any light source needed to allow for clear imaging. The Contractor will be responsible for providing sufficient

proof that excess sediment has been removed in accordance with Subsection 625.27. The determination of the shaft's tip elevation after excavation to the anticipated base of rock socket will either be made by the Engineer's judgment of conditions found in previously performed test borings drilled within the dimensions of the rock socket, examination of rock socket shaft excavation results (recovered cores or observation of shaft drilling response) or by examination of rock cores taken at least 8 feet below the shaft bottom as discussed in **Subsection 625.31**.

625.31 Core Drilling. When required by contract documents, core drilling shall be performed as described in the contract plans and paid for under Core Drilling and Sampling at the contract unit price. When core drilling is not included in the contract documents and is required by site conditions and directed by the Engineer, core drilling shall be paid at the contract unit price for Concrete Coring. The Engineer may require rock core samples to be taken a minimum depth of 8 feet and up to a maximum depth of 20 feet below the bottom of the drilled shaft excavation to either aid in predetermining acceptable rock socket elevations prior to beginning of shaft excavation or to provide information to determine the acceptability of a completed rock socket. Core sampling should be performed in accordance with ASTM D 2113 using a double or triple wall core barrel of NX (54.7 mm / 2.16 in.) or NQ (47.5 mm / 1.87 in.) size. The Contractor will perform this core sampling or schedule his qualified representative to do this work.

625.32 Log of Excavated Material. The Contractor shall maintain a log of cored material for each foundation inspection hole, and such logs shall be delivered to the Project Supervisor within 24 hours of completion of the boring. The log shall include the following:

(a) The amount of NX or NQ cored per run and the amount recovered. All core loss shall be noted and explained. Clay layers shall be noted and located on the log by depth.

(b) The Rock Quality Designation (RQD) for the NX or NQ core. The bedding thickness and degree of weathering shall also be noted.

(c) Location and elevation of holes.

625.33 Storage and Labeling of Rock Cores. Rock cores shall be stored in structurally sound core boxes and shall be protected from the elements. The core boxes shall be properly labeled to indicate location, depth, beginning elevation, Contractor and date, and shall be delivered to the Engineer.

625.34 Reinforcing Steel Cage Fabrication and Placement. The reinforcing steel cage, consisting of the longitudinal bars, ties, spirals, cage stiffener bars, spacers, centering devices, and other necessary appurtenances, shall be completely assembled as a unit, and shall be placed immediately after the shaft excavation is inspected and accepted, and just prior to shaft concrete placement. Temporary internal cage stiffeners shall be removed as the cage is placed in the shaft such that interference with the placement of concrete does not occur. The Contractor shall verify the stability of the reinforcing steel cage. The Contractor shall submit verification calculations to the Engineer for review and approval. Calculations shall be sealed by an engineer licensed in the State of Tennessee.

625.35 Reinforcing Ties, Splices and Clearances. All reinforcing steel in the shaft shall be tied at every intersection and supported such that the steel remains within the allowable tolerances specified herein during placement of concrete or casing removal. The reinforcing steel cage shall have sufficient rigidity to prevent racking or permanent deformations during delivery or installation.

Concrete Cover			
Shaft Diameter	**Uncased**	**Casing Remains**	**Casing Withdrawn**
3'-0" or less	3"	3"	4"
>3'-0" & <5'-0"	4"	4"	4"
5'-0" or larger	6"	6"	6"

625.36 Spacers. Rolling spacers for reinforcing steel shall be used to minimize disturbance of the shaft sidewalls and to facilitate removal of the casing during concrete placement. Sets of concrete spacers or other approved non-corrosive spacing devices shall be used at sufficient vertical intervals, near the bottom and along the shaft at intervals not exceeding five feet, to ensure concentric location of the cage within the shaft excavation. When the vertical steel is greater than one inch in diameter, the maximum spacing may be increased to 10 feet. As a minimum, a set of spacers shall be provided within two feet of both the top and bottom of the shaft. In addition, one set of spacers shall be provided at both two feet above and below each change in shaft diameter. Non-corrosive spacers shall be provided at a minimum of one spacer per 30 inches of circumference of cage with a minimum of three at each vertical level to maintain the required reinforcement clearances. The spacers shall be of adequate dimension to maintain the specified clearance between the outside of the reinforcing cage and the side of the excavated hole or casing.

625.37 General Considerations. Accumulations of water in casings and excess sediment at the base shall be removed as described herein before the concrete is placed. No concrete shall be placed until all casings, if used, within a 15 foot radius have been installed. Within the 15-foot radius, all driving or vibratory installation methods shall be discontinued until the concrete in the last shaft has set at least five days. Concrete placement shall begin as soon as possible after completion of the excavation, inspection and setting of the reinforcing cage, and shall proceed in a continuous operation from the bottom of the shaft to the Plans construction joint or above as specified herein. An unplanned stoppage of work may require an emergency construction joint during the shaft construction.

625.38 Placement of Concrete in the Shaft. Concrete shall be placed for each shaft with the flow of concrete directed down the center of the shaft. Concrete shall be placed by free fall or through a tremie or concrete pump. The free fall placement method will only be permitted in dry holes. Concrete placed by free fall shall fall directly to the base without contacting either the reinforcing cage or hole sidewall. Drop chutes may be used to direct concrete to the base during free fall placement.

625.39 Time Limitations. The Contractor shall maintain a continuous pour until shaft is complete. All admixtures shall be adjusted for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the two-hour placement limit. Prior to concrete placement, the Contractor shall provide test results of both a trial mix and a slump loss test conducted by an approved testing laboratory using approved methods to demonstrate that the concrete meets the two-hour requirement. The Contractor may request a longer placement time if a concrete mix is provided that will maintain a slump of 4 inches or greater over the longer placement time in the entire shaft as demonstrated by trial mix and slump loss tests. The trial mix and slump loss tests shall be conducted using concrete and ambient temperatures approved for site conditions.

625.40 Concrete Placement by Tremie. Tremies used to place concrete shall consist of a tube of sufficient length to discharge concrete at the shaft base elevation. The tremie shall have sufficient weight to rest on the shaft bottom before the start of concrete placement and to prevent curling of the tremie line during placement of the concrete. The tremie shall not contain aluminum parts that may come in contact with the concrete. A tremie shall consist of a watertight tube having an inside diameter of no less than 10 inches and fitted with a hopper at the top. The inside and outside surfaces of the tremie shall be clean and smooth to permit both flow of concrete and unimpeded withdrawal during concrete placement. The tremie wall thickness shall be adequate to prevent crimping or sharp bends that restrict concrete placement.

625.41 Tremie Operation. Underwater placement of concrete shall not begin until the tremie is at the shaft base elevation. The discharge end of the tremie shall be constructed to permit the free radial flow of concrete during placement operations. The tremie discharge end shall remain immersed as deep as practical in the concrete, but shall be no less than five feet at all times. The tremie shall be supported such as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be sealed closed at the start of work to prevent water from entering the tube before the tube is filled with concrete. After placement has started, the level of the concrete in the tremie shall be maintained above the level of slurry or water in the borehole at all times to prevent water or slurry intrusion into the shaft concrete. If water enters the tube after placement is started, the tremie shall be withdrawn, the discharge end resealed, and the placement restarted. The flow of concrete shall be continuous until the work is completed.

625.42 Removal of Tremie Orifice From Concrete. If at any time during the concrete pour, when using the wet construction method, the tremie line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete surface, the entire drilled shaft will be considered defective. Corrections made by the Contractor will be non-compensable and any effect on time of performance non-excusable.

625.43 Concrete Placement by Pump. Concrete pumps and lines may be used for concrete placement by either the wet or dry construction method. All pump lines shall have a minimum diameter of 5 inches and shall be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation. For the wet construction method, a plug or similar device shall be used to separate the concrete from the fluid in the hole until pumping begins. The plug shall either be removed from the excavation or

shall be of a material that does not cause a defect in the shaft if the plug is not removed. The discharge orifice shall remain at least 5 feet below the surface of the fluid concrete. If at any time during the concrete pour the pump line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the shaft will be considered defective. . Corrections made by the Contractor will be non-compensable and any effect on time of performance non-excusable.

625.44 Adjustment of Concrete Free Fall or Rate of Concrete Flow. If the free fall concrete causes the shaft excavation to cave, the Contractor shall control the movement of concrete by reducing the free fall of the concrete or the rate of flow of concrete into the excavation. The Contractor shall be responsible for proposing, developing, and after approval from the Engineer, implementing corrective work.

625.45 Drop Chutes. Drop chutes may be used to direct placement of free fall concrete down the center of the shaft excavations. Drop chutes shall be a smooth tube constructed either as a continuous one-piece unit or as removable sections. Aluminum drop chutes will not be permitted. Concrete may be placed through either a hopper at the top of the tube or side openings as the drop chute is retrieved during concrete placement

625.46 Construction Joints. Construction joints shall not be utilized unless otherwise approved by the structural Engineer. All planned reinforcing steel shall extend uninterrupted through joints. Surfaces of fresh concrete at horizontal construction joints shall be rough floated sufficiently to thoroughly consolidate the surface and to intentionally leave the surface in a roughened condition.

625.47 Concrete Curing. Portions of drilled shafts exposed to a body of water shall be protected from the action of water by leaving the forms in place for at least seven days after concrete placement or until the shaft concrete reaches a minimum strength of 3,375 psi. After placement, the temporarily exposed surfaces of the shaft concrete shall be cured to prevent loss of water.

625.48 Construction Tolerances. During excavation of the shaft, the Contractor shall monitor the plumbness, alignment and dimensions of the shaft. Any deviation exceeding the allowable construction tolerances specified herein shall be corrected with a procedure approved by the Engineer. Drilled shaft excavations constructed in such a manner that the concrete shaft cannot be completed within the required tolerances will not be accepted. Correction methods shall be submitted by the Contractor for the Engineer's approval. Drilled shaft construction shall not begin until approval has been obtained. When a shaft excavation is completed with unacceptable tolerances, the Contractor shall propose, develop and, after approval from the Engineer, implement corrective work. Redesign drawings and computations submitted by the Contractor shall be signed by a professional Engineer registered to practice in the State of Tennessee. The following construction tolerances will apply to drilled shafts unless stated otherwise in the contract documents:

(a) Temporary casing diameters shall provide a final shaft diameter as shown on the Plans. When approved by the Engineer, the Contractor may provide a larger casing at the

Contractor's expense.

(b) Shafts shall be constructed such that the center of the top of the shaft is within 3 inches of Plans position in the horizontal plane at the plan elevation for the top of the shaft.

(c) For shafts in rock, the vertical alignment of a vertical shaft excavation shall not vary from the Plans alignment by more than ¼ inch per foot of depth. For shafts in soil, the vertical alignment of a vertical shaft excavation shall not vary from the Plans alignment by more than 3/16 inch per foot of depth.

(d) The bottom of the shaft excavation shall be normal to the axis of the shaft within a tolerance of 3/8 inch per foot of shaft diameter.

(e) Shaft steel reinforcing bar shall be no higher than six inches above Plans location or three inches below Plans elevation.

625.49 Integrity Testing. The completed shaft shall be subjected to the testing methods, specified by Plans, such as concrete coring or sonic logging testing, to determine the extent of any defects that may be present. If CSL testing is indicated in the plans, TDOT will supply a CSL consultant to perform the testing. If testing reveals voids or discontinuities in the concrete which indicate that the shaft is not structurally adequate, the shaft will be retested within 3 to 7 days of receiving the initial testing report. In the event retesting confirms the initial test, further measures as specified in **625.50** shall be conducted at the Contractor's expense.

The placement of concrete in additional drilled shafts shall be discontinued until the Contractor demonstrates the adequacy of the shaft construction method to the satisfaction of the Engineer. Any additional work required by the Contractor as a result of shaft defects will be non-compensable and any effect on time of performance non-excusable.

625.50 Concrete Coring. At locations where concrete coring is to be provided, as indicated in the contract documents or as directed by the Engineer, the following will apply. Upon completion of placing concrete and after waiting a minimum of 48 hours, the top surface of concrete shall be cleaned of laitance and any unsound concrete, and then one core hole, or as specified on the plans, shall be drilled completely through the shaft concrete and the rock socket to approximately one foot below the bottom of the rock socket of each shaft. Provisions for the inspection of the concrete surface shall be in accordance with the applicable requirements described herein. Core holes shall be drilled at locations specified by the Engineer. The holes shall be drilled to recover NX (54.7 mm / 2.16 in.) or NQ (47.5 mm / 1.87 in.) size cores. The core samples recovered shall be labeled as to the location from which the samples were taken. The samples shall be delivered to the Engineer for examination. If the cores indicate defective concrete in the shaft, which in the judgment of the Engineer impairs the strength of the completed shaft, the Contractor shall drill additional cores as directed by the Engineer. If the concrete is found to be defective, the Contractor shall submit to the Engineer in writing a proposal for correction, and those corrective procedures shall be approved by the Engineer before such corrective work is undertaken. The cored holes in non-defective concrete shall be filled with grout such that all voids are filled. Grout shall be non-shrink and obtain a

compressive strength equal to or in excess of that specified for the drilled shaft concrete. Grout shall be selected from TDOT Qualified Products List or alternate submitted for TDOT approval. No direct payment will be made for grout and grouting.

625.51 Sonic Logging Testing.

If CSL testing is indicated on a project with CEI oversight, the CEI shall supply a CSL consultant to perform the testing. Shafts six feet in diameter and larger require the addition of 3D tomography. Testing will be performed after the shaft concrete has cured as specified in Table 625.51 – 1. The Contractor shall provide reasonable access to the shaft top for performance of the sonic logging testing.

Table 625.51 Sonic Logging Time Requirements

Shaft Diameter	Minimum Cure Time (prior to testing)
4 to 6 ft.	72 hours
6 to 8 ft.	96 hours
>8 ft.	120 hours

Installation of Pipes. The Contractor shall furnish and install ≥1 ½" nominal inside diameter steel pipes with 0.145" minimum wall thickness, ASTM A 53, Standard Weight, for use in sonic testing of each drilled shaft. Pipes shall be installed in each drilled shaft at the locations shown on the Plans, as required by the testing agency or as directed by the Engineer. The pipes shall be sufficiently regular and free from defects to permit the free and unobstructed passage of the probes. The pipe shall be installed such that all internal joints are flush. Stiffening devices such as mandrels, tape or similar material to seal the joints shall not be used. Pipe shall be watertight with clean internal and external faces, the latter to ensure a good bond between the concrete and the pipes. The pipes shall be fitted with a screw-on watertight shoe and cap and shall be securely fixed to the interior of the reinforcement cage with a minimum cover of three inches from the shaft periphery. The pipes shall be as near to parallel as possible, equally spaced and vertical. Where several sections of pipe are required to reach the full length, joints shall be made watertight. The pipes shall be filled with water and plugged or capped before shaft concrete is poured. The upper end of the pipe shall not be left open after the pour. The pipes shall extend at least three feet above the top of the concrete in the shaft to compensate for water displaced by insertion and removal of the transmitter, receiver, and cable. For shafts with a rock socket, the lower end of the pipes shall extend to the bottom of the rock socket. Care shall be taken during the drilled shaft concrete pour to not damage the pipes. If a tremie is used, the tremie shall not be permitted to rest on top of the pipes during the pour. After completion of the sonic logging and final acceptance of the drilled shaft, the Contractor shall fill the access pipes with grout. All cost associated with materials and installation of steel pipes for sonic logging testing shall be included in the cost of Drilled Shaft Concrete.

Sonic Logging Equipment. The sonic logging equipment furnished by the CSL consultant shall consist of all necessary supplies, support equipment and power to perform the sonic logging testing requirements as described herein.

Sonic Logging Test Procedure. The drilled shaft shall be tested between three and 7 days after concrete placement. The following procedures shall apply:

(a) Pipes shall be checked to ensure the pipes are free from blockages and are filled with water.

(b) Levels shall be taken on top of each pipe, each pipe shall be plumbed and the length shall be recorded.

(c) Testing shall be performed between each pair of adjacent pipes around the shaft perimeter and also in pairing combinations between each pipe with all other pipes in the shaft.

(d) All tests shall be carried out with the probes in the same horizontal plane unless the Engineer directs that defects be further evaluated with the probes on different horizontal planes.

(e) The probes shall be raised simultaneously from the bottom of the pipes ensuring that all slack is taken out of the cables before the analyzer is switched on, and that the distance between transducers remains constant during the course of the test. The speed of ascent shall be less than 12 inches per second. Measurements shall be taken at three inch intervals or less. Anomalies indicated by longer pulse first-arrival times (FAT) and significantly lower amplitude per energy signals shall be reported. If anomalies are detected, additional tests with two or more sources per receiver vertical offsets of greater than or equal to 20 inches shall be conducted between the same tubes unless the anomaly is within 20 inches of the bottom of the shaft.

(f) The CSL Consultant shall provide accurate measurements of probe depths on the logs.

Record of Testing. Preliminary results of the testing shall be provided on site prior to the CSL consultant leaving the site. A detailed CSL report and test data shall be submitted to the Engineer within seven days. The CSL report shall be signed and sealed by a Professional Engineer. The CSL report shall include, but is not limited to, the following: project identification and dates of testing, a table and schematic showing shafts tested with accurate identification of tube coordinates and collar elevation, name of personnel that performed the tests and interpretation and those personnel's affiliation, equipment used, data logs, interpretation, analysis, and results. The data logs shall include XY plots of FAT, amplitude and velocity versus depth. CSL data shall be processed to provide easy to understand 2D cross-sections between tubes for all tube pair combinations. These plots shall be annotated by the CSL consultant as appropriate to delineate anomalous results. For shafts six feet in diameter and larger, 3D tomography will be required along with CSL testing. If 3D tomography is requested, the data shall be submitted to the Engineer within ten days. If offset surveys are performed as part of 3D tomography, data plots shall include 3D volumetric images for the entire shaft, color-coded, to indicate velocity variations along the shaft. Locations and geometry of anomalies or unconsolidated zones shall be identified in 3D color images with detailed discussion. The results for CSL and 3D surveys shall be based on the percentage decrease in velocity as correlated to the

following Concrete Condition Rating Criteria (CCRC). The velocity datum of good concrete shall be established by averaging the velocities in the good concrete along the drilled shaft. Deviations from the velocity datum shall be used for determining the Concrete Condition Rating.

Concrete Condition Rating Criteria				
		Overall Rating shall be the lower of the two criteria		
Concrete Condition Rating	**Rating Symbol**	**Velocity Reduction**	**Signal Distortion/Strength**	**Indicative Results**
Good	G	0 to 10%	None / normal Energy Reduction ≤ 6 dB	Acceptable concrete
Questionable	Q	10% to 20%	Minor / lower Energy reduction = 6.1 to 9 dB	Minor concrete contamination or intrusion. Questionable quality concrete.
Poor	P/D	> 20%	Severe / much lower Energy reduction > 9 dB	Defects exist, possible water slurry contamination, soil intrusion, and or poor quality concrete.
Water	W	V= 4760 to 5005 ft/sec (≈60% reduction)	Severe / much lower Energy reduction > 12 dB	Water intrusion, or water filled gravel intrusion with few or no fines present.
No Signal	NS	No signal received	None	Soil intrusion or other severe defect absorbed the signal, tube debonding if near top.

[a] The baseline velocity shall be 13,000 feet per second for normal weight concrete with f'c = 3 to 5 ksi.

Correction of Unacceptable Results. The CSL consultant shall immediately inform the Engineer of any suspected anomalies, honeycombing or poor concrete quality detected by testing. The Contractor and CSL consultant shall duly perform further tests as directed by the Engineer to evaluate the extent of any detected anomalies. Core drilling, or other investigative methods as approved by the Engineer, shall be performed to further investigate the anomaly. If a defect is confirmed, the Contractor shall bear all costs involved with the shaft coring, grouting and remediation. Within 14 days of the completion of testing, the Contractor shall provide a report signed and sealed by a Professional Engineer registered in the State of Tennessee providing the results of the additional investigations and recommendations to accept or repair the shaft. The report shall also contain recommendations for modification of construction procedures to prevent defects for subsequent shaft installations. The dates of the completion of drilling, cleaning, steel placement and concrete pour shall also be provided. Construction above the top of shaft shall not be performed until the shaft has been accepted by the Engineer.

625.52 Drilled Shaft Load Tests. All load tests, when required by the contract documents, shall be completed and submitted to the Engineer for review and approval before construction of any production drilled shafts. The locations of load test shafts, the maximum loads to be applied, the test equipment to be furnished by the Contractor, and the actual sequence of the load testing shall be as shown on the Plans or as specified in the contract documents. After completion of testing, test shafts not used as production shafts shall be cut off at an elevation three feet below the finished ground line. The portion of shafts cut off shall be disposed of by the Contractor, at the Contractor's expense, in a manner approved by the Engineer.

Compensation

625.53 Method of Measurement.

Drilled Shaft Excavation (Soil). Accepted drilled shafts will be measured for payment to the nearest 0.10 vertical foot of length along the axis of each shaft. For shafts without a rock socket, measurement will be from the Plans elevation for the top of shaft to the bottom of the shaft. For shafts with a rock socket, measurement will be from the Plans elevation for the top of shaft to the top of the rock socket as defined in section "Drilled Shaft Excavation (Rock)".

Drilled Shaft Excavation (Rock). For pay purposes Drilled Shaft Excavation (Rock), the "top of rock" is defined as the elevation at which natural material cannot be drilled by conventional drilling tools and requires the use of special rock augers, core barrels, air tools, or specialized removal methods. The accepted rock sockets and drilling through rock will be measured for payment to the nearest 0.10 vertical foot of length along the axis of the shaft for the cumulative length of rock, as determined by the Engineer.

Drilled Shaft Concrete. Drilled shaft concrete shall include all cost for materials, placement concrete, and installation of steel pipes, as required by contract documents, for Sonic Logging Testing. Drilled shaft concrete will be measured by the cubic yard and computed from the dimensions indicated on the Plans or ordered in writing by the Engineer.

Drilled Shaft Reinforcing Steel. Drilled shaft reinforcing steel will be measured and computed for payment by the pound, unless otherwise stipulated in the Plans, in accordance with **subsection 604.30** of the Standard Specifications for Road and Bridge Construction .

Drilled Shaft Casing (Permanent). Permanent drilled shaft casing will be measured by the vertical foot of permanent casing installed. Additional permanent drilled shaft casing installed for the convenience of the Contractor will not be measured for payment.

Drilled Shaft Casing (Temporary). Temporary Drilled shaft Casing will not be measured for payment and shall be incidental to the work.

Foundation Probe Holes. Foundation probe holes will be measured for payment to the nearest 0.10 linear foot of length along the axis of each hole and paid for as Item Rock Drilling Bridges.

Foundation Core Holes. Measurement for payment for foundation core holes will be to the nearest 0.10 linear foot of length along the axis of each hole.

Concrete Coring. Measurement for payment for concrete cores will be to the nearest 0.10 vertical foot of length along the axis of the shaft from the top of concrete to a point determined

by the Engineer, and may extend the entire length of the shaft plus one foot below the bottom of the rock socket.

Sonic Logging Testing. When testing is not performed by the CEI, sonic logging testing of drilled shafts, as required, will be measured for payment per each drilled shaft.

Drilled Shaft Load Tests. Load tests will be measured for payment per each load test performed.

625.54 Basis of Payment.

Drilled Shaft (Soil). Payment will be considered full compensation for all temporary steel casing required, costs of drilling, excavation, slurry, dewatering, cleaning, and incidental work and materials required to complete the excavation. Payment for any drilled shaft excavation will be at the contract unit price per vertical foot for the diameter of the drilled shafts specified. No additional compensation will be made for concrete required to fill an oversized casing or for oversized excavation.

Drilled Shaft (Rock). Payment will be considered full compensation for drilling, excavation, slurry, cleaning, dewatering, and incidental work and material required to complete the excavation. For payment purposes the length of any rock socket installed and accepted shall be paid for at the contract unit price per vertical foot for the diameter of the rock socket specified. If the method of construction requires that drilled shaft casing be seated into the sound rock such that the bottom of the casing is below the determined top of sound rock elevation, payment for excavation below the top of the sound rock layer (top of the rock socket) will be included in the payment for the rock socket. In the event that the Engineer orders additional rock socket construction, payment for the additional length will be at the contract unit price per vertical foot of rock socket. Payment will be considered full compensation for the additional excavation into rock including all incidentals necessary to complete the work down to the elevation designated by the Engineer. Additional reinforcing steel and concrete shall be paid for at the contract unit bid price.

Obstructions. Removal of obstruction(s) will be paid at two times the unit price bid for Item Drilled Shaft (Rock) V.F. for the shaft length from the first occurrence of the obstruction until such depth that the shaft is advanced to the point of removal of the obstruction and normal shaft excavation methods can resume.

Drilled Shaft Concrete. Include all costs associated with furnishing and placing concrete in the drilled shaft in the unit price bid per cubic yard for Drilled Shaft Concrete in accordance with the Contract Plans. Include all costs associated with furnishing and installing Sonic logging access tubes and any required extensions in the unit price bid per cubic yard for Item Drilled Shaft Concrete. No payment will be made for construction delays resulting from the initial sonic logging testing of the drilled shaft. The Department will pay the costs for the initial sonic logging testing. The Contractor shall pay for all costs associated with coring, engineering design, cost required to correct defects and any construction delay costs, if a defect is found based on the sonic logging. The Contractor shall pay the costs of sonic logging testing to re-test the repaired drilled shafts.

Drilled Shaft Reinforcing Steel. Include all costs associated with furnishing and placing reinforcing steel, including but not limited to spacers, ties, and splices, in the drilled shaft at the

unit price bid per pound for Reinforcing Steel in accordance with Subsection **604.31** of the Standard Specifications.

Drilled Shaft Casing (Permanent). Include all costs associated with furnishing and installing permanent casing in the drilled shaft in the unit price bid per vertical foot of Drilled Shaft Casing. Temporary Casing, including all costs associated with installation and removal, shall be included in the bid price for item Drilled Shaft Excavation.

Foundation Core Holes. When core drilling is required by contract documents, payment will be at the contract unit price per linear foot for Item Core Drilling and Sampling. Payment will be considered full compensation for drilling or coring the holes, extracting and packaging the samples or cores, laboratory testing, delivering the samples or cores to the specified TDOT location and for all other expenses necessary to complete the work. When Core Drilling is not included in the contract documents and is required by site conditions and directed by the Engineer, Core Drilling shall be paid at the contract unit price for Item Concrete Coring. Payment shall be full compensation for completing the core drilling as specified above.

Concrete Coring. Payment for concrete coring will be considered full compensation for all material, labor, tools, equipment, grouting and incidentals necessary to complete the work. The field measured quantity shall be paid at the contract unit price per vertical foot for Item Concrete Coring.

Sonic Logging Testing. When testing is not performed by the CEI, payment for sonic logging testing of drilled shafts, when required by contract documents, or directed by the Engineer, will be made at the contract unit price per each drilled shaft for sonic logging testing. No payment will be made for supplementary sonic logging testing to evaluate defects. Payment for sonic logging testing will be considered full compensation for providing all equipment, conducting the actual probing measurements as specified, furnishing reports, removing equipment, and all tools, labor and any incidentals necessary to complete the work. The number of sonic logging inspections may vary from the estimated quantities, but the contract unit price shall prevail regardless of the variation.

Drilled Shaft Load Tests. When required by contract documents, drilled shaft load test will be paid at the contract unit price per each and will be considered full compensation for all costs related to performing and reporting load tests as specified.

S T A T E **O F** **T E N N E S S E E**

Rev. 8-21-17 January 1, 2015

SPECIAL PROVISION
REGARDING
AGGREGATE FOUNDATION SYSTEMS

626.01 Description – This work shall consist of the design, furnishing of materials and the construction/installation and testing of aggregate foundations, consisting of either stone columns or aggregate piers. The intent of the aggregate foundations specified herein is to provide sufficient soil reinforcement and/or soil densification (i.e. global slope stability, bearing capacity, settlement) within the limits indicated on the contract documents to achieve the degree of improvements required to meet the performance criteria stated in the contract documents.

626.02 Method – Stone columns or aggregate piers shall be designed and constructed for the aggregate foundations based upon the soil information provided in the contract documents, the Contractors expertise, and other factors. The Contractor shall be responsible for all aspects of the design of the aggregate foundation system selected and meeting the performance requirements specified in the contract documents, including any grading deemed necessary by the contractor to prepare the project site for the aggregate foundations.

If the Prime Contractor does not possess the capability or expertise to design and/or install the aggregate foundations, as stated herein, or they select a system that is considered proprietary, they shall make arrangements to contract the services of a licensed Contractor or other qualified personnel, who meet the requirements stated herein, to perform the design and/or installation. All aggregate foundation improvement documents shall be signed and sealed by a Professional Engineer licensed in the State of Tennessee. The procurement of any permits required for the installation of the aggregate foundations, including the disposal of any water or spoils, shall be the sole responsibility of the Contractor.

626.03 Qualifications of Designer/Installer – The Contractor performing the work described herein shall have personnel on-site (engineer, operator, and/or foreman or superintendent) experienced in the aggregate foundations being installed. This work shall be performed under the supervision of the Contractors superintendent, who is knowledgeable and experienced in the method of constructing

aggregate foundations as required by the project. The Contractors equipment shall have the capacity to undertake the work and shall be sufficient to complete the work within the specified contract time.

The Contractor selected for this project shall meet the following criteria:

1. A minimum of five (5) years of experience in the selected aggregate foundation system design and installations.
2. At least one (1) registered Professional Engineer licensed to perform work in the State of Tennessee. The Contractor shall assign an engineer to supervise the work with at least (3) years of experience in the design and installation of the selected aggregate foundations.
3. A superintendent or foreman with a minimum of two (2) years of experience in the supervision of the aggregate foundation. The contractor may not use consultants or manufacturers' representatives in order to meet the requirement of this section.
4. Evidence of successful design and installation of the selected aggregate foundation system, within the United States of America, under similar conditions on at least three (3) projects in the last three (3) years. This documentation shall contain at a minimum: name of client contact, address, and telephone number; location of project; contract value, description of aggregate foundations and use (i.e. slope stability, settlement, bearing capacity, etc.)

626.04 Design Requirements – The Contractor shall be responsible for ensuring that the size, pattern, depth and spacing of the aggregate foundations are adequate to provide the required global slope stability, bearing capacity and/or settlement. The contractor shall be fully responsible for all assumptions, made by the contractor in regard to the aggregate foundation system, the strength of the soil and rock, and all implications that the properties of the soil and rock have on the design, constructability and stability.

The design of the aggregate foundation system shall meet all requirements contained within the contract documents.

626.05 Submittal of Designs and Details– The Contractor shall submit the designs and details (Design Packet) for review and acceptance by the Engineer (Materials and Test Division) no less than sixty (60) calendar days prior to beginning construction of the aggregate foundations.

INITIAL SUBMITTAL

1. Work experience in accordance with required qualifications mentioned in Subsection 625.03 of this Special Provision.
2. The Contractor shall submit one (1) full size plan set and one (1) electronic copy (PDF) of the

design packet to the Engineer as an initial submittal. If clarifications are required, an email with an accompanying electronic file (PDF) will be sent to the Contractor for clarifications within 15 business days after the receipt of the initial submittal.

3. The Contractor will be allowed 5 business days for comments clarification after the initial comments have been received. The Engineer will be allowed 5 business days following the Contractors response to determine if further clarification is needed.
4. The Engineer will not approve the submittal of the design packet but will review the submittal for completeness.
5. The initial submittal shall be signed and sealed by a registered Professional Engineer licensed to perform work in the State of Tennessee.

FINAL SUBMITTAL

1. Once the Engineer informs the Contractor that the design packet is complete, the Contractor shall submit one (1) full size set and one (1) electronic copy (PDF) of the final approved set of plans.
2. The final submittal shall be signed and sealed by a registered Professional Engineer licensed to perform work in the State of Tennessee.

MINIMUM REQUIREMENTS OF THE SUBMITTAL OF DESIGN CALCULATIONS

1. Configuration of the Design Submittal
    a. The design packet shall contain in the title block the project number, county, foundation locations, initials of the preparer, contract number and page number. An index page shall be included to provide a list of the pages of the submitted design packet.
    b. The design packet shall include an explanation of the symbols on the calculations, a description of the computer program(s) used in the design, and at least one hand calculation documenting the computer program results. The design calculations shall indicate the target minimum replacement ratio and target minimum composite angle of internal friction at each section.
2. Diagrams of Critical Cross Sections
    a. The design packet shall include diagrams of the critical design cross section geometry including soils and rock strata, along with the locations, size and depths of the aggregate foundations.
    b. The design cross sections shall also include the critical slip surface shown where it will result with the minimum factor of safety.

3. Physical Properties of Rock and Soil

    a. The soil and rock properties, including shear strength, friction angle, cohesion and unit weights shall be shown for each soil and rock strata. Geotechnical information is provided in the contract documents.

4. Factor of Safety

    a. The comparison of the calculated factor of safety and the minimum required factor of safety shall be clearly shown in the design packet.

MINIMUM REQUIREMENTS OF THE SUBMITTAL OF AGGREGATE FOUNDATION DETAILS

1. Plan View of the Aggregate Foundations

    a. A plan view of the aggregate foundations shall be submitted. The following details shall be shown in the plan view:

        i. Identification numbers of the aggregate foundations;

        ii. A reference baseline;

        iii. Offset from the construction centerline or baseline to the aggregate foundations;

        iv. Size and alignment of aggregate foundations;

        v. Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned existing utilities, adjacent structures and other potential interferences;

        vi. The centerline of any drainage structures or drainage pipes located behind, within, or under the foundations.

2. Elevation View of Aggregate Foundations

    a. A drawing of the elevation view of the aggregate foundations shall be submitted. The following details shall be shown in the elevation view:

        i. Identification numbers of the aggregate foundations;

        ii. The elevation at the top and bottom of the aggregate foundations;

        iii. Size and alignment of the aggregate foundations;

        iv. Schematic and elevations of the structure, slope, etc. being supported by the aggregate foundation.

        v. The centerline of any drainage structures or drainage pipes located behind, within, or under the foundations.

626.06 Work Plan – The Contractor shall develop a work plan and submit the plan for review and acceptance to the Engineer no less than sixty (60) days prior to beginning construction of the aggregate foundations. The Contractor shall submit one (1) paper copy set and one (1) electronic copy (PDF) of the Quality Control Plan to the Engineer as an initial submittal. If clarifications are required, an email with an accompanying electronic file (PDF) will be sent to the Contractor for clarifications. Submittal clarifications and responses will follow same process as outlined in Subsection "626.05 Submittal of Designs and Details" The Work Plan shall provide detailed project specific information, including the following:

1. Work experience in accordance with required qualifications mentioned in Subsection 625.03 of this Special Provision, SP626.
2. List and size of all equipment and construction procedures to be used during installation;
3. The source of the proposed aggregate foundation backfill material and the gradation with tolerances the Contractor proposes to use. Upon approval of the backfill source and gradation, the contractor shall maintain this gradation throughout the aggregate foundation installation;
4. Details of the sequence and proposed schedule of aggregate foundation installation, including the anticipated order in which aggregate foundations will be constructed;
5. Details of excavation methods;
6. Designs of temporary embankment slopes and/or shoring deemed necessary by the Contractor;
7. Details on how water and spoils will be handled;
8. Other information shown in the Plans or requested by the Engineer.

626.07 Quality Control Plan – The Contractor shall develop a Quality Control Plan and submit the plan for review and acceptance to the Engineer no less than sixty (60) days prior to beginning construction of the aggregate foundations. The Contractor shall submit one (1) set and one (1) electronic copy (PDF) of Quality Control Plan to the Engineer as an initial submittal. If clarifications are required, an email with an accompanying electronic file (PDF) will be sent to the Contractor for clarifications. Submittal clarifications and responses will follow the same process as outlined in Subsection "626.05 Submittal of Designs and Details" The quality control plan shall include the following:

1. A proposed plan for quality control throughout the installation process;
2. Controls and measurements of the aggregate foundations;
3. A proposed verification program, including proposed independent testing agency to be used;
4. Copies of forms to be used for daily reports, testing reports and other pertinent reports;

5. Copies of testing methods to be used;
6. Copy of written Verification Program.

626.08 Verification Program – A verification plan designed, accomplished and reported by the Contractor is required to measure the quality of the installed aggregate foundations. The proposed verification program is subject to approval by the Engineer. As a minimum, the verification program shall include the following:

1. Proposed means and methods for verification that design and performance criteria, as stated in contract documents, has been satisfied. This may include but shall not be limited to modulus testing on individual elements and/or groups, soil borings, and other methods as required by the aggregate foundation system designer and approved by the Engineer.
2. Quality control program to verify that aggregate foundation elements are installed in accordance with the specifications and requirements as outlined in this Special Provision. The quality control program shall include testing and/or observations by an independent testing agency.
3. Program to monitor performance of the aggregate foundation system during and after construction of the overlying embankment. This procedure may include the installation of instrumentation. Instrumentation installed to monitor performance may also be used to aid in the verification that design and performance criteria have been satisfied.

626.09 Daily Progress Reports and Final Reports – During construction the Contractor shall submit an electronic file (PDF) copy of daily progress reports to the Engineer. Daily reports shall contain (if applicable) but shall not be limited to, element identified by location number, date constructed, drilled diameter, elevation of top and bottom of element, average lift thickness, the type and size of equipment used, description of soil and ground water conditions, quantity of aggregate used per element, results of quality control testing, and other pertinent daily activity information. The Contractor shall immediately report any unusual conditions encountered during aggregate foundation installation to the Engineer.

At the completion of the installation of the aggregate foundations, the Contractor shall submit a final report to the Engineer detailing the equipment and methods used, production rates, the performance of the site during treatment, and that the site meets the established criteria set forth in the contract documents. This report shall include a summary of all verification testing performed.

626.10 Pre Construction Conference – A pre-construction conference shall be held a minimum of 14 calendar days prior to the Contractor beginning any aggregate foundation installation work at the site to

discuss construction procedures, personnel, verification program, quality control and equipment to be used. Those in attendance shall include:

1. The superintendent and/or foreman, on-site supervisors, and the independent testing agency representative.
2. The Engineer, key inspection personnel, and representatives of the Contracting Authority.

If significant changes are made to the Contractors personnel, or significant revisions are made to the Contractors Design Packet and Work Plan, an additional conference shall be held before any additional work is performed.

626.11 Materials – Aggregate foundation backfill materials shall be furnished by the Contractor. Aggregates used for the construction of aggregate foundations shall be relatively clean crushed stone, meeting the requirements of Section 903 of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction for abrasion loss and sodium soundness.

Gradations for aggregate foundations shall be Type I, Grade B in accordance with ASTM D1241, ASTM C33 sizes No. 57, No. 67, or shall be a graded aggregate selected by the installer and approved by the Designer and Engineer. For aggregate foundation elements that extend below the water table, the gradation shall be the same as ASTM D1241 Type I, Grade B, except that particles passing the number 40 sieve shall be eliminated. Alternatively, ASTM C33 size No. 57 stone or other stone selected by the installer and approved by the Designer and Engineer. The aggregate shall have been successfully used in the modulus test.

626.12 Installation – The excavation, installation and testing shall be performed in accordance with the requirements shown on the submittals outlined in Subsection “626.05 Submittal of Designs and Details” and “Subsection 626.06 Work Plan”.

1. Excavation and Shoring
    a. The site shall be graded and leveled as needed for proper installation of the aggregate foundation system selected by the Contractor. The Contractor is also responsible for determining the need for and consequently designing any temporary embankment slopes and/or types of temporary shoring used to ensure proper installation. Any designs of temporary embankment slopes and/or types of temporary shoring shall be signed and sealed by a registered Professional Engineer licensed to perform work in the State of Tennessee.

626.13 Tolerances – Aggregate foundations shall be installed so that each completed element will be

continuous throughout its length. Aggregate foundations shall be installed in a sequence that will minimize ground heave. Any heaving shall be re-compacted or excavated as directed by the Engineer, and be considered incidental to aggregate foundation installation.

1. The center of the completed element shall be within 6 inches of the required horizontal location as shown on the approved details.
2. The completed element shall be out of plumb no more than 2 inches horizontal for every 10 feet vertical of depth as shown on the approved details.
3. The diameter of the completed element shall not be less than 10% of the required diameter as shown on the approved details
4. The centerline of the top of the ground improvement provided by the completed element shall be within 6 inches of the required elevation.

If the aggregate foundation elements are determined to be out of one of more of these tolerances, installation of an additional element may be required at the Contractors expense. The Engineer may require additional aggregate foundation elements to be installed at the Contractors expense if the average effective diameter of any group of 40 consecutively installed elements is less than the plan diameter as shown on the approved design and details.

626.14 Modulus Testing – Testing to evaluate performance values selected for design will be provided by the Contractor. A telltale shall be installed at the bottom of the test foundation so that the deflection at the bottom of the element can be measured. The modulus test shall be conducted at a location where the bottom of the element terminates in soil. ASTM D1143 general test procedures shall be used to establish load increments, load increment duration, and load decrements. Performance will be deemed acceptable when the deflection at the bottom of the element does not exceed 20% of the deflection at the top of the element.

1. The minimum number of modulus tests required will be presented in the contract documents, if not specified in the contract documents a minimum of one modulus test shall be required.
2. The location(s) of the modulus test(s) shall be determined by the Engineer.
3. A seating load of approximately 5% to 9% of the design load shall be applied prior to application of load increments and prior to the measurement of deflection.
4. With the exception of the load increment representing approximately 115% of the design maximum foundation stress, all load increments shall be held for a minimum of 15 minutes and a maximum of 1 hour, and until the rate of deflection reduces to 0.01 inches per hour or less.
5. The load increment that represents approximately 115% of the design maximum on the foundation shall be held for a minimum of 15 minutes, a maximum of 4 hours and until the rate

of deflection reduces to 0.01 inches per hour or less.

6. The modulus testing shall be performed as described in the design packet.

626.15 SPT Verification Testing – Testing to evaluate performance values selected for design will be provided by the Contractor. SPT verification testing parameters will be given in the contract documents. The SPT verification testing shall be conducted in compliance with the following criteria;

1. Testing at each SPT location shall be performed at 2.5 ft. intervals through the entire depth of the improved soil zone.
2. The normalized SPT blow count shall be equal to the sum of the hammer blows required to drive the sample from 6 to 18 inches below the cleanout depth adjusted to an overburden pressure of 1 tsf and for a hammer efficiency of 60%.
3. SPT testing shall be conducted in accordance with ASTM D1586.
4. SPT testing shall be conducted at midpoint locations between the column patterns.
5. Failure to satisfy the minimum normalized SPT blow count criterion given in the contract documents shall require the installation of additional aggregate columns at the Contractors expense. The Engineer may elect to perform additional SPT verification testing.

626.16 Rejection of Aggregate Foundation Elements – If an aggregate foundation element is installed in an incorrect location or does not satisfy the specified tolerances, the Contractor shall install an additional element near the rejected element at a location approved and agreed upon by both the Designer and the Engineer. Alternate remedial procedures will be accepted only if they are approved by the Engineer. Unless the rejection is caused by an obstruction, refusal in rock, dense soil or errors in the project drawings, the cost of all labor and materials required for the additional element shall be the responsibility of the Contractor.

626.17 Method of Measurement – Aggregate Foundation Improvements will be measured as Lump Sum.

626.18 Basis of Payment – The Contractor will be paid the contract Lump Sum price for the aggregate foundation improvements. This payment shall be full compensation for all submittals, labor, equipment, tools, materials, material tests, field tests, verification program, and incidentals necessary to acceptably construct the foundations.

Payment will be made under Item Number:

- 626-01.01 Aggregate Foundation Improvements – Lump Sum

S T A T E **O F** **T E N N E S S E E**

Rev. 5-14-18 January 1, 2015

SPECIAL PROVISION

REGARDING

PREFABRICATED VERTICAL DRAINS

627.01 Description – The work shall consist of furnishing all necessary labor, equipment, materials, incidentals and transportation for the installation of Prefabricated Vertical Drains (PVDs) in accordance with the details shown on the Plans and the requirements of these Specifications.

627.02 Testing Standards – Use the latest edition of the testing standards indicated in this Special Provision. Substitution of standards will require the prior written approval of the Engineer. The Contractor or the PVD Installer is to provide copies of all substituted standards to the Engineer.

The most recent version of the following testing method(s) may be employed:

- Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method); ASTM D3884
- Grab Breaking Load and Elongation of Geotextiles; ASTM D4632
- Trapezoid Tearing Strength of Geotextiles; ASTM D4533
- Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products; ASTM D4833
- Mullen Burst Test; ASTM 3786
- Water Permeability of Geotextiles by Permittivity; ASTM D4491
- Apparent Opening Size of a Geotextile; ASTM D4751
- Tensile Properties of Geotextiles by the Wide-Width Strip Method; ASTM D4595
- (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head; ASTM D4716
- Particle-Size Analysis of Soils; ASTM D422

627.03 Materials - The PVDs shall consist of newly manufactured materials and shall consist of a continuous polymeric drainage core and nonwoven geotextile filter fabric (jacket). The jacket shall allow

free passage of pore water to the core without loss of soil material or piping. The core shall provide continuous vertical drainage. The core and jacket material may be either non-bonded or bonded. For non-bonded PVDs, the jacket material is wrapped around the core and seamed to itself. For bonded PVDs, the jacket material is fused to both faces of the core along the peaks of the corrugations.

JACKET MATERIALS – The jacket components shall conform to the following:

- The jacket material shall be a synthetic nonwoven polymeric geotextile meeting the criteria listed in Table 1.
- The jacket material shall not be subject to localized damage (e.g., punching through the filter fabric by sand/gravel particles).
- The jacket material shall be rigid enough to withstand lateral earth pressures due to embedment and surcharge so that the vertical flow capacity through the core will not be adversely affected.
- The jacket material shall be flexible enough to bend smoothly during installation and during any induced consolidation settlement without damage.
- The jacket material shall not undergo cracking and peeling during installation of the vertical drain.

Table 1 – Jacket Material Properties

PROPERTY[1]	TEST METHODS	UNITS	REQUIREMENTS
Mass	ASTM D5261	oz./yd^2	≥ 4.0
Grab Elongation	ASTM D4632	%	≥ 50
Grab Strength[2]	ASTM D4632	lbs.	≥ 130
Tear Strength[3]	ASTM D4533	lbs.	≥ 60
Permittivity	ASTM D4491	sec.$^{-1}$	≥ 0.5
AOS	ASTM D4751	Sieve Size (mm)	#100 (≤ 0.15)
Ultraviolet Stability (Retained Strength)	ASTM D4355	%	≥ 50 after 500 hrs. of exposure

Notes:

[1]All numeric values represent Minimum Average Roll Value (MARV) in the weaker principal direction. Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing meets or exceeds minimum values provided in this Table.

[2]For bonded drains, grab tensile strength tests shall be conducted on the assembled drain using ASTM D4595.

[3]For bonded drains the trapezoidal tear strength test shall be waived.

CORE MATERIALS – The core materials shall conform to the following:

- The core material shall be continuous polymeric material fabricated with grooves to promote drainage along the axis of the vertical drain. Studded cores are not allowed.
- The core material shall meet the criteria listed in Table 2.

Table 2 – Core Material Properties

PROPERTY	TEST METHODS	UNITS	REQUIREMENTS
Thickness	ASTM D5199	in.	0.09375 (3/32)
Mass	ASTM D3776	oz./ft.	≥ 0.60
Tensile Strength	ASTM D638	lbs.	300
Crush Strength	ASTM D1621	psi	450
Ultraviolet Stability (Retained Strength)	ASTM D4355	%	≥ 50 after 500 hrs. of exposure

ASSEMBLED PVD – The assembled PVD shall conform to the following:

- The mechanical properties (strength and modulus) of the assembled drain shall equal those specified for the component jacket and core.
- The assembled PVDs shall be resistant against wet rot, mildew, bacterial action, insects, dissolved salts, acids, alkalis, solvents, and other components in the site ground water.
- Use only one single type of assembled PVD on the project.
- Provide an assembled PVD that meets the properties indicated in Table 3

Table 3 – Assembled PVD Properties

PROPERTY	TEST METHODS	UNITS	REQUIREMENTS
Perimeter	--	in.	≥ 7.75
Width	Measure with caliper	in.	≥ 3.75
Thickness	ASTM D5199	in.	≥ 0.1250 (1/8)
Discharge Capacity	ASTM D4716	gpm	1.5 (at 50 psi)
	ASTM D6918		1.5 (at 25% compression)

TRANSPORTATION AND STORAGE OF ASSEMBLED PVD – The transportation and storage of the assembled PVD shall conform to the following:

- Label or tag the assembled PVDs in such a manner that the information for sample identification and other quality control purposes can be read from the label. As a minimum, identify each roll of assembled PVD by the manufacturer as to lot or control numbers, individual roll number, date of manufacture, manufacturer and product identification of the jacket and core.
- During shipment and storage, wrap the PVDs in burlap or similar heavy duty protective covering. Protect the PVDs from sunlight, mud, dirt, dust, debris, and other detrimental substances during shipping and on-site storage. The PVDs shall be free of defects, rips, holes, and/or flaws. Material which is damaged during shipment, unloading, storage, or handling, or which does not meet the requirements of the drain material will be rejected by the Engineer.

SPLICING PVD

- Non-bonded PVDs may be field spliced. Remove approximately 6 inches of the jacket material from the current assembled PVD roll exposing the core. Insert the exposed core into the new roll of assembled PVD and secure using methods approved by the PVD supplier and accepted by the Engineer. The core material shall not be exposed after splicing. The core materials from each roll should be in firm contact with the corrugated peaks of one core overlapping the corrugated valleys of the other core.
- For bonded PVDs, provide to the Engineer the PVD Manufacturer's splicing procedure for review and acceptance by the Engineer prior to any PVD material being installed.

PVD DRAINAGE LAYER – Unless otherwise stated in the Plans, the PVD drainage layer shall conform to the following:

- Place a drainage layer consisting of at least 24 inches, unless otherwise specified in the plans, prior to PVD installation.
- Unless otherwise specified in the plans, the drainage layer material shall conform to the following gradation requirements (ASTM D422), as shown in Table 4:

Table 4 – Drainage Layer Gradation

SIEVE	PERCENT PASSING
2-inch	100
½-inch	65-100
¼-inch	50-100
No. 10	40-70
No. 40	10-40
No. 200	0-5

- Material not meeting the gradation defined above will be rejected. Acceptance of materials will be at the project site.

627.04 Submittals – At least 30 calendar days before the beginning of the PVD installation, the Contractor shall submit to the Engineer for review, full details of the materials, equipment, sequence and method of installation. Review by the Engineer of these items shall not relieve the Contractor of the responsibility to install PVDs in accordance with this Special Provision. As a minimum, the submittal shall contain the following:

PREFABRICATED VERTICAL DRAIN MATERIAL - Acceptance of the sample PVD material by the Engineer will be required prior to delivery of the PVD material to the Project. At least 30 calendar days before beginning PVD installation, the Contractor and PVD Installer shall:

- Identify the proposed source of the assembled PVDs prior to delivery to the site.
- Supply, to the Engineer, a manufacturer's material certification that the assembled PVD meets or exceeds the material requirements of this specification. The manufacturer's literature shall document the physical and mechanical properties of the PVD. The PVD Manufacturer shall be a specialist in the manufacture of PVDs and shall have produced a minimum of 5,000,000 linear feet of the PVD material similar to that proposed for the Project and that has been successfully used in similar applications within the past 5 years, including details on prior performance on these projects.
- Submit to the Engineer, for review and visual inspection, 3 samples of the un-spliced PVD to be used and 3 samples of proposed splices, if splices are allowed on the project. The samples of un-spliced PVD shall be at least 5 feet long. Samples of spliced PVD shall be long enough to include the splice plus 2 feet of un-spliced drain on both sides of the splice. The samples shall be stamped or labeled by the manufacturer as being representative of the PVD material having its specified trade name.
- Submit to the Engineer, for review and visual inspection, 3 samples of the proposed anchor plate to be used to anchor the PVDs at the design depth shown on the plans.

PREFABRICATED VERTICAL DRAIN INSTALLER - Provide proof to the Engineer of the experience of the PVD Installer for the work described at least 30 calendar days prior to PVD installation. The PVD Installer shall:

- Document successful installation of at least 5,000,000 linear feet of PVDs during the last 5 years and shall be a certified installer of the PVD Manufacturer.
- Document at least 5 successfully completed projects within the last 5 years of similar size and complexity to that of the Project. Document the PVD Installer's experience by providing a project summary that includes for each referenced project, the project start and completion dates, total quantity of PVDs installed, and a detailed description of the project, site conditions,

and subsurface conditions. Include in the project description details of the PVD materials, the equipment and technique used to install the PVDs, the average and maximum length of PVD installed, the client name and address, the name and telephone number of the representative of the consultant and owner for whom the work was performed and who can attest to the successful completion of the work, and any other information relevant to demonstrating the PVD Installer's qualifications.

- Identify a full-time supervisor who has been in responsible charge of supervising PVD installation operations for at least 5 projects in the last 5 years. The supervisor shall be present at the work site at all times during PVD installation operations. Provide a detailed resume of the supervisor's experience and qualifications. Provide a detailed resume for the replacement supervisor, if required.

PREFABRICATED VERTICAL DRAIN INSTALLATION PLAN - At least 30 calendar days prior to PVD installation, the Contractor shall submit to the Engineer, for review, a PVD Installation Plan that includes as a minimum the following information:

- The configuration of the installation equipment including size, type, weight, maximum pushing force, and vibratory hammer rated energy.
- Dimensions and length of the mandrel.
- Details of the PVD anchorage.
- Detailed description of proposed installation procedures.
- Proposed methods for securing splices in non-bonded PVDs or the manufacturers splicing procedure for bonded PVDs, if splicing is allowed.
- Proposed methods and equipment for pre-augering or spudding.
- Submit documentation of the successful application of the proposed PVD installation operations.
- Provide shop drawings showing the planned locations and bottom elevations of all PVDs, a unique identification number for each PVD, the proposed installation sequence, the location of all potential conflicts with the locations of the PVDs.

627.05 Submittal Reviews – Acceptance of the proposed materials, equipment, construction sequence, and installation method will be accepted by the Engineer. Acceptance of the PVD materials, equipment, construction sequence, or installation method does not relieve the Contractor and PVD Installer of its responsibility to install the PVDs in accordance with the plans and specifications. Acceptance by the Engineer of the method and equipment to be used to install the PVDs is contingent upon satisfactory demonstration of PVD installation at the project site. If, at any time, the Engineer

considers that the method of installation does not produce satisfactory PVDs, alter the method and/or equipment as necessary to comply with this Special Provision. The Engineer will determine the adequacy of the Contractor's methods and equipment.

627.06 Installation Requirements

- Install PVDs as indicated on the plans or as directed by the Engineer. Install the PVDs with equipment that will minimize the disturbance of the subsoil during the installation operation and maintain the mandrel in a vertical position. Size the equipment to minimize the disturbance of the subsoil during the installation operation. Provide equipment with sufficient push force to install the PVDs through all existing subsurface material to the depths shown on the plans. Size the equipment to have the capability of installing the PVDs to a depth of approximately 20 feet greater than the maximum PVD depth shown on the plans. Select equipment such that it will not force the fill soil into the existing soil, nor disturb the fill soil, nor cause any bearing capacity problems with the subgrade soils due to the weight of the equipment.
- Install the PVDs using a mandrel or sleeve that can be advanced through the soils to the required depth. The mandrel or sleeve shall protect the PVD material from tears, cuts, and abrasion during installation and shall be retracted after each PVD is installed. To minimize disturbance of the subsoil, the mandrel or sleeve shall have a maximum cross-sectional area of 10 square inches. The mandrel or sleeve shall be sufficiently stiff to prevent wobble or deflection during installation. In no case will alternative raising and lowering of the mandrel during advancement be permitted. Permit the raising of the mandrel only after completion of the PVD installation to the bottom PVD elevation shown on the plans or otherwise authorized by the Engineer.
- Install the PVDs using either a constant load or constant rate of advancement technique. Use a vibrator only when approved by the Engineer in areas where constant load or constant rate of advancement methods cannot install the PVDs to the design depths. Jetting or use of an impact hammer will not be allowed to install PVDs.
- Provide each PVD with an "anchor" plate or similar arrangement to anchor the bottom of the drain at the required depth during mandrel removal and to prevent soil from entering the bottom of the mandrel during PVD installation. The anchorage shall be adequate to keep the bottom of the PVD at the required depth subject to approval and field verification by the Engineer. The corresponding dimension of the anchor shall conform as closely as possible to the breadth dimensions of the mandrel to minimize soil disturbance. The projected cross-sectional area of the mandrel and anchor combination shall not be greater than 14 square inches.

- Notify the Engineer at least 3 working days prior to installation of the initial PVDs at the location(s) shown on the plans to allow the Engineer sufficient time to provide the necessary inspection for the initial PVD installation. Do not begin installation of the initial PVDs at the location(s) indicated without the presence of the Engineer or his/her representative. During the installation of the initial 10 PVDs at the indicated location(s), demonstrate that the equipment, method, and material produce a satisfactory installation, as determined by the Engineer. Following completion of the initial PVD installations at the indicated location(s), do not proceed with the installation of the remaining PVDs at the embankment location until authorized by the Engineer.
- If foundations have been previously installed, install the PVDs in a manner as to avoid these foundations. The location of the PVDs relative to the foundations shall be determined and staked out prior to the installation of the PVDs. In addition, take precautions to preserve the stake locations and re-stake PVD locations as necessary.
- Using a baseline and benchmark determined by the Contractor, locate, number, and stake out the PVDs. All other construction staking, for taking precautions to preserve the stake locations, and for re-staking, if necessary, is the responsibility of the Contractor. Do not vary the as-installed locations of the PVDs by more than 6 inches from the locations designated on the plans or approved shop drawings.
- PVDs that deviate from the plan locations by more than 6 inches, that are damaged, or improperly installed will be rejected. Abandon in place rejected PVDs. Replacement PVDs shall be placed as close as possible to the correct original locations.
- Provide the Engineer with a means of verifying the plumb-ness of the mandrel and determining the depth of the PVDs. Check the equipment for plumb-ness prior to installing each PVD. A deviation from the vertical of no more than 2 percent (2%) during installation is allowed.
- Splices, if allowed in the plans or by the Engineer, shall be done in accordance with approved PVD Installation plan.
- Cut off the PVDs neatly at least 6 inches above the working layer, unless otherwise shown on the plans.
- Provide the Engineer with a means of determining the depth of the advancing PVD at any given time and the length of the drain installed at each location. Submit a summary tabulation of the number and length (to nearest 1/2 foot) of acceptable PVD daily to the Engineer.
- Refusal is defined as the point where the soils resist a reasonable effort at further penetration of the PVDs. The Engineer will establish refusal criteria based on the existing soil borings and the initial PVD installations to be performed by the PVD Installer in the presence of the Engineer or his/her inspector, as specified herein. Terminate no PVDs above the design PVD bottom

elevations shown on the plans without the approval of the Engineer. The Engineer may vary the depths, spacing, and/or number of PVDs to be installed, and may revise the plan limits for this work based on the actual subsurface conditions encountered.

- Where obstructions are encountered below the working surface, install a new drain within a 1 foot radius of the original location of the obstructed PVD. As directed by the Engineer make a maximum of 2 additional installation attempts for each obstructed PVD. If the PVD still cannot be installed to the design bottom elevation, abandon the PVD location and install a new PVD at a location directed by the Engineer. Clearly mark in the field locations where PVDs do not meet the depth criteria due to obstructions. The Engineer will have the right to waive the replacement PVD requirement upon written notice to the Contactor and the PVD Installer.

- Pre-augering or spudding for the PVD installation shall be allowed to advance the PVDs through compacted fill material or other obstructions. Penetrate the overlying fill material or any dense layers or obstructions when encountered to satisfactorily install the PVDs. Obstructions are defined as any man-made or natural object or strata that prevents the proper insertion of the mandrel and installation of the PVD.

- The Contractor may use augering, spudding, or other approved methods to loosen the soil and obstructing material prior to the installation of the PVDs. The obstruction clearance procedure is subject to the approval of the Engineer; however, such approval shall not relieve the Contractor or PVD Installer of the responsibility to clear obstructions in accordance with the specifications.

- If augering is the selected method, the augers shall have a minimum outside diameter equal to the largest horizontal dimension of the mandrel, shoe, or anchor, whichever is greatest. The maximum outside diameter of the auger shall be no more than 3 inches greater than the maximum dimension of the mandrel.

- Limit the use of obstruction clearance procedures and use only when approved by the Engineer. Penetrate no more than 3 feet beneath the obstruction when using augering or other obstruction removal techniques.

- Provide the Engineer with “As-Built” plans of the PVD installation. Include in the plans the location, the date installed, and the length of each PVD below the fill soil surface elevation. In addition, include on the “As-Built” PVD plans the fill soil surface elevation at each location, the “As-Built” PVD bottom elevation, and identify any rejected or abandoned PVD installations. Submit “As-Built” plans at least weekly during PVD installation operations. Submit a final “As-Built” PVD plan within 7 calendar days of the completion of PVD installation in all embankment locations. The final “As-Built” plans will be subject to the approval of the Engineer.

627.07 Method of Measurement – Furnish all supervision, materials, equipment, mobilization, crews, tools, required permits, survey stake out of PVD locations, and other equipment and materials as necessary to properly execute the work. In addition, this item includes clearing of obstructions and the proper disposal of surplus materials brought to the ground surface by obstruction clearance, if required.

Mobilization will be paid for by lump sum.

PVDs will be measured and paid for as the number of linear feet satisfactorily installed, or abandoned as directed by the Engineer. Measure the length of acceptably installed PVDs to the nearest 1/2 foot. The length of the PVDs to be paid for shall be the distance the installation mandrel tip penetrates below the working grade plus the required cut-off length above the working surface. Payment will not be made for drains that are not anchored to the required depth, unless previously approved by the Engineer in writing.

The Engineer may vary the depths, spacing, or numbers of PVDs to be installed and may revise the PVD installation limits shown on the plans based on the actual subsurface conditions encountered. Such changes or revisions may increase or decrease the total quantity of the PVDs estimated based on the plans. In the event of such changes in required PVD quantity, the payment for PVDs shall be made on the basis of the contract unit price per linear foot.

Drainage Layer Material will be paid for in cubic yards of material, complete and in place.

627.08 Basis of Payment – Mobilization shall include the cost of furnishing of all equipment and materials necessary to properly execute the work.

PVD payment will be based on the sum total length of all acceptably installed. No payment will be made for PVDs, or for any delays or expenses incurred through changes necessitated by improper material, equipment, or installation. No payment will be made for PVDs placed deeper than the bottom elevation designated on the plans unless authorized in writing by the Engineer. The unit bid price for PVDs shall include the cost of survey and stakeout, installing PVDs, and furnishing all labor, tools, and incidentals necessary to complete the work.

Drainage layer material payment will be based on the sum total cubic yards of material in place. The unit bid price for the drainage layer material shall include the cost of furnishing all labor, tools, and incidentals necessary to complete the work.

Payment will be made under Item Number:

- 627-01.01 Mobilization Lump Sum
- 627-01.02 Prefabricated Vertical Drain Linear Feet
- 627-01.03 Drainage Layer Material Cubic Yard

S T A T E **O F** **T E N N E S S E E**

(Rev. 02-03-07) January 1, 2015

SPECIAL PROVISION

REGARDING

HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS

Scope:
The design requirements of this Special Provision shall apply to Section 713-Highway Signing, Section 714-Roadway and Structure Lighting, and Section 730-Traffic Signals of the Standard Specifications for Road and Bridge Construction, January 1, 2015

Description:
The design of the supports for overhead sign bridges, cantilever and butterfly configurations, high mast lighting, luminaires and traffic signals shall be in accordance with the American Association of Highway and Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, current edition, with addenda.

General Conditions:
All overhead sign bridge, cantilever and butterfly sign structures, traffic signal mast arm structures and high mast light poles, as well as any luminaire poles 90-ft or greater in height, shall be designed using the Fatigue Category 1 provisions found in the subject specifications except that, design for galloping-induced fatigue, is excluded. Fatigue designs are not required for luminaire poles less than 90-ft in height, span-wire poles or roadside sign poles.

In lieu of designing for galloping-induced fatigue in mast arm pole assemblies, a 60-inch by 16-inch by 0.125 gauge aluminum or galvanized steel panel shall be installed near the end of the mast arm with the long axis of the panel collinear with the long axis of the mast. The panel shall be mounted at such a height as to provide a least a 6-inch clearance from the top of the signal assembly or sign blank located on the mast arm within the length of the anti-galloping panel. The panel and attachment hardware shall be shown on the shop drawings, and is considered an item included in the price bid for the mast arm assembly.

Additionally, all mast arm connections to the support pole shall be accomplished using a wrap-around ring stiffener assembly.

The following design coordinating instructions are as follows:

- The Basic Wind Speed shall be 90 mph.
- The Design Life/Recurrence Interval shall be 50-years.
- The speed for calculating Truck-induced gust loads shall be 65 mph.

S T A T E **O F** **T E N N E S S E E**

(Rev. 07-01-04)
(Rev. 10-01-06)
(Rev. 10-31-11)

January 1, 2015

SPECIAL PROVISION

REGARDING

TRAFFIC CONTROL SUPERVISOR

At the preconstruction conference the Contractor shall designate a Worksite Traffic Supervisor other than the Superintendent to be responsible for initiating, installing, and maintaining all traffic control devices in accordance with all applicable special provisions, standard drawings, plans, specifications, and the most current edition of the Manual on Uniform Traffic Control Devices.

Qualifications. The Worksite Traffic Supervisor shall be certified by the American Traffic Safety Services Association Worksite Traffic Supervisor Certification Program, or the National Highway Institute by having satisfactorily completed training in "Design and Operation of Work Zone Traffic Control" taught by the University of Tennessee Transportation Center. In addition, they shall have at least one-year's experience directly related to worksite traffic control in a supervisory or responsible capacity.

Responsibilities. The Worksite Traffic Supervisor shall:

1. Oversee all operations which contribute to the convenience, safety and orderly movement of traffic.

2. Be available on a twenty-four hour basis with access to all manpower, equipment and materials needed to maintain traffic control devices and handle traffic related situations.

3. Maintain documentation to become part of the final project records of all daily activities including deficiencies found, how they were corrected and the personnel, equipment and traffic control devices utilized.

4. Correct routine deficiencies within a twenty-four (24) hour period after discovery.

5. Be available on the site within 45 minutes after notification of an emergency situation, prepared to effect corrective measures immediately.

6. Make daily inspections of all traffic control devices (at least every third inspection shall be at night).

7. Prepare and submit for approval any revisions to the existing traffic control plan sufficiently in advance to allow Department review prior to implementation.

8. Coordinate project traffic control activities with appropriate local law enforcement and emergency agencies.

9. Coordinate public awareness of changing traffic conditions through TDOT.

10. Educate all employees of the Contractor utilized as flaggers on proper flagging procedures.

Emergency Maintenance. Emergency maintenance shall consist of maintenance, repair, or replacement of traffic control devices that have been damaged, vandalized, or otherwise rendered ineffective to the extent that a serious hazard exists. The Traffic Control Supervisor shall cause such emergency work to begin within two (2) hours after being notified. When emergency maintenance is required during nonworking hours, devices that are classified as "unacceptable" according to ATSSA Quality Standards for Workzone Traffic Control Devices may be used, provided that the devices are effective in reducing the existing hazard, and further provided that they are replaced not later than the next business day. The Traffic Control Supervisor shall keep the Resident Engineer informed of the name, address, and telephone number of the individual responsible for performing emergency maintenance.

Failure to Comply. In the event a routine traffic control deficiency is not corrected within twenty-four (24) hours after discovery, a deduction in the amount of one hundred dollars ($100.00) shall be made from monies due the Contractor for each calendar day that the deficiency is allowed to remain, not as penalty, but as liquidated damages.

In the event that immediate action is not taken to correct an emergency situation, a deduction in accordance with Subsection 712.04 shall be made from monies due the Contractor. In addition, if deemed necessary by the Engineer due to lack of response by the Contractor, State Maintenance Forces may be mobilized to correct the emergency situation with all costs of the corrective action being assessed against monies due the Contractor. This assessment for costs incurred shall be in addition to the assessment of the amount in accordance with Subsection 712.04.

The preceding assessments shall be in addition to any liquidated damages which may be assessed in accordance with Subsection 108.07.

Basis of Payment. The labor costs involved in the provision of the Traffic Control Supervisor, and any equipment, tools, or incidentals necessary to complete the work, are to be compensated fully by the lump sum price bid for Traffic Control Supervisor, Item No. 712-01.04.

S T A T E **O F** **T E N N E S S E E**

(Orig. 01-11-2018) January 1, 2015

SPECIAL PROVISION

REGARDING

CONTRACTOR PROVIDED

UNIFORMED POLICE OFFICER

Description. This work shall consist of furnishing and maintaining a Uniformed Police Officer and an official law enforcement vehicle within the project site limits as specified on the Plans or as directed by the Engineer. It shall be the primary responsibility of the Police Officer to enforce regulatory speed limits and to coordinate the removal of vehicles with the Tennessee Department of Safety and/or other law enforcement agencies having jurisdiction through the work zone. Authorization to move a vehicle involved in a traffic accident is retained exclusively by law enforcement officers.

Definition of Terms

Police Officer: (Uniformed State Commissioned Police Officer) A law enforcement officer, with an official law enforcement vehicle equipped with blue lights, having the authority to write traffic tickets and make arrests at the project site.

All Uniformed Law Enforcement Officers shall have POST certified training and shall have an additional 4 hours of FHWA approved work zone training. Copies of each officer's record of training shall be provided to the Project Supervisor and placed in the project file.

Uniformed Law Enforcement Officers shall have training from a Peace Officer Standards and Training (POST) certified police training academy in the State of Tennessee. These academies are as follows:

a. Tennessee Law Enforcement Training Academy (3025 Lebanon Rd., Nashville, TN 37214-2217)
b. Tennessee Department of Safety THP Training Academy (275 Stewarts Ferry Pike, Nashville, TN 38124)
c. Blount Co. Sheriff's Office Law Enforcement Training Academy (940 E. Lamar Alexander Pkwy., Maryville, TN 37804)
d. Chattanooga Police Department Training Academy (3200 Amnicola Hwy., Chattanooga, TN 37406)
e. Cleveland State Community College Police Training Academy (P.O. Box 3570, Cleveland, TN 37329-3570)
f. Knox Co. Sheriff's Office Regional Training Academy (4900 Maloneyville Rd., Knoxville, TN 37921)

g. Knoxville Police Department Training Academy (220 Carrick St., Suite 202, Knoxville, TN 37921)
h. Memphis Police Academy (4371 O.K. Roberson Rd., Memphis, TN 38128)
i. Metro Nashville Police Department Training Department (2715 Tucker Rd., Nashville, TN 37218)
j. Shelby Co. Sheriff's Office Training Academy (993 Dovecrest, Memphis, TN 38134)
k. Walter State Community College Regional Law Enforcement Academy (215 North College St., Greenville, TN 37743)

Construction Zone Requirements

1. Police Officer Patrol Requirements and/or Procedures. The contractor is to provide one or more Police Officers as needed and approved by the Engineer during the period of construction or any time he has activities underway in or adjacent to traveled lanes of the highway project.
2. The Police Officer shall enforce the speed limit on the project site. When not driving through the project site, the Police Officer shall position his vehicle at various locations within the construction zone to optimize visibility for the purpose of speed enforcement and other traffic control enforcement as required by the project and requested by the Engineer. The Police Officer shall maintain a detailed written log of his enforcement activities and shall submit the log to the Engineer for verification each month.
3. Accidents. The Police Officer shall respond to incidents/accidents within the construction zone and shall contact the appropriate agencies to investigate and discharge the accident. The Police Officer shall provide assistance until arrival of the enforcement agency with authority, and then resume his/her patrol.

Compensation

Basis of Payment. The Department will pay for Uniformed Police Officers provided by the Contractor at the invoice price of the work plus 5%, not to exceed $50 per hour for the hours present on the Project. No compensation will be made for drive time.

S T A T E **O F** **T E N N E S S E E**

Rev. 10-9-17 **January 1, 2015**

SPECIAL PROVISION

REGARDING

TRAFFIC QUEUE PROTECTION

Description: When construction activities are performed on control-access or limited access facilities, the Contractor shall pursue efforts for the protection of traffic queues caused by project operations and clearly demonstrate adequate good faith efforts as described herein. The queue protection truck is expected to alert motorists (inside or outside of project limits) of all stopped traffic caused by construction activities or incidents within the project limits.

Equipment: The contractor shall provide a minimum of one (1) queue protection truck for each traveling direction where traffic flow is reduced. One (1) additional queue protection truck shall be onsite in reserve. The system deployed must fulfill the following minimum requirements:

1. A truck mounted attenuator that meets or exceeds NCHRP TL-3 requirements.
2. Four (4) round yellow strobe lights (with auto-dimmers) positioned rear facing
    - Two (2) mounted under rear bumper
    - Two (2) mounted at cab level
3. One (1) standard cab mounted light bar.
4. A truck mounted message board with a minimum of 3 Lines and 8 Characters per line.
5. Four Hour National Traffic Incident Management (TIM) Responder Training for Queue Truck Operators.

Maintenance of Traffic: The following procedures will be followed until free flow traffic conditions are present:

- The queue protection truck shall be positioned approximately ½ mile upstream from the back of the slow moving traffic.
- The queue protection truck shall be positioned on the shoulder and clear of the traveled way so as not to impede traffic.
- The queue protection truck shall relocate as needed to maintain approximately ½ mile distance from the back of the slow moving traffic.
- The 2nd queue protection truck shall be held in reserve, on site, and

support the primary truck if conditions prevent repositioning by reverse. This truck shall not be paid for idle time.

- Trucks shall be kept in project limits during planned lane closures and other project activities expected to cause a queue.
- Queue length estimates and traffic conditions shall be reported to the TDOT District Operations Supervisor or designee at the following periods:
    1. At 30 minute intervals
    2. At significant changes
    3. When free flow traffic is achieved

The queue protection truck shall be mobilized as directed by the District Operations Supervisor or designee and shall be de-mobilized when free flow conditions are reached.

Basis of Payment: The queue protection truck, all related equipment, and labor shall be paid for as Item No. 712-08.10, per hour. All costs are to be included in the price bid. Idle time shall not be paid.

SP716DB

STATE OF TENNESSEE

Project Specific
for DB 1801
I-75 at I-24 Interchange

SPECIAL PROVISION 716DB

REGARDING

CONTRAST PAVEMENT MARKINGS

Description:

This specification covers the requirements for placement of a Contrast Pavement Marking system on portland cement concrete pavements and bridge decks.

Material:

Provide black, white and yellow Thermoplastic Pavement Marking Material meeting the requirements of subsection 919.02, Spray Thermoplastic Pavement Marking Material, of the TDOT Standard Specifications. All material shall be matching systems from the same supplier.

As an Alternate to spray thermoplastic marking material, provide a product from the TDOT Qualified Products List (QPL)

List 1: SECTION B PREFORMED PLASTIC PAVEMENT MARKINGS TAPE

Preformed Tape

List 1: SECTION B PREFORMED PLASTIC PAVEMENT MARKINGS

Preformed Thermoplastic

Provide a manufacturer's certification to the engineer for each lot furnished certifying that the materials supplied conform to all requirements specified. The certification shall include, or have attached, results of all required tests and the requirements it represents.

Construction Requirements:

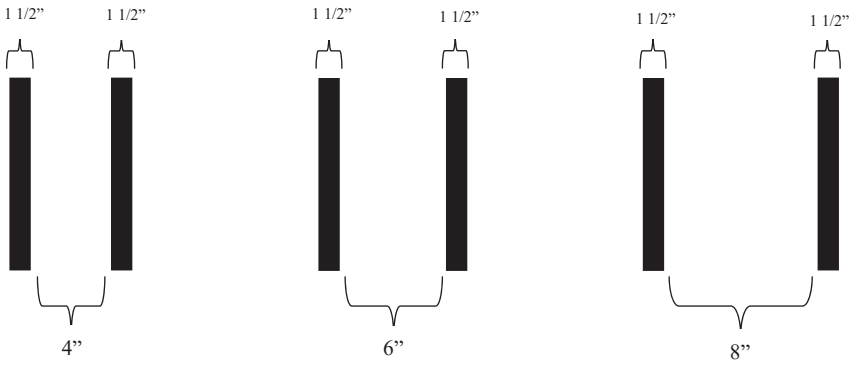
Apply the contrast pavement markings in accordance with section 716.03 and 919.02 of the TDOT Standard Specifications, with the following changes.

- Ensure the pavement temperature is a minimum of 40°F and rising before beginning application and suspend operations if the temperature of the pavement falls below 40°F.

- Apply the black thermoplastic material at a rate of 40 mils followed by either the white or yellow thermoplastic material at a rate of 60 mils for a total thickness of 100 mils.
- If an Alternate product is selected, apply in accordance with section 716.06 of the TDOT Specifications and the manufactures recommendations.

Basis of Payment:

The Department will measure Contrast Pavement Marking Traffic stripe and markings, complete in place.



Contrast striping, 4-inch with 1-1/2 inch black border

Contrast striping, 6-inch with 1-1/2 inch black border

Contrast striping, 8-inch with 1-1/2 inch black border

Payment will be for the work under this provision shall be included in other items.

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

(Rev. 10-08-2015)
(Rev. 09-06-2016)

SPECIAL PROVISION

REGARDING

REMOVAL AND DISPOSAL OF LITTER

Description. This work shall consist of removal and disposal of litter from the entire highway rights-of-way where accessible (fence to fence where applicable), including shoulders and excluding the travel lanes on designated interstate and state routes.

Definitions.

Litter. Any object or group of objects foreign to the right-of-way which has been discarded or abandoned and is or may become visible from the edge of the roadway or shoulder as a result of mowing, vegetation management, maintenance operations, or traffic. Examples under this definition include but are not limited to paper, plastic, bottles, cans, wood, tires, portions of tire, and metal products.

Continuous Operation. The uninterrupted performance of work on successive working days until the completion of all of the items of work specific to litter removal in the contract are approved by the Engineer.

Working Day. A calendar day, exclusive of Sundays and State recognized holidays, which weather or other conditions not under the control of the Contractor, will permit litter operations to proceed for at least five (5) hours of the day with the normal working force engaged in performing the controlling item or items of work which are normal to progress at the time, as determined by the Engineer.

Equipment. The contractor shall furnish all necessary equipment for the satisfactory performance of the work. All vehicles used on the project will be equipped with at least two 6" diameter flashing amber lights, visible in both directions and with a covering device to prevent the litter from being blown from the vehicle.

Work Schedule. The litter removal for each section of road shall be accomplished on a schedule that will assure that the spacing between the beginnings of each cycle is constant throughout the entire life of the contract. For example, if there are 26 cycles to be accomplished they are to be started and completed every two weeks. The maximum cycle time allowed for

sections with fewer than 12 cycles shall be 30 working days. For contracts which require fewer than 12 cycles the Engineer will notify the Contractor in writing at least (5) working days prior to the beginning of each litter cycle. Work shall begin on the date specified by the Engineer and shall be a continuous operation. Each litter cycle shall begin at the same location and proceed as established in the preconstruction conference or as directed by the Engineer (see Section 105.06 of the January 1, 2015 Standard Specifications). The contractor shall supply sufficient resources to accomplish the work during the allotted cycle time.

Time and Frequency Litter. The number of litter cycles will be indicated in the Special Notes, but may be decreased by one litter cycle. In addition, the Engineer may require a partial litter cycle at certain locations. A litter cycle will be considered complete when litter has been removed from the right-of-way specified in the Special Notes and all quantities associated with litter removal have been accepted as complete by the Engineer.

Litter removal shall be performed only during the hours of daylight Monday through Friday, or as directed by the Engineer. If work is performed on Saturday the Contractor will be charged a Calendar Day. No work shall be conducted on Sunday

Litter Removal and Disposal. All litter shall be bagged and removed daily from the right-of-way. All litter accumulated each cycle by the Contractor will be removed from the right-of-way to a Class I dumpsite facility. All fees associated with disposal of litter removed from the state right-of way shall be included in the unit price bid for litter (item no. 719-02). The Contractor shall supply the Engineer with copies of dump tickets for each load deposited at the qualified dumpsite facility.

Acceptance of Work. The Department may accept a portion of the project before the entire project is completed. Such portion(s) shall be of reasonable length as determined by the Engineer, and shall be clean and free of litter when the inspection is made.

Additional Work. The Contractor may be required to remove litter in areas not specifically detailed in the Special Notes under the direction of the Engineer. Additional work shall be limited to the counties and systems which are designated in the Special Notes. Payment will be made at the contract unit price for litter removal (item no. 719-02).

Traffic Control. The Contractor shall maintain work zone traffic control and all traffic control devices for litter removal operations according to the requirements contained herein, the State of Tennessee's currently adopted edition of the Manual on Uniform Traffic Control Devices (MUTCD) defined under the Rules of Tennessee Department of Transportation Chapter 1680-3-1, and the Standard Specifications. Although Traffic Control may be included in the cost of other items, the contractor will be responsible for submitting certifications per Materials & Tests Division Standard Operating Procedures.

Method of Measurement. Litter pickup and disposal will be measured by the centerline mile. Measurement will be made longitudinally along the centerline of the project including bridges, and such single measurement shall include removal and disposal of all litter on interchanges;

State maintained cross roads, and service roads within the lateral limits of the rights-of-way excluding the travel lanes.

Basis of Payment. Removal and disposal of litter will be paid for at the contract unit price per centerline mile which shall be full compensation for mobilization and performance of the work in accordance with the stipulations, provisions and requirements contained herein.

All costs for traffic control as defined above shall be included in the unit bid price for litter removal Item No. 719-02.

Chattanooga

Hamilton County

I-75/I-24 Interchange
DESIGN-BUILD CONSTRUCTION

Federal Project No.
State Project No.
PIN 114174.00

SPECIAL PROVISION (SP) 725

July 27, 2018

Revised November 13, 2018

Prepared For:

Tennessee Department of Transportation

Prepared by:

TDOT ITS Office

Special Provision (SP) 725
STATE OF TENNESSEE
Date: 7/27/2018
Project No.

TABLE OF CONTENTS

SECTION 1
GENERAL REQUIREMENTS

1. All commands and references in, or in connection with, the text in this Special Provisions (SP) document are written to direct Design-Builder responsibility for action unless otherwise specified.

2. This section specifies the minimum general requirements for this contract. These Section 1 General Requirements apply to all aspects of the contract, including, but not limited to, the materials, installation, measurement, and payment requirements for all contract items.

3. The Design-Builder is responsible for all work required in this Section 1. All costs associated with the work in this Section 1 shall be included in the contract price for the items included in the project and no separate payment shall be made.

1.1 General Requirements

For specific information about the project, see the Scope of Work in the contract plans. The Design-Builder shall be fully responsible for complete construction and testing of the Project as shown in the contract documents. This contract includes work on segments of freeways where proposed ITS devices, electrical infrastructure, and system communications are being installed as detailed in this SP, contract documents and design plans.

The system includes, but is not limited to: the furnishing and installation of poles, sign structures, cabinets, foundations, guardrail, conduit, wireless communications, fiber optic cable network, electrical power service, and other required vendor software/hardware necessary to complete a fully functioning system.

All the equipment provided shall comply with the applicable industry approved standards for the subsystems and communications network. Use of approved industry standards and the National Transportation Communications for ITS Protocols (NTCIP) shall be required for the DMS and CCTV devices.

1.1.1 *ITS and Network Communications Devices*

Quantitative and performance requirements for each type of equipment provided in this SP are mandatory minimum requirements. Functional equivalents proposed by the Design-Builder that fully meet or exceed these SP will be considered, provided the functional equivalent is compatible with the communications, hardware, and software included in the project, and provided that the functional equivalent meets all design and operational objectives of TDOT. Experimental devices that are not proven in existing field installations at the time they are proposed for this project shall not be considered. All equipment and component parts that are furnished shall be new, with warranty and not used or refurbished, shall meet all requirements

of this SP, and shall be in an operable condition at the time of delivery. All parts shall be of high quality workmanship and no part or attachment shall be applied contrary to the manufacturer's recommendations or standard practices. All materials and installation of all devices shall be in accordance with this SP and Plans and with the manufacturer's recommendations for the exact intended application. The entire quantity of any particular new item shall be the exact same manufacturer, model, revision, firmware, etc. In addition, each major component must be provided, integrated, and warranted by a single vendor/manufacturer.

Manufacturers of ITS and Network Communications active electronic equipment and other critical system components shall be required to establish minimal qualifications prior to approval of equipment submittals, by submitting for consideration the following years of experience supplying the general type of device indicated:

- CCTV and DMS: 5 years
- RDS, Network Switches, Video Communications Equipment ,Spread Spectrum, Ethernet and any other wireless communications equipment: 3 years

The experience statements shall include but not be limited to, three (3) owner references and documentation of operational equipment installations. The statement of experience shall identify the number of years of experience as well as the references listed above and shall be provided during the submittal program as outlined in Section 1.8 of this SP.

1.1.2 *Applicable Standards*

All materials and installation procedures shall conform to the Design Plans, Special Provisions, the Tennessee Department of Transportation (TDOT) the latest edition of the Standard Specifications for Road and Bridge Construction, the latest edition of the TDOT Standard Roadway and Structure Drawings, the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD), and the supplemental Specifications, as included in the Specifications package. All electrical materials and work shall conform to the standards of the National Electrical Manufacturers Association (NEMA), the Underwriters' Laboratories Inc. (UL), the Electrical Testing Laboratories (ETL), the National Electrical Testing Association (NETA), Institute of Electrical and Electronics Engineers (IEEE) and the Electronic Industries Association (EIA), wherever applicable. In addition to the requirements of the approved shop drawings to be prepared by the Design-Builder, and these Special Provisions, all materials and workmanship shall conform to the requirements of the National Electrical Code (NEC), National Electrical Safety

Code (NESC) and applicable codes of governing jurisdictions. Unless specified, all standards used for this project shall be the latest edition available.

1. Video Standards and Protocols

    a. One of the major system components to be furnished, installed, and tested under this project is IP addressable Closed Circuit Television (CCTV) video equipment. Digitization of the video signals for transmission shall utilize the H.264 standard, MPEG4, Part 10 Standard, MPEG2 as defined by the International Telecommunication Union (ITU), Motion Picture Experts Group (MPEG) and as required by the device specifications within this SP. If necessary for proper operation of the encoding devices, the digitization of the video signal frame timing sequencing shall be properly tuned by the Design-Builder to eliminate video artifacts, and the L, P, and B frame settings for each digitized video stream shall be documented and provided to the Engineer as required by the submission requirements contained in this SP.

2. NTCIP Standard Protocols

    a. The Dynamic Message Signs (DMS) shall be compatible with the latest approved version of the National Transportation Communications for ITS Protocol (NTCIP) as applicable. The Design-Builder shall provide documentation from an independent testing entity, which may be in the vendor's possession, to identify NTCIP objects successfully incorporated and tested. The Design-Builder shall provide the Management Information Base (MIB) for all objects from the sign vendor during the submittal process. Additional NTCIP testing may also be required as part of the Factory Acceptance Test. Deviation from NTCIP compliance shall require advance written approval by the Engineer prior to installation of the offending device. This approval may be withheld at the discretion of the Engineer depending upon the circumstance and/or Federal Highway Administration guidance.

    b. CCTV control protocol for pan, tilt, and zoom in addition to other camera controls shall meet NTCIP requirements.

3. Ethernet and IP Standards and Protocols

    a. The Ethernet communications system and all connected devices shall, as an entire interconnected system, completely implement and be compatible with IEEE 802.3 industry standards for Ethernet and NTCIP standards supporting Ethernet as applicable and required. Ethernet switching equipment is used to transport the digital IP-based video and control data from field devices to hub cabinets. Network equipment at the field master hub switches routes the video and data to the TMC, other facilities and end users as needed.

1.1.3 *Device Control Protocols*

For all active electronic devices controllable through any type of communications interface, the Design-Builder shall be required to voluntarily, and without seeking additional fees, restrictions, licenses or compensation from TDOT, coordinate with each respective system representative for each piece of equipment supplied, to support direct communication with and control of devices by the TDOT SmartWay operational systems identified.

A list of all pertinent device makes and models that are already supported by each system will be provided at the project pre-bid meeting. If a supported make and model is provided under this contract, no further coordination with the operating system venders will be required. However, if a new make and/or model is provided, the Design-Builder will be responsible for coordinating with the system venders to insure sufficient drivers are developed to support the new devices without additional compensation. Complete documentation of the interface protocol and/or MIB shall be provided during the submittal program as outlined in Section 1.8 of this SP.

1.1.4 *Design-Builder and Qualifications*

The Design-Builder selected to perform the ITS portion of the project certifies to be qualified as an expert in the trade, capable of understanding the intent of this SP and constructing the project in accordance with the prevailing standard practice of the trade. Teams qualifying as Design-Builder to perform ITS work must demonstrate at least five (5) years of experience and at least two projects within the last five (5) years in the type of work they plan to do on this project:

1. Fiber-optic Communications
2. Wireless Communications
3. Radar Detection Systems
4. CCTV camera surveillance
5. DMS
6. Hardware and Software used for Transportation Management Centers

1.1.5 *Complete, Compatible Installations*

This SP is for materials and equipment necessary to construct the proposed Project; however, every fitting, minor detail, or feature may not be described. Any component not explicitly stated in this SP, but necessary for the ITS sites to function, shall be considered incidental and shall be furnished and installed by the Design-Builder at the sole discretion of the Engineer. The Design-Builder is responsible for providing all miscellaneous, associated, and incidental materials to provide fully

operational and complete ITS Roadside Equipment Sites that are readily compatible with the communications technologies utilized, and compatible with the hardware, software, and communications equipment installed at the TMC, and such miscellaneous materials shall be considered incidental to the project.

1.1.6 *Complete Operational Systems*

The Design-Builder shall furnish and install all necessary equipment for completely operational ITS Roadside Equipment Sites which are of high quality, high reliability, and operational stability. Compliance with minimum requirements for individual items identified in this SP does not, in and of itself, constitute compliance with the reliability and operational stability requirements necessary to provide for the integration of the sites into a complete, integrated system. It is the Design-Builder's responsibility to ensure that the components provided will work together to form a complete working system as described in this SP. It is the Design-Builder's responsibility to notify the Engineer in writing of any components outlined in the Specifications or Plans that would prohibit the Design-Builder from being able to install a completed working system. The completed system shall be fully integrated with TMC central software already in use.

1.1.7 *Communications System/Equipment Software Compatibility*

The Design-Builder is responsible for ensuring that all equipment and software versions provided for this project is compatible with the existing communications system, TMC software, and all other equipment provided for this project, as installed, configured and programmed by the Design-Builder and while complying with all system functionality and performance requirements. This compatibility includes but is not limited to, all field devices and their respective controllers, all wired and wireless communications links, all control center hardware, and all software applications and control systems including, but not limited to, the CCTV, DMS, RDS, network switches, video communications equipment, wireless communications system, and the network management system. The Design-Builder shall ensure that the delay in equipment response times throughout the entire system is compatible with the existing software. Any modifications to the vendor software, firmware, and hardware to account for system latency and compliance with the total video response delay performance requirements shall be the responsibility of the Design-Builder.

1.1.8 *Equipment and Materials*

1. All equipment and materials furnished and installed on this project shall be new and unused.

2. All equipment and materials of a similar type and nature shall be of the same manufacturer, model, revision, firmware, etc.

3. All bolts, nuts, and fastening hardware less than 5/8-inch diameter shall be stainless steel. All bolts, nuts, and fastening hardware 5/8-inch in diameter and greater shall be hot-dipped galvanized. Refer to Subsection 908.04 of the Standard Specifications for High Strength Structural Bolts.

4. All components, materials, and incidentals shall be recommended by the manufacturer as suitable for the intended application, including any material exposed to the weather.

5. All equipment and associated materials shall be installed and configured in accordance with the manufacturers recommendations and standard practices.

1.1.9 *Coordination with Various TDOT Highway and Bridge Construction Contractors*

The Design-Builder shall coordinate his activities with any other Contractors, which may be in the same work area. There are areas within the project limits where roadway widening activities may be occurring during the same timeframe as this project. Conflicts will be handled at the discretion of the Engineer. The Design-Builder shall notify TDOT promptly in writing if there are any conflicts which may impact the Design-Builder's schedule or construction activities. The mere presence of these roadway construction activities alone will not be a sufficient reason for schedule delays. Design-Builder is expected to coordinate with these other Contractors to the extent possible.

Field adjustments may be needed for conduit and device locations shown throughout the project.

1.2 Abbreviations and Acronyms

AASHTO - American Association of State Highway and Transportation Officials
ADA – Americans with Disabilities Act
AM – Amplitude Modulation
ANSI – American National Standards Institute
ASCE – American Society of Civil Engineers
ASCII – American Standard Code for Information Interchange
ASN.1 – Abstract Syntax Notation – 1
ASTM – American Society for Testing and Materials
ASSY – Assemblies
ATMS – Advanced Traffic Management System
ATSC – Advanced Television Systems Committee
AWG – American Wire Gauge
AWS – American Welding Association
BER – Bit Error Rate
BICSI – Building Industry Consulting Service International
BNC – Binary Network Connector
BSC – Bare Solid Copper
BSU – Base Station Unit
BTC – Bench Test Component
BTS – Bench Test System
°C – Centigrade
CATV – Community Access Television
CCITT – International Telegraph and Telephone Consultative Committee, now being referred to as ITU
CCTV – Closed-Circuit Television
CIF – Common Intermediate Format
CLD – Camera Lowering Device
CLI – Command Line Interface
COMM – Communications
CORBA – Common Object Request Broker Architecture Protocol
CRC – Cyclical Redundancy Check
D1 - Refers to "full resolution"
DB – Decibel
DHCP – Dynamic Host Configuration Protocol
DMS – Dynamic Message Sign
DSP – Digital Signal Processing
DVMRP – Distance Vector Multicast Routing Protocol
EIA – Electronics Industries Association
EIRP – Effective Isotropic Radiated Power
EMI – Electromagnetic Interference

EOTL - Edge of Travel Lane
EOP – Edge of Pavement
EOTW – Edge of Travel Way
ETL – Electrical Testing Laboratories
°F – Fahrenheit
FAT – Factory Acceptance Test
FCC – Federal Communications Commission
FDS – Fog Detection System
FHWA – Federal Highway Administration
FO – Fiber Optic
FOTP – Fiber Optic Test Procedures
Fps – Frames Per Second
FSK – Frequency Shift Keying
FTP – File Transfer Protocol
GBIC – Gigabit Ethernet Interface Card
GB/S – Gigabytes per Second
GFCI – Ground Fault Circuit Interrupter
GHz – Gigahertz
GIS – Geographic Information System
G.M. – Ground Mounted
GMRP – Generic Multicast Registration Protocol
GOP – Group of Pictures
GPS – Global Positioning System
GR – Guardrail
GVRP – Generic VLAN Registration Protocol
HAR – Highway Advisory Radio
HART - Highway Advisory Radio Transmitter
HARS - Highway Advisory Radio Sign
HDPE – High Density Polyethylene
HSPG – Hub Single Point Ground
HVAC – Heating, Ventilation and Air Conditioning
IAB – Internet Activities Board
IANA – Internet Assigned Numbers Authority
ICC – Intelligent Cruise Control
ICEA – Insulated Cable Engineers Association
IEC – International Electrotechnical Commission
IEEE – Institute of Electrical and Electronic Engineers
IETF – Internet Engineering Task Force
IGMP – Internet Group Multicast Protocol
IMSA – International Municipal Signal Association
IP – Internet Protocol
ISO – International Organization for Standardization
ITE – Institute of Transportation Engineers
ITS – Intelligent Transportation Systems
ITSA – Intelligent Transportation Society of America
ITU – International Telecommunications Union
JPL – Jet Propulsion Laboratories
kAIC – one thousand amps interrupting current
Kbps – Kilobits per second
KHz - Kilohertz
km – Kilometer
LAN – Local Area Network
LCD – Liquid Crystal Display
LED – Light Emitting Diode
LF – Linear Feet
LHCP – Left hand circular polarization
LT – Left
Mbps – Megabits per Second
MGB – Main Ground Busbar
MHz – Megahertz
MIB – Management Information Base
MMFO – Multimode Fiber Optic
MPEG – Motion Picture Experts Group
MSEC – Millisecond
MTBF – Mean Time Before failure
MUTCD – Manual on Uniform Traffic Control Devices
NAB – National Association of Broadcasters
NEC – National Electric Code
NEMA – National Electrical Manufacturers Association
NESC – National Electrical Safety Code
NETA – National Electrical Testing Association
NHI – National Highway Institute
NIST – National Institute of Standards and Technology
NHTSA – National Highway Traffic Safety Administration
NMS – Network Management System
NOAA – National Oceanic and Atmospheric Administration
NSF – National Science Foundation
NTCIP – National Transportation Communications for ITS Protocol
N.T.S – Not to Scale
NTSB – National Transportation Safety Board
NTSC – National Television System Committee
NWS – National Weather Service
O/H – Overhead
OSP – Outside Plant
OTDR – Optical Time Domain Reflectometer
OVDS – Overheight Vehicle Detection System
P – Power
PB – Pull Box
PC – Intel/Windows-based personal computer
PCB – Printed Circuit Board
PE – Polyethylene
PIT – Pre-Installation test
POCSAG – Post Office Code Standardization Advisory Group
PPM – Parts per Million
PPT – Puncture Propagation Tear
PM – Preventive Maintenance
PSI – Pounds per Square Inch
PTZ – Pan Tilt and Zoom
PV - Photovoltaic
PVC – Polyvinylchloride
RADIUS – Remote Authentic Dial-in User Server/Service
RDS – Radar Detection System
RF – Radio Frequency
RFI – Radio Frequency Interference
RGS – Rigid Galvanized Steel
RMON – Remote Networking Monitoring
ROW – Right-of-Way
RSL – Received Signal Level
RUS – Rural Utilities Service
RT - Right
SAE – Society of Automotive Engineers
SAP – Session Announcement Protocol
SAT – Stand Alone Site Test
SCH. – Schedule
SCTE – Society of Cable Telecommunication Engineers
SCU – Sign Controller Unit
SDP – Session description protocol
SDR – Standard Dimension Ratio
SIA – Security Industry Alliance
SIF – Standard Interchange Format
SMFO – Single Mode Fiber Optic

SNMP – Simple Network Management Protocol
SPD - Surge Protective Device
SST – Sub-system Test
STA. – Station
STMF – Simple Transportation Management Framework
STMP – Simple Transportation Management Protocol
STP – Shielded twisted pair
SU – Subscriber Unit
TACACS – Termination Access Controller Access Control System
TCIP – Transit Communications Interface Protocol
TCP – Transmission Control Protocol
TCP/IP – Transmission Control Protocol / Internet Protocol
TDMA – Time Division Multiple Access
TDOT – Tennessee Department of Transportation
TEES – Transportation Electrical Equipment Specifications
TFTP – Trivial File Transfer Protocol
THHN – Thermoplastic High Heat Resistant Nylon Coated
THWN – Thermoplastic Heat and Water Resistant Nylon Coated
TIA – Telecommunications Industry Association
TIS – Traveler Information Service
TMC – Transportation Management Center
SP – Special Provision
SPD - Surge Protective Device
UDP – User Datagram Protocol
UDP/IP – User Datagram Protocol/Internet Protocol
UL – Underwriter's Laboratory Incorporated
UNII – Unlicensed National Information Infrastructure
UPS – Uninterruptible Power Supply
UTP – Unshielded Twisted Pair
UV – Ultraviolet
VAC – Volts Alternating Current
VDC – Volts Direct Current
VDS – Video Detection System
VLAN – Virtual Local Area Network
VSWR – Voltage Standing Wave Radio

1.3 Design Summary

For specific information about the project, see the Scope of Work in the contract plans.

1.3.1 *Phasing*

For specific information about the project, see the Scope of Work in the contract plans. All work in this project will be completed in a single phase due to the limited coverage off new deployment. However, proper sequencing of the work is still critical to ensure that the existing devices are taken off-line for as short a time as possible.

This project sequencing is intended to establish a general work flow for the Design-Builder's various discrete crew types. For example, the Design-Builder's underground crew should largely complete work in a geographic location before moving into new locations. However, crews that have generally completed work in a given area can move to the area prior to the completion of work by additional type crews within the earlier area. For example, the Design-Builder may move the conduit crews to secondary locations after completing the initial location even though other crews such as cable crews and cabinet crews have not completed their efforts in the initial area. However, the actual physical cutover of the existing devices to the new network cannot occur until all efforts are complete.

Upon Conditional Acceptance, TDOT will assume operations of those devices where practical. This use by TDOT does not constitute Final Acceptance or waive any other requirements in this Contract. Also, the Burn-In period described in this SP does not begin until Conditional Acceptance of all Phases.

1.3.2 *Electrical Power*

The local electrical service provider within the limits of this contract is the Electric Power Board of Chattanooga (EPB). For new devices, each provider shall provide power drops at proposed demarcation points, as appropriate. The Design-Builder shall include the initial install cost from the utility as well as the cost of coordinating with the utilities in the bid price for electrical connections. The Design-Builder is required to coordinate with the utility company for the installation of the service. Within 14 days of installation, the Design-Builder shall provide to TDOT the address recorded in the power company records. The address will also be included on the as-built plans required in this SP. The Design-Builder will pay for all monthly service charges until after Conditional System Acceptance. Within the interstate right-of-way, any physical facilities, such as conduit runs, needed by the service provider shall be the responsibility of the Design-Builder to install as shown in Plans. The electrical demarcation points within the existing device project limits will remain in place.

1.4 General System Requirements

System wide requirements for latency to roadside sites shall be as follows:

1.4.1 *CCTV and Control Data Latency*

Control commands will be generated from the off-the-shelf video control software provided by the Design-Builder, and shall pass through the Ethernet network to the field equipment, such as CCTV cameras. Operation of the pan, tilt, zoom, presets, focus, iris, and any other available functions of the CCTV cameras shall be provided. Status data generated by the camera shall be transmitted to the camera control unit and to the TMC. The total video response delay between the operator issuing a command to move a camera (through a mouse, keyboard, or joystick through the TMC Software System), movement of that camera, and the resulting display on the operator's monitor of that camera's viewing image as it is moving, shall be minimized to avoid over steering and operator difficulty in positioning the camera. The maximum allowable total video response delay anywhere in the project shall not exceed an average of one (1.0) second for any ten cameras sequentially randomly sampled, and shall not exceed one and one half (1.5) seconds for any one camera sampled.

1.4.2 *DMS Control Latency*

The total delay in sending a message to a DMS shall not exceed 5 seconds from the time the operator commands the message until the message is displayed on the DMS.

1.4.3 *Existing System*

Details on the location of the existing devices are included in the Plans. If any additional information regarding the existing system is needed for bidding purposes, it is the Design-Builder's responsibility to request in writing the specific information desired in accordance with the question submittal deadlines in the pre-bid instructions. Questions shall be addressed to the Engineer.

1.5 Project Testing Plan Requirement

The Design-Builder shall conduct a Project Testing Plan as required below in addition to all other project testing and acceptance procedures required elsewhere in this SP and Plans. The Project Testing Plan shall include a series of tests on all project materials occurring at various stages in the project. The Project Testing Plan includes all testing in the Standard Specifications including all modifications and supplemental procedures contained in this SP. All costs associated with the Project Testing Plan shall be included in overall contract prices; no separate payment will be made for any testing.

1.5.1 *General Requirements*

The Design-Builder is responsible for planning, coordinating, conducting, and documenting all aspects of the Project Testing Plan and providing all required equipment for the tests. The Engineer is responsible only for attending and observing each test, and reviewing and approving the Design-Builder's test results documentation. The Engineer reserves the right to attend and observe all tests.

Each test shall be an individual and separate event for each type of test and for each type of equipment as defined in this SP. The Design-Builder shall follow the testing sequence as described in this SP and shall perform the required tests on all applicable devices and infrastructure.

Each test shall fully demonstrate that the material under test is clearly and definitively in full compliance with all project requirements.

Test procedures shall be submitted and approved for each test as part of the project submittals programs in Section 1.8. Test procedures shall include every action necessary to fully demonstrate that the material under test is clearly and definitively in full compliance with all project requirements. Test procedure actions shall cross-reference to this SP or Plans requirement that is the subject of the test action. Test procedure actions shall cross- reference the applicable sections of the final approved Project Submittal Compliance Form and the submittal materials for the subject of the test action. Test procedures shall contain test setup and block/wiring diagrams showing all materials being tested and all test and measurement equipment, with calibration documentation, and shall contain documentation regarding the equipment configurations and programming. Test procedures shall include check off blanks for each project requirement included in that test, and shall include forms for the documentation of all measured test results.

No testing shall be scheduled until approval of all project submittals for all materials covered under a given test and approval of the test procedures for the given test.

Unless otherwise required herein, the Design-Builder shall request in writing the Engineer's approval for each test occurrence a minimum of 14 days prior to the requested test date. Test requests shall include the test to be performed and the material to be tested. The Engineer reserves the right to reschedule test requests if needed.

For any series of tests on different installations of a given material (e.g., different sections of cable), the Design-Builder shall request in writing the Engineer's approval for the first test occurrence of the series a minimum of 14 days prior to the requested test date, regardless of the notification requirements for subsequent test occurrences.
The Design-Builder shall provide all ancillary equipment and materials as required in the approved test procedures.

The Design-Builder shall document all test results in writing in accordance with the test procedure and submit to the Engineer within 7 days of the test. Any given test session is considered incomplete until the Engineer has approved the documentation for that test session.

The Design-Builder shall repeat all tests if results are deemed by the Engineer to be unsatisfactory, following all test requirements as given here. In the written request for each test occurrence that is a repeat of a previous test, the Design-Builder shall summarize the diagnosis and correction of each aspect of the previous test that was deemed unsatisfactory. Any revisions to the test procedures for a repeated test occurrence shall meet all requirements for the original test procedures, including review and approval by the Engineer.

The satisfactory completion of any test shall not relieve the Design-Builder of his responsibility to provide a completely acceptable and operating system that meets all requirements of this project.

The tests for the Conditional Acceptance may be completed in Phases as described in Section 1.3.1. However, the overall Conditional System Acceptance which starts the Burn-In period shall not be granted until all elements in this contract have passed the Conditional System Acceptance tests. The phased acceptance testing is only to allow the Design-Builder to receive milestone payment for work completed.

1.5.2 *Factory Acceptance Test (FAT)*

FATs shall be conducted at the Manufacturer or Design-Builder's facility or at a facility acceptable to all parties. All equipment to be utilized for this project shall be subject to tests that demonstrate the suitability of the design and manufacturing procedures and compliance with the contract requirements, unless an exception for a specific equipment item is granted by the Engineer. The tests shall be performed on production units identified to be delivered under this Contract. As a minimum, a FAT is required for each of the following project materials:

1. Dynamic Message Signs and controllers

The FAT procedure shall demonstrate all requirements defined in these special provisions are met, including, but not limited to: functional/system performance requirements, electrical requirements, data transmission/communication requirements, safety/password requirements, environmental requirements, and interface requirements with other components of the system including the DMS control software, the Ethernet switches, etc.

The Engineer reserves the right to witness all FATs. At a minimum, the Engineer will be in attendance at the FAT for the first new DMS (If the project contains DMS's). The FAT for the first two signs shall be conducted during the same time period and shall be completed before additional signs are produced.

The Engineer shall be notified a minimum of thirty calendar days in advance of such tests. Salary and travel expenses of the Engineer and his representatives will be the responsibility of the Department. In case of equipment or other failures that make a retest necessary, travel expenses of the Engineer and his representatives shall be the responsibility of the Design-Builder. This shall include all costs associated with having two of the Engineer's representatives on site including, but not limited to, airfare, automobile rental, lodging, and per diem. These costs, excluding airfare, shall not exceed $500.00, per representative, per day. These costs shall be deducted from the payments due or charged to the withholding account of the Design-Builder when the project is terminated.

The vendor must complete the FAT on all remaining signs on their own and submit documentation to the Engineer that the FATs were completed. The Engineer reserves the right to randomly attend those FATS.

No equipment for which a FAT is required shall be shipped to the project site without successful completion of a FAT as approved by the Engineer and the Engineer's approval to ship.

1.5.3 *Bench Test Component (BTC)*

The Design-Builder shall perform a complete BTC on all equipment and materials as specified in this subsection below. The full contract quantity of all materials shall be tested, unless a different quantity for the purposes of the BTC is given in this subsection below. The quantity listed in the subsection below is a "minimum" quantity and the Engineer reserves the right to require testing of additional quantities if the initial testing is not deemed adequate. The Design-Builder shall provide the testing location and facility, which shall be in Tennessee and within a 25-mile radius of the project limits. The test location must be approved by the Engineer as part of the BTC test procedure submittal.

The BTC shall demonstrate that all equipment and materials are in full compliance with all project requirements and works "out of the box", by visual inspection, setup and operation "on the bench", functional testing of the component including manufacturer's recommended startup diagnostics, and testing prior to any field installation of that equipment or material. Test results documentation shall be provided for each equipment item and material in the full contract

quantity; test results documentation shall include the manufacturer's serial number and the project location ID for each item.

As a minimum, a BTC is required for each of the following project materials for quantities as shown.

1. Closed Circuit Television Equipment, 1 unit
2. Dynamic Message Sign, 1 complete unit
3. Network Switches, 3 units
4. Radar Detection System, 1 unit
5. Off-the-shelf and Vendor Software
6. TMC System Compatibility
7. Equipment Cabinet (Type A), 2 cabinets
8. Equipment Cabinet (Type B), 2 cabinets
9. Equipment Cabinet (Type C), 1 cabinets

1.5.4 *Bench Test System (BTS)*

The Design-Builder shall perform a complete BTS on all equipment and materials as specified below. The Design-Builder shall provide the testing location and facility, which shall be within a 25-mile radius of the project limits or as approved by the Engineer. The test location must be approved by the Engineer as part of the BTS test procedure submittal. The Design-Builder shall not request any BTS until the BTCs have been satisfactorily completed for all equipment and materials to be included in the BTS.

The BTS shall demonstrate that all equipment and materials are in full compliance with all project requirements and that a fully set up and configured sample of the project is completely integrated and interoperable in accordance with the project requirements. The BTS shall include all manufacturer's recommended startup diagnostics, configuration and testing procedures. Equipment items and materials included in the BTS shall be setup in temporary configurations (e.g., cameras, DMS and antenna on mounting stands). At least one camera shall be located a minimum of 20 feet above ground and shall have a clear one mile viewing area in at least one direction. Equipment to be located in cabinets or equipment racks shall be mounted as if in its final installation. Test results documentation shall include the manufacturer's serial number and the project location ID for each item. All temporary permits, wiring and cabling, equipment mounting, electrical service, and permitting necessary for the BTS shall be the responsibility of

the Design-Builder. The Design-Builder shall arrange, at no additional expense to the State, the attendance of qualified technical representatives of all of the equipment manufacturers to attend the BTS.

No field installation of any equipment and materials included in the BTCs shall occur until after the BTS has been satisfactorily completed, and the Engineer has approved test results.

1.5.5 *Pre-Installation Tests (PIT)*

The Design-Builder shall perform Pre-Installation Tests (PIT) on all device quantities that are not included in the BTC. The Design-Builder shall provide the testing location and facility, which shall be within a 25-mile radius of the project limits or as approved by the Engineer. The test location must be approved by the Engineer as part of the PIT test procedure submittal. The PIT shall be a shortened version of the BTC to ensure the equipment will power up, operate, and was not damaged during shipment. The Engineer reserves the right to attend any PIT as desired; however, the Design-Builder shall submit documentation of the PITs whether the Engineer is present or not.

As part of the pre-installation tests, the Design-Builder shall install bar code labels on all equipment prior to installation as described in Section 23.8 of this SP. The cost of the bar code installation shall be considered incidental and included in the cost of other items.

1.5.6 *Stand Alone Site Tests (SAT)*

The Design-Builder shall perform a complete SAT on all equipment and materials associated with the field device site, including, but not limited to, electrical service, conduit, pull boxes, fiber optic infrastructure, cable, poles, camera lowering devices, RDS cable, etc. An SAT shall be conducted at every field device site including communications hubs. A SAT shall be conducted for a fully installed and completed control center in the TMC. A SAT shall be conducted for all fiber optic infrastructure.

The SAT shall demonstrate that all equipment and materials are in full compliance with all project requirements and fully functional as installed and in final configuration. The SAT shall demonstrate full compliance with all operational and performance requirements of the project including, but not limited to, detection accuracy for RDS. SATs for the Spread Spectrum radio communications links shall include a demonstration of the radios and antennas at both ends of the link, and a demonstration of the link itself. All SATs also include a visual inspection of the cabinet and all construction elements at the site to ensure they are compliant with the Specifications. The SATs for each site type shall include but are not limited to, the following:

- CCTV Stand Alone Site Test: Shall be conducted at the CCTV Cabinet and shall demonstrate the complete operation of the CCTV, Network Switch, and the link(s) to any RDS that is connected to the Power Supply in the CCTV Cabinet.

- RDS Stand Alone Site Test: Shall be conducted at the RDS Cabinet and shall demonstrate the complete operation and proper configuration of the RDS unit(s).

- DMS Stand Alone Site Test: Shall be conducted at the DMS Cabinet and shall demonstrate the complete operation of the DMS and Network Switch.

- Wireless Equipment Stand Alone Site Test: Shall be conducted from the cabinet at the receiving antenna and shall demonstrate the complete operation of the entire link.

The Design-Builder shall request in writing the Engineer's approval for each test occurrence a minimum of 14 days prior to the requested test date. No more than two (2) SATs shall be scheduled simultaneously at any given time unless otherwise approved by the Engineer. The Design-Builder shall arrange, at no additional expense to the State, the attendance of a qualified technical representative of the equipment manufacturers to attend each test until a minimum of two (2) sites of that particular type are approved.

1.5.7 *Conditional System Acceptance Test*

The Design-Builder shall perform a complete conditional system acceptance test on all equipment and materials in the project. A conditional acceptance test can be requested and performed on a phased approach as described in Section 1.3.1 as the phases are completed. The Design-Builder shall not request the conditional system acceptance test until the SATs have been satisfactorily completed, all as-built documentation has been submitted and approved, and all other project work has been completed to the satisfaction of the Engineer. Prior to a Conditional System Acceptance Test, the Design-Builder shall provide advance notice of and written test results documentation that the Design-Builder has performed a dry-run of the conditional system acceptance test, and the Engineer reserves the right to require attendance of a dry-run test session.

The Design-Builder shall test all project systems simultaneously from the TMC in a manner equivalent to the normal day-to-day operation of the system. The Conditional System Acceptance Test shall demonstrate that all equipment and materials in the network are in full compliance with all project requirements and fully functional as installed and in final configuration, communicating with and being controlled through the control center at the TMC.

The Engineer reserves the right to require, at no additional expense to the State, the attendance of a qualified technical representative of the equipment and/or software manufacturers to attend any given Conditional System Acceptance Test.

Upon completion and full approval of the Conditional System Acceptance Test for all equipment in all phases, Conditional System Acceptance will be given and the Burn-In period will begin.

1.5.8 *Burn-In Period*

1. Burn-In Period

a. Following the Engineer's written notice of successful completion of the Conditional System Acceptance Test, the entire newly installed system must operate successfully for a six (6) month Burn-In period. The Design-Builder shall be responsible for the full maintenance of the newly installed equipment as required in Section 23 of this SP during the Burn-In period. However, no separate payment will be made beyond the contract unit price bid for the Burn-In period. Successful completion of the Burn-In period will occur at the end of six complete months of operation without a system failure attributable to hardware, software, or communications components. Each system failure during the Burn-In period will require an additional month of successful operation prior to being eligible for Final Acceptance. (i.e., if there are two system failures during the initial six month period, the Burn-In period would be increased to 8 months.)

2. Burn-In General Requirements

a. Determination of a system failure shall be at the sole discretion of the Engineer.

b. System failure is defined as a condition under which the system is unable to function as a whole or in significant part to provide the services as designed. While a single component failure will not constitute a system failure, chronic failure of that component or component type may be sufficient to be considered a system failure.

c. Components are defined as contract items or major material elements in a contract item. For electrical and electronic contract items, components are defined as the complete assembly of materials that makes up the contract item.

d. Chronic failure of a component or component type is defined as 3 or more failures for components with a contract quantity of 50 units or less. For components or component types that have a contract quantity greater than 50 units, chronic failure will be defined as having a failure of that component type more times than a number equal to 5 percent of the total contract quantity of that unit.

e. Multiple (more than 1) communication outages or failures will be considered a system failure in any case. Communication failure due to a minor component may not be a system failure. A single path/link failure (e.g. CCTV or DMS link) is not considered a system failure.

f. Specifically exempted as system failures are failures caused by accident, acts of God, or other external forces that are beyond the control of the Design-Builder. However, failure of the Design-Builder to respond to the repair request for that failure within 24 hours may be considered a system failure.

g. The existing devices and equipment are not part of the Burn-In period; therefore, any failures of the existing equipment will not affect the Burn-In period.

h. The Department will advise the Design-Builder in writing when it considers that a system failure has occurred or chronic failure exists.

i. If multiple system and/or chronic failures continue to occur throughout the Burn-In period due to a single component type, the Design-Builder may be required to replace all units of that component type with a different model or manufacturer.

j. The Design-Builder shall document all failures and subsequent diagnosis and repair. The repair documentation shall include as a minimum:

    i. Description of the problem

    ii. Troubleshooting and diagnosis steps

    iii. Repairs made

    iv. List of all equipment and materials changed including serial numbers

    v. Update of the equipment inventory where needed

k. The Design-Builder shall provide the repair documentation to the Engineer within two
(2) days of completing the repair; failure to provide acceptable documentation as required shall be reason to not approve the repair as complete. The Engineer will provide acceptance or rejection of the repair and documentation within seven (7) days.

l. The Engineer reserves the right to require, at no additional expense to the State, the presence of a qualified technical representative of the equipment and/or software manufacturers as related to the diagnosis and/or repair of any system failure.

m. During the Burn-In period the Design-Builder shall perform incidental work such as touching up, cleaning of exposed surfaces, leveling and repair of sites, sodding/grassing, and other maintenance work as may be deemed necessary by the Engineer to insure the effectiveness and neat appearance of the work sites.

n. During the Burn-In period the Engineer shall maintain a "Burn-In period punch list" that contains required Design-Builder actions but that the Engineer does not define as a system failure. Each Burn-In period punch list action item shall be completed by the Design-Builder to the Engineer's satisfaction within seven (7) days of Design-Builder notification of the action item.

o. During the Burn-In period the Design-Builder shall maintain the system as specified in Section 23 of this SP. No separate payment will be made beyond the contract unit prices for the Burn-In period pay item.

p. The overall Burn-In period will be considered complete upon the successful completion of the Burn-In time periods, the Engineer's acceptance of all repairs and repair documentation, completion of all Burn-In period punch list actions and a final inspection as described below.

1.5.9 *Final Inspection*

Upon successful completion of the Burn-In period, the entire project shall be eligible for Final Inspection. The Final Inspection will be conducted provided the Burn-In period has demonstrated the entire system is operating successfully. The Final Inspection shall include but is not limited to:

1. Monitoring of all system functions at the TMC to demonstrate the overall system is operational.

2. A field visit to each site to ensure all field components are in their correct final configuration.

3. Verification that all Burn-In punch list items have been completed.

4. Verification that all final cleanup requirements have been completed.

5. Approval of final as-built documentation

Prior to conducting the Final Inspection, the Burn-In period shall demonstrate that all requirements defined in this SP have been met, including, but not limited to: functional/system performance requirements, electrical requirements, data transmission/communication requirements, safety/password requirements, environmental requirements, and interface requirements with other components of the system.

The Design-Builder shall request in writing the Engineer's approval to start the Final Inspection a minimum of 14 days prior to the requested start date. The Engineer reserves the right to reschedule the start date if needed. The start date for the Final Inspection cannot be prior to the successful completion of the overall Burn-In period.

An unsuccessful or incomplete Final Inspection shall require a new Final Inspection after the Design-Builder has made the necessary corrections. Up to 14 days shall be allowed for the Engineer to conduct a Final Inspection.

The Engineer reserves the right to require, at no additional expense to the State, the attendance of a qualified technical representative of the equipment and/or software manufacturers to attend a portion of a Final Inspection.

The Design-Builder shall be responsible for the full maintenance of all project equipment and materials as described in Section 18 of this SP during the entire time period from the successful completion of the Burn-In period until Final System Acceptance is granted.

1.5.10 *Final System Acceptance*

Upon successful completion of the Final Inspection, the Engineer will grant Final System Acceptance.

1.5.11 *Beneficial Use of Dynamic Message Signs During Construction*

Each DMS shall be roadside controllable (by sign vendor software) within 30 days of attachment to trusses over the roadway (visible to motorists). The Design-Builder's construction schedule shall clearly identify when installation of the signs over the roadway shall occur, and when roadside control shall be established for each sign. The Design-Builder shall not install a DMS over the roadway until all ancillary and infrastructure elements, including cabinets, controllers, conduits, cabling, etc. necessary to operate the sign are in place and functional. Once roadside controllable, the Design-Builder shall display emergency, special event, construction, safety or traveler information messages approved by TDOT, only when requested by TDOT, at no additional cost to TDOT. Normal diagnostic messaging for the purpose of installation and testing shall be determined by the Design-Builder, but shall not be allowed to the extent that excessive power consumption or distraction to motorists occurs as determined by the Engineer. Any beneficial use of the signs to TDOT and the public prior to Final Acceptance does not constitute TDOT acceptance or waive any Design-Builder testing requirements. Failure to make signs roadside controllable within 30 days after installation over the roadway shall constitute failure to meet the Design-Builder's construction schedule and liquidated damages will be assessed as described in Special Provision 108B. The cost that may be incurred by the Design-Builder to display messages as described above during this construction contract shall be considered incidental and included in the cost of other items.

1.6 Training

Prior to Conditional System Acceptance, the Design-Builder shall provide a four-hour training session covering CCTV and camera lowering device, DMS, RDS, and wireless communications. An additional four-hour session shall be conducted to describe the configuration and operation of all electronic equipment including network switches, video communications equipment, wireless communications equipment, communications hubs and associated equipment, electrical and solar power services, fiber optic cable network.

The training shall be provided at the TMC for at least six (6) personnel with individual copies of all training materials and manuals provided to each participant. The training must include a complete demonstration of the configuration, operation, and capabilities of each component in

the system. The training should also consist of a hands-on demonstration of all software configuration and functionality where applicable.

Each training session shall include a mixture of classroom style training in equipment operation, hands-on operator training, and question and answer sessions. The Design-Builder shall submit the trainers' qualifications to the Engineer for approval prior to scheduling the training. The qualifications of the trainers must meet, at a minimum, the recommended qualifications of the equipment manufacturer. If qualified personnel are not on the Design-Builder's staff, a representative of the manufacturer shall provide the training.

The Design-Builder shall submit to the Engineer for approval a detailed Training Plan including course agendas, detailed description of functions to be demonstrated, and a schedule.

1.7 Warranties

Each component of the Project shall be warranted against manufacturing defects and workmanship for a period of at least one year from the date of Final Acceptance. These warranties shall cover complete replacement at no charge for the equipment. The Design-Builder will be responsible for all labor, shipping, insurance, and other charges until Final System Acceptance. Equipment covered by the manufacturers' warranties shall have the registration of that component placed in the Department's name prior to Final Inspection. Even though the warranties will be in TDOT's name, the Design-Builder is still responsible for executing the warranties during Annual Maintenance. The Design-Builder is responsible for ensuring that the vendors or manufacturers supplying the components and providing the equipment warranties recognize TDOT as the original purchaser and owner/end user of the components from new.

1.8 Project Submittal Program Requirements

The Design-Builder shall develop and conduct a submittal management program that shall meet the following minimum requirements, supplemented by any additional requirements regarding submittals that may appear in subsequent sections of this SP or any other contract documents. All materials used on this project will require a submittal and approval prior to purchase and use regardless of whether or not they are called out specifically in this SP.

With each submittal package, the Design-Builder shall complete a Project Submittal Compliance Form. The compliance form will list each SP subsection and will require the Design-Builder to verify and check that it meets that subsection of the Specification. The Engineer shall provide at contract Notice to Proceed (NTP) blank copies of the contract item specific compliance form. Submittal packages without these completed forms will be considered unallowable and returned to the Design-Builder without review or consideration.

The Project Submittal Compliance Form will include, but is not limited to, the following data:

1. Contract pay item number

2. Submittal package identification

3. Submittal description with make/model/part number information

4. Authorized Design-Builder signature

5. Reference to SP requirement

6. Compliance or non-compliance statement for each SP requirement

7. Cross-reference to attached documentation for each SP requirement

8. Authorized Design-Builder signature

The Design-Builder shall at minimum provide the following submittals for review and approval by the Engineer. All submittals must be submitted electronically. The table below is meant as a guide and is not all-inclusive. Items not listed below may also be required during the submittal stage.

Item	Catalog Cutsheets and Technical Specifications	Test Procedure	Installation Procedures	Maintenance Manuals	Operational Manuals	Manufacturer's Statement of Experience	Final Documentation	Interface Protocols
CCTV Equipment	X	X	X	X	X	X	X	X
Camera Lowering Device with Tool	X	X	X	X	X	X	X	
Dynamic Message Signs	X	X	X	X	X	X	X	X
Radio and Antennas Type (all types)	X	X	X	X	X	X	X	
Radar Detection System	X	X	X	X	X	X	X	X
Cabinets	X	X	X	X	X		X	
Network Switches (all types)	X	X	X	X	X	X	X	X
All Software	X	X	X	X	X		X	
TMC Hardware	X	X	X	X	X		X	
System Console	X					X	X	
Demarcation Point Riser Assembly	X							
Ground Mounted Demarcation Point	X							
TMC Systems Design Report							X	

Traffic Maintenance Plans	X							
Training Plan							X	
Conduit and Pull Boxes	X							
Fiber Optic Infrastructure	X	X	X	X	X		X	
Number of Copies	**5**	**5**	**5**	**5**	**5**	**5**	**5**	

1.8.1 *Fifteen (15) Day Submittals*

Within 15 calendar days of Notice to Proceed, the Design-Builder shall submit a written description of his proposed submittal program, including a comprehensive list of all intended submittals and schedule of the submittals for the remainder of the project. The Design-Builder shall develop an appropriate schedule based on the schedule of work, with the exception of the items identified below that have specific due dates. At a minimum, the submittals listed in the table above shall be included in the submittal program. Note that the 15 day submittal is ONLY a schedule of the submittal program. The 15 day submittal does not include any actual equipment submittals.

The Design-Builder shall submit to the Engineer for approval one electronic copy of the program including a complete list and initial schedule of all of those materials, components, and structures to be incorporated in the work for which submittals are required. This list shall form the basis for a log of submittals that will be used by the Design-Builder and Engineer to manage the submittal process. The list shall be submitted as an Excel spreadsheet. In addition, the 15 day submittal shall also contain a letter from the Design-Builder certifying that all required interface protocols will be submitted from all vendors as requested.

1.8.2 *Forty-Five (45) Day Submittals*

Within 45 calendar days of Notice to Proceed, the Design-Builder shall submit the following:

1. Catalog Cut Sheets and Technical Specifications: Within 45 Days of Notice to Proceed, the Design-Builder shall submit to the Engineer for approval equipment catalog cut sheets and technical specifications for all items listed in the above table and any related items. The catalog cut sheets and technical specifications shall include all necessary information to clearly demonstrate that the proposed equipment meets the requirements of this SP and the Plans. In addition, the equipment cut sheets shall include manufacturer's name, model number, and any other descriptive data as necessary to clearly evaluate the item. Interface Protocols for all devices and equipment should also be submitted. All materials included within a specific section of this SP shall be submitted at the same time as a submittal package.

   Specific submittal requirements contained herein shall be supplemented by any requirements shown in the various Special Provisions such as the Traffic Maintenance

Plans and Project Schedules as described in Special Provision 105H. Materials shall not be ordered or released for fabrication without the approval of submittals by the Engineer.

The review and approval of submittals by the Engineer is based on the information provided in the submittal and the conformance with the design concept of the project. Submittal reviews do not relieve the Design-Builder of the responsibility for making the overall system conform to the requirements of the contract. Approvals at the submittal stage are always conditional upon demonstration that the equipment is fully compliant with the Contract including compatibility with all other equipment in the system.

2. Installation Procedures: Within 45 Days after Notice to Proceed the Design-Builder shall submit to the Engineer the Installation Procedures for approval by the Engineer. The installation submittal shall include step-by-step installation directions as developed by the equipment manufacturer. The Design-Builder will be required to follow these installation procedures during construction.

1.8.3 *Ninety (90) Day Submittals*

Within 90 Calendar Days of Notice to Proceed the Design-Builder shall submit the following:

1. Shop Drawings and Design Calculations: Within 90 days of Notice to Proceed the Design-Builder shall submit to the Engineer shop drawings and design calculations for all structural elements and attachments including, but not limited to; all sign structures, support poles, structure attachments and foundations.

1.8.4 *Other Submittal Timeframes*

1. Test Procedures: A minimum of 60 days prior to each desired test date, the Design-Builder shall submit to the Engineer all test procedures for approval by the Engineer. The test procedure submittal shall include all of the test forms for each of the required tests as required in this Special Provision. The actual test cannot be scheduled until the test procedures are approved.

2. Operational Manuals: A minimum of 60 days prior to bench testing, the Design-Builder shall submit to the Engineer Operational Manuals for approval by the Engineer. The Operational Manual submittal shall include step by step directions for the operators to execute all of the function as required in this Special Provision. The Operational Manuals shall be functionally organized, and identify available (built-in) options to operational characteristics. The Engineer reserves the right to request Operational Manuals during the cut sheet submittal stage if the Engineer deems it necessary to adequately check the operational characteristics of the equipment. Operational Manuals shall be provided in hard copy and on CD-ROM.

3. Maintenance Manuals: A minimum of 60 days prior to bench testing, the Design-Builder shall submit to Engineer Maintenance Manuals for approval by the Engineer. The Maintenance Manual submittal shall include all of the necessary steps to maintain the equipment in good working condition, and as indicated by the manufacturer to maintain the warranty. The Engineer reserves the right to request Maintenance Manuals during the cut sheet submittal stage if the Engineer deems it necessary to adequately check the required features of the equipment. Maintenance Manuals shall be provided in hard copy and on CD-ROM.

4. Final Documentation: Prior to the start of the Burn-In Period, the Design-Builder shall submit 10 copies of final documentation for review and approval by the Engineer. Burn-In Period will not start until final documentation is approved by the Engineer. In addition to any specific final documentation requirements outlined in the individual sections of this SP, final documentation shall include a single binder containing all of the equipment warranties and other manufacturer produced documentation. In addition, final documentation shall include an inventory list of all of the furnished and installed equipment. This list shall include equipment description, manufacturer's part number, model number, serial number, and warranty start and end date. The final documentation shall also include a troubleshooting matrix which can be utilized by the system operators to determine the most appropriate action for various problems that may occur in the system.

1.8.5 *Review Process*

1. The Engineer will review and return submittals to the Design-Builder within 21 days of receipt.

2. If additional information is requested or if a re-submittal is required, the Design-Builder is required to re-submit within 21 days of receipt of the Engineer's comments.

3. The Engineer will review and return the re-submittals to the Design-Builder within 21 days of receipt.

4. Any additional re-submittals must also meet this 21 day timeline.

5. The Design-Builder shall maintain a file of approved submittals, shop drawings, and operating data for reference purposes and shall provide an electronic copy of that file to the Engineer upon completion of construction.

1.9 SystemDocumentation

The Design-Builder shall maintain a formal procedure to document the configuration of the as-built system as described in Section 17 of this SP. That program will include maintenance of record drawings and other documentation of the actual location and arrangement of all hardware installed on the project. In addition, the program will include maintenance of

records of the system integration procedures. Provisions will be made to accommodate changes to the system both during and after construction.

1.10 Payment Terms for 725 Item Numbers

Stored Materials Payment will be made for all 725 Item Numbers per TDOT Standard Specifications. For 725 items that describe payment terms based on completing certain testing or installation requirements, those payment terms will apply only to the unit price amount that is in excess of the stored materials payment. For example, if an item says that 50 percent of the contract unit price will be paid upon approval of Bench Test results, this payment will only be applicable if the stored materials payment was not already in excess of 50 percent of contract unit price. At the point which the percentage associated with a testing requirement exceeds the amount previously paid for stored materials, the additional amount will be paid to the Design-Builder at the time of that particular test completion.

1.11 Liquidated Damages

See Special Provision 108B for liquidated damages related to the ITS infrastructure.

Fiber Network
The Design-Builder shall ensure continuous operation of the fiber optic lines affected by construction activities. Temporary disconnect of communication shall not exceed forty-eight hours. Failure to restore communication within the allowed forty-eight hours will result in liquidated damages of $500 per hour until communication is restored.

Dynamic Message Signs (DMS)
The Design-Builder shall ensure continuous operation of the dynamic message signs (DMS) affected by construction activities. Temporary loss of DMS operation during construction activities shall not exceed thirty calendar days. Failure to restore full operation within the allowed thirty calendar days will result in liquidated damages of $500 per day/per DMS until full operation of the DMS is restored. Full operation is defined as the DMS being installed, integrated with TMC software, and accessible/controllable by TMC personnel.

CCTV Cameras (CCTV)
The Design-Builder shall ensure continuous operation of the all CCTV cameras affected by construction activities. Temporary loss of CCTV camera operation during construction activities shall not exceed forty-eight hours. Failure to restore full operation within the allowed forty-eight hours will result in liquidated damages of $500 per hour/per CCTV camera until full operation of the camera is restored. Full operation is defined as the CCTV camera being installed, integrated with TMC software, and accessible/controllable by TMC personnel.

Radar Detection System (RDS)
The Design-Builder shall ensure continuous operation of the radar detection systems (RDS)

affected by construction activities. Temporary loss of RDS operation during construction activities shall not exceed fourteen calendar days. Failure to restore full operation within the allowed fourteen calendar days will result in liquidated damages of $500 per day/per RDS until full operation of the RDS is restored. Full operation is defined as the RDS being installed, integrated with TMC software, and accessible/controllable by TMC personnel.

The table below summarizes the liquidated ITS related damages referenced in the section.

ITS Device Type	Allowable Down Time	Liquidated Damages
Fiber Network	48-Hours	$500 per hour
DMS	30 Calendar Days	$500 per day per DMS
CCTV	48-Hours	$500 per hour per CCTV
RDS	14 Calendar Days	$500 per day per RDS

SECTION 2
CONDUIT

2.1 Description

This section specifies the minimum requirements for conduit furnished and installed on this project as shown on the Plans or as directed by the Engineer.

2.2 Materials

The Conduit shall meet the following material requirements:

2.2.1 *General Requirements*

1. All Continuous Flexible Conduit products and structure mounted multi-cell conduit shall meet the requirements specified herein.

2. All Continuous Flexible Conduit products and structure mounted multi-cell conduit shall have been manufactured and labeled no earlier than in the sixth calendar month preceding the TDOT letting date of the Contract.

2.2.2 *Continuous Flexible Conduit (Conduit Duct Bank)*

Continuous Flexible Conduit shall meet specifications for ASTM F2160 and ASTM D3350 (Cell Classification 334480C or E) Slow crack growth minimum requirement is F10>96 h per ASTM D1693, condition B, 10% Igepal.

1. Conduit shall be extruded from colored material for uniform full-thickness coloring.

2. All Continuous Flexible Conduit shall be labeled with durable identification giving the name of the manufacturer, ASTM F-2160, conduit size (inner diameter trade size and wall thickness/rating), manufacturer/date codes, the legend “TENN DOT”, and sequential foot marking. Labeling shall occur a maximum of every 2 ft.

3. Conduit to be used in bends and sweeps shall have a minimum burn through time of 30 minutes when tested in accordance with Generic Requirement GR-356-CORE.

4. The conduit manufacturer shall have a documented Quality Control/Assurance System.

5. All buried conduit used on this project shall conform to the color scheme and use described below:

    a. Conduit Bank Type 1

        - Green Drop Fiber and/or RDS Cable

    b. Conduit Bank Type 2

        - Green Drop Fiber and/or RDS Cable
        - White RDS Cable, Second Drop Fiber or Spare

    c. Conduit Bank Type 3

        - Green Drop Fiber and/or RDS Cable
        - Blue RDS Cable or Second Drop Fiber
        - White Second RDS Cable or Spare

    d. Conduit Bank Type 4

        - Orange Trunk Fiber Cable
        - Blue RDS Cable or Drop Fiber
        - White Spare or Second RDS Cable
        - Brown Spare

    e. 2” and 3” Electrical Conduit

        - Grey Electrical wire

6. 1¼ in. conduit shall conform to ASTM F2160 and meet the following requirements:

a. SDR 9 for all Bored conduit.

b. SDR 11 for all other conduit.

7. 2 in. conduit shall conform to ASTM F2160 and meet the following requirements:

    a. SDR 9 for all Bored conduit.

    b. SDR 11 for all other conduit.

8. Coupling

    a. Make every effort to minimize coupling. Couplings are permitted only with the Engineer's prior approval.

    b. Couplings shall be airtight and watertight. All couplings shall be installed in accordance with the conduit and the coupling manufacturer's recommendations. Only couplings of the type specified below and approved by the conduit manufacturer are permitted.

    c. Couplings shall be accomplished only by hydraulic press-on or electro-fusion coupling methods.

        i. Use hydraulic press-on couplings of seamless tool-grade tubular aluminum with sealing ring barbs and center stop.

        ii. Use hydraulic compression duct coupling tools and follow all manufacturer's installation procedures, fully inserting both conduit sections to the coupling center stop.

        iii. Use pre-fabricated electro-fusion couplings that are field-installed using the coupling manufacturer's recommended automatic self-monitoring fusing machine and installation procedures.

        iv. Do not use any other coupling methods.

2.2.3 *Multi-Cell "Factory Installed Bullet Resistant" Fiberglass Conduit System (Structure Conduit Bank)*

1. The multi-cell conduit system shall be a pre-assembled conduit manufactured from a minimum of a 4 inch round outerduct containing 4 factory installed round 1-1/4 inch innerducts.

    a. The innerducts shall be held together in a square (4 conduit system) configuration by a system of spacers or equivalent mechanism.

b. The coupling system shall be resistant to water infiltration, air loss during cable installation and shall be capable of locking the system tightly together in order to not allow free twisting of the innerducts.

2. The multi-cell conduit system manufacturer shall have a documented Quality Control/Assurance System.

3. Outerduct:

a. All outerduct shall be a minimum of 4 in. trade size and shall have a nominal 20 ft lay length. Types to be used shall be designated on the Plans.

b. The spigot end of the duct shall have a circumferential insertion depth mark to insure that proper insertion depth is achieved.

c. Bullet resistant fiberglass conduit shall have a minimum wall thickness of 0.250 inches. The conduit shall prevent the penetration of a .45 caliber slug fired from a distance of 20 feet. The conduit shall conform to the following requirements when tested in accordance with this SP. All accessories and fittings, including outerduct couplings, expansion joints, anchor and stop rings, etc., shall meet all the same "bullet resistant" requirements as the conduit. All conduit and fittings shall be grey.

d. Outerduct shall be labeled with durable identification giving the name of the manufacturer, manufacturer/date codes and the legend "TENN DOT". Labeling shall occur a maximum of every 2 ft.

e. Physical and Mechanical Properties and Test Methods

i.	Ultimate Tensile Strength – 11,000 PSI Min.	ASTM D-2105
ii.	Dielectric Strength - >=500 Volts/Mil.	ASTM D-149
iii.	Water Absorption – 1% Max.	ASTM D-570
iv.	Specific Gravity – 1.9 – 2.0	ASTM D-792
v.	Glass Content – 68 + - 2%	API Spec 15 LR
vi.	Barcol Hardness – 58-52	ASTM D-2583

f. Where Structure Conduit Bank Type 1 and 2" Structure Conduit w/bank is shown in the plans, the conduit shall be 2" fiberglass conduit and shall meet the same applicable characteristics as the outerduct described above.

4. Innerduct:

    a. Innerducts shall be manufactured from polyvinyl chloride (PVC) or high density polyethylene (HDPE). Innerducts shall be factory treated with an atomized silicone or manufactured in a manner to reduce friction during pulling of fiber optic cable. Innerduct to be used in bends and sweeps shall have a minimum burn through time of 30 minutes when tested in accordance with Generic Requirement GR-356-CORE, Issue 1, October 1995. The dimensions of innerduct shall meet the requirements of the manufacturer's catalog cuts approved by the Department.

    b. HDPE innerduct shall have a permanent dry lubricant extruded within the inner wall and shall incorporate longitudinal ribs within the inner wall.

    c. HDPE innerduct shall conform to the following requirements:

        i. Color of innerducts – 4-way (orange, blue, brown, white)

        ii. Nominal Inner Size – 1 ¼"

5. Coupling Body:

    a. The coupling body shall be designed with 4 bores and so that when the conduit is joined, the outer walls of the innerducts and the inner walls of the outerduct shall be sealed, providing an airtight seal from within the innerduct system and a watertight seal from the outside of the outerduct. The coupling body shall be tested for water tightness and air tightness in accordance with BellSouth Telecommunications Specification BS 622-0004, Latest Issue. The coupling body shall conform to the following requirements:

        i. Water tightness – 6 PSI Minimum

        ii. Air tightness - no leakage at 100 PSI

6. Bends and Sweeps

    a. Each multi-cell system shall offer a complete line of factory-made fixed bends and sweeps. No flexible bends or field-made bends will be permitted. Bullet resistant fiberglass bends and sweeps shall have compatible bell and spigot ends. In no case shall bends and sweeps exceed a 90-degree direction change.

    b. Fixed bends for bullet resistant fiberglass multicell conduit shall be available in radii no less than 3 ft.

        i. 4 ft. radius: 11 ¼ degrees

        ii. 6 ft. radius: 22 ½ degrees

iii. 9 ft. radius: 45 and 90 degrees

2.2.4 *Rigid Galvanized Steel (RGS) Conduit*

All rigid galvanized steel conduit shall meet TDOT Standard Specifications for Road and Bridge Construction.

2.2.5 *PVC Schedule 40 Conduit*

All PVC Schedule 40 conduit shall meet TDOT Standard Specifications for Road and Bridge Construction.

2.2.6 *Marking Tape*

The Marking Tape shall meet the following requirements:

1. The color of the tape shall be orange with the legend "TENN DOT FIBER OPTIC CABLE" printed at intervals no greater than every 6 ft.

2. The tape shall be a dielectric, polyolefin film tape, 0.004 in. thick and 3 in. wide. The tape shall be constructed using material and ink colors which will not change when exposed to acids and other destructive substances commonly found in the soil.

3. Physical and Mechanical Properties and Test Methods:

a. Standard Weight – 0.02 lb/ft²	ASTM D-2103
b. Thickness-Overall – 0.004 in.	ASTM D-2103
c. 3" Tensile Break-MD – 35lbf	ASTM D-882
d. 3" Tensile Strength-MD – 2900 PSI	ASTM D-882
e. 3" Tensile Break-TD – 38 lbf	ASTM D-882
f. 3" Tensile Strength-TD – 3160 PSI	ASTM D-882
g. Elongation-MD – 530%	ASTM D-882
h. Elongation-TD – 660%	ASTM D-882
i. PPT Resistance-MD – 12 lbf	ASTM D-2582

j. PPT Resistance-TD – 14 lbf ASTM D-2582

k. Tear Strength – 3” x 8” – MD – 24 lbf ASTM D-2261

l. Tear Strength – 3” x 8” – TD – 32 lbf ASTM D-2261

PPT Puncture Propagation Tear
MD/TD Machine Direction / Transverse Direction

2.2.7 *Conduit Detection Wire*

The conduit detection wire shall meet the following requirements:

Conduit detection wire shall be #10 AWG stranded copper orange-insulated THHN- THWN conductor.

2.2.8 *Cable Markers*

The Cable Markers shall meet the following requirements:

1. Shall be a six-foot post with an 18” Cable Marker as shown in the plans.

2. Shall be a cylindrical polymeric marker mounted on a 3.5” outside diameter post and may be used for the identification of buried utility services. These markers may be used in road right-of-ways and installations requiring 360° visibility, good outdoor durability, and impact resistance.

3. The marker shall be comprised of polymer materials, which are resistant to impact (high MTBF), ultraviolet light, ozone, or hydrocarbon damage. The post and marker shall remain impact resistant in temperatures of -20°F to 140°F.

4. Shall incorporate a cylindrical tube construction.

5. The marker shall be capable of permanent installation on a 3.5” O.D. tube and may utilize an anchor barb below ground level to prevent rotation and marker removal.

6. The marker shall have an outside diameter of 3.5 – 4.0 inches. The wall thickness shall be approximately 0.12 – 0.15 inches and the overall length shall be 18.00 inches.

7. The marker shall be orange in color and be pigmented throughout its entire cross section.

8. The graphics shall consist of a solvent-based ink that is abrasive and UV resistant and include the text, “TDOT ITS Fiber Optic Cable” “Call XXX-XXX-XXXX Before

Digging in this Area". (Phone number will be provided upon approval of cable marker cut sheets)

9. The marker shall have a minimum tensile strength of 2700 pounds per square inch, as measured by ASTM D-638 (specimen type I with separation rate of two inches per minute.) Tensile strength shall not deviate more than 10 percent from the standard room temperature result when tested at both 140°F and 20°F after a minimum of two hours conditioning at the respective temperature.

10. A "Distance to Conduit" sticker or label shall also be provided. This label shall meet the following minimum requirements:

    a. Lettering shall be a minimum of 1 inch in height.

    b. Labels shall be manufactured from pre-coated adhesive backed reflective sheeting material meeting the minimum requirements of AASHTO M268 Type 1.

    c. The Label shall have the words "Distance to Conduit - - - Feet" pre-printed on the label. The distance numerals shall be added in the field and shall be manufactured from the same type of reflective sheetings. (See Plans for layout of label).

2.2.9 *Pull Tape*

The Pull Tape for cable installation shall meet the following requirements:

1. 1250 lb tensile strength

2. Flat, not round, construction

3. Printed sequential foot markings

4. Pre-lubricated for reduced pulling tension at start of cable pull

5. Low susceptibility to absorption of moisture; moisture resistant

2.2.10 *Duct Plugs*

Duct plugs shall meet the following requirements:

1. Duct plugs intended for underground telecommunications infrastructure shall be installed on conduits.

2. Duct plugs shall be sized to fit the conduits and cables with which they are used.

3. Duct plugs shall provide watertight and airtight gasketed seals by use of mechanical expansion of the duct plug body and gasket. No sealants or caulks shall be used.

4. All metallic components of duct plugs shall be stainless steel.

5. Blank duct plugs are used to seal spare conduits and shall have inner rings to which pull tape can be tied.

6. Cable duct plugs are used to seal conduits that contain a cable. The plug shall be sized to fit the conduit and cable with which it is used and shall be a split plug with a bushing assembly for sealing around the cable by mechanical compression.

2.3 Installation Requirements

2.3.1 *General Requirements*

1. All material installed shall follow the guidelines in the following sections.

2. Use blank duct plugs to seal the ends of all conduit within 24 hours of conduit placement. This includes but is not limited to intermediate/incomplete sections of conduit prior to conduit splicing or termination in pull boxes and empty conduits in pull boxes prior to cable installation.

3. Conduit shall be installed in a straight line horizontal path between pull boxes except where shown otherwise in the plans.

2.3.2 *Continuous Flexible Conduit (Conduit Duct Bank).*

1. Install Conduit Duct Banks by configuring individual continuous flexible conduits into a continuous duct bank from termination point to termination point as shown in the Standard Details and other Contract Documents.

2. Continuous flexible conduit installation in earth shall be trenched, horizontal directional bored or drilled, or plowed at the Design-Builder's discretion, unless otherwise noted on the Plans, at a minimum depth of 24 inches from the top of the conduit. Unless identified as "bored" in the plans, the Design-Builder shall be paid at the unit price bid for Conduit Bank Type X, regardless of what installation method is used.

3. All continuous flexible conduit located under the paved shoulder in the plan sheets shall meet the following requirements. The conduit shall be placed at a minimum depth of 24 inches. Backfill shall meet TDOT Standards for a paved shoulder. All areas in the paved shoulder shall be completely restored daily according to the time frames set under the approved Traffic Control Plan. Unless otherwise approved by the Engineer, the conduit

shall only be placed under the shoulder in the areas identified in the plans. There is no separate payment for conduit located under the shoulder. These locations shall be paid at the same unit price as Conduit Bank Type X.

4. All continuous flexible conduit routes underneath asphalt or concrete roadways shall be horizontal directional bored or drilled at a minimum depth of 5 feet from the top of the conduit. No open trenching will be allowed in asphalt or concrete unless specified on Plan sheets. Separate encasement is not required for borings unless needed for proper installation due to poor soil conditions. All conduit underneath railroad tracks shall be horizontal directional bored or drilled at a minimum of 10 feet below the railroad bed. It is also the Design-Builder's responsibility to determine any additional requirements from the railroad owner and shall meet those requirements in addition to those included in the plans and this SP. Any required steel casings or other materials needed to meet the railroad authority requirements shall be included in the cost of the conduit.

5. All conduit to be installed under streams shall be horizontal directional bored or drilled. No open trenching through an area deemed to be a current or wet weather stream will be allowed. All conduit bored under streams shall be a minimum depth of 5 feet below the streambed.

6. Bore Logs will be required for each bore location.

7. The Design-Builder shall submit a proposed bore log format to the Engineer for review and approval.

8. If a drainage or utility conflict arises, the Design-Builder shall submit a plan for resolving the conflict to the Engineer for review and approval.

9. Make every effort to minimize coupling. Couplings are permitted only with the Engineer's prior approval and will typically be approved where conduit types change or at locations where conduit reels end. Other locations will be on a case by case basis.

10. Conduit shall be placed in the straightest orientation possible, reducing bends, twists, rises, and waves. Conduits shall be held in place during backfilling when necessary to keep straight and at the proper depth. Where field conditions require the trench to change direction and bends are necessary, the bends shall be formed in the trench and should be smooth and even and shall not have less than a 4 foot radius (as measured to the inside surface of the conduit)

11. Every conduit shall be tested after installation and before cable or pull tape is installed. Perform testing on all conduit types in this SP, including but not limited to each cell of multi-cell conduits, each conduit in duct banks, and each conduit. All testing shall be performed using the procedures and mandrel size recommended by the conduit manufacturer. Testing shall be performed in the presence of the Engineer. Payment for all testing is included in the cost of the conduit.

2.3.3 *Multi-Cell "Factory Installed Bullet Resistant" Fiberglass Conduit System (Structure Conduit Bank)*

1. Conduit will be attached to bridge decks by either clamps or hanger systems as indicated on the plans.

2. Conduit that is to be hung by a bridge hanger system attached to the bridge decking shall be designed by the Design-Builder and approved by TDOT Division of Structures. Hangers shall be spaced no more than 10 feet apart.

3. For all bridge installed conduit, it is the Design-Builder's responsibility to obtain the bridge design drawings from TDOT Structures Division to show the exact location and design of the attachment.

4. Secure from the manufacturer or supplier of the multi-cell system and provide to the Department complete and comprehensive written installation manuals for the complete system. At the start of the multi-cell installation, have the manufacturer or supplier provide technical assistance, as needed. At any time during the construction process, ensure that the manufacturer or supplier provides technical assistance to the Design-Builder and/or the Department.

5. Install expansion and deflection joints, anchors, stop rings, etc. according to the multi-cell conduit system manufacturer's and support hanger manufacturer's recommendations. Fiberglass couplings shall be epoxied unless otherwise recommended. Ensure that during the construction process and at the request of the Department, the multi-cell conduit system or support hanger manufacturer provides on-site technical assistance at no additional cost to the Department.

6. Test every conduit after the conduit is installed and before cable or pull tape is installed. Perform testing on all conduit types in this SP, including but not limited to each cell of multi-cell conduits, each conduit in duct banks, and each innerduct. All testing shall be performed using the procedures and mandrel size recommended by the conduit manufacturer. Testing shall be performed in the presence of the Engineer. Payment for all testing is included in the cost of the conduit.

7. All holes in concrete for conduit passes shall be core drilled.

8. All conduit passing through abutment walls shall be sealed around, using a sealant approved by the TDOT Division of Structures.

9. Damage to paved end fills shall be repaired to the satisfaction of the Engineer at the expense of the Design-Builder.

2.3.4 *Multi-Cell "Bullet Resistant" Fiberglass Conduit System (Surface Clamped)*

1. Conduit will be attached to accessible exposed bridge or barrier walls by clamps as indicated on the plans.

2. Clamps shall be spaced no more than 10 feet apart.

3. Test every conduit after the conduit is installed and before cable or pull tape is installed. Perform testing on all conduit types in this SP, including but not limited to each cell of multi-cell conduits, each conduit in duct banks, and each innerduct. All testing shall be performed using the procedures and mandrel size recommended by the conduit manufacturer. Testing shall be performed in the presence of the Engineer. Payment for all testing is included in the cost of the conduit.

2.3.5 *Rigid Galvanized Steel Conduit*

1. Exposed conduit runs shall be 2" rigid galvanized steel unless otherwise required by the Plans.

2. All conduit runs on structures and poles shall be properly terminated into the respective device, or a weatherhead shall be installed so as to seal the conduit from moisture, insects, rodents and other foreign material. The costs of the galvanized steel conduit, weatherheads and all associated fittings shall be included in the cost of other items.

3. Bushings shall be installed in conduit at all exposed conduit terminations for protection of the conductors.

2.3.6 *PVC Schedule 40 Conduit*

1. Shall meet the specifications of Section 2.3.2.

2.3.7 *Marking Tape*

1. As shown in the Plans Typical Details, install marking tape above all underground conduit installed by trenching or plowing.

2. Marking tape shall be installed in continuous manufactured lengths. No splicing or overlap is permitted.

3. Install a minimum of 4 feet of marking tape into pull boxes where trenched conduit is terminating. Marking tape shall enter under the lower edge of the pull box.

4. Marking tape is not required when conduit is bored.

2.3.8 *Conduit Detection Wire*

1. Install one conduit detection wire with all conduits directly below or at the same level as the conduit. Conduit detection wire is required with all conduits installed by any installation method, including trenching, directional boring, or plowing.

2. Only one conduit detection wire is required per installed conduit segment regardless of the number of conduits installed in that segment.

3. Conduit detection wire shall be installed outside of the conduit, except when boring conduit then the detection wire shall be placed in a spare conduit.

4. Conduit detection wire is not required for structure mounted conduit, except where underground segments of structure mounted conduit are greater than 50 feet in length.

5. Conduit detection wire is not required for conduit segments between pull boxes and pole/sign structure foundations, where conduit segments are less than 50 feet in length.

6. The conduit detection wire shall be continuous and unspliced between pull boxes and shall enter the pull boxes at the same location as the conduit with which it is installed, entering under the lower edge of the pull box.

7. Coil and secure 4 ft. of conduit detection wire in each pull box or vault.

8. Testing:

    a. Perform a continuity or tone test after installation to confirm that a continuous run of conduit detection wire was installed between pull boxes or vaults.

    b. Prepare a test plan, supplying equipment, conducting the test and documenting the results. Submit a test plan at least 15 working days prior to the desired testing date. Testing shall not begin until the Engineer has approved the test plan, and all tests shall be conducted in the presence of the Engineer.

2.3.9 *Cable Markers*

1. Install cable markers at the following locations:

    a. At the back side of the right-of-way (or treeline) laterally even with each pull box, or adjacent pull boxes, on conduit runs parallel to the roadway. If distance between pull boxes is greater than 650 feet one additional cable marker shall be

placed at the midpoint between the adjacent pull boxes, at the back of the right-of-way (or treeline). Additional cable markers shall be placed such that no distance between cable markers shall be greater than 650 feet.

b. Directly beside any pull box that is on the interior of an interchange.

c. At each end of any bore under a roadway, directly beside the pull boxes.

d. Any additional locations directed by the Engineer.

2. All cable marker locations shall be approved by the Engineer prior to installation. The proposed schedule for installing the cable markers shall also be approved by the Engineer prior to installation.

3. After the cable markers are installed, the distance to conduit labels shall be applied.

2.3.10 *Pull Tape*

1. Install pull tape into each empty conduit and empty cell within a multi-cell conduit.

2. Install the pull tape after conduit testing has been completed.

3. Install and secure 5 ft of slacked pull tape in each empty conduit or cell at each pull box.

4. Secure the pull tape by tying it to the blank duct plug for the conduit in which it is installed.

2.3.11 *Duct Plugs*

1. Install blank duct plugs in each empty conduit that enters a pull box, ground-mounted cabinet, pole foundation, hub, or building entrance.

2. Install cable duct plugs in each conduit containing fiber optic or RDS communications cable that enters a pull box, ground-mounted cabinet, hub, or building entrance.

3. Do not install cable duct plugs on conduits containing power service conductors.

4. Duct plugs will be installed within 24 hours of the associated duct installation.

2.3.12 *Spare Conduits in Foundations*

1. A minimum of one 2 inch spare conduit shall be installed in all pole foundations and a minimum of two 2 inch conduits shall be installed in the base of all ground mounted cabinets.

2. Spare conduits shall be sealed with blank duct plugs.

2.4 Measurement

2.4.1 *General Requirements*

1. All conduit material shall be measured following the guidelines in the following sections.

2. All conduit types shall be measured in linear feet per type to the nearest foot. All conduit types will be measured along the conduit by the following:

    a. From center of pull box to center of pull box.

    b. No additional measurement will be made for vertical conduit inside the pull box or structure.

    c. No additional measurement will be made for conduit between a pull box and the nearby pole or structure, within 10 feet or less.

2.4.2 *Continuous Flexible Conduit (Conduit Duct Bank)*

1. Unless otherwise specified in the Plans, all costs for materials, trenching, installing, backfilling trench, plowing, directional boring, restoration, repaving of shoulders, marking tape, pull tape, duct plugs, fittings, conduit detection wire, testing, bore logs, and other accessories and hardware necessary for installation of the conduit system shall be included in the overall cost of the conduit or conduit duct bank.

2. Continuous flexible conduit installation in earth or shoulder shall be trenched, horizontal directional bored or drilled, or plowed at the Design-Builder's discretion, unless otherwise noted on the Plans, and shall be measured and paid as the unit items in Section 2.4.2.5.a through 2.4.2.5.d, regardless of installation method used.

3. All continuous flexible conduit routes underneath asphalt or concrete roadways shall be horizontal directional bored or drilled at a minimum depth of 5 feet from the top of the conduit and shall be measured and paid as the unit items in Section 2.4.2.5.i through 2.4.2.5.m. No open trenching will be allowed in asphalt or concrete unless specified on Plan sheets.

4. All conduit to be installed under streams shall be horizontal directional bored or drilled and shall be measured and paid as the unit items in Section 2.4.2.5.i through 2.4.2.5.o. No open trenching through an area deemed to be a current or wet weather stream will be allowed.

5. Continuous Flexible Conduit (Conduit Duct Bank) will be measured by the linear foot for each type of conduit bank indicated after installation and shall include the items identified in Section 2.4.2.1, as well as the type and number of conduit indicated below.

    a. Conduit Bank (Type 1): One – 1 ¼" Continuous Flexible Conduit

    b. Conduit Bank (Type 2): Two – 1 ¼" Continuous Flexible Conduits

    c. Conduit Bank (Type 3): Three – 1 ¼" Continuous Flexible Conduits

    d. Conduit Bank (Type 4): Four – 1 ¼" Continuous Flexible Conduits installed in soil or areas with intermittent (non-solid) rock. This pay item applies to areas where trenching is physically possible using typical trenching equipment.

    e. Conduit Bank (Type 4–Roadway Shoulder) Four – 1 ¼" Continuous Flexible Conduits installed in the roadway shoulder. This construction method will only be permitted where traditional construction methods are impractical and only with the approval of the Engineer.

    f. Conduit Bank (Type 4–In Rock) Four – 1 ¼" Continuous Flexible Conduits installed in solid rock or solid shot rock fill. The locations for this pay item will be determined in the field and are not identified separately on the plans. Final determination of the applicability of this item will be at the discretion of the Engineer.

    g. 2" Conduit: One – 2" Continuous Flexible Conduit or PVC Schedule 40 Conduit.

    h. 2" Conduit with Bank : One – 2" Continuous Flexible Conduit installed in the same trench as the related Conduit Bank Type as specified in the Plan Sheet.

    i. Conduit Bank (Type 2–Bored): Two – 1 ¼" Continuous Flexible Conduits

    j. Conduit Bank (Type 3–Bored): Three – 1 ¼" Continuous Flexible Conduits

    k. Conduit Bank (Type 4–Bored): Four – 1 ¼" Continuous Flexible Conduits

    l. 2" Conduit (Bored): One – 2" Continuous Flexible Conduit

    m. 2" Conduit with Bank (Bored): One – 2" Continuous Flexible Conduit installed in the same bore as the related Conduit Bank Type as specified in the Plan Sheets.

n. 3” Conduit (Bored): One – 3” Continuous Flexible Conduit

o. 3” Conduit with Bank (Bored): One – 3” Continuous Flexible Conduit installed in the same bore as the related Conduit Bank Type as specified in the Plan Sheets.

(Note: Separate encasement for borings is not required unless necessary for proper installation due to poor soil conditions. If encasement is needed in those situations the cost of the encasement shall be included in the cost of the conduit.)

2.4.3 *Multi-Cell “Factory Installed Bullet Resistant” Fiberglass Conduit System (Structure Conduit Bank)*

1. Unless otherwise specified in the Plans, all costs for materials, cutting asphalt or concrete, trenching, installing, backfilling trench, restoring asphalt or concrete, drilling existing concrete shoulder, replacement of existing transverse joint material, directional boring, bridge hanger materials and assemblies, testing of conduit, pull tape, duct plugs, and bridge attachment design shall be included in the overall cost of structure conduit or structure conduit bank.

2. Conduit will be measured by the linear foot for each type of conduit bank indicated after installation.

    a. Structures Conduit Bank Type 4: One 4” outerduct with four 1 ¼” innerducts

    b. Structures Conduit Bank Type 1: One 2” Fiberglass Conduit

    c. 2” Structures Conduit with Bank: One 2” Fiberglass Conduit installed in the same Hanger assembly as the related Conduit Bank type as specified in the Plan Sheets.

    d. 3” Structures Conduit with Bank: One 2” Fiberglass Conduit installed in the same Hanger assembly as the related Conduit Bank type as specified in the Plan Sheets.

2.4.4 *Multi-Cell “Bullet Resistant” Fiberglass Conduit System (Surface Clamped)*

1. Unless otherwise specified in the Plans, all costs for materials, cutting asphalt or concrete, trenching, installing, backfilling trench, restoring asphalt or concrete, clamps, testing of conduit, pull tape, duct plugs, and bridge attachment design shall be included in the overall cost of surface clamped conduit bank.

2. Conduit will be measured by the linear foot for Structure Conduit Bank Type 4: One 4” outerduct with four 1 ¼” innerducts.

2.4.5 *Rigid Galvanized Steel Conduit*

1. Rigid Galvanized Steel Conduit, and all related materials including but not limited to weatherheads, bushings, couplings, mounting straps, bonding to ground, etc., that is installed on sign structures, poles, or between the pull boxes and equipment cabinets is included in the cost of other items and will not be measured separately.

2.4.6 *PVC Schedule 40 Conduit*

1. PVC Conduit is included in the cost of other items and will not be measured separately.

2.4.7 *Marketing Tape*

1. Marking Tape is included in the cost of the conduit and will not be measured separately.

2.4.8 *Conduit Detection Wire*

1. Conduit Detection Wire is included in the cost of the conduit and will not be measured separately.

2.4.9 *Cable Markers*

1. Cable Markers will be measured per each and paid for at the contract price per each. The price bid shall include furnishing and installing the complete cable marker and distance sticker/label. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

2.4.10 *Pull Tape*

1. Pull Tape is included in the cost of the conduit and will not be measured separately.

2.4.11 *Duct Plugs*

1. Duct Plugs are included in the cost of the conduit and will not be measured separately.

2.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-22.21	CONDUIT BANK (TYPE 1)	LF
725-22.23	CONDUIT BANK (TYPE 3)	LF
725-22.24	CONDUIT BANK (TYPE 4)	LF
725-22.31	CONDUIT BANK (TYPE 1 - BORED)	LF
725-22.33	CONDUIT BANK (TYPE 3 - BORED)	LF
725-22.34	CONDUIT BANK (TYPE 4 - BORED)	LF
725-22.71	2 IN CONDUIT	LF
725-22.72	2 IN CONDUIT BORED	LF
725-23.01	ITS CABLE MARKER	EACH

All Conduit will be paid per linear foot, as applicable, as follows:

1. Stored Materials will be paid per TDOT Standard Specifications.
2. Final Payment will be made after complete installation and testing.

Cable Markers will be paid per each, as applicable, as follows:

1. Stored Materials will be paid per TDOT Standard Specifications.
2. Final Payment will be made after complete installation and testing of the conduits.

SECTION 3
PULL BOXES

3.1 Description

This section specifies the minimum requirements for furnishing and installing pull boxes and covers as indicated on the Plans.

Standard pull boxes shall be installed by the Design-Builder at the locations shown on the Plans. The Plans will indicate pull box locations relative to the cabinet and other installation details.

3.2 Materials

3.3.1 *Type C Pull Box with Cover*

The pull box shall meet the following requirements:

1. Minimum dimensions: 25”W x 16”L x 18”D exterior, 24”W x 13”L x 16”D interior.
2. Pull Box cover shall be precast composite polymer concrete product.
3. Pull Boxes and covers shall be single-stack, open-bottom assemblies configured as shown in the standard drawings.
4. Shall meet or exceed current ANSI/SCTE 77 Tier 22 loading requirements.
5. Pull Box shall meet current NEC standards for handhole enclosures.
6. Pull Box cover shall be labeled (TDOT ITS ELECTRICAL).
7. Type C pull boxes shall only be used for electrical power conduit/wiring.

3.3.2 *Type D Pull Box with Cover*

1. Minimum dimensions: 24”W x 36” L x 36”D exterior.

2. Pull Box cover shall be precast composite polymer concrete product. Note this is a different Pull Box than shown in TDOT Standard Drawings.

3. Pull Boxes and covers shall be single-stack open-bottom assemblies configured as shown in Plans.

4. Shall meet or exceed current ANSI/SCTE 77 Tier 22 loading requirements.

5. Pull Box shall meet current NEC standards for handhole enclosures.

6. Pull Box cover shall be labeled (TDOT ITS COMMUNICATIONS).

7. Each Pull Box shall come equipped with four Cable Racks and twelve Rack Hooks. The Cable Racks shall be a minimum of 24 inches and Rack Hooks shall be a minimum of 7 inches in length. The cable Racks and Rack Hooks shall be Hot- Dipped Galvanized Steel.

8. Type D pull boxes shall only be used for communications conduit/cabling.

3.3.3 *Type E Pull Box with Cover*

1. Minimum dimensions: 30” W x 48” L x 36”D exterior.

2. Pull Box cover shall be precast composite polymer product. Note this is a different pull box than shown on TDOT Standard Drawings.

3. Pull Boxes and covers shall be single-stack open-bottom assemblies configured as shown in Plans.

4. Shall meet or exceed current ANSI/SCTE 77 Tier 22 loading requirements.

5. Pull Box shall meet current NEC standards for handhole enclosures.

6. Pull Box cover shall be labeled (TDOT ITS COMMUNICATIONS).

7. Each Pull Box shall come equipped with four Cable Racks and twelve Rack Hooks. The Cable Racks shall be a minimum of 24 inches and Rack Hooks shall be a minimum of 7 inches in length. The cable Racks and Rack Hooks shall be Hot- Dipped Galvanized Steel.

8. Type E pull boxes shall only be used for communications conduit/cabling.

3.3.4 *Terminator Ring*

Shall meet the following requirements:

1. Shall accommodate the number of ducts penetrating the side of the Pull Box or Manhole.

2. The Terminator shall mount securely to the side of the box or cast into the side of the Manhole. The Terminator shall be a minimum of 1 inch thick and allow adequate spacing of the ducts.

3. The Terminator shall be manufactured from a composite material that will not deteriorate in any type of weather conditions.

3.3 Installation Requirements

3.4.1 *Type C Pull Box with Cover*

1. This section shall be as per guidelines of the TDOT standard for the Standard Specifications for Road and Bridge Construction, latest version.

2. Pull Boxes and covers shall be installed per the design details.

3.4.2 *Type D Pull Box with Cover*

1. This section shall be as per guidelines of the TDOT standard for the Standard Specifications for Road and Bridge Construction, latest version.

2. Pull Boxes and covers shall be installed per the design details.

3. Cable Racks and Rack Hooks shall be installed per the manufacturer's recommendations.

4. Ducts shall enter the side of the Pull Box using a Terminator and shall extend into the box no more than 4 inches and no less than 2 inches.

3.4.3 *Type E Pull Box with Cover*

1. This section shall be as per guidelines of the TDOT standard for the Standard Specifications for Road and Bridge Construction, latest version.

2. Pull Boxes and covers shall be installed per the design details.

3. Cable Racks and Rack Hooks shall be installed per the manufacturer's recommendations.

4. Ducts shall enter the side of the Pull Box using a Terminator and shall extend into the box no more than 4 inches and no less than 2 inches.

3.4.4 *Terminator*

1. Shall be installed per the manufacturer's recommendations.

3.4 Measurement

3.4.1 *Type C Pull Box with Cover*

Pull Box will be measured in units of each and paid for at the contract price per each after the complete installation. The price bid shall include furnishing and installing the pull box and cover including excavation, gravel, restoration, and miscellaneous materials necessary for a complete and accepted installation. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

3.4.2 *Type D Pull Box with Cover*

Pull Box will be measured in units of each and paid for at the contract price per each after the complete installation. The price bid shall include furnishing and installing the pull box and cover including excavation, gravel, restoration, cable rack rails and hooks, terminator rings, and miscellaneous materials necessary for a complete and accepted installation. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

3.4.3 *Type E Pull Box with Cover*

Pull Box will be measured in units of each and paid for at the contract price per each after the complete installation. The price bid shall include furnishing and installing the pull box and cover including excavation, gravel, restoration, cable rack rails and hooks, terminator rings, and miscellaneous materials necessary for a complete and accepted installation. This price shall be

full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

3.4.4 *Terminator*

Shall be included in the measurement and payment of the Type D Pull Boxes, Type E Pull Boxes and Manhole and will not be measured separately for payment.

3.5 Payment

The contract unit price shall be full compensation for all work specified in this section. Payment will be made under:

Item No.	Description	Unit
725-20.43	PULL BOX (TYPE C)	EACH
725-20.44	PULL BOX (TYPE D)	EACH
725-20.45	PULL BOX (TYPE E)	EACH

Pull boxes will be paid per each as follows:

1. Stored materials will be paid per TDOT Standard Specifications.

2. Final Payment will be made after complete installation and testing.

SECTION 4
FIBER OPTIC INFRASTRUCTURE

4.1 Description

This section specifies the minimum requirements for fiber optic infrastructure furnished and installed (underground and aerial) on this project. This work includes but is not limited to, cable, splicing, termination, connectors, closures, panels, installation, and testing.

The fiber optic infrastructure will serve as the backbone for the communications systems (wireline) and will be used to transport data and video signals to/from field device locations using an Ethernet protocol.

4.2 Materials

4.2.1 *General*

1. The Design-Builder shall furnish fiber optic infrastructure materials that meet applicable industry standards including, but not limited to:

    a. Fiber optic cable manufacturer shall comply with RUS Bulletin 1753F-601 and be currently ISO 9001 certified

    b. Provide and install fiber optic cable in accordance with contract drawings, specifications, IEEE C2 (NESC), NFPA 70 (NEC), ICEA S-83-596, UL 1666

    c. EIA/TIA-455 Testing procedures

    d. Telcordia

    e. UL

    f. Fiber optic cable physical requirements and cable construction shall be in accordance with ICEA S-87-640, ASTM D 4976

g. Fiber optic cables shall be tested in accordance with ASTM C 338

2. Upon request of the Engineer, provide certification from an independent testing laboratory that certifies that the cable conforms to industry standards.

3. Furnish fiber optic infrastructure materials recommended by the manufacturer for outside plant use and the intended application.

4. Furnish all optical fiber, fiber optic cable, fiber optic branch cable, integrated fiber optic termination unit, optical termination and connectorization materials, and all ancillary and incidental materials that are single-mode and/or compatible. All materials shall meet the following requirements:

    a. EIA/TIA-568-B.3, 598B, 758, Fiber Optic Connector Intermateability Standard (FOCIS), and Telcordia GR-20 core requirements.

    b. Manufacturer is currently ISO 9001 certified. This requirement applies to assemblers of manufactured components, such as patch cords and termination cabinet interconnection cables.

    c. All cables and termination infrastructure shall be assembled from Corning SMF28e, OFS All Wave or approved equivalent single-mode optical fiber.

    d. All fibers and buffer tubes shall follow EIA/TIA-598B identification using colors. Do not use printed legends.

    e. All cables shall have been manufactured and labeled no earlier than in the third calendar month preceding the TDOT letting date of the contract.

5. Fiber optic installation and testing tools shall be maintained and calibrated in accordance with the tool manufacturer's recommendations. Provide tool manufacturer certified calibration documentation upon Engineer's request. Installation and testing tools include but are not limited to:

    a. Fusion splicers

    b. Cable pulling strain dynamometers and breakaway links

    c. Cable air jetting/blowing systems

    d. OTDRs

    e. Optical attenuation testers (light sources and power meters)

6. Fiber optic installation and testing tools shall be operated only by Design-Builder personnel who have been trained and certified by the tool manufacturer. Installation and testing tools requiring certified operators include but are not limited to:

    a. Fusion splicers

    b. Cable air jetting/blowing systems

    c. OTDRs

    d. Optical attenuation testers (light sources and power meters)

4.2.2 *Fiber Optic Cable (48 SMFO Cable)*

1. Provide fiber optic cable that meets the following requirements:

    a. All-dielectric outside plant loose tube cable shall have central strength/anti-buckling member.

    b. Dry, water blocking materials and construction

    c. Reverse oscillating "SZ" stranded buffer tube construction

    d. High tensile strength yarn

    e. Medium density polyethylene outer jacket shall be a consistent thickness that is free of holes, splits, and blisters, and containing no metal elements. Outer jacket polyethylene shall contain carbon black for ultraviolet light protection and does not promote the growth of fungus.

    f. 48 fiber cable with 4 active buffer tubes and 12 individual stranded fibers per buffer tube

    g. Cable construction design that allows no more than 6 buffer tube positions

    h. Maximum diameter 0.48 inches

    i. Maximum weight 0.07 pounds per foot

    j. Rated for conduit and lashed aerial installations

    k. Rated attenuation: 0.35dB/km and 0.25dB/km at 1310nm and 1550nm, respectively

2. Provide Corning ALTOS All-Dielectric, Pirelli FlexLink, OFS MiDia, or approved equivalent cables.

3. Designate this cable as a trunk cable.

4. Ensure that the cable can withstand a maximum pulling tension of 600 lbf during installation and 180 lbf installed long term (at rest).

5. Provide cable with shipping, storage, and operating temperature range of -30°C to +70°C.

6. Provide cable with an installation temperature range of -30°C to +60°C.

7. Provide cable with outer jacket marking using the following template:

   Manufacturer's Name – "Optical Cable" – Month/Year of Manufacture - Telephone Handset Symbol – "TENN DOT" – "48F SM"

8. Include in the outer jacket marking the cable sequential length in accordance with the following:

   a. In English units every 2 feet

   b. Within -1%/+1% of the actual length of the cable

   c. In contrasting color to the cable jacket

   d. Marking font height no less than 0.10 inches

   e. On any single length of cable on a reel, the sequential length markings do not run through "00000"

4.2.3 *Fiber Optic Branch Cable (12 SMFO Cable)*

1. Provide fiber optic cable that meets the following requirements:

   a. All-dielectric outside plant loose tube cable shall have central strength/anti-buckling member.

   b. Dry water blocking materials and construction

   c. Reverse oscillating "SZ" stranded buffer tube construction

   d. High tensile strength yarn

e. Medium density polyethylene outer jacket shall be a consistent thickness that is free of holes, splits, and blisters, and containing no metal elements. Outer jacket polyethylene shall contain carbon black for ultraviolet light protection and does not promote the growth of fungus.

f. 12 fiber cable with 1 active buffer tube and 12 individual stranded fibers

g. Cable construction design that allows no more than 6 buffer tube positions

h. Maximum diameter 0.48 inches

i. Maximum weight 0.07 pounds per foot

j. Rated for conduit and lashed aerial installations

k. Rated attenuation: 0.35dB/km and 0.25dB/km at 1310nm and 1550nm, respectively

2. Provide Corning ALTOS All-Dielectric, Pirelli FlexLink, OFS MiDia, or approved equivalent cables.

3. Designate this cable as a branch cable.

4. Ensure that the cable can withstand a maximum pulling tension of 600 lbf during installation and 180 lbf installed long term (at rest).

5. Provide cable with shipping, storage, and operating temperature range of -30°C to +70°C.

6. Provide cable with an installation temperature range of -30°C to +60°C.

7. Provide cable with outer jacket marking using the following template:

    a. Manufacturer's Name – "Optical Cable" – Month/Year of Manufacture - Telephone Handset Symbol – "TENN DOT" – "12F SM"

8. Include in the outer jacket marking the cable sequential length in accordance with the following:

    a. In English units every 2 feet

    b. Within -1%/+1% of the actual length of the cable

    c. In contrasting color to the cable jacket

    d. Marking font height no less than 0.10 inches

e. On any single length of cable on a reel, the sequential length markings do not run through “00000”

4.2.4 *Fiber Optic Fusion Splice (FO Splice, Fusion)*

1. Provide fusion splices for splicing of all fibers on the project. Do not provide any other type of fiber splicing.

2. Perform fusion splicing with a fully automatic portable fusion splicer that provides consistent low loss (max 0.10 dB) splices. Splicer shall provide three-axis fiber core alignment using light injection and loss measurement techniques. The fusing process shall be automatically controlled. The splicer shall provide splice loss measurements on an integral display, as well as a magnified image of the fiber alignment. The Design-Builder shall retain ownership of the fusion splicer.

4.2.5 *Fiber Optic Connectors*

1. Provide fiber optic connectors compliant with this SP for all fiber optic infrastructure including, but not limited to, fiber optic termination cabinets, fiber optic branch panels, and fiber optic patch cords.

2. Provide only factory-installed keyed LC compatible connectors for all fiber optic infrastructure. Provide only factory-installed connectors of a type other than LC when required by the Network Switches. Do not use field-installed connectors. Do not use adapter couplers to change connector types.

3. Use ceramic ferule connectors factory-installed with a thermal-set heat-cured epoxy and machine polished mating face. Install connectors as per manufacturer application and recommendations, including proper termination to the outer-tubing (900 micron tubing, 3 mm fan out tubing, etc.) required for the application.

4. Use connectors rated for an operating temperature of -40°C to +75°C.

5. Provide connectors that have an installed insertion loss of less than 0.50 dB, a typical loss of 0.20 dB, and an optical return loss of greater than 45 dB.

6. Use simplex connectors for all male LC connectors. Provide latching cover for two male connectors being used in a duplex configuration. Female couplers may be duplex but must allow simplex mating connectors.

7. Label each fiber position on panels and termination cabinets containing duplex couplers with the port/position ID as shown in the Plans.

8. Provide dust caps for all exposed male connectors and female couplers at all times until permanent connector installation.

9. LC connectors shall comply with TIA/EIA-4750000-C and TIA/EIA-604-10A.

4.2.6 *Fiber Optic Termination Units (FO Termination Units – 48F)*

1. Provide fiber optic termination units in communications hubs, field junctions, and the TMC as shown in the Plans for full termination of 48 fiber outside plant (OSP) cables.

2. Use termination units that are fully compatible with all components of the fiber optic infrastructure as specified, including, but not limited to, fiber optic cable, fiber optic fusion splices, and fiber optic connectors.

3. Use rack-mount termination units designed to fit standard 19-inch EIA equipment racks.

4. Provide all mounting hardware and supports to mount the termination units in the locations shown in the Plans.

5. Use fiber optic termination units providing 48 fiber connectors and capable of storing 48 fusion splices in splice trays.

6. Use termination units that integrate the splice trays and connector modules into one compartment within one cabinet, or houses the splice trays and connector modules in separate compartments integrated into one cabinet.

7. Maximum dimensions of a complete termination unit shall be 7 rack units high (12.25 inches) by 16 inches deep.

8. Use fiber optic termination unit with fully enclosed metallic construction and with a protective hinged front cover for the connector ports.

9. Provide cable access on all sides of the enclosed area behind the connector port panel.

10. Provide sufficient splice trays for storing 48 fusion splices in 12 splice increments.

11. Provide termination cabinets with fiber optic connector modules in a 12 fiber configuration of 4 rows of 1 duplex connector couplers.

12. Connector modules shall mount vertically in the termination cabinet front panel.

13. Connector modules shall include clearly legible and permanent labeling of each of the 12 fiber connector couplers, and shall be labeled and identified as shown in the Plans.

14. Provide factory-assembled 12 fiber termination interconnect cables (pigtail cables) to be fusion spliced to the outside plant cable and connected to the rear of the connector modules.

    a. Termination interconnect cables shall be all-dielectric single jacketed cable with high tensile strength yarn surrounding 12 individual single mode fibers following EIA/TIA-598B color identification with factory-installed connectors.

15. Provide all incidental and ancillary materials including, but not limited to, grommets, cable strain relief and routing hardware, blank connector panels, and labeling materials.

4.2.7 *Fiber Optic Closure (FO Closure)*

1. Provide fiber optic closures (splice closures) designed for underground outside plant use for splicing cables in pull boxes.

2. Use fiber optic closures that are impact and corrosion resistant and waterproof when immersed in 10 feet of water.

3. Use fiber optic splice closures that are fully compatible with all components of the fiber optic infrastructure as specified, including, but not limited to, fiber optic trunk cable, fiber optic branch cable, integrated fiber optic termination unit, and fiber optic fusion splices.

4. Use a cylindrical dome-type splice closure with cable entry at one end only and a sealed single-molded piece dome body of high density polyethylene or equivalent non-metallic material.

    a. The cable entry end shall be manufactured of a similar material as the dome body and shall seal the closure with flexible thermoplastic rubber or polymer gasket seals.

    b. The cable entry end shall include cable entrance ports that shall seal the cable and port opening with flexible thermoplastic rubber or polymer gasket seals with mechanical compression.

    c. Closures shall be re-enterable and re-sealed without the need for specialized tools or equipment, or the use of any additional parts.

    d. Do not use any heat shrink or caulk/encapsulate materials for sealing the assembled closure or terminated cables.

5. Provide splice closures with maximum outer dimensions of 8.0 inches diameter and 21 inches length.

a. Splice closures shall provide cable entrance ports for at least five fiber optic cables.

b. At least two cable entrance ports shall accommodate cables of at least 0.60 inches outer diameter.

c. The closure shall allow for the storage and express of at least 6 unopened buffer tubes.

6. Provide a splice closure with a cable entry end with pre-template cable ports and a split-plate design permitting installation of the closure in mid-span cable segments.

7. The splice closure size shown in the Plans specifies the minimum number of fusion splices to be accommodated by the closure. With the splice closure, provide all materials to accommodate the number of splices specified by the closure size, including splice tray, storage, and organizing materials.

4.2.8 *Fiber Optic Branch Panel (FO Branch Panel, 12F)*

1. Provide fiber optic branch panels designed for outside plant use for terminating branch cables in equipment cabinets.

2. Use fiber optic branch panels that include fiber optic branch cable as an integral component.

3. Use fiber optic branch panels that are fully compatible with all components of the fiber optic infrastructure as specified, including, but not limited to, fiber optic trunk cable, fiber optic closures, integrated fiber optic termination unit, fiber optic fusion splices, and fiber optic connectors.

4. Use fiber optic branch panels that are factory manufactured assemblies of fiber optic branch cable with factory-installed fiber connectors and integral ruggedized fiber connector enclosures.

5. Use branch panels with 12 fiber connectors (duplex LC).

6. Use ruggedized fiber connector enclosures of thermally stable rigid plastic housings fully potted with a thermally stable epoxy filling that encapsulates the branch cable fan out, fibers, and connector bodies.

7. Use permanent labels on the enclosure with contrasting color to identify each connector body by its associated fiber number.

8. Fiber connectors shall be arranged in rows of 1 duplex connector couplers. All fiber connectors shall be arranged on one of the long (vertical) faces of the enclosure.

9. Provide a unique serial number permanently attached on the enclosure body of each branch panel.

10. Provide an outer non-metallic cable strain-relief boot where the branch cable enters the fiber connector enclosure and that secures the cable and to the enclosure; the strain-relief boot shall fully encircle the cable for a minimum of 2 inches from the enclosure's outer surface.

11. Use fiber connector enclosures on the branch panel that are no more than 2 inches wide and deep (the maximum dimension of the enclosure plus fiber connector body) and no more than 11 inches long.

12. Provide a 0.125-inch thick aluminum mounting plate that secures to the fiber connector enclosure. The mounting plate shall have at least four mounting holes near the plate's corners that permit horizontal or vertical mounting flush to a panel, and are spaced appropriately for vertical mounting to an EIA equipment rack rail using two of the mounting holes.

13. Test all completed and assembled fiber optic branch panels at the point of manufacture and provide two copies of the manufacturer test documentation. Test each connectorized fiber in the branch panel to demonstrate compliance with all requirements for cables and connectors as detailed in this SP. Include in the test documentation the location station number where the branch panel is to be installed, the serial number of the branch panel, the branch cable sequential length markings at each end of the branch cable, and the total branch cable distance.

4.2.9 *Integrated Drop Cable / Fiber Optic Termination Unit*

1. The integrated fiber optic termination unit will provide the connectivity between the fiber optic splice and the end of line termination at field cabinets.

2. Proposed units shall conform to the following:

    a. The cable should be of a modular design.

    b. 12-port, single mode component.

    c. Component should use LC connectors.

    d. The component should be constructed out of a rugged molded material to ensure that the component is not vulnerable to the elements.

    e. The component must be a pre-terminating fiber optic cable.

f. The fiber cable should be a maximum length of 275 feet including 75 feet of coiled cable in the adjacent pull box.

g. The components must be pretested by manufacturer to ensure quality and safety.

h. The component should be equivalent to Fiber Connections Gator Patch, or the Nordx/CDT FiberExpress Bar.

3. Proposed units shall be provided with:

a. Factory tested.

b. This unit has a pre-terminated, rugged, and modular design.

c. The housing material consists of a molded unit of ABS plastic.

d. 12-port compact design where unit is 13 by 1.5 by 1.35 inches.

e. For single mode, the insertion loss is 0.15dB typically from the Fiber Connections Gator Patch and 0.5dB from the MTP connector.

f. This unit uses LC connectors.

4.2.10 *Cable Labels*

1. Provide cable labels that meet the following requirements:

a. Self-coiling wrap-around type.

b. PVC or equivalent plastic material with UV and fungus inhibitors.

c. Base materials and graphics/printing inks/materials designed for underground outside plant use including solvent resistance, abrasion resistance, and water absorption.

d. Minimum size of 2.5 inches wide by 2.5 inches long.

e. Minimum thickness of 0.010 inches.

f. Orange label body with pre-printed text in bold black block-style font with minimum text height of 0.375 inches.

2. Pre-print the following text legibly on labels used for all fiber optic trunk cables (FO Cable):

3. On all cable labels, print the text specified above twice on the label with the text of the second image inverted. The end result shall be text which “reads correctly” when the label is coiled onto a cable.

4.2.11 *Fiber Optic Patch Cords*

1. Provide fiber optic patch cords consisting of a length of fiber optic cable terminated on both ends.

2. All patch cords shall be factory preconnectorized assemblies adhering to all applicable cable and fiber specifications stated in this SP.

3. Provide patch cords of the appropriate length for the necessary connections, maintaining minimum bend radius, and with no residual strain at the connector or anywhere on the patch cord itself beyond self-support. Patch cords shall not have excess length beyond what is necessary for equipment connection and routing.

4. All patch cords shall be duplex zip-cord fiber cable with simplex LC connectors, except as otherwise allowed in Section 4.2.5.

    a. The two connectors of each end of the patch cord shall be differentiated by different colors.

    b. Provide sufficient flexibility at each end to disconnect one connector without disturbing the other, or to allow swapping of the two connectors within the same duplex coupler without disturbing the remainder of the patch cord.

    c. Provide strain relief and reinforcement at the point where the duplex cable separates for the individual simplex connectors.

5. Fiber cable shall be 3mm jacketed cable with high tensile strength yarn protecting the inner fiber manufactured into a duplex zip-cord configuration. All Inside Plant patch cords shall meet NEC jacketing requirements.

6. Connector strain relief boots shall be fixed to the outer jacket and strength yarn.

7. Use yellow outer jackets for single mode fiber.

8. No splices of any type are allowed within a patch cord assembly.

9. Fully test each patch cord assembly at the source of manufacture and place those test results on a test tag for each mated pair of connectors. Attach the associated tag to one end of each fiber within the duplex assembly.

4.2.12 *Fiber Optic Attenuator Patch Cords*

1. Provide fiber optic attenuator patch cords that meet all requirements of Section 4.2.11 for fiber optic patch cords.

2. Each fiber in the attenuator patch cord shall contain a passive optical attenuator with the following performance characteristics:

    a. Dual-wavelength capability (1310 and 1550nm)

    b. Fixed attenuation value of 6dB +/- 15%.

    c. Minimum optical return loss 40 dB

    d. Operating temperature range no less than -30 to +65 C

4.2.13 *Project Submittal Program Requirements*

1. General Requirements

    a. The Design-Builder shall provide project submittals for all fiber optic infrastructure as required in Section 1.8 of this SP, including scheduling requirements. The project submittals for fiber optic infrastructure shall include but are not limited to, the additional specific requirements in this subsection.

2. Fiber Optic Installation and Testing Tools

    a. Provide project submittals including manufacturer-recommended operations, maintenance, and calibration procedures for the following equipment:

        i. Fusion splicers

        ii. Cable pulling strain dynamometers and breakaway links

        iii. Cable air jetting/blowing systems

        iv. OTDRs

        v. Optical attenuation testers (light sources and power meters)

b. Submit documentation and proof of manufacturer-recommended operator training and certification for the following equipment:

   i. Fusion splicers

   ii. Cable air jetting/blowing systems

   iii. OTDRs

   iv. Optical attenuation testers (light sources and power meters)

4.3 Installation Requirements

4.3.1 *General*

1. Install all fiber optic infrastructure according to the manufacturer's recommended procedures and specifications.

4.3.2 *Cable Shipping and Delivery*

1. Package the cable for shipment on factory reels. Each package shall contain only one continuous length of cable. Radius of the real drum shall not be smaller than the minimum bend radius recommended by the manufacturer for the media. Construct the packaging so as to prevent damage to the cable during shipping and handling.

2. Seal both ends of the cable to prevent the ingress of moisture.

3. Include with each reel a weatherproof reel tag attached identifying the reel and cable that can be used by the manufacturer to trace the manufacturing history of the cable and the fiber. Include with each cable a cable data sheet containing the following information:

   a. Manufacturer name

   b. Cable part number

   c. Factory order number

   d. Cable length

   e. Factory measured attenuation of each fiber

4. Cover the cable with a protective and thermal wrap.

5. Securely fasten the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit.

6. Project the inner end of the cable a minimum of 6.5 feet into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner to make it available for testing.

7. Plainly mark each reel to indicate the direction in which it is to be rolled to prevent loosening of the cable on the reel.

4.3.3 *Cable Handling and Installation*

1. Do not exceed the maximum recommended pulling tension during installation as specified by the cable manufacturer.

2. Continuously monitor pulling tensions with calibrated measuring devices, such as a strain dynamometer.

3. Protect all pulled installations with calibrated breakaway links.

4. Do not violate the minimum recommended bend radius during installation as specified by the cable manufacturer. Unless the manufacturer's recommendations are more stringent, use the following guidelines for minimum bend radius:

    a. 20 X Cable Diameter Short Term - During Installation

    b. 10 X Cable Diameter Long Term – Installed

5. Before cable installation, carefully inspect the cable reels and reel stands for imperfections or faults such as nails that might cause damage to the cable as it is unreeled.

6. Take all necessary precautions to protect reeled cable from vandals or other sources of possible damage while unattended. Any damage to reeled cable or the reel itself shall necessitate replacement of the entire cable section at Design-Builder's expense.

7. Whenever unreeled cable is placed on the pavement or surface above a pull box, provide means of preventing vehicular or pedestrian traffic through the area in accordance with the approved Maintenance of Traffic provisions.

8. Keep the cable continuous throughout the pull. Cable breaks and reel end splices are permitted only as shown in the Plans.

9. Where a cable ends in an underground fiber optic closure, secure and store all unused fibers and buffer tubes in splice trays in preparation for future reel end splicing and continuation.

4.3.4 *Cable Storage*

1. Properly store all cable to minimize susceptibility to damage.

    a. Maintain proper bend radius, both short and long term, during cable storage.

    b. Storage coils shall be neat in even length coils, with no cross over or tangling.

    c. Storage coils of different cables shall be kept completely separate except when the cables terminate in the same splice closure.

    d. Storage coils shall be secured to cable racking hardware with tie wraps, Velcro straps, or non-metallic cable straps with locking/buckling mechanism.

    e. Do not use adhesive or self-adhering tapes, metal wires and straps, or rope/cord.

2. Unless otherwise noted on the plans, the following are the requirements for cable slack storage for underground applications:

    a. Trunk fiber optic cable in Type “D” Pull Box – 25 feet

    b. Trunk fiber optic cable in Type “E” Pull Box – 200 feet

    c. Trunk fiber optic cable in pad-mount cabinet – 25 feet

    d. Trunk fiber optic cable in aerial splice – 50 feet on each side of the splice closure

    e. Branch fiber optic cable in Type “E” Pull Box – 100 feet

    f. Branch fiber optic cable in pad-mount cabinet – 25 feet

4.3.5 *Fiber Optic Fusion Splice (FO Splice, Fusion)*

1. Perform fusion splicing of all fiber optic splices as shown in the Plans in the locations shown.

2. Perform fusion splicing only in enclosed spaces such as splice trailers or tents specifically intended for this operation.

3. Completed fusion splices shall have no more than 0.10dB optical loss as measured in accordance with Section 4.2.4.2.

4. Adequately protect all fusion splices in splice trays in a splice closure or termination cabinet. Provide the splice with strain relief and protection of the stripped fiber splice in a manner recommended by the fiber and the splice tray manufacturers.

5. Use fusion splice protectors of a heat shrink tubing that protects the splice and extends over the fiber coating. Splice protectors shall be compatible with and as recommended by the fiber and the splice tray manufacturers.

6. No bare fiber may be exposed.

4.3.6 *Fiber Optic Termination Unit (FO Termination Unit – 48F)*

1. Install only one outside plant cable per termination cabinet, including within the separate splice tray storage compartment if so equipped. Install the connector modules for fibers 1 through 48 as shown in the Plans. Equip any remaining unused connector module slots with blank panels.

2. Install all fibers, buffer tubes, and cables following minimum internal and external bend radius, proper management, routing, fastening and protection, and with no residual strain on any connector, fiber, buffer tube or cable.

3. Install one cable buffer tube to one termination cabinet interconnect cable, matching fiber to fiber. Keep all fibers of the outside plant cable buffer tube and their corresponding termination-interconnect cables complete within the same splice tray.

4. Label the front and rear of the termination cabinets with the trunk cable segment ID of the cable terminated within; use permanent clearly legible labels with minimum 0.5 inch text height.

5. Label each end of termination cabinet interconnect cables to identify the 12 trunk cable fibers/buffer tube connected; use permanent overlapping cable labels with clearly legible text.

4.3.7 *Fiber Optic Closure (FO Closure)*

1. Install fiber optic splice closures where, and of the size, shown in the Plans. Install splice closures in the center ± 3 feet of the entire length of stored cable coils, or install at the end of cables that terminate in the pull box.

2. Store FO closures and cable coils on the pull box cable rack hooks. Keep all closures and cable coils off of the bottom of the pull box. Secure closures and/or cable coils as needed to hold them in place.

4.3.8 *Fiber Optic Branch Panel (FO Branch Panel, 12F)*

1. Prior to factory manufacture of fiber optic branch panels, verify the final installed location of all portions of each branch cable route from the splice closure to the equipment cabinet (including, but not limited to, the cabinet location, all conduit and pull boxes, and the splice closure location) to determine the required length of branch cable, including all splice closure and storage coils, to be factory manufactured with each branch panel. Do not use the plans quantity for determining the branch cable length to be factory manufactured.

2. Using the branch panel mounting plate, install branch panels on the side panel or equipment cabinets. Mount the fiber optic branch panel with the connectors horizontal or facing downward, and route the branch cable up or down as necessary. Route and secure the branch cable such that it is fully strain-relieved, does not violate the manufacturer's recommended bending radius, and does not interfere with the operation of or access to any cabinet equipment or electrical components.

3. Place one copy of the manufacturer test documentation in the equipment cabinet, where the branch panel is installed, and submit the other copy to the Engineer.

4.3.9 *Aerial Fiber Optic Splice Closure (Aerial FO Closure)*

1. Install aerial fiber optic splice closures where and of the size shown in the Plans.

2. Secure aerial fiber optic splice closures to messenger cable using manufacturer recommended hanger kit.

3. Coil 50 feet of fiber optic cable on either side of splice closure. Bending radius shall not exceed manufacturer recommended bending radius.

4.3.10 *Integrated Fiber Optic Drop Cable / Termination Unit*

1. Secure integrated fiber optic drop cable / termination unit to side of equipment cabinet in an accessible location.

2. Coil 75 feet of cable in the adjacent pull box.

4.3.11 *Cable Labels*

1. Install cable labels on all trunk cables. Clean the installed cable of all dirt and grease before applying any label.

2. Label all cables in or at every location where the cable is exposed outside of a conduit, innerduct or pole, using the cable IDs for trunk cables. As a minimum, install cable labels in the following locations:

    a. Within 12 inches of every cable entry to a pull box, equipment cabinet, communications hub, or the TMC.

    b. Within 12 inches of the exterior entry point of every fiber optic splice closure, termination cabinet, and branch panel.

    c. Every 30 feet for the entire length of cable in any storage coil in pull boxes.

4.3.12 *Fiber Optic Patch Cords*

1. Install fiber optic patch cords to connect all electronic equipment with the fiber optic infrastructure. Follow port assignments as shown in the Plans.

2. Install fiber optic patch cords to connect all active optical paths between fiber optic termination cabinets in communications hubs as shown in the Plans.

3. Neatly route and dress all patch cords to the connected devices and within cable management facilities.

4.3.13 *Fiber Optic Attenuator Patch Cords*

1. Provide fiber optic attenuator patch cords in accordance with Section 4.2.11.

4.3.14 *Project Testing*

1. General Requirements

    a. The Design-Builder shall conduct a project testing program for all fiber optic infrastructure as required in Section 1.5 of this SP. The project testing program for fiber optic infrastructure shall include but is not limited to, the additional specific requirements in this subsection.

b. All test results shall confirm physical and performance compliance with this SP including, but not limited to, optical fibers and fusion splices. No event in any given fiber may exceed 0.10 dB. Any event measured above 0.10 dB shall be replaced or repaired at the event point.

c. In addition to the notification requirements of Section 1.5, provide the tentative date, time and location of fiber optic infrastructure testing no less than 7 days in advance of the test. Provide confirmed date, time and location of fiber optic infrastructure testing no less than 48 hours before conducting the test.

d. Provide test results documentation in electronic format (1 copy) and printed (3 copies) format. Electronic formats shall be readable in Microsoft Excel or other approved application. Printed copies shall be bound and organized by cable segment.

e. Provide all test results in English units of measure of length.

f. Submit all test results documentation to the Engineer within 14 days of completion of the tests. The Engineer will review test documentation in accordance with the Submittal Review Process in Section 1.8.

2. Pre-Installation Test (PIT)

a. Perform a PIT on all FO Cable prior to any cable removal from the shipping reels. Perform a PIT on each cable reel delivered to the job site.

b. The PIT for FO Cable shall include but is not limited to:

i. A visual inspection of each cable and reel

ii. An OTDR Test and documentation as required in the SAT below, for three randomly selected fibers from each buffer tube.

iii. An Optical Attenuation Test is not required. If the Design-Builder decides to perform one for their own protection, said test should be documented and provided to the engineer.

3. Standalone Acceptance Test (SAT)

a. Perform an SAT on all fiber optic infrastructure on this project after field installation is complete, including, but not limited to, all splicing and terminations.

b. An SAT for each fiber in each cable shall include OTDR Tests and Optical Attenuation Tests.

c. All fibers in all FO Cables and FO Branch Cables shall be tested from termination point to termination point, including:

    i. fibers from FO Termination Cabinet to FO Termination Cabinet

    ii. fibers from FO Termination Cabinet to FO Branch Panel

    iii. fiber from FO Branch Panel to FO Branch Panel

    iv. fibers from FO Termination Cabinet to the end of the cable run in the last FO Closure

d. Fiber that is not terminated shall be temporarily terminated in order to perform OTDR testing.

e. All test results shall confirm compliance with this SP including, but not limited to, optical fibers and fusion splices. No event in any given fiber may exceed 0.10 dB. Any event measured above 0.10 dB shall be replaced or repaired at the event point.

f. Test documentation shall include but is not limited to:

    i. Cable & Fiber Identification

        - Cable & Fiber ID and Location – Physical location (device ID and station number of FO Termination Cabinet, FO Branch Panel, or cable end FO closure), fiber number, and truck or branch cable ID for both the beginning and end point.

        - Operator Name

        - Engineer's Representative

        - Date & Time

    ii. Setup and Test Conditions Parameters

        - Wavelength

        - Pulse width Optical Time Domain Reflectometer (OTDR)

        - Refractory index (OTDR)

        - Range (OTDR)

        - Scale (OTDR)

- Ambient Temperature

iii. Test Results for OTDR Test (each direction and averaged)

- Total Fiber Trace (miles)
- Splice Loss/Gain (dB)
- Events > 0.05 dB
- Measured Length (Cable Marking)
- Total Length (OTDR Measurement)

iv. Test Results for Attenuation Test (each direction and averaged)

- Measured Cable Length (Cable Marking)
- Total Length (OTDR Measurement from OTDR Test)
- Number of Splices (Determined from As-Builts)
- Total Link Attenuation

g. OTDR Test

i. Conduct the OTDR Test using the standard operating procedure and recommended materials as defined by the manufacturer of the test equipment.

ii. Use a factory patch cord ("launch cable") of a length equal to the "dead zone" of the OTDR to connect the OTDR and the fiber under test.

iii. Conduct bi-directional OTDR Tests for each fiber. Calculate bi-directional averages.

iv. Conduct all tests at 1310 and 1550 nm for single mode cable.

h. Optical Attenuation Test

i. Conduct the Optical Attenuation Test using the standard operating procedure and recommended materials as defined by the manufacturer of the test equipment.

ii. Conduct bi-directional Optical Attenuation Tests for each fiber. Calculate bi-directional averages.

iii. Conduct all tests at 1310 and 1550 nm for single mode cable.

4.4 Measurement

4.4.1 *Fiber Optic Cable (SMFO Cable, 48F)*

Single Mode Fiber Optic Cable (SMFO Cable, 48F) will be measured in units of linear feet and paid for at the contract price per linear feet. The price bid shall include; the length in feet of actual cable installed as measured from the cable sequential length markings, cable labels, patch cords, ancillary and incidental materials, mounting brackets, testing, documentation and all labor and equipment necessary to complete the work. No measurement for payment will be made for cable storage amounts in excess of that required in this SP or the Plans. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

4.4.2 *Fiber Optic Branch Cable (SMFO Cable, 12F)*

Single Mode Fiber Optic Cable (SMFO Cable, 12F) will be measured in units of linear feet and paid for at the contract price per linear feet. The price bid shall include; the length in feet of actual cable installed as measured from the cable sequential length markings, cable labels, patch cords, ancillary and incidental materials, testing, documentation and all labor and equipment necessary to complete the work. No measurement for payment will be made for cable storage amounts in excess of that required in this SP or the Plans. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

4.4.3 *Fiber Optic Splice, Fusion (FO Splice, Fusion)*

Fiber Optic Splice, Fusion (FO Splice, Fusion) will be measured in units of each splice and paid for at the contract price per each individual splice. The price bid shall include but not limited to all ancillary and incidental materials, testing, documentation, and all labor and equipment necessary to complete the work. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

4.4.4 *Fiber Optic Connectors*

Fiber Optic Connectors are included in the quantities of other pay items and will not be measured separately for payment.

4.4.5 *Fiber Optic Termination Unit (FO Termination Unit – 48F)*

Fiber Optic Termination Unit (FO Termination Unit – 48F) will be measured in units of each and paid for at the contract price per each but not limited to fiber optic connectors, cable labels, patch cords, splice tray, mounting hardware, ancillary and incidental materials, testing, documentation, and all labor and equipment necessary to complete the work. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

4.4.6 *Fiber Optic Closure (FO Closure)*

Fiber Optic Closure (FO Closure) will be measured in units of each and paid for at the contract price per each. The price bid shall include but not be limited to, cable labels, patch cords, mounting hardware, ancillary and incidental materials, testing, documentation, and all labor and equipment necessary to complete the work. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

4.4.7 *Fiber Optic Branch Panel (FO Branch Panel, 12F)*

Fiber Optic Branch Panel (FO Branch Panel, 12F) will be measured in units of each and paid for at the contract price per each. The price bid shall include but not limited to fiber optic connectors, cable labels, patch cords, manufacture with the fiber optic branch cable, mounting hardware, ancillary and incidental materials, testing, documentation, and all labor and equipment necessary to complete the work. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

4.4.8 *Integrated Fiber Optic Drop Cable / Termination Unit*

Integrate Fiber Optic Drop Cable / Termination Unit will be measured in units of each and paid for at the contract price per each. The price bid shall include but not limited to, cable lengths up to 275 feet, cable labels, mounting hardware, ancillary and incidental materials, testing, documentation and all labor and equipment necessary to complete the work. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

4.4.9 *Cable Labels*

Cable Labels are included in the quantities of other pay items and will not be measured separately for payment.

4.4.10 *Fiber Optic Patch Cords*

Fiber Optic Patch Cords are included in the quantities of other pay items and will not be measured separately for payment.

4.4.11 *Fiber Optic Attenuator Patch Cords*

Fiber Optic Attenuator Patch Cords are included in the quantities of other pay items and will not be measured separately for payment.

4.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-23.12	FIBER OPTIC CABLE (48 F)	LF
725-23.21	FIBER OPTIC DROP CABLE (12 F)	LF
725-23.26	FIBER OPTIC CLOSURE (12 F)	EACH
725-23.28	FIBER OPTIC SPLICE FUSION	EACH
725-23.29	FIBER OPTIC TERMINATION CABINET	EACH
725-23.31	FIBER OPTIC DROP PANEL (12 F)	EACH

Fiber optic infrastructure, except as specified below, will be paid per linear foot or per each, as applicable, as follows:

1. 25% of the contract unit price upon delivery and PIT test.

2. Additional 35% of the contract unit price for complete installation of cables.

3. Additional 30% of the contract unit price for completion of SAT testing and documenting of all fibers in any lineal foot and in each splice or termination/connectorization location, and submission of and acceptance of all test documentation.

4. Final 10% of the contract unit price upon Final System Acceptance

Fiber optic splices, fusion, will be paid per each as follows:

1. 60% of the contract unit price upon completion of the splice.

2. Additional 30% of the contract unit price for completion of SAT testing and documenting of all fibers in any lineal foot and in each splice or termination/connectorization location, and submission of and acceptance of all test documentation.

3. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 5
ELECTRICAL EQUIPMENT

5.1 Description

This section describes the minimum requirements for the electrical systems to be furnished and installed on this project. The work required includes all materials, labor, coordination, auxiliaries, and incidentals necessary to furnish, install, and test a complete electrical system as indicated on drawings and as specified in this section. The electrical systems will provide power to the ITS devices installed as part of this project including, but not limited to, communications hubs and field cabinets.

5.2 Material

5.2.1 *Demarcation Points for Electrical Service (Riser and Ground-Mounted)*

1. Demarcation points for power service installations shall include a service power meter base, fusible disconnect switch with fuse(s) and/or power distribution breaker panel (Mini Load Center) and enclosure, SPD, wire, conduit and appurtenances, wire splices, and all labor materials associated with the installation of these devices except as approved by the Engineer. Where multiple power circuits are originating from the same demarcation point, the demarcation point shall include all equipment needed for all circuits.

2. All demarcation point conduit shall be Rigid Galvanized Steel (RGS).

3. Conduit for the pole mounted electrical service pertains to the RGS riser assembly and any underground conduit connected to the riser and extending to the nearby pull box.

5.2.2 *Electrical Cable*

1. Electrical cable shall be stranded copper wire with XHHW (cross-linked polyethylene (XLPE) high heat-resistant, water-resistant) insulation, rated at 600V.

5.2.3 *Surge Protective Device (SPD)*

1. All SPD shall be UL listed and bear the UL label.

2. All metal oxide varistors used for surge protection shall be rated in the appropriate voltages.

3. Surge suppressors operating temperature shall be between -40°C to +85°C.
4. Power Carrying Conductors

    a. The SPD shall be installed on the load side of the main circuit breaker with leads as short and straight as possible. This shall be required for all voltage levels.

    b. The SPD shall have a clamping voltage response time of less than 5 nanoseconds.

    c. The SPD shall have a Voltage Protection Rating (VPR) of 700V or less for L-N, L-G, & N-G.

    d. The SPD shall have a Maximum Continuous Operating Voltage (MCOV) of 150V.

    e. The SPD peak surge current shall be equipped with a minimum surge current rating of 70 kA per phase.

    f. The SPD shall be UL1449 listed.

    g. The SPD shall be located adjacent to the electrical power service and distribution panel.

    h. The SPD shall have a visual indicator of loss protection.

    i. The SPD shall include one set of Normally Open (NO), Normally Closed (NC) Form C contacts for remote monitoring.

5.2.4 *Transformers*

1. Provide transformer (Type A) - 25 KVA, 480V - 240V transformers as indicated on the Plans.

2. Provided transformer (Type B) - 5 KVA, 480V - 120V transformers as indicated on the Plans.

3. Each of the transformer Types shall also meet the following requirements:

    a. UL listed

b. 60 Hz operation

c. Built in accordance with ANSI short term overload capability

d. Meet or exceed NEMA ST-20 sound levels. (37dB for 0-9KVA; 42dB for 10-30KVA)

e. Tested in accordance with NEMA, ANSI, and IEEE Standards.

f. Dry Type Transformers: ANSI/NEMA ST 20: factory-assembled, non-vented, dry type transformers; ratings as shown in Plans.

g. Voltage rating for transformers shall be:

    i. 480V - 240V, 25 KVA, single phase, dry type step down transformer. (Type A)

    ii. 240V - 480V, 25 KVA, single phase, dry type, step up transformer. (Type A)

    iii. 480V - 120V, 5 KVA, single phase, dry type step down transformer. (Type B)

    iv. 120V - 480V, 5 KVA, single phase, dry type step up transformer. (Type B)

h. The average temperature rise shall be 115°C.

i. Shall comply with NEC standards for transformers and disconnects.

j. Basic Impulse Level (BIL): 10 KV for transformers less than 300 KVA.

k. Coil Conductors shall be continuous copper windings with terminations brazed or welded.

l. Enclosure: Non-Ventilated, NEMA 3R enclosure standard. Suitable for outdoors. Provide lifting lugs or brackets.

m. Isolate core and coil from enclosure using vibration-absorbing mounts.

n. Nameplate: Include transformer connection data and rating.

o. Provide transformer with lug kits which are compatible with the type and amperage of the windings.

p. All cores to be constructed of high grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point.

q. Terminations shall consist of wire leads with minimum insulation rating of 125 degrees Celsius.

4. Pad Mounted Transformers

    a. Provide transformer capable of being pad mounted.

    b. Provide concrete pad for pad mounted transformers as indicated on the plans.

5. Rack Mounted Transformers

    a. Provide transformers mounted on a channel steel frame as indicated on the plans.

    b. Concrete pad shall be an extension of proposed cabinet foundation or stand alone as indicated on the plans.

    c. Provide a galvanized steel stand constructed of 3 inch channel with welded construction.

    d. Legs shall be bolted to or buried into concrete pad to depths indicated on the plans.

    e. Provide knee bracing as required to prevent excess stand movement.

    f. Stand shall not be installed to prohibit safe working clearances or obstruct access doors to any equipment.

    g. Bond equipment grounding conductor to the steel frame.

5.2.5 *Power Distribution Breaker Panel*

1. Power distribution breaker panels shall be 120/240 volt, 1 phase, 10 kAIC minimum rated, 12 space maximum, 4 space minimum, and Main Circuit Breaker (MCB) panels. Shall be in a NEMA 3R enclosure for use in outdoor locations. Ampere rating of each power distribution breaker panel shall be as indicated on the Plans.

2. Panels shall be bottom feed and capable of being surface mounted inside a cabinet.

3. Power distribution breaker panel schedules shall be filled in by the PDE manufacturer with descriptions of each circuit in accordance with Article 110-22 of the National Electric Code.

4. Molded Case, bolt-on thermal magnetic trip circuit breakers, with common trip handle for all poles shall be provided factory installed in accordance with the power distribution breaker panel schedules on the Plans.

5.2.6 *Disconnect Switches*

1. Provide fused disconnect switches, ampere rating, voltage rating, number of poles, and fuse size as indicated on the Plans.

2. Disconnect switches shall be in a NEMA 3R enclosure for use in outdoor locations and able to be locked in both the on and off positions.

5.2.7 *Solar Power*

The Design-Builder shall provide required solar power equipment as shown in the Plans at required RDS and wireless radio sites as per the guidelines stated in this document. The photovoltaic power supply shall include but not be limited to: the battery, photovoltaic modules and all required peripherals. The Design-Builder shall be responsible for conducting a performance design study and for designing the solar power supply for the sites shown on the Plans. The Design-Builder shall submit all design calculations for solar power to the Engineer for approval. The solar power generated should be able to optimally operate the ITS device for which it is intended.

1. Photovoltaic Power Supply

   The following criteria shall be used for the purpose of specifying solar electric modules for procurement:

   a. The solar module shall have cells made of high efficiency single crystal silicon and processed with textured optimized pyramidal type surface for maximum amp-hours delivered per day.

   b. The cells shall have dual interconnect ribbons soldered using a continuous flow process (not spot welds) that fully span both the top and bottom of each cell to insure cell interconnection even when glass is shattered.

   c. The solar module shall be constructed using a specially formulated EVA polymer to bond the solar cells to a “Solar Grade” tempered glass for maximum protection and light transmission.

   d. A white tedlar back sheet shall be used in the lamination process to reduce cell temperature and act as a moisture barrier maximizing cell and module output.

e. The solar module shall incorporate built-in bypass diode protection in the weatherproof junction box to preserve array output power even during periods of local shading.

f. The solar module shall feature UL rated junction boxes designed for easy wiring, safety, and environmental protection.

g. The solar module shall be certified that it has passed the environmental tests required by JPL 5101-16 (Block V).

h. The solar module shall meet UL 1703 requirements and be listed under file No. E79555.

i. The solar module shall be certified that it is performance tested in accordance with the method specified in IEC 904 and 1036.

j. The modules shall be comprised of Single Crystalline Silicon.

k. They shall have a minimum of (10) year limited warranty.

2. Performance Design Study

A performance design study is to be custom created for the TDOT ITS project site. This design study shall include, but is not limited to:

a. The daily Solar Insulation data averaged on a monthly basis.

b. The correct Tilt Angle for the solar array.

c. The daily Array Output, in Amp-Hours, averaged on a monthly basis.

d. The total Daily Load requirement, in Amp Hours, averaged on a monthly basis.

e. A monthly Loss of Load Probability (LOLP) of the designed power supply.

f. A minimum of 21 days battery autonomy. (Based on the 100 hour discharge rate @ 77 F to 1.75vpc)

g. The monthly Average Battery State of Charge.

h. The statistical Interval to Loss of Load, in years.

i. Worst-case design parameter of 2 KWH/Sq. M/average December Day.

3. Battery

The battery(s) used in this system shall have the following design features:

a. Batteries shall be Valve Regulated Sealed Lead Acid batteries.

b. Batteries shall be Absorbed Glass Mat (AGM) design.

c. Meet DOT shipping requirements, 49 CFR section 173.159.

d. Shelf Life of 6 months at 68 – 77°F.

5.3 Installation Requirements

5.3.1 *Electrical Connections (Demarcation Points)*

Electrical power service, from the power service provider, shall be provided at the Demarcation Points as indicated on the Plans. The Design-Builder shall be responsible for all coordination with the power service provider as well as all materials, labor, or any other means to install electrical service to the field cabinets as indicated on the Plans.

5.3.2 *Demarcation Points for Electrical Service (Riser and Ground-Mounted)*

1. The installation of all electrical devices including wire sizing, conduit sizing, electrical conductor splicing in pull boxes, and grounding/bonding shall be as shown in Plans and in accordance with the National Electrical Code (NEC) and National Electrical Safety Code (NESC).

2. The size and rating of all electrical devices shown in the Plans shall be considered minimums and the Design-Builder is responsible for determining, furnishing, and installing larger size and ratings as required by Code and/or the utility provider.

3. There are two (2) electrical utility companies involved on this project, Knoxville Utilities Board, and Lenoir City Utilities Board will be the primary power provider unless labeled in the Plans differently.

4. Design-Builder is responsible for contacting each electrical utility company for service feed information. Each utility company may vary in its procedure for obtaining and providing electrical service.

5. It is the Design-Builder's responsibility to coordinate with each electrical utility well ahead of the desired (scheduled) date for electrical service, so that proper procedures can be followed for each electrical utility provider.

6. It is the Design-Builder's responsibility for obtaining the address for each electrical demarcation point.

7. The Design-Builder shall get all finished electrical demarcation points inspected by the appropriate authority, as determined by each electrical utility provider, prior to asking for required activation from the electrical utility.

8. The Design-Builder shall coordinate with the electrical utility to ensure conformance with interface requirements for point of attachment and metering. (Demarcation voltages on Plans reflect voltage required for equipment and does not indicate type of service or meter from electrical utility. Example: 240V meters may still be required for 120V service to ITS equipment.)

9. The Design-Builder shall not order service activation more than 60 days before anticipated installation of the roadside equipment cabinet to be served, so as not to incur unwarranted service costs.

10. Electrical service may not be connected to a cabinet or other device until all required grounding installation is complete.

5.3.3 *Electrical Cable*

Design-Builder shall abide by the following installation requirements:

1. Conductors of the type, size, and specification shall be installed at the location shown on Plans or as directed by Engineer.

2. Conductors in conduits shall be carefully pulled into place using methods in conformance with standard industry practice and the cable manufacturer's recommendations.

3. When wire or cable is brought up into the base of a foundation, sufficient slack shall be left to enable the connections to be made outside the foundation.

4. Powdered soapstone, talc, or other approved inert, non-oily cable lubricant shall be used in placing conductors in conduit.

5. Conductors shall be handled and installed in such a manner as to prevent kinks, bends, or other distortion, which could cause damage to the conductor or outer covering.

6. All wires and cables within a single conduit shall be pulled at the same time. When cables are pulled through hand holes, in pole shafts, etc., a pad of firm rubber or other suitable material shall be placed between the cable and the edges of the opening to prevent cable damage.

7. Cable, entrances into panels, transformers, cabinets, and conduit outlets shall be sealed from moisture, insects, rodents, and foreign material with a sealing compound manufactured for this application.

8. Splices and taps for circuits rated below 600 volts shall be performed in accordance with the National Electrical Code and materials shall be used that will be compatible with the sheath and insulation of the cable and suitable for direct burial.

9. Straight splices shall be made with tubular copper compression type connectors, or bronze or copper split bolt connectors.

10. Tap splices shall be made with parallel tubular copper compression type connectors or parallel groove bolted connectors.

11. Compression connectors shall be crimped with the connector manufacturer's recommended compression tool and die.

12. The compression tool shall be of the type which will prevent removal of the tool until the crimp has been completely closed.

13. After a conductor splice is made, it shall be insulated with a rubber insulating tape and then covered with material suitable for direct burial.

14. The tape shall be applied half-lap with a minimum of two full laps of each tape to a point approximately three (3) inches from the conductor splice.

15. All sharp points and edges of the connector shall be padded and all voids filled with insulating putty.

16. The tape shall not be stretched in such a manner as to cause creeping. All spliced joints shall be watertight.

17. Splices and taps for circuits rated above 600 volts shall be made using a splice kit as supplied by the cable manufacturer suitable for direct burial and splices shall be made in accordance with manufacturer instructions and recommendations for the particular cable and voltage level.

18. Splices shall be completed the same day started and shall not be done during damp or inclement weather.

19. Medium and high voltage cables exposed at equipment terminations shall be provided with a suitable insulating sleeve from over the cable insulation to terminal points of the equipment.

20. Special attention shall be given to the shielded cable to maintain the continuity of the metallic shielding tape and to the proper termination and grounding of the shield at each splice of the cable run and at each end.

21. Cable warning tape shall be installed in all conduit trenches as specified.

22. Junction boxes containing conductors of different voltages shall be permanently labeled to identify voltage and disconnecting location. Conductors shall be color coded to identify voltage.

5.3.4 *Grounding Wire*

1. Grounding splices shall not be insulated.

2. The grounding conductor shall be continuous and shall be connected to the ground system at all supporting poles and structures, to each transformer, to each sign support assembly, to each gate, and to each grounding conductor in a multi-conductor cable assembly. Additional grounding rod electrodes shall be installed to obtain a maximum value of 10 ohms to ground.

3. Single ground rods shall be driven vertically until the top of the rod is at least 12" below the finished ground.

4. A length of #6 base copper, seven-stranded wire shall be attached to the ground rod with suitable ground rod clamps and connected to the grounding system.

5. Bolted grounding connections of solder-less type made of the high strength electrical bronze with silicon bronze clamping bolts and hardware may be used; designed such that, bolts, nuts, lock washers and similar hardware which might nick or otherwise damage the ground wire will not directly contact the ground wire.

6. Non-dielectric circuit going into and leaving communication equipment cabinet shall be equipped with Department-approved Surge Protective Device (SPD) system.

7. Exothermic welded ground connections shall be used where specified.

5.3.5 *Surge Protective Device (SPD)*

1. The Design-Builder shall provide SPD on all electrical service points at the load side of distribution panels.

2. The Design-Builder shall install SPD as follows:

a. The placement of equipment and wiring within an outside enclosure shall be arranged so that the surge suppressors are located near the conductor's point of entry.

b. Surge suppressors shall be located as close as possible to the electrical panel board.

c. SPD shall be mounted on the underside of riser and ground-mounted demarcation point breaker panel enclosures.

d. The surge suppressor grounding conductor shall be free from sharp bends.

5.3.6 *Transformers*

1. Transformer installation shall meet the following requirements:

   a. Set transformer plumb and level on concrete pads. The pad is to extend a minimum of 6" from the edge of all sides of the transformer.

   b. All transformers shall be installed to form a complete installation ready for operation.

   c. Check for damage and tight connections prior to energizing transformer.

   d. Measure primary and secondary voltages and make appropriate tap adjustments with transformer 100 percent design load.

   e. After installation is completed the transformer shall be tested prior to acceptance.

   f. Operational test shall be performed in the presence of Engineer.

   g. The test shall include a voltage, current, and insulation resistance test.

   h. Test shall be performed in accordance with TDOT Standard Specifications Section 714.

5.3.7 *Power Distribution Breaker Panel*

1. Power distribution breaker panels shall be installed on the demarcation pole as indicated on the Plans.

5.3.8 *Disconnect Switch*

1. Disconnect switches installed at the demarcation shall be fused and secured to the demarcation pole.

2. Disconnect switches installed at transformer locations shall be fused and secured to the primary side of the transformer.

5.3.9 *Solar Power*

The Design-Builder shall be responsible for all testing and documentation required for establishing approval and acceptance of the product. At a minimum, the following tests shall be conducted for both RDS and Wireless radio sites:

1. Perform field tests with various ITS devices as noted in design Plans to verify that each device operates optimally.

2. Verify Array Output (Amp-Hours)

3. Verify Daily load requirement (Amp-Hours)

4. Verify Loss of Load Probability (LOLP) of the designed power supply

5. Verify the Expected Battery Reserve Days

6. Verify the Average Battery State of Charge

7. Verify the statistical Interval to Loss of Load

5.4 Measurement

5.4.1 *Electrical Connections (Demarcation Points)*

Electrical Connections shall be paid for on a lump sum basis wherein no measurement will be made. Electrical Connections (Demarcation Points) shall cover the Design-Builders time and costs for coordinating with the utility companies as described in these SP. This price does NOT include any charges from the utilities as each utility will invoice TDOT directly for any installation charges associated with providing power to the demarcation points.

5.4.2 *Demarcation Site (Overhead)*

Demarcation Site (Overhead) for power service shall be measured in units of each and shall include the power service meter base, power distribution breaker panel or mini load center, SPD,

all RGS conduit risers and weatherhead, conduit from nearest pull box to the pole, connection hardware, grounding, wiring, and all related appurtenances as necessary to provide power service to each site. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

5.4.3 *Demarcation Site (Underground)*

Demarcation Site (Underground) for power service shall be measured in units of each and shall include the power service meter base, fusible disconnect switch, power distribution breaker panel, SPD, mounting brackets, concrete poles, RGS conduit from nearest pull box to the demarcation point, connection hardware, grounding, wiring, and all related appurtenances as necessary to provide power service to each site. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

5.4.4 *Electrical Cable*

The Electrical Cable will be measured in units of linear feet per cable installed and paid for at the contract price per linear feet of each cable. The price bid shall include furnishing, installing, configuring, and testing of the electrical power cable including all required splices and other ancillary items required for complete installation of the cable. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

5.4.5 *SPD*

The SPD is included in the quantities of other pay items and will not be measured separately for payment.

5.4.6 *Transformers*

The transformer will be measured in units of each and paid for at the contract price per each. The price bid shall include but not be limited to furnishing and installing of the transformer, mounting brackets, transformer disconnect switch, SPD, incidental connecting wire and conduit to an adjacent equipment cabinet, conduit riser or ground-mounted brackets and all work, equipment, and appurtenances as required effecting the full operation of the transformer. The price bid shall also include all documentation including: configuration drawings, equipment interconnect diagrams, full operation documentation, block diagrams, and other material necessary to document the installation of the cabinet transformer and testing according to this SP detailed herein, within the Plans and/or in the contract document. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

5.4.7 *Power Distribution Breaker Panel*

The Power Distribution Breaker Panel is included in the quantities of other pay items and will not be measured separately for payment.

5.4.8 *Disconnect Switch*

Fused disconnect switch shall be included in the quantities of other pay items and shall include connection hardware, grounding, wiring, and all related appurtenances as necessary to provide a disconnecting means to equipment and is inclusive coordination efforts for all labor, tools, materials, equipment and incidentals necessary to complete the work.

5.4.9 *Solar Power for RDS*

The Solar Power assembly power service shall be measured in units of each and shall include the photovoltaic modules, battery(s), connection hardware, grounding, wiring, and all related appurtenances as necessary to provide power service to each site. This price shall also include coordination efforts and for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

5.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-20.53	CABLE (1/C #10 AWG)	LF
725-20.54	CABLE (1/C #10 AWG)	LF
725-20.55	CABLE (1/C #10 AWG)	LF
725-20.56	CABLE (1/C #10 AWG)	LF
725-20.71	ELECTRICAL CONNECTION	LS
725-21.73	TRANSFORMER (25KV)	EA

725-21.41	DEMARCATION SITE (OVERHEAD PWR/COMM)	EA
725-21.43	DEMARCATION SITE (OVERHEAD POWER)	EA

All other 725 Electrical items listed above will be paid per each as follows:

1. Stored materials will be paid per TDOT Standard Specifications.
2. Final Payment will be made after complete installation and testing of that particular item.

SECTION 6
EQUIPMENT CABINETS

6.1 Description

This section specifies the minimum requirements for equipment cabinets furnished and installed on this project as shown in the Plans. The cabinet will provide a protective outdoor housing enclosure in which to install field hardware required for ITS devices to communicate with the TMC. Major elements of the equipment cabinet include the cabinet housing and equipment mounting hardware, interior wiring and termination facilities, power supplies, electrical accessories, and field installation.

6.2 Materials

6.2.1 *General*

1. Furnish only new equipment and materials.

2. Furnish equipment cabinets and integral materials recommended by the manufacturers for outside plant use and the intended application. This requirement includes wiring and electrical materials and configurations (including connector pin- outs) that are wholly or partially related to the field device applications (CCTV, RDS, etc.).

3. Furnish and configure equipment cabinets to be installed at locations as shown in the Plans. Furnish and configure all equipment and materials for each specific location as shown in the Plans.

4. Provide electrical system and components with UL-listings.

5. Unless otherwise specified, provide wire and cable with stranded copper conductors, 75°/90° Celsius wet/dry rated insulation, and sized for the maximum voltage and current in the circuit.

6. All components specified as rail-mounted shall be compliant as follows:

a. DIN EN 50022 (NS35) component rails

b. Component rails shall be the perforated type and of sufficient length as to protrude beyond the mounted components for fastening to cabinet panels as specified herein

c. UL 1059

d. UL 486E

e. NEMA ISC-4

7. Terminal blocks and component terminals shall be nickel-plated copper, copper alloy, or brass.

8. Terminal blocks shall have voltage and current ratings greater than the ratings of the wires that are terminated, be able to terminate wires from #8 AWG to #4/0 AWG wiring, and shall be assembled into housing enclosures such that all exposed surfaces are touch-safe. Conductor fastening screws shall be captive. Terminal block housings shall be colored as follows:

    a. 120 VAC line/hot: black

    b. 120 VAC neutral: white

    c. 24 VDC positive: red

    d. 24 VDC negative: gray

    e. RS485 communications: orange

    f. Ground: green or green/yellow

9. Provide door locks for all cabinet doors, keyed to TDOT standard Corbin #B4R01365 using #8960 heavy-duty blanks and mastered to #B4R87965. Provide one key with each cabinet.

10. Provide sunshields and mounting fasteners on all cabinets (except Type D). Sunshields and fasteners shall meet the following minimum requirements:

    a. Sunshields shall be 0.125 inch aluminum with smoothed, deburred edges and rounded corners. Provide cutouts for door handles and/or locks as required.

    b. Cabinets shall be equipped with press-in threaded inserts on the cabinet wall interior surface. Sunshields shall be mounted by fasteners and aluminum or stainless steel standoffs tightened into the threaded inserts.

c. Provide a minimum of four inserts/fasteners for top face sunshields.

d. Provide a minimum of six inserts/fasteners for any door or side sunshield.

e. For doors or sides greater than 54 inches tall, provide inserts and fasteners sufficient for a maximum vertical or horizontal distance of 27 inches between any fasteners.

f. Furnish and install a top face sunshield on all cabinets.

g. Furnish and install door or side sunshields on all cabinet faces except for pole attachment faces (for pole-mounted cabinets only).

11. Provide agency name, device name and ID labels on all cabinets. Labels shall meet the following minimum requirements:

    a. Labels shall be flat black lettering on a reflective white background. Lettering shall be a minimum of 1 inch in height.

    b. Labels shall be manufactured from pre-coated adhesive backed reflective sheeting material meeting the minimum requirements of AASHTO M268 Type 1.

    c. The agency name labels shall be "TDOT ITS" in one continuous adhesive sheet.
    d. The device ID labels shall include the device name as an acronym and a hyphen, and shall be one continuous adhesive sheet. Device name acronyms are "CCTV-", "RDS-",or "DMS-".

    e. The device ID shall be numerals corresponding to the location and shall be installed adjacent to the acronym sheet. Multiple device IDs of the same type shall be on the same line separated with a space. Examples: "CCTV-040XX", "RDS-040XX 040XX", "DMS-040XX".

    f. Labels shall be installed along the top of the cabinet door (front cabinet door on Type B cabinets), with TDOT ITS label at the top and the device ID labels immediately underneath.

12. Provide a voltage label on all cabinets or enclosures in accordance with the NEC labeling requirements. Voltage labels shall meet the following minimum requirements:

    a. Labels shall be flat black lettering on a reflective yellow background. Lettering shall be a minimum of 1 inch in height.

    b. Labels shall be manufactured from pre-coated adhesive backed reflective sheeting material meeting the minimum requirements of AASHTO M268 Type 1.

c. Labels shall include the voltages entering the cabinet and shall be one continuous adhesive sheet. Examples are “120VAC“ or “24VDC”.

d. Labels shall be installed on all cabinet doors.

6.2.2 *Type A Cabinet*

1. Type A cabinets will be used to support Type 1 RDS units and Type 3 RDS units.

2. Provide a Type A cabinet intended for outdoor use with a minimum NEMA 3R rating.

3. The cabinet enclosure shall be manufactured from 0.125-inch aluminum.

4. The cabinet shall provide a minimum of one ventilation louver on at least two sides. Any louver opening greater than 3/16 inch in any dimension shall be screened to prevent insect entry.

5. The cabinet shall be intended for strapped pole-mounting; provide all mounting hardware necessary including ½-inch stainless steel mounting straps.

6. Provide a Type A cabinet enclosure with dimensions of 18 inches (H) by 14 inches (W) by 8 inches (D) with a tolerance of +/- 0.25 inches.

7. Cabinet door shall reveal the entire front opening of the cabinet for accessibility. The hinge shall be designed to prevent the door from sagging.

8. Include a single-piece 0.125-inch aluminum back panel covering no less than 90% of the cabinet back wall. Back panel shall be affixed to the enclosure with threaded fasteners and shall be removable from the enclosure with hand tools only and without requirement to remove the cabinet door, mounting straps, or any other components other than communications or device wiring.

9. The cabinet shall be furnished with doorstops, which retain the doors open in a 90 degree and 120 degree positions.

10. Provide on the back panel a grounding lug capable of terminating #6 AWG wire and directly bonded to the back panel.

11. All Type A cabinets supporting RDS units, shall be identical in manufacture and assembly regardless of the number of RDS units shown in the Plans at a specific location.

12. All Type A cabinets supporting RDS units, shall provide a remote RDS communications wiring module, comprised of DIN rail-mounted components, that includes the following:

    a. Component rail physically and electrically fastened to the cabinet back panel

b. Strain relief brackets for the RDS cable(s) and the RDS unit harness cables

13. Din Rail mount, UL 497B Listed, series connected SPD for the two pair RS-485 data signal consisting of three stages of surge suppression.

14. Din Rail mount, UL 497B Listed, Parallel or Series-connected surge suppressor for the 12-24VDC power supply for the RDS units with integral or separate terminals for a minimum of three RDS cables and two RDS unit harness cables.

15. Local/remote communications disconnect module for the RS-485 data signal that includes the following:

    a. Terminal facilities for one remote RDS cable connection from the surge suppressor, bus-connected to two separate local/remote disconnect switches, one for each RDS unit that simultaneously makes/breaks all of the RS-485 signal lines for a given RDS unit.

    b. Separate terminal facilities for each of the RDS unit harness cables on the local side of the local/remote disconnect switch.

    c. Separate DB9 connectors with gold-plated pins/sockets and shell for each of the RDS units, bus-connected with the RDS unit harness cable terminals on the local side of the local/remote disconnect switches. Provide protective covers for DB9 connectors.

    d. Provision for installing RS-485 terminating resistors on the terminals on the remote side of the local/remote disconnect switch. Provide terminating resistors at cabinet locations in accordance with the RDS manufacturer's recommendations.

    e. Alternately, provide two separate local/remote communications disconnect modules, one per RDS unit, with jumper wiring between the remote side terminals of the two modules.

16. Connection/jumper wiring between the surge suppressors and the local/remote communications disconnect module(s) shall be of the same conductor size, type, and insulation color as in the RDS cable.

6.2.3 *Type B Cabinet*

1. Type B cabinets will be used to support Type 2 RDS units and new CCTV units.

2. All Type B cabinets (except those at solar power locations) shall be identical in manufacture and assembly, capable of supporting two RDS units, one CCTV location,

one Type A network switch, one Type A radio/antenna, RDS cable and fiber drop panel terminations, regardless of the devices shown in the Plans at a specific location.

3. A complete Type B cabinet shall be an assembly consisting of a cabinet housing, electrical subsystems, and an RDS communications subsystem.

4. Provide a Type B cabinet housing meeting the following requirements:

    a. Conforms to the standards for a Type 170 336S (approximate exterior dimensions 46 inches (H) x 24 inches (W) x 23 inches (D)), including standard EIA 19-inch rack cabinet cage, as defined in the latest version of the Caltrans Transportation Electrical Equipment Specifications (TEES). The minimum clear vertical inside dimension of the 19-inch rack for equipment mounting shall be 39.5 inches. Standard cabinet accessories for traffic signal operations, such as controller, power distribution assembly, input/output file and termination panels, and the police panel, are not required as part of this cabinet assembly.

    b. Provide a thermostatically controlled 100 CFM fan and louvered air intake in door with a pleated filter.

    c. Provide all mounting hardware necessary including ¾-inch stainless steel mounting straps.

    d. Includes hooks, welded to the inside of each cabinet door, for hanging a side-opening, re-sealable, opaque, heavy-duty plastic documentation pouch with metal or hard-plastic reinforced holes for the door hooks. Provide one pouch with each cabinet.

    e. Includes a rack-mounted cabinet sliding storage drawer in accordance with the following:

        i. Approximate exterior dimensions 1.75” H x 16” W x 14” D.

        ii. Telescoping drawer guides to allow full extension from the rack cage.

        iii. Opening storage compartment lid to access storage space for cabinet documentation and other items.

        iv. Supports a weight of 25 lb. when extended.

        v. Non-slip plastic laminate surface attached to the compartment lid which covers a minimum of 90% of the surface area of the lid.

        vi. Mounted in the rack cage with the bottom surface approximately 9 inches above the bottom of the rack cage.

f. Includes side panels within the two sides of the rack cabinet cage, inserted and fastened from the inside of the cage. Use side panels fabricated from 0.125 inch 5052 sheet aluminum alloy and sized to the full inside dimensions of the rack cabinet cage. Side panel surfaces for equipment mounting are denoted by cabinet side, with the "right" side being the support pole side, and by upper or lower as related to the sliding storage drawer. Upper right side panel (support pole side of cabinet, above the drawer) and lower left side panel (opposite side from the support pole, below the drawer) are example side panel surface names.

g. Includes a 12-inch long DIN rail (for future components) mounted in the horizontal and vertical center of the lower left side panel.

5. Provide Type B cabinet electrical subsystems meeting the following requirements: (Note: Type B Cabinets at Solar Power Locations are not required to meet Section 6.2.3.5 requirements)

    a. Includes an electrical distribution module comprised of the following DIN rail-mounted components:

        i. Service entrance terminal block with positions for 120VAC line, neutral, and ground and capable of terminating minimally #6 through #8 AWG wire, located at one end of the mounting rail with an approximately 0.75 inch blank spacer module adjacent to the main cabinet breaker.

        ii. Main cabinet automatic overcurrent 15A circuit breaker that is UL-listed and of the mechanical-magnetic type rated for use from -18° C to 50° C minimum.

        iii. Main cabinet surge suppressor for single-phase 120VAC service entrance, UL 1449 3rd Edition Listed, parallel wired with a Voltage Protective Rating (VPR) of 700V or less for L-N & N-G, and a minimum surge current rating of 40kA per mode.

        iv. Main cabinet filter for power line noise and switching transient suppression, integral to, or separate from and wired to, the main cabinet surge suppressor.

        v. Electrical distribution terminal block for line and neutral conductors parallel wired to the main cabinet surge suppressor but non-filtered, with a minimum terminating capability of six conductors of #10 to #18 AWG. Label the terminal block as "ACCY POWER".

        vi. Electrical distribution terminal block for line and neutral conductors for circuits on the load/equipment side of the power line filter, with a minimum terminating capability of six conductors of #10 to #18 AWG. Label the block as "EQUIP POWER".

vii. Electrical distribution terminal block for grounding and bonding conductors located on the same rail but separate from the service entrance terminal block and connected to the entrance ground with a #6 AWG green insulated wire. The grounding block shall have a minimum terminating capability of two #6 AWG conductors and ten #10 to #18 AWG conductors.

viii. Ground fault interrupt duplex receptacle (NEMA 5-15R) with 2.5A circuit breaker connected to the ACCY POWER distribution block. Permanently affixed to the receptacle, provide two red, orange, or green/yellow labels with minimum 0.25 inch lettering with the legend "300 WATTS MAX". This receptacle is for technician use only and shall not be used to power equipment.

ix. Interconnection wiring between all electrical distribution module components and the other systems included in or housed in the Type B cabinet.

b. Include a cabinet lighting subsystem comprised of the following components:

i. One fluorescent lighting fixture, minimum 15 watt, mounted on the inside top front portion of the cabinet, with a cool white lamp with shatter-proof cover and operated by a normal power factor UL listed ballast.

ii. A resistor-capacitor network noise suppressor installed across the light fixture power terminals.

iii. Two door-actuated switches installed to turn on the cabinet light when either door is opened.

iv. Powered from the ACCY POWER distribution block.

c. Include two duplex non-GFCI equipment power receptacles (NEMA 5-15R) connected to the EQUIP POWER distribution block mounted on the upper rear corner of the cabinet upper right side panel. Provide two red, orange or green/yellow labels with minimum 0.25 inch lettering with the legend "75 WATTS MAX" permanently affixed to the receptacle.

6. Provide a Type B cabinet RDS communications subsystem meeting the following requirements: (Note: Type B Cabinets at Solar Power Locations are not required to meet Section 6.2.3.5 requirements)

a. Include a remote RDS communications wiring module as specified in Section 6.2.2.12, regardless of the number of RDS units shown in the Plans at a specific location.

b. Include a headend RDS communications wiring module, comprised of DIN rail-mounted components, that includes the following:

   i. Nominal 24VDC output power supply, capable of user setting between 23 and 28VDC minimum, with minimum 1A output rating and minimum operating temperature range of -25° C to +70° C. Power supply shall provide terminal facilities for a minimum of three sets of #14 AWG conductors (in the RDS cable). Maximum size of the power supply shall be 1 inch (W) X 7 inches (H) X 7 inches (D). Connect the power supply to the EQUIP POWER distribution block for 120VAC input.

   ii. Surge suppressor for the RS485 data signal, wired between the video encoder and the RDS units. The surge suppressor shall protect the 4-wire RS485 data signal with hybrid multi-stage suppression components including gas tube and silicon avalanche diode. The surge suppressor shall have a response time no greater than 1 nanosecond. The surge suppressor shall provide terminal facilities for a minimum of four two-pair cables of #22 AWG conductors (in the RDS cable or wired to the adjacent remote RDS communications wiring module).

c. Include interconnection wiring between the RDS communications subsystem and the video encoder.

d. Complete subsystem of remote and head end modules mounted on the same DIN rail located on the bottom half of the cabinet upper right side panel.

6.2.4 *Type C Cabinet*

Type C cabinets will be used to support DMS units and fiber junctions. (For the DMS Type C Cabinets see Section 10 of this specification for additional requirements.) The Type C cabinet shall meet the following requirements:

1. Shall meet the same lighting, 19” rack, and ventilation requirements as Caltrans Type 170 model 332 cabinet.

2. Shall meet the applicable requirements of a Type B equipment cabinet in Section 6.

3. Shall be ground mounted.

4. Shall be constructed of 5052 sheet aluminum alloy with a minimum thickness of 1/8 inch.

5. All inside and outside edges shall be free of burrs.

6. The outside surface of the cabinet shall have a smooth, uniform, and natural aluminum finish.

7. All welds shall be neatly formed and free of cracks, blow holes, and other irregularities.

8. All welds shall be made by using the Heli-arc welding method.

9. The cabinet should be of sufficient size to hold all of the Field Junction support equipment as shown in the Plans.

10. Cabinet hinges shall be 14 Gauge diameter stainless steel or 1/8 inch diameter aluminum.

11. The hinge pins shall be constructed of stainless steel.

12. Shall be furnished with a three point latching system (top, bottom, center locations).

13. Shall be furnished with a doorstop, which retains the door at a 90 degree and 120 degree positions.

14. Shall have thermostatically controlled fan located at the top of the cabinet.

15. Minimum fan rating of 100 cubic feet per minute.

16. Fan thermostat shall have a user adjustable range from 80 to 125oF.

17. Minimum of 2-½ inch galvanized anchor bolts shall be used to secure the cabinet to the foundation.

18. Shall be provided with a minimum 20-Watt fluorescent lamp with a clear shatter- proof shield.

19. The lamp shall automatically turn ON when either cabinet door is open.

20. Shall include a three wire GFCI 115 VAC duplex convenience receptacle.

21. The receptacle shall be protected by a 15 Amp circuit breaker.

22. Shall include a main circuit breaker, which shall turn off all power to the cabinet.

23. Provide Type C cabinet electrical subsystems meeting the following requirements:

    a. Includes an electrical distribution module comprised of the following DIN rail-mounted components:

i. Service entrance terminal block with positions for 120VAC line, neutral, and ground and capable of terminating minimally #8 through #6 AWG wire, located at one end of the mounting rail with an approximately 0.75 inch blank spacer module adjacent to the main cabinet breaker.

ii. Main cabinet automatic overcurrent 15A circuit breaker that is UL-listed and of the mechanical-magnetic type rated for use from -18° C to 50° C minimum.

iii. Main cabinet surge suppressor for single-phase 120VAC service entrance, UL 1449 Listed, parallel wired with a Voltage Protection Rating (VPR) of 700V or less for L-N & N-G, a minimum surge current rating of 40kA per mode, and I-nominal rating of 20kA.

iv. Main cabinet filter for power line noise and switching transient suppression, integral to, or separate from and wired to, the main cabinet surge suppressor.

v. Electrical distribution terminal block for line and neutral conductors parallel wired to the main cabinet surge suppressor but non-filtered, with a minimum terminating capability of six conductors of #10 to #18 AWG. Label the terminal block as “ACCY POWER”.

vi. Electrical distribution terminal block for line and neutral conductors for circuits on the load/equipment side of the power line filter, with a minimum terminating capability of six conductors of #10 to #18 AWG. Label the block as “EQUIP POWER”.

vii. Electrical distribution terminal block for grounding and bonding conductors located on the same rail but separate from the service entrance terminal block and connected to the entrance ground with a #6 AWG green insulated wire. The grounding block shall have a minimum terminating capability of two #6 AWG conductors and ten #10 to #18 AWG conductors.

viii. Ground fault interrupt duplex receptacle (NEMA 5-15R) with 2.5A circuit breaker connected to the ACCY POWER distribution block. Permanently affixed to the receptacle, provide two red, orange or green/yellow labels with minimum 0.25 inch lettering with the legend “300 WATTS MAX”. This receptacle is for technician use only and shall not be used to power equipment.

ix. Interconnection wiring between all electrical distribution module components and the other systems included in or housed in the Type B cabinet.

b. Include a cabinet lighting subsystem comprised of the following components:

   i. One fluorescent lighting fixture, minimum 20 Watt, mounted on the inside top front portion of the cabinet, with a cool white lamp with shatter-proof cover and operated by a normal power factor UL listed ballast.

   ii. A resistor-capacitor network noise suppressor installed across the light fixture power terminals.

   iii. Two door-actuated switches installed to turn on the cabinet light when either door is opened.

   iv. Powered from the ACCY POWER distribution block.

c. Include two duplex non-GFCI equipment power receptacles (NEMA 5-15R) connected to the EQUIP POWER distribution block mounted on the upper rear corner of the cabinet upper right side panel. Provide two red, orange or green/yellow labels with minimum 0.25 inch lettering with the legend "75 WATTS MAX" permanently affixed to the receptacle.

6.2.5 *Type D Cabinet*

Type D cabinets will be used to support above ground splicing of RDS vender provided cable to RDS lead-in cable described in Section 11. The Type D cabinet shall meet the following requirements:

1. Provide a Type D cabinet intended for outdoor use with a minimum NEMA 3R rating.

2. The cabinet enclosure shall be manufactured from 0.125-inch aluminum.

3. The cabinet shall be intended for strapped pole-mounting; provide all mounting hardware necessary including ½-inch stainless steel mounting straps.

4. Provide a Type D cabinet enclosure with dimensions of 12 inches (H) by 12 inches (W) by 8 inches (D) with a tolerance of +/- 0.25 inches.

5. Cabinet door shall reveal the entire front opening of the cabinet for accessibility. The hinge shall be designed to prevent the door from sagging.

6. Include a single-piece 0.125-inch aluminum back panel covering no less than 90% of the cabinet back wall. Back panel shall be affixed to the enclosure with threaded fasteners and shall be removable from the enclosure with hand tools only and without requirement to remove the cabinet door, mounting straps, or any other components other than communications or device wiring.

7. Provide on the back panel a grounding lug capable of terminating #6 AWG wire and directly bonded to the back panel.

8. All Type D cabinets supporting RDS units, shall be identical in manufacture and assembly regardless of the number of RDS units shown in the Plans at a specific location.

6.3 Installation Requirements

6.3.1 *General*

1. Install and configure cabinets as shown in the Plans, including installations and dimensions given for pole-mounting in relationship to the surrounding grade.

2. Provide a level technician standing pad at every cabinet door.

3. Bond all cabinets to the pole grounding lug with minimum #6 AWG stranded copper bare or green-insulated cabinet grounding wire. Alternately on existing poles only, bond the cabinet grounding wire to an existing pole grounding wire with a cast brass or copper alloy threaded compression connector within 4 inches of the existing pole grounding lug.

4. Do not install electrical service or electronic devices in the cabinet or connect to the cabinet until ground testing for the pole or structure has been successfully completed and accepted, and the cabinet ground connection has been installed.

6.3.2 *Type B and C Cabinets*

1. Install and configure equipment in the Type B and C cabinet in accordance with the requirements for that equipment, including RDS units, CCTV, Type A network switches, radio/antennas, RDS cables and/or fiber distribution or drop panels.

2. Do not install electronic devices in the cabinet until electrical service has been installed and activated, and the cabinet ventilation fan is operational.

3. Provide protection bollards at every Type C cabinet location.

4. Install Type A network switches in the topmost area of the cabinet rack. Use the equipment receptacles for power.

5. Install supporting equipment/electronics for CCTV on the lower area of the cabinet upper left side panel. Ensure there is no physical or access conflict with the network switch. Use the EQUIP POWER distribution block for the power source.

6. Install fiber drop panels in a vertical configuration on the lower rear edge of the cabinet upper right side panel.

6.3.3 *Project Testing*

1. General Requirements

    a. The Design-Builder shall conduct a project testing program for all equipment cabinets as required in Section 1.5 of this SP. The project testing program for equipment cabinets shall include but is not limited to, the additional specific requirements in this subsection.

    b. All test results shall confirm physical and performance compliance with this SP.

    c. Submit all test results documentation to the Engineer within 14 days of completion of the tests. The Engineer will review test documentation in accordance with the Submittal Review Process in Section 1.8.

2. Standalone Acceptance Test (SAT)

    a. Perform an SAT on all equipment cabinets on this project after field installation is complete, including, but not limited to, all field devices (RDS, CCTV, communications electronics, etc.) to be installed in or connected to that given cabinet.

    b. A SAT for a given equipment cabinet shall only be performed in conjunction with the SAT for all devices installed in or connected to that given cabinet.

        i. Visual inspection of installation.

        ii. Inspection of cabinet documentation.

        iii. Functional test of all cabinet equipment, including circuit breaker, receptacles, fan and thermostat, and lights and door switches.

        iv. Measurement of DC power supply operating under full load.

6.4 Measurement

Cabinets will be measured in units of each and paid for at the contract price per each. The price bid shall include furnishing and installing the equipment cabinet and all related material and equipment specified in the Plans and this SP, and all labor, system integration, testing, system documentation and miscellaneous materials necessary for a complete and accepted installation. The unit price shall also include but is not limited to, the cabinet and all interior materials,

mounting hardware foundations, protection bollards, external conduit entrances including conduit bodies and nipples, electrical service and pole grounding terminations, technician work pads, and protection bollards. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work. Price for Type C cabinets used to support DMS will be included in the DMS pay item and not a stand- alone item.

6.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-24.01	CABINET (TYPE A)	EACH
725-24.02	CABINET (TYPE B)	EACH
725-24.03	CABINET (TYPE C)	EACH
725-24.04	CABINET (TYPE D)	EACH

Equipment Cabinet will be paid per each as follows:

1. 40% of the contract unit price for delivery of the cabinet housings.

2. Additional 40% of the contract unit price for complete installation of equipment cabinet and all interior components, electrical service feed (activated), interior cabinet components, all conduit entrances, grounding connection, and testing.

3. Additional 10% of the contract unit price for completion of Stand Alone Site Test of all field devices housed or connected to the equipment cabinet.

4. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 7
POLES AND STRUCTURES

7.1 Description

This section specifies the minimum requirements for equipment poles and structures furnished and installed in accordance with this SP and the Plans. This work shall consist of furnishing, installing, and testing 50’ and 80’ galvanized steel camera poles with foundations; 25’, 35’, and 40’ detection poles and foundations; and overhead sign structures all in accordance with this SP and the TDOT Standard Specifications for Road and Bridge Construction.

7.2 Materials

7.2.1 *Galvanized Steel Poles*

Fifty foot (50’) CCTV pole and foundation, Eighty foot (80’) CCTV pole and foundation with lowering device, conduit, connections, clamps, anchor bolts, shoe bases, and all other members shall be designed and fabricated in accordance with the Standards and requirements listed below. Design and materials documentation shall be furnished as part of the approval request submittal. Certifications will be furnished upon request by the Engineer.

1. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, current edition, including all interims and updates shall be met. Design life shall be 50 years for all poles. The “Fatigue Category”, “Galloping Loads” category and “Truck-Induced Gust Loads” would NOT apply to the poles but would apply to the sign structures.

2. Shall be designed to withstand the specified forces including those produced by a 90 mph wind with a 1.14 gust effect factor.

3. The Design-Builder shall submit manufacturer’s shop drawings, layout drawings and specifications for equipment and appurtenances for the approval of the Engineer ninety (90) days after notice to proceed.

4. Fabricator: The Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction Quality Certification Program. Proof of this certification will be required.

5. Welding: All welding shall be in accordance with Sections 1 through 8 of the American Welding Society (AWS) DI. 1 Structural Welding Code.

6. Tackers and welders shall be qualified in accordance with the American Welding Society Structural Welding code.

7. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and be visually inspected. Inspection records will be furnished to the Engineer.

8. Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt welded pole and arm splices shall be ultrasonically and radio graphically inspected. Inspection records will be furnished to the Engineer.

9. Camera Pole System shall consist of a pole, anchor bolts, base plate, ground rod array, and communication and power conduits to nearest pull box, grounding conduit, spare conduit, and foundation.

10. Design computations for the camera poles shall be complete and shall include but not be limited to the following:

    a. Consideration for all parts of the structure.

    b. Consideration for all possible loading combinations including wind and ice loads.

    c. Design stresses and allowable stresses for all components which comprise the proposed structure.

    d. The top of the pole deflection shall not exceed the following:

        i. 1 inch deflection from center (2 inch deflection diameter) due to 30 mph (non-gust) winds for the 50 foot poles.

        ii. 1.5 inches deflection from center (3 inch deflection diameter) due to 30 mph (non-gust) winds for the 80 foot poles.

    e. All complete shop drawings and design computations shall bear the stamp of a registered Professional Engineer.

    f. Shop drawings shall be approved prior to fabrication. Approval of the shop drawings does not relieve the Design-Builder of responsibility for the design, fabrication, and erection of the structure.

g. The Engineer reserves the right to reject a pole design if the calculated deflection exceeds that specified herein.

h. The foundation design shall be based on actual soil conditions from soil borings conducted by the Design-Builder. The cost of the soil borings shall be included in the cost of the pole.

11. The calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, 5 foot pole intervals, and at each slip joint splice.

12. For each pole as shown in the plans, the following information shall be given:

    a. The pole's diameter, thickness, section modulus, moment of inertia, and cross sectional area.

    b. The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each trapezoidal pole segment.

    c. The axial force, shear force, primary moment, total moment, axial stress, bending stress, allowable axial stress, allowable bending stress, and combined stress ratio (CSR) at each elevation.

    d. The pole's angular and linear deflection at each elevation.

13. Pole Mounted Cabinet Access Conduit Nipple

    a. Each pole will be manufactured with a 2" diameter rigid threaded nipple for conduit connection to a pole mounted cabinet.

    b. The height of this nipple above the base of the pole shall be such that a cabinet mounting height of 3 feet above ground height can be achieved as shown in the typical details in the plans.

14. Hand Holes

    a. The hand hole openings are reinforced with 2" wide hot rolled steel bar. The opening shall be rectangular and 5" x 8" nominal.

    b. The cover shall be 11-gauge steel and shall be secured to a clip-on lock with a tamper-proof screw.

    c. The reinforcing rim shall be provided with a ½" tapped hole and ½" hex head cap screw for grounding.

d. For poles with lowering devices two (2) hand holes shall be approximately 18" apart, center to center, or as recommended by the lowering device manufacturer.

e. The hand holes shall be fully compatible with the Camera Lowering Device and Portable Lowering Tool. If desired and compatible with the lowering device, one larger hand hole may be provided in place of two separate hand holes.

f. Hand holes on poles with pole mounted cabinets and transformers shall be placed toward oncoming traffic. For all other poles, hand holes shall face away from traffic.

15. Pole Top Junction Box: All 80' camera poles shall have a pole top connector box fastened to the pole top for cable strain relief.

16. Cable Supports (J-Hooks & Eyelets): Top and bottom J-hooks and eyelets shall be located within the pole directly aligned with each other.

17. Base Plate:

    a. Base plates shall conform to ASTM A572.

    b. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar.

    c. Plates shall be hot dip galvanized.

18. Anchor Bolts:

    a. Anchor bolts shall conform to the requirements of AASHTO M314-90 (105 ksi min. yield.) The upper 12" of the bolts shall be hot dip galvanized per ASTM A153.

    b. Each anchor bolt shall be supplied with two (2) hex nuts and two (2) hardened washers.

    c. The strength of the nuts shall equal or exceed the proof load of the bolts.

    d. The top nut shall be torqued so as to produce 60% yield stress of anchor bolt.

    e. The Design-Builder shall not grout between bottom of base plate and top of concrete foundation.

7.2.2 *Camera Lowering Device Requirements for 50' and 80' Poles*

1. All poles shall have a heavy duty Camera Lowering Device(s) (CLD) with the design capabilities of supporting both IP Base and analog base CCTV cabling. The camera

lowering system shall be designed to support and lower a Simultaneous DUAL Analog & IP closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The camera lowering system device(s) and the pole are interdependent; and thus, must be considered a single unit or system. The lowering system shall consist of a pole, suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, pole top junction box, conduit mount adapter and camera connection box. The CLD shall also meet the following requirements. The Camera Lowering Device shall be safely operable by one technician working alone, to lower the Camera Assembly to ground level for maintenance as necessary and return the Camera Assembly to the pole top mounting and secure it in place, eliminating the need for access by a bucket truck.

2. Weatherproof connectors (camera to the lowering device) shall allow for adaptation of the camera and the dome type housing for lowering and hoisting and be provided as an integral part of the design to provide a water resistant seal when the camera is raised and secured in place for surveillance operation.

3. Lifting and lowering shall be done with a motorized gear box (winch).

4. The CLD should be a stand-alone device mounted on a camera pole to be supplied by the Design-Builder and included in the cost of the associated pole.

5. An integrated CLD with pole assembly may be procured provided it meets all specifications.

6. The Camera Lowering Device shall be designed to preclude the lifting cable from contacting the power or video cabling. In the case where there are dual lowering devices the lifting cable shall not come in contact with the other CCTV's lifting cable, power and video cabling. The only cable permitted to move within the pole or lowering device shall be the stainless steel lowering cable(s). All other cables must remain secure and separate from the lowering cable.

7. The Camera Lowering Device shall support the Camera Assembly a minimum of 20" from the pole.

8. The composite cable between the camera and the CCTV cabinet will be a continuous run with available slack. No pole top interconnections or splices will be permitted.

9. The tenon top shall be a plate mounted tenon that allows for field modification of the arm/camera orientation up to 360 degrees. The tenon shall have mounting holes and slots as required for the mounting of the CLD. Unless otherwise noted, when DUAL mount lowering devices, the mounting slots shall be 180 degrees apart.

10. For dual lowering devices on the same pole the lowering devices shall be designed and installed to work independently of the other. The CLD shall be installed such that the cables from either CCTV will not come into contact with the other's cabling.

7.2.3 *Portable Camera Lowering Device Tool*

The Design-Builder shall furnish and test one Portable Lowering Tool capable of being operated by a hand winch and an electric drill motor, which is fully compatible with the Camera Lowering Device and the Steel Camera Pole and meets the following requirements:

1. The Portable Lowering Tool shall be one recommended by the manufacturer of the Camera Lowering Device.

2. The Portable Lowering Tool shall have a minimum load capacity of 200 pounds with a 4 to 1 safety factor.

3. The tool shall consist of a lightweight metal frame and winch assembly with cable, a quick release cable connector, an adjustable safety clutch, and a variable speed industrial duty electric drill motor.

4. This tool shall be compatible with the hand hole of the pole and the Camera Lowering Device inside the hand hole.

5. When attached to the hand hole, the tool will support itself and the load assuring lowering operations and provide a means to prevent freewheeling when loaded.

6. The Portable Lowering Tool shall be delivered to the Engineer upon project completion.

7. The Portable Lowering Tool shall have a reduction gear to reduce the manual effort required to operate the lifting mechanism.

8. The Portable Lowering Tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The Portable Lowering Tool shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations.

7.2.4 *Suspension Unit*

1. The Design-Builder shall design the required pole mounting adapters, brackets, and mounting hardware.

2. The Camera Lowering Device shall have a minimum load capacity 200 pounds with a 4 to 1 safety factor.

3. The enclosure receptacle and camera enclosure shall incorporate a mating device.

4. The mating device shall have a minimum of 2 latching devices. These latching devices shall securely hold the camera housing and its control equipment free of vibration or motion between the enclosure receptacle and camera enclosure.

5. The latching devices shall lock and unlock by alternately raising and lowering the camera enclosure.

6. When the camera enclosure is latched, all weight shall be removed from the lowering cable.

7. The enclosure receptacle and camera enclosure shall have a heavy-duty tracking guide.

8. The tracking guide and latching devices shall lock the camera enclosure in the same position each time.

9. Electrical contacts shall be provided to support all camera functions including both IP and analog based CCTVs. The electrical contacts shall be brass or copper and gold coated to prevent corrosion. The contacts shall be minimum 0.09" diameter, or as approved by the Engineer.

10. Replaceable gaskets shall be provided to seal the electrical contacts and latching devices from moisture and dust.

11. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless steel lowering cable. All other cables shall remain stable and secure during lowering and raising and shall be secured such that it will not come in contact with the steel lowering cable.

12. The Camera Lowering Device shall be designed to permit a ±3 degree of horizontal adjustment for leveling the dome enclosure.

13. The lowering cable shall be a minimum 5/32" diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds.

14. Weights and/or counterweights shall be provided to assure the alignment pin and connectors for the camera connection can be raised into position without binding and that it can be lowered properly.

7.2.5 *Light Standards (for RDS)*

1. This work shall consist of furnishing detection poles with foundations. Heights shall be as indicated on the Plans or as directed by the Engineer. All work shall be in accordance

with the TDOT Standard Specifications for Road and Bridge Construction. The poles supplied shall be standard TDOT luminaire poles.

2. Poles heights shall be as indicated on the Plans.

3. The Design-Builder shall supply poles as specified on the Plans and install as shown on the Plans.

4. Light Standards for RDS shall consist of, but not limited to a pole, anchor bolts, breakaway base, base plate, ground rod array, communication and power conduit to nearest pull box, grounding conduit, spare conduit, and foundation as shown in Plans.

7.2.6 *DMS Overhead Mounting Structures*

This section describes the requirements for the span type structures (Sign Bridge) to support the DMS elements.

1. The work to be completed by the Design-Builder includes the design, assembly of the component parts and installation including sign span type structures, footings, associated attachment hardware, conduit, wiring, and testing of the structure.

2. The sign structure shall have demonstrated long-term durability to withstand extreme temperatures and weather conditions.

3. Each structure shall be fully warranted for but not limited to rust, corrosion, and structural failure as a complete assembly by the manufacturer for a period of five (5) years, and prorated for up to seven (7) years.

4. The following are the DMS structural design criteria that must be adhered to by the Design-Builder:

    a. Minimum vertical clearance between pavement or shoulder to the lowest DMS or DMS sign component: 20 feet.

    b. Design wind load on signs and mountings shall be based on the TDOT standard wind velocity, no less than 90 mph from any direction.

    c. The sign design area for wind load shall be the width of the entire roadway times the height of the DMS sign times 1.5.

    d. The foundation design shall be based on actual soil conditions from soil borings conducted by the Design-Builder. The cost of the soil borings shall be included in the cost of the structure.

5. The Design-Builder shall provide to the Engineer additional calculations as necessary to design the connections between DMS and the structure and special attachment details.

6. The sign manufacturer shall consider truck induced wind loading in deflection calculations. The natural frequency response of the structure to truck induced wind loads when span type DMS structures are used shall be considered. More information can be obtained on this subject in the Transportation Research Board (National Research Council) "Truck Induced Wind loads on Variable Message Signs," Research Record No. 1594, published in 1997.

7. The Design-Builder shall provide the Engineer calculations and shop drawings for all items associated with the manufacturing, construction, and installation of the sign structure, its attachments, and its foundation.

8. The Design-Builder shall determine the actual length of support columns for all sign structures on the basis of existing field conditions.

7.3 Installation Requirements

All equipment shall be installed according to the manufacturer's recommendations and Plans. Materials and associated accessories/adapters shall not be applied contrary to the manufacturer's recommendations and standard practices.

7.3.1 *Poles*

Standards and posts for the camera poles shall be installed as indicated on the Plans and shall conform to the following requirements:

1. All poles shall be installed in accordance with the National Electric Safety Code and ASSHTO.

2. Foundations:

    a. The Design-Builder shall submit a design for pole foundations that has been sealed by a registered Professional Engineer.

    b. The foundation design shall adhere to the prescribed loading and wind deflection as specified in TDOT Standards Specification.

    c. The foundations shall be constructed in accordance with the TDOT Standard Specifications and shall adhere to the approved shop drawings for the loading specified.

d. If soil conditions require the use of any shoring, casings, or sonotube for proper installation of the foundations, the cost of the shoring, casings or sonotube shall be included in the cost of the pole and foundation.

3. The dimensions and reinforcing steel shall be in accordance with the requirements of Specifications.

4. Cast-in-place concrete pole foundation shall cure a minimum of 7 days before any load is applied to the foundation.

5. Conduit shall be installed in the pole foundation for access and includes conduit to the nearest pull box as shown in plans.

6. A minimum of one 2 inch spare conduit shall be installed in all pole foundations as shown in the Plans Typical Details. Spare conduits in pole foundations shall be sealed with blank duct plugs.

7. Grounding System

   a. The Design-Builder shall supply and install a grounding system with ground rod array at the base of all poles as shown on the Plans.

   b. The ground rod array system shall be connected to the pole through an appropriate ground clamp.

   c. A #6 AWG copper stranded bonding wire shall be installed between the pole and the field cabinet providing a common ground system for each site.

   d. All ground bonding wires shall be unspliced.

8. The installation method for the CCTV poles and cameras shall be such that the camera can be rotated as needed around the pole for optimum placement.

7.3.2 *DMS Structure Construction Requirements*

1. DMS Structures shall be installed according to the manufacturer's recommendations and Plans.

2. The Design-Builder shall procure all overhead sign structures required for the Regional TMS project according to the Specifications shown in the Plans.

3. All sign structure plans and calculations shall be approved by the Engineer. Materials certifications, including mill test reports, shall be submitted to the Engineer prior to erection of the sign structure.

4. It should be noted that no soil borings have been conducted. The Design-Builder shall perform soil borings to be included in the cost of the structure. All soil data utilized by the Design-Builder shall be part of the as-built design plan set for the project.

5. If soil conditions require the use of any shoring, casings, or sonotube for proper installation of the foundations, the cost of the shoring, casings, or sonotube shall be included in the cost of the pole and foundation.

6. DMS structures shall be grounded in accordance with the DMS and the structure manufacturers' recommendations and the Standard Specifications.

7.4 Measurement

7.4.1 *CCTV Pole and Foundation (50' Pole)*

CCTV Pole and Foundation (50' Pole) will be measured in units of each and paid for at the contract price per each. The price bid shall include but is not limited to a 50' steel strain pole foundation, lowering device (where identified in the plans), conduit inside foundation and to the nearest pull box, wiring between camera and field cabinet, connections to support structures, satisfactory completion of testing and training requirements, and all work, equipment, and appurtenances as required to effect the full operation including remote and local control of the CCTV site complete in place and ready for use. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

7.4.2 *CCTV Pole and Foundation (80' Pole)*

CCTV Pole and Foundation (80' Pole) will be measured in units of each and paid for at the contract price of each. The price bid shall include but is not limited to a 80' steel strain pole, lowering device, foundation, conduit inside foundation and to the nearest pull box, wiring between camera and field cabinet, connections to support structures, and satisfactory completion of testing and training requirements, and all work, equipment, and appurtenances as required to effect the full operation including remote and local control of the CCTV site complete in place and ready for use. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

7.4.3 *DMS Structures*

DMS Structure will be measured in units of each and paid for at the contract price of each. The price shall include but is not limited to support structures, foundations, catwalk, connection hardware, conduit on the structure, inside foundation and to the nearest pull box, repaving and material restoration around the foundation, satisfactory completion of testing, and all work,

equipment, and appurtenances as required to have the structure complete, in place and ready for use. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

7.4.4 *Lowering Tool for Camera Lowering Device*

Lowering Tool for Camera Lowering Device will be measured in units of each and paid for at the contract price of each. The price bid shall include the complete operational device including all attachments. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

7.4.5 *Light Standard (for RDS)*

Light Standards, for RDS, will be measured in units of each and paid for at the contract price of each. The price bid shall include but is not limited to a light standard pole, breakaway base, foundation, conduit inside foundation and to the nearest pull box as indicated in the plans, wiring between RDS and field cabinet, connections to support structures, satisfactory completion of testing and training requirements, and all work, equipment, and appurtenances as required to effect the full operation including remote and local control of the RDS site complete in place and ready for use. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

7.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
714-08.09	LIGHT STANDARDS (25’ POLE HEIGHT)	EACH
725-20.01	CCTV POLE & FOUNDATION (50FT POLE W/LWRNG DVICE)	EACH
725-20.02	CCTV POLE & FOUNDATION (80FT POLE W/LWRNG DVICE)	EACH
725-20.03	LOWERING TOOL FOR CAMERA LOWERING DEVICE	EACH

725-20.22	STEEL OVERHEAD SIGN STRUCTURE (SPANS 51 FT TO 70 FT)	EACH

The CCTV Pole and Foundation Items (50’ and 80’), Light Standards, and Steel Overhead Sign Structures will be paid per each as follows:

1. 25% of the contract unit price upon complete installation of foundations.

2. Additional 45% of the contract unit price upon delivery of poles or structure to the site.

3. Final 30% of the contract unit price upon complete installation of poles or structure.

Lowering Tool for Camera Lowering Device will be paid at the unit price for each device when delivered to TDOT.

SECTION 8
CCTV CAMERA SYSTEM

8.1 Description

This Section specifies the minimum requirements for CCTV Camera Systems furnished and installed on this project.

The CCTV Camera System will provide TMC personnel with live streaming video of the roadway network via CCTV Camera Systems installed at locations shown in the Plans. It is the Design-Builder's responsibility to furnish, program, install, and integrate the CCTV camera system in the field and at the TMC. The Design-Builder installed CCTV cameras shall be integrated by the Design-Builder into the existing video display wall and the PTZ video control system at the TMC.

The Design-Builder shall submit a plan for display of the IP CCTV cameras on the existing video wall equipment and submit it to the Engineer for approval. The Design-Builder shall work with the video wall manufacturer and the IP CCTV manufacturer to create a plan for the integration of the cameras into the video wall. This coordination and integration effort shall be included in the cost of the CCTV.

8.2 Materials

All materials furnished, assembled, fabricated or installed shall be new, corrosion resistant and in strict accordance with all of the details shown in the Plans and described in this SP.

The CCTV Camera System shall comply with the following minimum materials specifications:

8.2.1 *General Capabilities and Performance Requirements*

1. Overall CCTV Camera System capabilities and performance requirements include the following:

    a. CCTV Camera System shall be placed at fixed locations as shown on the Plans to provide full coverage within the project limits including the mainline travel lanes and shoulders.

b. The CCTV Camera System components shall be compatible with each other and be of rugged design and suitable for reliable operation when mounted in the configuration as specified in this SP and the Plans.

c. The CCTV Camera System shall be capable of attended and unattended, continuous 24 hours per day operation at the sites as shown on the Plans.

d. The Design-Builder shall ensure that the installed equipment provides unobstructed video of the roadway, traffic, and other current conditions around a roadside CCTV field site; that it responds to camera control signals from an operator of the system; and that the video images can be transmitted to remote locations interfaced to the system for observation.

e. The camera shall be fully digital, IP addressable and compliant with the H.264 video encoding standard. Any deviation from a digitally encoded H.264 IP CCTV camera shall be at the approval of the Engineer.

f. The camera shall be fully compliant with all aspects of the full motion National Television Standards Committee (NTSC) specification, and produce NTSC quality video.

g. The camera shall operate over wide dynamic light conditions ranging from low light/dusk to full sunlight having day (color)/night (monochrome) switchover and iris control, with user-selectable manual and automatic control capabilities.

h. The CCTV Camera System shall be capable of being remotely controlled and programmed.

i. Dome type enclosures shall be provided with pressurized integrated optic cartridge (IOC) for environmental protection

j. The camera shall be mounted together with the zoom lens and integrated into the pan and tilt device within the dome enclosure forming a totally integrated, easily removable assembly.

k. The camera shall include a high quality integrated camera/lens combination.

l. The camera shall also be equipped with an auto-iris lens capability compatible with the zoom lens supplied.

m. Iris capability shall include a provision for manual override via software.

n. The camera shall be capable of auto-focus during zoom-in or zoom-out, with provisions for override via software.

o. Overexposure protection shall be provided - the camera shall not be degraded or damaged under normal reasonable operating conditions.

p. The capability for local control of pan, tilt and zoom functions shall be provided at the roadside cabinet using vendor-supplied software installed on a laptop computer.

q. CCTV cameras shall support the NTCIP 1205 v1.08 communication protocol.

r. The cameras shall have image stabilization to reduce image jitter during viewing of the video.

s. The Vendor shall provide a minimum three (3) year warranty that covers manufacturing defects and workmanship. The warranty shall cover complete replacement at no charge for the equipment.

8.2.2 Camera Unit

The minimum Camera Unit requirements include:

1. Image Sensor Size: Not less than Diagonal 6mm (1/3" type)
2. Image Resolution: Not less than 1280 x 720
3. Picture Elements (total) Not less than 1348 (H) x 976 (V)
4. Video Output: 16 Bit Digital YUV: 4.2.0
5. Day/Night Operation: Adjustable (Auto, Color and Mono Modes) via removable IR cut filter
6. Maximum Lens Aperture: Not less than f/1.6 (wide) to f/2.8 (tele)
7. Optical Zoom Range: Not less than 35X, 4.7mm to 84.6mm
8. Optical Zoom Speed: Two speeds
9. Horizontal Angle of View: Optical: Not less than 55.2° to 3.2
10. Minimum Focus Distance: Not greater than 0.01m (w); 1.0m (t)
11. Auto Focus: Selectable Auto/Manual; Minimum Scene Illumination for Reliable Auto Focus shall be no more than 50% video output.
12. Manual Shutter: Selectable
13. Auto Iris; Selectable auto/manual; Iris shall automatically adjust to compensate for

changes in scene illumination to maintain constant video level output within sensitivity specifications.

14. Sensitivity: Scene Illumination minimums ; F1.6 @ 50% Video

    a. 1.8 Lux (0.18 fc) @ 1/30 shutter, color mode

    b. 0.1 Lux (0.01 fc) @ 1/30 shutter, mono mode

8.2.3 H.264/MJPEG Encoding Engine

The IP Camera Positioning System (IPCPS) system shall fully integrate within its enclosure an H.264/MJPEG encoding component with functions as specified below. The Design-Builder may submit a nonintegrated solution installed in the traffic control cabinet or separate CCTV cabinet if it provides the same capabilities and is hardened for extreme temperatures, under approval by the Engineer.

1. Video Encoding: H.264 (Main Profile/Level 3.1) and MJPEG standards

2. Video Streams: Two independently configurable streams; (1) H.264 and (1) MJPEG

3. Video Stream Configuration Properties;

    a. Stream Settings

        i. Video Stream 1: H.264.

        ii. Video Stream 2: MJPEG

    b. Video Resolution: Not less than 480p and 720p

    c. Streaming Mode: Capable of selectable CBR or VBR

    d. Frame Rates: 30, 15, 7, 4, 2, 1 fps

4. Data Rate: Adjustable in a range of not less than 256k up to 12Mb/sec for streaming video

5. Connection Types: Uni-cast or multi-cast

6. IPCPS Video Latency: <150ms

7. Network Protocol Layers: RTP, RTSP, UDP, TCP, IP, DHCP, DNS, HTTP, HTTPS IGMPv2, ICMP, SMNPv2c/v3, and ARP as aminimum

8.2.4 Positioning Drive

1. Pan Movement; 360 degrees continuous rotation
2. Pan Speed; Variable from 0.1 to 90 degrees/second or better.
3. Pan Repeatability; +/- 0.25 degree precision or better
4. Pan Preset Speed; 180 degree movement < 2 Seconds
5. Tilt Movement; Minimum of +90 to –90 degrees
6. Tilt Speed; Variable from 0.1 to 45 degrees/second or better.
7. Tilt Repeatability; +/- 0.25 degree precision
8. Tilt Preset Speed; 180-degree movement < 3 Seconds or better

8.2.5 Operational

The camera shall utilize NTCIP v1.08 communication protocol.

1. Presets; Minimum of 64, with each preset consisting of a pan, tilt, zoom and focus coordinate.
    a. Video Freeze between presets; Allow selection of freeze or live video during preset movements.
2. Preset Tours; Minimum 8 tours required, each tour shall consist of up to 32 pre-programmed presets, with individual dwell time property per preset per tour.
    a. Tour presets shall be useable in any order
    b. Presets may be used multiple times in tour
    c. Tours shall stop upon receipt of any pan/tilt positioning command.

d. Tour data shall be stored in non-volatile memory and shall not be lost if a power failure occurs.

3. Sector Zones; Provide a minimum of up to 16 user defined sector zones with each zone having a unique 24 character ASCII title programmed for description purposes.

4. Camera Site ID: Provide up to 2 lines of up to 24 ASCII characters each on video for user site description ID. If both lines are programmed, line 1 of ID shall always appear above line 2 regardless of top or bottom selection

5. Preset ID: Provide 1 line of up to 24 ASCII characters on video for Preset ID description. When a preset position is recalled the corresponding preset ID shall be displayed. The preset ID shall remain displayed until a pan, tilt, zoom, manual focus, auto focus select, or another preset command is received.

6. Scalable Zoom; Variable speed pan/tilt ranges based off of zoom position. This adds the capability of limiting the maximum pan/tilt speed, while maintaining variable speed capability, throughout the zoom range of the camera.

7. Updates: The IPCPS shall allow updates of firmware for new features via the Ethernet network communication channel. An internal IPCPS web server shall be provided for performing this task.

8. The IPCPS system shall return to previous position and state of operation upon power loss and restoration.

8.2.6 IP Management

The IPCPS shall provide at minimum the following network configuration properties;

1. IP Configuration: DHCP or Static IP address entry

2. Net mask address entry

3. Gateway address entry

8.2.7 Power Input

The IPCPS system shall fully comply with and include independent laboratory test results confirming compliance with the following electrical operating conditions;

1. Power; <100 Watts Maximum

2. Operating Voltage; 100-240 VAC

3. The nominal voltage shall be 120 VAC, Per NEMA-TS2 para 2.1.2

8.2.8 Mechanical

1. Connectors weatherproof non-corrosion type

2. Weight; Maximum 25lbs

3. Construction; Light Colored Powder Coated aluminum; all internal and external parts corrosion protected, stainless steel fasteners.

4. Faceplate shall be optically correct glass.

5. Camera Mount; provided to match pole locations on plans. See plans for variable types of poles.

6. Camera housing shall be equipped with a 1.5" NPT pipe thread to allow for connection to the Camera Lowering Device connection box

8.2.9 Environmental

The IPCPS system shall fully comply with and include independent laboratory test results confirming compliance with the following environmental operating conditions;

1. Temperature; The operating ambient temperature range shall be from -34°C (-30°F) to +60°C (+140°F).

2. Vibration; Per Nema-TS2 paragraphs 2.1.9, 2.2.3, 5-30Hz sweep @ 0.5g applied in each of 3 mutually perpendicularplanes.

3. Shock; Per Nema-TS2 paragraphs 2.1.10, 2.2.4, 10g applied in each of 3 mutually perpendicular planes.

4. Water Spray; Per IEC 60529+A1, 1999, Para 14.2.6, Solid water stream delivered thru 12.5mm nozzle @ 25 gallons/minute @ 9ft for 3 minutes

5. External Icing; Per Nema-TS2 250-2003, paragraphs5.6

6. Corrosion Protection; Per NEMA 250-2003, paragraphs 5.10

7. Humidity; The IPCPS shall withstand the effects of humidity up to 100%, in accordance with MIL-E-5400T, paragraphs 3.2.24.4

8. Minimum Standards; IP66

8.2.10 Certifications

1. CE (24VAC)

2. FCC Class A

8.2.11 Surge Protection

All CCTV Camera System electrical interconnects shall be protected from transient over-voltages (surges) including lightning and external electromagnetic fields coming into the cabinet. All cables shall be protected from a surge coming in on the ground and load side of the cabinet. The minimum surge protection requirements include:

1. Surge protectors shall be furnished for all non-dielectric cable and conductors (video, data/signal and device/assembly power) between the CCTV Camera System and the equipment cabinet.

2. The surge protectors shall have leads that are kept to a minimum length as recommended by the surge device manufacturer.

3. All surge protection devices shall be designed and selected to meet the temperature and humidity requirements expected in this type of outdoor application. Surge suppressors including variable temperature components (i.e., PTCs) shall not impede signals at any elevated temperatures.

4. All Surge protectors shall be U.L. listed (UL 1449 3rd Edition, UL 497, 497A, 497B,) and bonded to the same single-point ground point. Any DIN rail mounted SPDs shall be grounded via conductor and shall not rely solely upon the DIN rail's mechanical connection as a grounding point.

5. Any directional SPDs shall be clearly marked as "Protected Side" and "Unprotected Side" and installed such that the Protected Side faces the equipment and the Unprotected Side faces the conductors coming into the cabinet.

6. If coaxial cable surge protectors are used from acceptance by the Engineer, the Coaxial Cable Surge protectors for coaxial cable shall meet/provide the following functionality:

    a. Attenuation: 0.3dB @ 10 MHz, typical.

    b. Input/Output Impedance: 75 ohms nominal.

    c. Operating Voltage of the surge protector shall match characteristics of the ITS device/assembly.

    d. Peak Surge Current: 5,000-amperes for an 8x20 microsecond waveform.

    e. Response Time: 1 nanosecond or less.

    f. Surge suppressor shall be self-resetting.

    g. Coaxial SPDs shall be installed in a manner that prevents ground loops and resulting signal deterioration. This is usually caused where the cable has different references to ground at either end and connecting SPDs at both ends that have only Pin to Shield protection completes a ground loop circuit through the Shield. SPDs having Pin to Shield protection, and separate Shield to Ground protection are acceptable to eliminate ground loops.

7. Low Voltage/Signal Cable Surge protectors for data/signal/control cable shall meet/provide the following functionality:

    a. Peak Surge Current: 10,000-amperes for an 8x20 microsecond waveform.

    b. Shall be rated for the appropriate voltage.

    c. Response Time: 1 nanosecond or less.

d. Life Expectancy: Capable of surviving at a minimum of 25 occurrences at 2000-amperes.

e. Surge suppressor shall be self-resetting.

8. CCTV power surge protectors for power from equipment cabinet power distribution to the CCTV Camera System shall meet/provide the following functionality:

    a. Frequency: DC to 10MHz.

    b. Clamping Voltage: < 30VAC (rms) or 42VDC.

    c. Insertion Loss: < 0.2dB

    d. Input/Output Impedance: 75 ohms, typical.

    e. Peak Surge Current: 3000-amperes.

    f. Response Time: 1 nanosecond or less.

    g. Surge suppressor shall be self-resetting.

8.3 Installation Requirements

The following applies to both new CCTV sites and where an existing CCTV is being replaced under the contract. All equipment shall be installed according to the manufacturer's recommendations, the Plans and as follows:

1. Materials and associated accessories/adapters shall not be applied contrary to the manufacturer's recommendations and standard practices.

2. Shall include all materials needed to permanently mount the CCTV camera to the support structure as indicated in the plans.

3. Furnish and install power, video, and data cables, and any and all ancillary equipment required to provide a complete and fully operational CCTV system site.

4. Verify all wiring meets NEC requirements where applicable.

5. Cameras shall be mounted in positions which allow 360 degree continuous rotation and mounting arm position shall be approved by the Engineer prior to pole placement.

6. Furnish and install all appropriate field surge protection devices, and ensure proper ground per manufacturer recommendations.

7. Coordinate with the Department for IP addresses, and video encoding settings for all CCTV camera sites prior to turn-on/installation and site testing.

8. The CCTV system shall be compatible with, and integrated into the existing TMC video wall and CCTV control software. It shall be the Design-Builder's responsibility to coordinate with the TMC operations personnel for Design-Builder integration of the new CCTV cameras into the existing video wall and video control software systems. It is the Design-Builder's responsibility to integrate and test all video control and display of the cameras at the TMC.

8.4 Measurement

CCTV Camera System will be measured in units of each and paid for at the contract price per each. The price bid shall include furnishing, installing, system integration, training, documentation, and testing of a complete CCTV Camera System including the CCTV Camera Assembly, PT unit, zoom lens, enclosure, camera controller/receiver, coaxial cable (if required and approved), outdoor rated category 5e cable, control/signal cable, power cable, surge suppressors and conduit between the camera and the cabinet, connections to support structures, attachment hardware and brackets and all incidental items to provide and install the CCTV Camera System as intended, as well as the satisfactory completion of all testing requirements and all work, equipment and appurtenances as required for a full CCTV Camera System. The price bid shall also include all local configuration and control manufacturer software, system documentation including: shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams and other materials necessary to document the operation of the CCTV Camera System. The price bid shall include integration and configuration into the existing TMC video wall and controller, and testing for display of the video on the existing video wall. This price shall be full compensation for all labor, tools, materials, equipment and incidentals necessary to complete the work.

8.5 Payment

The contract unit price shall be full compensation for all the work specified in this Section.

Payment will be made under:

Item	Description	Unit
725-20.91	CCTV CAMERA SYSTEM	EACH

The CCTV Camera System will be paid per each as follows:

1. 50% of the contract unit price upon approval of Bench Test Component, Bench Test System and Pre-Installation test results.

2. Additional 20% of the contract unit price upon approval of Stand Alone Site Test results.
3. Additional 20% of the contract unit price upon approval of Conditional System
4. Acceptance Test results including CCTV video display on existing video wall.
5. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 9
TMC SYSTEMS

9.1 Description

This section describes the Region 1 Transportation Management Center (TMC) equipment and software specifications and requirements for this project. The work consists of providing all labor, materials, software, and incidentals necessary to furnish, install, integrate, and test the Region 1 Rural ITS SmartWay system deployment. The work includes all additional licensing, documentation and training necessary to operate the system as required in this SP.

TDOT has three (3) existing legacy central control software packages that will control the new ITS field devices after the completion and acceptance of this project. These systems include MIST provided by Telvent for RDS and DMS control; Cameleon by 360 Surveillance for CCTV distribution and control, FTP image capture, and videos stream selection for video wall; and Barco for video wall CCTV decoding. The Design-Builder will be responsible for integrating the ITS devices provided in this contract into those legacy systems. These systems currently support multiple ITS device makes and models. Therefore, this Contract is a total "turn-key" solution that ensures the DMS, RDS, and CCTV subsystems are fully functioning with the central software in place.

For all active electronic devices controllable through any type of communications interface, the Design-Builder shall be required to voluntarily, and without seeking additional fees, restrictions, licenses or compensation from TDOT, coordinate with each respective system representative for each piece of equipment supplied, to support direct communication with and control of devices by the TDOT SmartWay operational systems identified. The Design-Builder will be responsible for coordinating with the system venders to insure sufficient drivers are developed to support the new device make and/or model provided under this contract without additional compensation.

9.2 Materials

9.2.1 *General Requirements*

The TMC system procured and installed under this Contract shall support daily operations and maintenance activities associated with the SmartWay ITS.

1. TMC Systems Design Report Submittal

   The Design-Builder shall document and submit a TMC Systems Design Report to the Department for review and approval prior to any integration of new ITS field devices

within the TMC. The TMC Systems Design Report shall document the Design-Builder's overall TMC design including overall network modification configuration, and confirmation of device support by the TMC legacy system developers. Detailed submittal requirements are included in Section 9.2.6. The cost for this submittal is considered incidental and included in the cost of other items.

2. Local Area Network (LAN)

    a. The SmartWay shall operate over a TCP/IP client/server architecture, which will support operations over the TMC SmartWay local area network (LAN) and the TDOT network.

    b. The Design-Builder shall document in the TMC Systems Design Report submittal the TMC building infrastructure (e.g., cabling, patch panels/cords, etc.) requirements needed to support their TMC system configuration.

3. TMC Hardware / Equipment

    a. The Design-Builder shall be responsible for the integration, configuration, and testing of all ITS field devices with TMC hardware and equipment through the legacy software as specified herein.

    b. It is the Design-Builder's responsibility to ultimately install, configure, integrate and test the TMC SmartWay LAN modifications and legacy software along with the field network devices and ITS subsystems.

4. Communications

    a. The TMC shall be able to communicate with field devices via wireless/radio and fiber optics that support Ethernet communications.

9.2.2 *CCTV Software*

TDOT presently operates Cameleon (Enterprise Server Version 2011.4 Build 24) at the TMC for video management. The Design-Builder's responsibility related to this Software is to coordinate with the software developer to ensure that supported drivers include all new CCTV elements added as part of this contract.

9.2.3 *DMS Software*

The Design-Builder shall provide vendor supplied software capable of testing DMS commands from the TMC over the network. This software will be used for testing and verification only. Cost of the DMS Software shall be included in the cost of the DMS units. The software shall not require serial data converters (i.e., terminal servers) to establish DMS communications.

9.2.4 *RDS Software*

RDS devices will be used to drive this project's speed feedback DMS through the use of programmable logic controllers (PLC). The programing of these PLCs to achieve the described special feature operation will be the direct responsibility of the Design-Builder.

The Design-Builder shall also provide vendor supplied software capable of testing RDS data from the TMC over the network. This software will be used for testing and verification only. Cost of the RDS Software shall be included in the cost of the RDS units.

9.2.5 *System Integration*

System Integration shall include all integration tasks that are needed to meet all specification requirements but are not included specifically in the cost of other items.

This includes, but is not limited to, integration with the identified legacy system, efforts associated with meeting the general requirements of this SP, integration with the building UPS monitoring systems, coordination with the TDOT IT department, system integration diagrams to document the overall configuration of the system, and other related system and integration activities.

9.2.6 *Project Submittal Program Requirements*

1. General Requirements

    a. The Design-Builder shall provide project submittals for all TMC Systems as required in Section 1.8 of this SP, including scheduling requirements. The project submittals for TMC Systems shall include but are not limited to the additional specific requirements in this subsection.

2. TMC Systems Design Report Submittal

    a. The Design-Builder shall submit to TDOT for review and approval a TMC Systems Design Report submittal, which documents the detailed TMC integration

approach and includes all the elements specified in this section of this SP as follows:

i. Client/server network and operating system requirements, if different from that specified in this section.

ii. The Design-Builder shall review the equipment/hardware/infrastructure (workstations, servers, cabling, patch cords, etc.) specifications provided in this section. If the Design-Builder requires something different from that currently specified to support their System Integration efforts and configuration, they shall provide their rationale/reasons with supporting documentation for the requested changes or modifications as part of this submittal. If the Design-Builder is in full agreement with the hardware/equipment specifications as specified in this section they shall provide an affirmative acknowledgement/statement of this fact within the submittal.

iii. The Design-Builder shall provide documentation on application data file format/structure as specified herein.

iv. The Design-Builder shall provide description and integration details of the video wall subsystem.

v. The Design-Builder shall provide proposed expansions to the network addressing schemes and network traffic routing modifications.

vi. The Design-Builder shall provide ten (10) bound copies including one (1) signed original to TDOT for review and approval thirty (30) calendar days prior to any procurement.

vii. The Design-Builder shall provide three (3) CD copies of the TMC Systems Design Report submittal.

b. The Design-Builder shall also provide detailed discussion and rationale for any and all requested changes or modifications to system design configuration, hardware and software operating system requirements as specified in this section of this SP.

c. The Design-Builder may request that one or more of the requirements as specified herein be modified or replaced in support of their system solution. Any and all requested modifications and changes to requirements shall be documented in detail in the submittal for consideration and approval by TDOT. The Design-Builder will be responsible for any additional costs resulting from the requested changes.

d. The cost of the TMC Systems Design Report shall be included in the cost of other items, as are all submittals.

9.3 Installation Requirements

All equipment and software shall be installed according to the manufacturer's recommendations and the Plans.

Any beneficial use by TDOT of any portion of the TMC hardware or integrated software system does not constitute TDOT acceptance or waive any Design-Builder responsibility or testing requirements.

9.1.1 *General*

1. The Design-Builder shall configure, integrate, and test the TMC hardware and equipment in accordance with the Plans and this SP.

2. All patch cords and cabling within the TMC shall be consistent and meet the minimum cabling requirements as specified in this SP.

3. The Design-Builder is responsible for ensuring that all cables, connectors, interfaces, supplies, and any other items necessary for the proper operation and function of any component or software product shall be installed, integrated, and tested to provide a fully operational system. Note that TDOT will provide the network cabling from the equipment room out to the floor boxes under each console. The Design-Builder will be responsible for all other cabling between the equipment and floor boxes and between equipment within the Equipment Room.

4. IP address ranges for all devices will be provided by TDOT.

5. The Design-Builder shall be responsible for obtaining any MIB (Management Information Base) information for all field devices supporting SNMP. The Design-Builder shall configure the NMS software to meet all requirements of Section 10.2.7. In the NMS user interface, the Design-Builder shall configure the ITS Device ID's for each SNMP device on the network.

9.1.2 *Testing Requirements*

The Design-Builder shall conduct a project testing program for System Integration as required in Section 1 of this SP and as follows:

1. In addition to demonstrating that the System Integration functionality meets this SP, the Bench Test Component test shall demonstrate that TDOT furnished equipment operates with Design-Builder furnished and installed software.

2. The Design-Builder shall use TMC servers during the Bench Test System (BTS) to demonstrate that the System Integration meets the requirements of this SP and is operable with the new and existing system.

9.4 Measurement

9.4.1 CCTV System Software

For all active CCTV related devices controllable through any type of communications interface, the Design-Builder shall be required to voluntarily, and without seeking additional fees, restrictions, licenses or compensation from TDOT, coordinate with 360 Surveillance representatives, to support direct communication with and control of devices by the TDOT SmartWay Cameleon video distribution system and Barco video wall.

9.4.2 *DMS System Software*

DMS Software is vendor software for testing only; therefore, there is no separate payment for this item. For DMS devices controllable through any type of communications interface, the Design-Builder shall be required to voluntarily, and without seeking additional fees, restrictions, licenses or compensation from TDOT, coordinate with Telvent Farradyne representatives, to support direct communication with and control of devices by the TDOT SmartWay MIST system.

9.4.3 *RDS System Software*

PLC programing to extract data from RDS devices used to drive this project's speed feedback sign, truck information lane traffic signals, and associated queue backup detection is the direct responsibility of the Design-Builder. Payment for PLC programing is embedded in that item and there is no separate payment for this item.

RDS Software is vendor software for testing only; therefore, there is no separate payment for this item. For RDS devices controllable through any type of communications interface, the Design-Builder shall be required to voluntarily, and without seeking additional fees, restrictions, licenses or compensation from TDOT, coordinate with Telvent Farradyne representatives, to support direct communication with and control of devices by the TDOT SmartWay MIST system.

9.4.4 *Additional Software*

Any additional application software, tools, and associated licenses that are not listed in the items (9.4.1 through 9.4.3) above but are needed to provide a complete and operational system as well as meet the requirements of this SP shall be considered incidental and shall be included in the cost of the most appropriate item.

9.4.5 *System Integration*

System Integration will be paid for on a lump sum basis wherein no measurement will be made. The price bid for system integration shall include all integration tasks that are needed to meet all specification requirements but are not included specifically in the cost of other items. This includes but is not limited to integration with the video wall controller, integration between the various software packages, efforts associated with meeting the general requirements of this SP, integration with the Hub UPS and security monitoring systems, integration with the building UPS monitoring systems, coordination with the TDOT IT department, system integration diagrams to document the overall configuration of the system, and other related integration activities. This item shall also include the network cabling from the equipment room to the workstations (Cat-5e network cable), rack-mounted video monitor and keyboard, UPSs, KVM switch, and interface adaptors.

This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

9.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-24.51	SYSTEM INTEGRATION	LS

System Integration will be paid on a lump sum basis as follows:

1. 20% of the contract unit price upon successful completion of the bench test system (BTS) as stated in Section 1.5.4 of this SP.

2. Additional 70% of the contract unit price upon conditional system acceptance as stated in Section 1.5.7 of this SP.

3. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 10

COLOR DYNAMIC MESSAGE SIGN

10.1 Description

This section describes furnishing, installing, and integrating a high resolution color electronic Dynamic Message Sign (DMS) assembly on a full span structure over the roadway and ground testing of signs. The Design-Builder shall supply a complete operating Light Emitting Diode (LED) sign including the sign case, sign controller unit (SCU), all cabling, conduits, electrical service, surge suppression, and all hardware associated with a complete installation as required by these Special Provisions. Note that the DMS item used to include a Roadside DMS Controller Cabinet. Now a separate Type C cabinet item is included in the plans and utilized as the Roadside DMS Controller Cabinet.

The DMS assemblies will provide TMC personnel with a means to visually communicate with motorists regarding any incidents, accidents, special events, travel times, graphical representations of the roadway during the roadway construction project. The DMS system shall also include manufacturer software that allows the creation, placement and display of graphics on the DMS. This software shall be installed in the Regional TMC with TMC operator access to the DMS field controller to allow display status and operational status.

10.2 Materials

10.2.1 General

1. Each DMS assembly shall consist of the following minimum components and general requirements:

    a. Full matrix LED sign with walk-in sign case.

    b. Mounting brackets.

    c. Associated SCU and software.

    d. Cabling between the various components.

    e. All electrical components shall be of the solid-state design. Use of vacuum or gaseous tube devices is not acceptable.

2. Provide door locks for all sign case and DMS cabinet doors, keyed to TDOT standard Corbin #2 that will be provided and confirmed during the submittal process. Provide two keys with each DMS location.

3. Provide a voltage label on all sign cases and DMS cabinets or enclosures in accordance with the NEC labeling requirements. Voltage labels shall meet the following minimum requirements:

    a. Labels shall be flat black lettering on a reflective yellow background. Lettering shall be a minimum of 1 inch in height.

    b. Labels shall be manufactured from pre-coated adhesive backed reflective sheeting material meeting the minimum requirements of AASHTO M268 Type 1.

    c. Labels shall include the voltages entering the cabinet and shall be one continuous adhesive sheet. Examples are “120 VAC” or “120/240 VAC”.

    d. Labels shall be installed on all sign case and DMS cabinet doors.

10.2.2 Sign Display

The sign display shall meet the following requirements:

1. Each sign display shall have a single plane surface constructed of a single array of pixels.

2. The multi-color DMS system shall include manufacturer’s central control software.

3. Each sign display shall be able to display full color, a minimum of 24 bit displayable color.

4. Each full matrix sign display shall be able to display three (3) lines of twenty-one (21) -18” tall characters that adhere to the respective MUTCD required NEMA TS 4 font sizes for electronics changeable message signs.

5. Pixel columns and rows shall be perpendicular. The Pixel Matrix shall have a minimum of 96 rows x 400 columns.

6. Graphics shall be formed on the multi-color DMS.

7. Each sign shall be able to display graphic shapes including but not limited to arrows, roadway signs, and interstate shields, each of which can be designed and/or altered by the user through the supplied software.

8. Pixel spacing shall be such that three lines of text shall each have a nominal height of 18 inches.

9. Vertical and horizontal spacing between pixel centers shall be equal.

10. Each line shall contain a continuous matrix of pixels allowing the display of at least three (3) lines of 21 characters per line using a standard 18-inch font (23 X 15 pixel typical). Due to high-resolution aspect of the sign, pixel spacing between characters shall be determined as most compliant with latest version of MUTCD and NEMA TS 4 Hardware standard spacing.
11. A minimum 12" border shall surround the LED pixel array.

12. Provide an automated light intensity measurement through electronic light sensors that can be easily maintained. The sensors shall be mounted in a manner to measure front, rear and ambient light conditions to set brightness levels.

13. The matrix shall be capable of double stroking all characters in an individual line.

10.2.3 Physical Properties

The sign physical properties shall meet the following requirements:

1. Access for all maintenance shall be from within the sign case and from the rear (i.e., the side opposite of the display surface) of the sign display.

2. The sign design shall allow unobstructed and convenient access to all non-structural components. Structural components are defined as the metal sign case and Lexan display cover.

3. All serviceable components shall be modular, interchangeable, and removable from within the sign case.

4. The sign display shall be composed of identical and readily interchangeable display modules and drivers.

5. Each display module shall contain one or more display pixels.

6. The replacement of any display module shall not require the use of any special tools.

7. All wiring interconnecting individual display modules shall be modular harness assemblies with latching push-on/pull-off or twist on/off connectors.

8. The removal of any combination of one or more display modules shall not alter the structural integrity of the sign display assembly, nor of the sign case.

9. The removal of any combination of display modules shall not affect the operation of the remaining operational modules in any way.

10. The performance of the sign shall not be impaired due to vibration caused by wind, traffic, or any other source.

11. All serviceable components shall weigh 50 pounds or less.

12. Mating connectors shall be designated by the connector number and male/female relationship. Connectors shall be keyed or pinned to prevent improper insertion of the wrong connector or PCB.

10.2.4 Pixels

Each pixel shall meet the following requirements:

1. Each pixel shall consist of the number of LED's needed to output white colored light at a minimum of 12,400 Candelas/m2 (white).

2. The number of necessary LED's shall be determined by the Vendor and be provided to the Engineer for approval.

3. Pixel to pixel luminous intensity shall not vary by more than a 2:1 ratio.

4. The optical axis of all pixels shall be perpendicular to the face of the sign display.

5. Pixels shall be replaceable either individually or in groupings. Groupings with three or more pixels shall be permitted only if bench level repairs and replacements to individual pixels are possible.

6. The failure of an LED in one string within a pixel shall not affect the operation of any other string or pixel.

7. Pixel Pitch shall be 20 mm (0.81 in).

8. Pixel power shall not exceed 1.5 watts per pixel, including the driving circuitry.

10.2.5 LED Technology

LEDs used to form a display pixel shall meet the following minimum requirements:

1. The manufacturer shall be the same for all LED's in all signs.

2. The LED manufacturer shall perform color and intensity sorting to the bins. Each color and intensity of the LED's shall be obtained from no more than two (2) consecutive color 'bins' as defined by the LED manufacturer.

3. Each LED driver board shall be microprocessor controlled and shall communicate with the sign controller on a wire or fiber optic communications network using an addressable network protocol. The microprocessor shall process commands from the sign controller to display data, perform diagnostics, and report pixel status.

4. Red LEDs shall utilize AlInGaP semiconductor technology and shall display a red color at a wavelength of 615 nm – 630 nm (± 5 nm).

5. Green LEDs shall utilize InGaN semiconductor technology and shall display a green color at a wavelength of 520 nm – 530 nm (± 5 nm).

6. Blue LEDs shall utilize InGaN semiconductor technology and shall display a blue color at a wavelength of 465 nm – 470 nm (± 5 nm).

7. The LED shall have a nominal viewing cone of 30° with a half-power angle of 15° measured from the longitudinal axis of the LED. Viewing tolerances shall be a specified in the LED manufacturer's product specifications and shall not exceed ± 5°. Using optical enhancing lenses with 15° LED's will not conform to 30° half-power viewing cone specifications and will be cause for rejection.

8. The LED size shall be nominally 0.20 inches.

9. The luminous output shall be a minimum of 3,000 mcd luminous intensity at 20 mA forward current.

10. Current flow through any LED shall not exceed the following values under any light output level:

    a. RMS current of 25 mA

    b. Peak current of 30 mA

11. LED life shall be nominally rated for 100,000 hours of operation under field conditions, which shall include operating temperatures between -22° and +185°F (-30° and +85°C).

12. LED life shall be defined as time it takes for the LED light output to degrade to half of the LED's initial light output.

13. To maximize LED service life, LED drive currents will not be allowed that exceed the manufacturer's recommendations for the 100,000-hour life, but shall be sufficient to supply the required intensity.

14. The LED pixels shall be directly driven using pulse width modulation (PWM) of the drive current to control the display intensity. This LED driver circuitry shall vary the current pulse width to achieve the proper display intensity levels for all ambient light conditions. The drive current pulse shall be modulated at a frequency high enough to provide flicker- free operation and a minimum of 200 brightness levels.

10.2.6 Sign Case

The DMS Sign Case shall meet the following requirements:

1. Be a walk-in type, weatherproof enclosure that houses electrical, communication, and electronic control devices necessary for the operation of the sign. All steel components shall be stainless steel, unless otherwise noted in these specifications.

2. The sign case shall comply with AASHTO design standards for "Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals" and with the fatigue requirements of the National Cooperative Highway Research Program (NCHRP). All sign case and structural drawings shall be stamped by a Professional Engineer certified in the State of Tennessee.

3. Be attached to and become an integral part of the support structure.

4. The dimensions of the sign case (including walk-in cabinet) shall be as specified in this SP. Sign case dimensions shall be approved by Engineer.

5. The sign case shall present a clean, unbroken, neat appearance.

6. The front of the sign case shall not have any visible text or logos on it.

7. The sign case shall be weatherproof and protect the interior from moisture, dust, dirt and corrosion.

8. Positive corrosion protection shall be provided between dissimilar metals.

9. The angular alignment of the sign case shall be adjusted in the vertical direction down by three (3) degrees and be incorporated into the face of the display so as to leave the internal walkway as level as possible. If the sign can only be tilted using external brackets to the case, the provisions shall be made to make the internal walkway level.

10. The sign case shall be constructed of aluminum sheeting to be 5052-H32 and structural members to be 6061-T6.

11. Aluminum sheeting shall be not less than 1/8 inch thick with all seams continuously welded by the inert gasprocess.

12. The front of the sign case shall have a flat black matte finish applied in accordance with American Architectural Manufacturers Association (AAMA 2605) with an expected outdoor service life of 10 to 15 years.

13. All other surfaces shall have a bare aluminum mill finish.

14. Weep holes shall be provided to allow moisture to escape.

15. The sign case shall have an interior, non-skid walkway where the walkway shall extend the entire length of the sign case.

16. The unobstructed walkway shall be at least 24 inches wide and at least 75 inches high.

17. The interior walkway shall be capable of supporting a concentrated load of 300 pounds per square foot at any location, and a total load of 1000 pounds within any ten-foot section of the walkway.

18. Sign case shall have two (2) lifting eyes for placement of sign on structure.

19. Complete sign, including casing, all peripherals and electronics shall weigh no more than 4200 lbs.

20. Total sign case dimensions shall not exceed:

    a. Width: 31 feet (9.44 m)
    b. Height: 9 feet (2.74 m)
    c. Depth: 4.5 feet (1.4 m)

10.2.7 Access Door

The sign shall have an access door on the side of the sign case. The door shall meet the following requirements:

1. Access to the interior of the sign case shall be via a gasketed door that opens out. Door size should be no larger than 25 inches.

2. The door shall be located in the side of the sign case nearest the shoulder of the road and the catwalk when looking at the sign face.

3. The door, latches, and locks shall be engineered in such a way that the door can always be opened from inside of the sign to prevent a technician from being locked in the sign case.

4. The door latching mechanism shall be a three-point draw roller type.

5. The door latching pushrods shall be turned edgewise at the outward supports and have a cross section of 0.25 inch thick by 0.75 inch wide, minimum.

6. Gasketing shall be provided on all door openings and shall meet the following requirements:

    a. Be dust-tight.
    b. Meet NEMA 3R requirements.
    c. Permanently bonded to the door metal.
    d. Shall not stick to the mating metal surface.

7. A gasket top channel shall be provided to support the top gasket on the door (in order to prevent gasket gravitational fatigue).

8. When the door is closed and latched, the door shall be locked. The lock shall meet the following requirements:

a. The lock and lock support shall be rigidly mounted on the door.

b. In the locked position, the bolt throw shall extend a nominal 0.25-inch into the latch cam area.

c. A lid or seal shall be provided to prevent dust or water entry through the lock opening.

d. The locks shall be Corbin #2 type and shall match the master number of the existing TDOT signs.

e. Two keys shall be supplied with each lock.

f. The keys shall be removable in the locked position only.

g. The locks shall have rectangular, spring loaded bolts.

9. The door shall have catch mechanism that is capable of holding the door open at 90° in 60 mph wind acting at an angle perpendicular to the plane of the door.

10.2.8 *Sign Case Ventilation*

The sign case shall include ventilation system that meets the following requirements:

1. Louvered vents or hoods shall be installed in the back or side walls of the sign case.

2. No vent(s) or hood(s) shall be installed in the door.

3. Ventilation openings shall be louvered or hooded.

4. Ventilation openings shall be covered with screens so as to prevent the entrance of birds or insects.

5. The number and size of louvered vents shall be determined by the DMS manufacturer to be of sufficient size to provide adequate ventilation.

6. Air filters shall be installed behind each vent and shall meet the following requirements:

    a. Replaceable industrial grade pleated.

    b. Shall completely cover the vent opening area.

    c. Shall be manufactured per ASHRAE Standard 52.2P or later version.

d. Shall be of fire retardant and water resistant construction, able to withstand temperatures up to 300°F.

e. Filter replacement is to be accomplished without tools with easy access.

7. The sign case shall be equipped with one or more fans that meet the following requirements:

a. Positive pressure ventilation system.

b. The continuous duty electric fans shall include ball or roller bearings.

c. Sign case venting fan(s) shall have a minimum combined capacity to keep the signs housing internal temperature to a maximum of thirty (30) degrees Fahrenheit above external ambient temperature.

d. LED cooling fans shall be provided to vent the air between the display module and the sign face cover.

e. Sufficient LED cooling fans shall be provided to keep the air surrounding the LEDs to a maximum temperature not exceeding the rated temperature for the LEDs.

f. The sign shall be equipped with a minimum of one (1) ambient temperature sensor, one (1) internal temperature sensor, and one (1) sensor that measures relative humidity of the air inside the housing. Mount the sensors such that they will never be in direct sunlight, and easy to maintain/replace. All sensors shall report data to the SCU.

g. Provide sign case ventilation calculations and LED cooling calculations to show sufficient air circulation is provided to meet this SP requirements under worse case air humidity, solar loading, internal heat generation with 50% of all sign pixel turned on at maximum light out level. All sign case temperatures shall be measured at ceiling level.

h. The fan(s) shall be mounted within the housing.

i. The fan(s) shall be downstream from the air filters.

j. The sign case venting fan(s) shall blow the air into the sign case.

k. The DMS manufacturer shall determine the number, placement, and size of the electric fans.

l. The fans shall be thermostatically controlled. The thermostat shall meet the following requirements:

i. Shall be manually adjustable to turn off and on between 91°F and 149°F.

ii. On and off hysteresis shall not exceed three (3) degrees Fahrenheit.

iii. The manual adjustment shall be graded in five (5) degrees Fahrenheit increment scale.

iv. Measure sign case temperature at ceiling level.

m. The fan circuit shall be protected at 125% of the fan motor capacity.

10.2.9 Sign Face Cover

The sign face display cover shall meet the following requirements:

1. The sign face cover shall be attached to the front of the sign case.

2. The sign face cover shall be a weatherproof, multi-window assembly, which allows an unobstructed view of the sign display.

3. The window material shall meet the following requirements;

    a. Be scratch resistant and ultraviolet stabilized polycarbonate plastic panels (Lexan with stabilizer or equivalent).

    b. Be not less than 1/8 inch.

    c. Shall not exhibit any flaws as a result of normal cleaning, installation or removal, ventilation, vibration and/or positive or negative pressure caused by wind or the passing of large vehicles.

4. Documentation shall be provided the Engineer showing the materials used in the manufacture of the window material.

5. The window attachment mechanism shall provide for the replacement of individual windows without disturbing adjacent windows.

6. The removal of any combination of windows shall not adversely affect the integrity of the sign display cover.

7. The attachment mechanism shall allow the windows to expand and contract with changes in the temperature.

8. A weatherproof seal shall be maintained when the window expands and contracts.

9. The windows shall be installed with a reusable gasket or caulking. The gasket or caulking shall meet the following requirements:

a. Designed for outside plant use.

b. Design life of at least ten (10) years.

c. Remain flexible for at least ten (10) years.

10. Internal strip heaters shall be provided inside the sign case at the bottom of the sign face to prevent fogging of the sign face cover.

11. The internal axial or strip heaters shall be thermostatically controlled. The thermostat shall meet the following requirements:

    a. Shall be manually adjustable to turn on and off between -20 degrees Fahrenheit to 50 degrees Fahrenheit

    b. On and off hysteresis shall not exceed 3 degrees Fahrenheit.

    c. The manual adjustment shall be graded in 5 degrees Fahrenheit increment scale.

10.2.10 Redundant Power Supply

The DMS display power supply and driver electronics shall meet the following requirements:

1. Shall be auto-ranging regulated DC power source.

2. Operate from 90 VAC, 60 Hz (or 240 VAC, 60 Hz). Require NEMA TS 2 voltage input requirements.

3. Have an output of less than 24 VDC.

4. Shall be wired in a redundant parallel configuration that uses multiple supplies to power a single load.

5. Shall be rated such that if one power supply fails, the remaining supplies will be able to operate up to 75% of the pixels in their display section at full brightness.

6. Shall incorporate short circuit protection.

7. Shall incorporate power failed alarm under the following conditions:

    a. Output voltage below 15% of normal.
    b. Internal temperature outside the design operational range.

8. Power supply failure alarm and power supply location of number shall be reported to the Sign Controller Unit.

10.2.11 Sign Electrical Requirements

1. The 120/240 Volt electrical service panel shall be rated for 100 amperes maximum.
2. The panel shall have an interrupt rating of not less than 10KA.
3. Internal sign case illumination shall meet the following minimum requirement:
    a. Mounted near the DMS ceiling.
    b. Provide uniform light distribution in the sign case.
    c. The lighting shall be via compact fluorescent lamps with a life of at least 10,000 hours of operation and a minimum 30 watt rating.
    d. A minimum of one (1) compact fluorescent light fixture shall be installed every eight (8') feet of DMS width. The lamps shall provide uniform light distribution throughout the inside of the assembly.
    e. The lamps shall be self-ballasted and be rated for cold weather.
    f. The bulbs shall be shielded with a protective wire cage.
    g. The lights are to be controllable with a manual timer having an adjustable maximum on-time of four (4) hours.
    h. The light switch and timer shall be located near the entry door on the side away from the door hinges.
    i. Two of the light fixtures shall be located approximately two feet from each end of the sign case, and one fixture shall be located in the center of the sign case.
4. The sign case shall be constructed to prohibit any interior light from being visible from the outside when the door is shut.
5. The sign case shall be equipped with three, 15 amp, 120 VAC duplex GFCI (NEMA 15-R) AC receptacles.
6. Two AC receptacles shall be located approximately four feet from each end, and one receptacle shall be located in the center of the sign case.
7. The AC receptacle shall be mounted on the back wall of the sign case.
8. The interior lighting circuits shall be protected by ground-fault circuit-interrupters.
9. The ground-fault circuit interruption shall occur on 6 mA of ground-fault current and shall not occur on less than 4 mA of ground-fault current.
10. All lighting and receptacle circuits shall use #12 AWG wiring enclosed in thin wall ¾ or ½-inch conduit.

10.2.12 Sign Controller Unit (SCU)

The Sign Controller Unit (SCU) shall control the operation of all equipment housed at the Dynamic Message Sign site. The SCU shall meet the following requirements:

1. Shall include a front panel interface with graphical LCD and keypad for direct (local) operation and diagnostics.

2. Shall respond to the direct commands from the system computer and the portable, field-testing computer.

3. Shall be mounted in the roadside DMS cabinet and not in the sign enclosure.

4. Shall receive and interpret commands sent by the system computer and cause the immediate message to be displayed on the sign, and shall provide a return message to the computer that provides information concerning the status of the sign.

5. Shall continuously monitor command messages from the system computer.

6. Shall either blank the display, or continue to display a given message, depending on the option selected by the operator, when a computer system poll is not received within a user-definable threshold period.

7. Shall maintain a library of not less than 60 different display messages and related parameters. The SCU shall support uploading and downloading the message library.

8. Shall monitor and report internal sign case temperatures.

9. Shall be capable of detecting power failures. Power failure is defined when the power is out of limits for 3 or more cycles.

10. Shall include a battery backup that allows the controller to operate for a minimum of 30 minutes while the incoming AC power source has failed.

11. The battery backup circuit shall supply enough power capacity to operate the following equipment:

    a. SCU

    b. All communication equipment within the DMS roadside cabinet

12. Shall perform the following function when power is restored after a power failure is detected:

    a. Display the same message prior to power failure if the outage is less than the user specified period.

b. The sign display shall be blank if the power is restored after the user specified period.

13. Shall provide contact closure inputs alarms for the following functions:

a. Sign case door switch.

b. Roadside DMS cabinet door switch for each door.

14. Shall perform the following actions upon receiving a contact closure input alarm:

a. For sign case and roadside door open alarm, the SCU shall report a door open alarm.

b. For over-height vehicle detection alarm, the SCU shall perform the following actions:

i. Display a user programmable non-volatile message.

ii. The message shall overwrite any current message.

iii. The message shall be displayed for a user programmable time interval.

iv. The operator at the TMC must be able to override the message if needed.

15. Shall incorporate memory with the following requirements:

a. Permanent memory.

b. Non-volatile memory capable of retaining the data in memory for a minimum of 30 days without power.

16. Schedule and all configurable controller data shall be stored in non-volatile memory.

17. Shall have a user configurable IP address.

18. Shall have a user interface that allows resetting of the sign control unit.

19. Shall have a user interface that initiates a manual test of each pixel in the sign.

20. Shall have circuitry to perform the following functions:

a. Drive the sign display,

b. Determine ambient lighting levels,

c. Control pixel luminance levels and

d. Monitor the internal sign case temperature by mounting temperature sensors on the sign case.

21. Shall have a hardware watchdog timer that shall check its own operation. While the SCU program is running, the hardware watchdog timer shall be periodically reset. If the watchdog timer is not reset, the watchdog timer shall reset the SCU.

22. A slide-out notebook shelf, power, and connections to the Sign Controller Unit shall be provided at the roadside DMS cabinet to allow for control of the sign from the roadside cabinet with a laptop computer.

23. The presence of ambient radio signals, magnetic or electromagnetic interferences, including those from power lines, transformers, or motors within the proximity of any components of the system, shall not impair the performance of the system.

24. The system shall not radiate any electrical or electromagnetic signals that could adversely affect any other electrical or electronic device.

25. The sign controller as a function of the ambient light conditions shall automatically set the luminous intensity of the sign display pixels. Shall support brightness table with a minimum of 255 levels for automatic settings. Manually adjustable and may be set from 1% to 99% in 1% increments.

26. The controller shall monitor ambient light levels through a photo sensor assembly that senses the ambient illumination level using three (3) photodiodes oriented as follows:

    a. Cell 1 –Monitors the change from “day” to “night”.

    b. Cell 2 – Facing towards oncoming traffic; monitors prevailing ambient light levels in the upstream traffic.

    c. Cell 3 – Facing passed traffic; monitors prevailing ambient light levels in the downstream traffic.

27. In the event of communications failure, the sign shall blank and/or display a programmable stored message as determined by the Engineer at delivery time.

28. In the event of a controller lock-up due to any circumstance, the sign shall blank.

29. Shall be capable of auto line centering, left, and right justified in the specific line.

30. Shall be capable of flashing one or more words anywhere within a message.

31. Shall be capable of flashing one or more lines anywhere within a message.

10.2.13 Communications

The DMS controller shall provide interfaces for local and remote communications meeting the following minimum requirements:

1. Communication interface shall be 10/100 Base TX Ethernet for all DMS devices. No serial to Ethernet converters (i.e., terminal servers) are permitted either internal or external to the controller.

2. Communication interface shall comply with NTCIP 1203 v03 or later version.

10.2.14 NTCIP Requirements

This SP references several standards through their NTCIP designated names and numbers. Each NTCIP Component covered by these project specifications shall implement the most recent version of the standard that is available as of September 1, 2018, including any and all prepared Amendments to these standards as of the same date.

Profile Implementation Conformance Specifications (PICS) for each NTCIP standard required shall be submitted for review and approval to the Department.

1. Ethernet Interface

   Communication interfaces using Ethernet shall conform at a minimum with all mandatory objects of all mandatory Conformance Groups of the following standards:

   a. 1101 – NTCIP Simple Transportation Management Framework (STMF)

   b. 1203 – NTCIP Object Definition for Dynamic Message Signs

   c. 2301 – NTCIP AP-STMF

   d. 2202 – NTCIP TP-Internet

   e. 2104 – NTCIP SP-Ethernet

   f. 2104 - NTCIP SP-Ethernet

2. RS-232 Interface

   Communication interfaces using RS-232 shall conform at a minimum with all standards:

   a. 1101 - NTCIP Simple Transportation Management Framework (STMF)

   b. 1203 - NTCIP Object Definition for Dynamic Message Signs

   c. 2301 - NTCIP AP-STMF

   d. 2201 - NTCIP TP-Transportation Transport Profile

   e. 2104 - NTCIP SP-PMPP/RS232

3. Subnet Level

   For each communication interface, the Subnet Level shall meet the following minimum requirements:

   a. NTCIP Components may support additional Subnet Profiles at the manufacturer's option.

   b. At any one time, only one Subnet Profile shall be active on a given communication interface.

   c. The NTCIP Component shall be configurable to allow the field technician to activate the desired Subnet Profile.

4. Transport Level

   For each communication interface, the Transport Level shall meet the following minimum requirements:

   a. Communication interfaces may support additional Transport Profiles at the manufacturer's option.

   b. Response data-grams shall use the same Transport Profile used in the request.

   c. Each communication interface shall support the receipt of diagrams conforming to any of the identified Transport Profiles at any time.

5. Application Level

   For each communication interface, the Application Level shall meet the following minimum requirements:

a. All communication interfaces shall comply with NTCIP 1101 and shall meet the requirements for Conformance Level 1 (NOTE - See Amendment to standard).

b. Optionally, the NTCIP Component may support SNMP traps.

c. A communication interface may support additional Application Profiles at the manufacturer's option.

d. Responses shall use the same Application Profile used by the request.

e. Each communication interface shall support the receipt of application data packets at any time allowed by the subject standards.

6. Information Level

All communication interfaces Information Level protocol shall meet the following minimum requirements:

a. All communication interfaces shall provide Full, Standardized Object Range Support of all objects required by these procurement specifications unless otherwise indicated below.

b. The maximum Response Time for any object or group of objects shall be 200 milliseconds.

c. All communication interfaces shall implement all mandatory objects of all mandatory Conformance Groups as defined in NTCIP 1203 and their respective Amendments.

d. The sign shall blank if a command to display a message contains an invalid Message CRC value for the desired message and shall provide a return message.

e. Shall also implement all mandatory objects of the following optional conformance groups of NTCIP 1201.

i. Time Management Conformal Group

ii. Report Conformal Group. Table 4 indicates the modified object requirements.

f. Implement all objects of the Font Configuration Conformance Group, as defined in NTCIP 1203.

g. Implement all objects of the DMS Configuration Conformance Group, as defined in NTCIP 1203.

h. Implement all objects of the Multi Configuration Conformance Group, as defined in NTCIP 1203.

i. Implement all objects of the Multi Error Configuration, as defined in NTCIP 1203.

j. Implement all objects of the Illumination/Brightness.

k. Sign Status, as defined in NTCIP 1203.

l. Status Error, as defined in NTCIP 1203.

m. Pixel Error Status, as defined in NTCIP 1203.

n. Since the display of graphics is currently not defined within the NTCIP Standards or their amendments, the vendor shall propose, and provide detailed documentation (i.e., interface protocol description level), how the specified graphical shapes can be displayed.

10.2.15 NTCIP ComplianceDocumentation

Software shall be supplied with full documentation, including a CD-ROM containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

1. The relevant version of each official standard MIB Module referenced by the device functionality.

2. If the device does not support the full range of any given object within a Standard MIB Module, a manufacturer specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro.

3 A MIB Module in ASN.1 format containing any and all manufacturer-specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.

4 A MIB containing any other objects supported by the device.

Additionally, the manufacturer shall provide a test procedure that demonstrates how the NTCIP compliance of both, the data dictionaries (NTCIP 1201, 1203, and their amendments) and the communications protocols have been tested.

The manufacturer shall allow the use of any and all of this documentation by any party authorized by the Procuring Agency for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

10.2.16 Dynamic Message SignOperation

The Dynamic Message Sign shall support three distinct modes.

1. System Control: System control is the normal mode of operation. The SCU responds to commands from the systemcomputer.

2. Local Control: This is the mode of operation that is used to test the sign operation. In this mode, the SCU responds to commands from a portable computer that is interfaced to the SCU.

3. Failed Condition: This is the mode of operation that is used when the hardware watchdog timer or the communications watchdog timer is not reset, or a communications error is detected, or an error is detected by the SCU. In this mode, the sign face is blank (all LED pixels are off).

10.2.17 Sign Control Test Software

The Design-Builder shall provide Test Software that meets the following requirements:

1. The software shall operate on a laptop computer with at least 64 MB RAM memory.

2. The software shall interface with the SCU using the SCU Ethernet port and crossover cable.

3. The software shall be provided on CD. The Department shall have the right to make an unlimited number of copies for use with the SCUs acquired for this project.

4. The software shall include access security by name, password, and access rights.

5. The software shall provide interface using Active Directory Service Interfaces (ADSI).

6. The software shall initiate a test pattern that energizes and verifies each individual pixel in the sign.

7. The test pattern shall be supported by a test report that documents the results of the test.

8. The test report shall be written to disk with ASCII characters.

9. The software shall include a communication monitoring function that meet the following requirements:

    a. Display on the screen of the portable computer the commands received by the SCU from the systemcomputer.

    b. Display the response transmitted by the SCU to the system computer.

c. Display function shall be real-time and be functional when the SCU is operating in the system control mode.

10.2.19 *Central Control Sign Software*

The Design-Builder shall provide Test Software that meets the following requirements:

1. The software shall operate on TMC operator's workstation PCs. It shall be client-server type architecture, and be able to be installed on an existing server running Windows Server 2016. The relationship shall support multiple operator-client workstations that interface with the Server. One server license shall be required for multiple PC use.

2. The Display Control, the software shall be able to view, group and monitor multiple DMS's in real time.

3. Shall be able to communicate to any NTCIP-compliant sign communicating with the TMC, including portable NTCIP-compliant signs.

4. Shall be able to support list view and map view of signs. The map shall be configured to show all applicable signs in the Region, as required by the Engineer.

5. Shall support full-color text, shape and graphic message creation.

6. Shall be able to change messaging based on various input data, including time, temperature, date and speed

7. Shall be able to generate graphics, such as roadway signs and interstate shields, as well as clip art, shapes and free form creations. Standard MUTCD symbols shall be included in the graphics generator. The editing tool shall be able to move text and images on the editing area with graphical editing tools.

8. Shall be able to display multiple graphics, including shields and arrows for lane designation, or lane management.

9. Shall be able to schedule by date and time, up to one minute increments via a calendar view, with options for schedule recurrence.

10. Shall be able to configure message flash rates, scrolling, beacons, templates and fonts to provide optimal DMS legibility.

11. Shall provide spell check and be able to create a list of prohibited words that can only be accessed for edit by an administrator.

12. Shall be able to log events and subsystem failures.

13. Shall be able to run diagnostics and alert for all system failures, including pixel tests and failures, power failures, environmental status, and other failure notifications.

14. Shall have built in security levels of access, including login/password access.

15. The software shall be provided with the ability to install the client on Operator Workstations.

16. The Central Software shall include full software maintenance support for duration of three years.

17. The software shall also include the following functionality:

    a. Full diagnostic test of peripherals
    b. Remote SCU reset and password override
    c. Set/view brightness levels
    d. View NTCIP conformance group values
    e. Separate windows for multi-monitor display
    f. Support the latest NTCIP 1203 font table changes and graphics objects
    g. Display real time date/time/speed/temperature fields
    h. Variable spacing between characters
    i. View and Run Schedule Day Plans by week, month, year

10.2.20 Roadside DMS Cabinet (Type C Cabinet)

The Design-Builder shall provide a ground-mounted cabinet for each DMS. The DMS cabinet is labeled as a Type C cabinet in the Plans. (See section 10.2.13 for additional Roadside DMS Cabinet requirements)The cabinet shall meet the followingrequirements:

1. Shall meet the same lighting, 19" rack, and ventilation requirements as Caltrans Type 170 model 332 cabinet.

2. Shall meet the applicable requirements of a Type C equipment cabinet in Section 6.

3. A slide-out notebook shelf, power, and connections to the Sign Controller Unit (SCU) shall be provided at the roadside DMS cabinet to allow for control of the sign from the roadside cabinet with a laptop computer.

4. Shall be ground mounted.

5. Shall be constructed of 5052 sheet aluminum alloy with a minimum thickness of 1/8 inch.

6. All inside and outside edges shall be free of burrs.

7. The outside surface of the cabinet shall have a smooth, uniform, and natural aluminum finish.

8. All welds shall be made by using the Heliarc welding method.

9. The cabinet should be of sufficient size to hold all of the OMS support equipment (i.e. controller, power distribution panel, etc.), cabinet accessories (slide-out notebook shelf, etc.), and communication equipment as shown in the Plans.

10. Cabinet hinges shall be 14 Gauge diameter stainless steel or 1/8 inch diameter aluminum.

11. The hinge pins shall be constructed of stainless steel.

12. Shall be furnished with a three point latching system (top, bottom, center locations).

13. Shall be furnished with a doorstop, which retains the door at a 90 degree and 120 degree positions.

14. Shall have thermostatically controlled fan located at the top of the cabinet.

15. Minimum fan rating of 100 cubic feet per minute.

16. Fan thermostat shall have a user adjustable range from 80 to 125oF.

17. Minimum of 2-1/2 inch galvanized anchor bolts shall be used to secure the cabinet to the foundation.

18. Shall be provided with a minimum 20-Watt fluorescent lamp with a clear shatter- proof shield.

19. The lamp shall automatically turn ON when either cabinet door is open.

20. Shall include a three wire GFCI 115 VAC duplex convenience receptacle.

21. The receptacle shall be protected by a 15 Amp circuit breaker.

22. Shall include a main circuit breaker, which shall turn off all power to the cabinet and the OMS sign case.

23. Shall include separate circuit breaker to power the sign case.

24. Shall include transient suppression meeting the following requirements:

    a. Shall be UL Listed and labeled to UL 1449.

    b. Shall have an I-nominal rating of 20kA

    c. SPD surge current rating shall equal or exceed 50kA per mode. Per phase rating shall equal or exceed 100kA per phase.

d. Leads shall be as short and straight as possible.

e. All metal oxide varistors used for surge protection shall be rated in the appropriate voltages and its operational status shall be monitored via visual indicator.

f. SPD operating temperature shall be between -40°F and 185°F.

25. Shall include both serial and Ethernet communication cable surge protection devices with the following characteristics:

a. Hybrid Multi-stage Suppression components, including gas tube and silicon avalanche diode

b. Response time to greater than 1 nanosecond

c. UL listed (UL 1449, UL 497, 497A, 497B, etc. as appropriate) and bonded to the same single-point ground point. Any DIN rail mounted SPD's shall be grounded via conductor and shall not rely solely upon the DIN rail's mechanical connection as a grounding point.

d. Sides shall be clearly marked 'protected' and 'unprotected'

26. Provide sunshields and mounting fasteners on all roadside OMS cabinets. Sunshields and fasteners shall meet the following minimum requirements:

a. Sunshields shall be 0.125 inch aluminum with smoothed, deburred edges and rounded corners. Provide cutouts for door handles and/or locks as required.

b. Cabinets shall be equipped with press-in threaded inserts on the cabinet interior. Sunshields shall be mounted by fasteners and aluminum or stainless steel standoffs tightened into the threaded inserts. Provide a minimum of four inserts/fasteners for top face sunshields.

c. Provide a minimum of six inserts/fasteners for any door or side sunshield.

d. For doors or sides greater than 54 inches tall, provide inserts and fasteners sufficient for a maximum vertical or horizontal distance of 27 inches between any fasteners.

e. Furnish and install a top face sunshield on all cabinets.

f. Furnish and install door or side sunshields on any cabinet face that is within 60 degrees in either direction of due south. A minimum of two door or side faces shall have sunshields on any cabinet. A cabinet with a face exactly perpendicular to the south shall have three shields.

27. Provide agency name, device name and IO labels on all roadside OMS cabinets. Labels shall meet the following minimum requirements:

a. Labels shall be flat black lettering on a reflective white background. Lettering shall be a minimum of 1 inch in height.

b. Labels shall be manufactured from pre-coated adhesive backed reflective sheeting material meeting the minimum requirements of AASHTO M268 Type 1.

c. The agency name labels shall be "TOOT ITS" in one continuous adhesive sheet.

d. The device IO labels shall include the acronym and hyphen "OMS-" and shall be one continuous adhesive sheet.

e. The device IO shall be numerals corresponding to the location and shall be installed adjacent to the acronym sheet. Examples are "OMS-02401" and "OMS-07503".

f. Labels shall be installed along the top of the cabinet door (front cabinet door on OMS cabinets), with TOOT ITS label at the top and the device IO labels immediately underneath.

28. Provide agency name, device name and ID labels on all roadside DMS cabinets. Labels shall meet the following minimum requirements:

a. Labels shall be flat black lettering on a reflective white background. Lettering shall be a minimum of 1 inch in height.

b. Labels shall be manufactured from pre-coated adhesive backed reflective sheeting material meeting the minimum requirements of AASHTO M268 Type 1.

c. The agency name labels shall be “TDOT ITS” in one continuous adhesive sheet.

d. The device ID labels shall include the acronym and hyphen “DMS-“ and shall be one continuous adhesive sheet.

e. The device ID shall be numerals corresponding to the location and shall be installed adjacent to the acronym sheet. Examples are “DMS-02401” and “DMS-07503”.

f. Labels shall be installed along the top of the cabinet door (front cabinet door on DMS cabinets), with TDOT ITS label at the top and the device ID labels immediately underneath.

10.3 lnstallation Requirements

10.3.1 General Requirements

1. All equipment shall be installed according to the manufacturer's recommendations and the Plans. The Design-Builder shall have a OMS manufacturer representative commission the signs after installation.
2. DMS structures, sign cases, and cabinets shall be grounded in accordance with the DMS and the structure manufacturers' recommendations and the Standard Specifications.
3. Do not install the DMS sign case on the support structure until the structure grounding systems have been successfully completed and accepted, and the structure ground connection has beeninstalled.
4. Do not install electrical service or electronic devices in the roadside OMS cabinet or connect to the cabinet until the cabinet grounding systems have been successfully completed and accepted, and the cabinet ground connection has been installed.
5. Bundle all like cabling to minimize crosstalk and electrical interference. Route wiring to prevent conductors from being in contact with devices in the cabinet and metal edges. Arrange wiring so that any removable assembly may be removed without disturbing or unhooking conductors.
6. All power and communications wiring shall be one continuous run from cabinet to sign structure. No splicing of wiring will be permitted unless approved by the Engineer.
7. Do not install electronic devices in the cabinet until electrical service has been installed and activated, and the cabinet ventilation fan is operational.
8. A minimum of two 2-inch spare conduits shall be installed in the base of all DMS cabinets and shall terminate in the adjacent communications cable pull box. Spare conduits in the cabinet base and the pull box shall be sealed with blank duct plugs.
9. Prior to installation, all sign cases and cabinets must be stored in a location and manner approved by TOOT. The signs shall not be sitting directly on the ground or in a manner where standing water, mud, or debris will come in contact with the sign. The storage location should be free from excessive debris or other matter that may harm or deteriorate the sign. During storage, sign cases shall be structurally supported in accordance with the DMS manufacturer's recommendations.
10. The Design-Builder is responsible for coordinating with the Department for IP addresses and integrating the DMS system into the manufacturer provided DMS central control software.

10.3.2 Documentation

The documentation for the Dynamic Message Signs shall consist of the following: Communications Protocol (refer to Section 11.2.15), Operator's Manual, Maintenance Procedure Manual, Equipment Drawings, and Electrical Schematic Diagrams.

1. Operator's Manual

   This document shall fully describe the operation of the Dynamic Message Signs using the Windows based software that runs on a notebook computer. This document shall clearly define all functions that are supported by the software. The manual shall define the normal operation of the signs and the software including resetting and restarting the software package. Ten hardcopies of this document shall be supplied. Additionally, an electronic copy shall be provided that includes the capability for word searches. The manual shall include the following:

   a. General Description

   b. General Characteristics

   c. Installation

   d. Adjustments

   e. Theory of Operation

   f. Maintenance

      i. Preventive Maintenance

      ii. Trouble Analysis

      iii. Trouble Shooting Sequence Chart

   g. Wave Forms

i. Voltage Measurements

ii. Alignment Procedures

iii. Parts List

iv. Communications Protocol

v. Schematic and Logic Diagrams

2. Maintenance Procedure Manual

   This manual shall document the preventive and corrective maintenance procedures that should be followed to maintain the Dynamic Message Signs at the highest level of operational efficiency. The manual shall include step-by-step field and bench trouble-shooting procedures to isolate and repair faults. The document shall include descriptions of normative waveforms and test voltages. A detailed parts list shall be included. For each part or assembly, a circuit diagram or pictorial shall be provided. Ten hardcopies of this document shall be supplied. Additionally, an electronic copy shall be provided that includes the capability for word searches.

3. Equipment Drawings and Diagrams

   A pictorial drawing showing the physical location and identification of each component shall be provided for each different electronic assembly and each different subassembly. Wiring diagrams shall be provided for each sign case. These diagrams shall depict the location and interface of all components located within the sign case. Three hardcopies of these drawings shall be supplied. Additionally, an electronic copy (using common drawing software such as MicroStation) shall be provided.

4. Electrical Schematic Diagrams

   An electrical schematic, wiring diagram, and a logic diagram shall be provided for each different type of equipment. A stage-by-stage explanation of the circuit theory shall be provided with the circuit wiring diagrams. Connection diagrams for each DMS subsystem including block diagrams, terminal numbers, and conductor color codes shall be provided. Three hardcopies of these diagrams shall be supplied. Additionally, an electronic copy (using common drawing software such as MicroStation) shall be provided on a CD or DVD.

10.3.3 *Warranty*

The complete Dynamic Message Sign assembly shall carry a one-year manufacturer's warranty from the date of final acceptance against any imperfections in workmanship or materials. The

warranty shall include but not be limited to sign face panels (LED), Sign Controller Unit, sign communications hardware, and sign ventilation system.

10.3.4 *Training*

Prior to the acceptance of the first DMS unit, training shall be provided for the Department's engineering, maintenance, and operations staff, at a facility provided by the Department. The training shall include all material and manuals required for each participant.

The training shall be provided for two identical non-consecutive one day sessions for at least ten (10) engineering and operations personnel. The training shall include a complete demonstration of the operation and capabilities of the DMS equipment. This session shall include a complete review of any field adjustments or calibration that may be required for the LED's or any sign component. The training shall include operation instructions, theory of operation, circuit description, field adjustments, preventive maintenance procedures, troubleshooting and repair of all components. Particular attention shall be given to the operation of the software packages to be provided including procedures for configuring the signs, displaying messages and diagnosing faults. Attention shall also be given to graphics creation.

10.3.5 *Testing Requirements*

1. General Requirements

    a. The Design-Builder shall conduct a project testing program for all DMS as required in Section 1.5 of this SP. The project testing program for DMS shall include but is not limited to the additional specific requirements in this subsection.

    b. All test results shall confirm physical and performance compliance with this SP.

2. DMS Bench Test Component (BTC)

    The Design-Builder shall perform BTC on the DMS as they arrive from the factory. The goal of the DMS BTC is to verify that the DMS were not damaged during shipping. The BTC shall test or inspect the following DMS components:

    a. External or internal visible damage

    b. DMS display damage

    c. Verify all pixels are operational

    d. Verify that the ventilation system works

    e. Verify that all equipment is secured

f. Verify sign configurations

g. Run System Diagnostics Check

3. DMS Pre-Installation Test (PIT)

The Design-Builder shall perform PIT on the DMS prior to installation on-site. The goal of the DMS PIT is to verify that the DMS were not damaged during storage after shipping. The PIT shall test or inspect the following DMS components:

a. External or internal visible damage

b. DMS display damage

c. Verify all pixels are operational

d. Verify the ventilation system works

e. Verify all equipment is secured

f. Verify sign configurations

4. DMS Bench Test System (BTS)

The Design-Builder shall perform BTS on the DMS to verify that the DMSs are compatible and operational interoperability with the communication equipment, central software, and existing equipment. The Design-Builder shall refer to Section 1 of this SP for additional BTS requirements.

5. DMS Stand Alone Test (SAT)

The Design-Builder shall perform SAT on the DMS as they arrive from the factory. The goal of the SAT is to verify that the DMS has been properly installed and commissioned according to the manufacturer requirements. The SAT shall include at minimum the following tests and inspections:

a. Verify the signs have been attached properly to the structure.

b. Verify the sign case and roadside cabinet have been grounded.

c. Verify the sign has been properly connected to the power.

d. Verify the sign case has no structural damage or deformities.

e. Verify all pixel are operational.

f. Verify local sign control through the serial port.

g. Verify local sign control through the Type A Network Switch.
h. Verify text, colors and graphics can be displayed.
i. Verify diagnostics reporting by running maintenance software.
j. Verify environmental sensor operation by witnessing fan activation, correct temperature readings, ambient light sensors, etc.

10.4 Measurement

The Dynamic Message Sign will be measured in units of each and paid for at the contract unit price per each. The price shall include furnishing, installing, system integration, and testing of the complete dynamic message sign including the sign case, light sources, display apparatus, wiring, controller, roadside DMS (Type C) cabinet, communications interface, wiring between the sign case and DMS cabinet, structure mounted conduit, fittings, and junction boxes, sign case support connections to the sign support structure, satisfactory completion of testing and training requirements, wireless communication platform (identified remote locations only), and all work, equipment, and appurtenances as required to effect the full operation including remote and local control of the sign complete in place and ready for use. (Note this item does not include the sign support structure). The price bid shall also include all system documentation including: shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams, and other material necessary to document the operation of the DMS. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

10.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-21.02	DYNAMIC MESSAGE SIGN (MULTI-COLOR)	EACH

Dynamic Message Signs sites will be paid per each as follows:

1. 50% of the contract unit price upon satisfactory Factory Acceptance Test results, delivery to the site, and Pre-Installation Test results. For those signs not going through the FAT, 50% of the contract unit price upon delivery to the site and satisfactory Pre-Installation Test results.
2. Additional 20% of the contract unit price upon satisfactory Stand Alone Site Test results.
3. Additional 20% of the contract unit price upon satisfactory Conditional System Acceptance Test results.
4. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 11
RADAR DETECTION EQUIPMENT

11.1 Description

11.1.1 *General Description*

This section specifies the minimum requirements for Radar Detection Systems (RDS) furnished and installed on this project. The work shall consist of providing all labor, materials, equipment, and incidentals necessary to furnish, install, test, and operate a RDS System for TDOT.

The RDS will provide roadway monitoring capabilities via microwave radar detectors transmitting data over both wireline and wireless network equipment specified in this SP. The data provided includes, but is not limited to, lane occupancy, speeds, classification, and volume. The RDS device shall support high definition radar consisting of multiple radar beams. Two receive antennas shall be positioned side-by-side with enough space between to create two separate high definition beams.

11.1.2 *Project Specific Description*

The RDS system for this project shall be capable of detecting truck class vehicles and capturing their speed. The system will also include two logic controllers capable of communicating a specific message to the DMS when a truck class vehicle is detected traveling above a specified speed.

11.2 Materials

11.2.1 *Microwave Transmission*

1. The microwave radar detector shall transmit on a frequency band of 24.0-24.25 GHz or another approved spectral band. It shall comply with the limits for a Class A digital

   device, pursuant to Part 15 of the FCC rules or the appropriate Spectrum Management Authority. The RDS shall not interfere with any known equipment.

11.2.2 *Area of Coverage*

The RDS's field of view shall cover an area defined by a beam its maximum detection range shall be as follows:

1. Elevation Beam Width 40 degrees or more
2. Azimuth Beam Width 15 degrees or less
3. Range 6 to 250 feet

11.2.3 *Detection Zones*

1. The minimum number of detection zones defined shall be no less than twenty (20) lanes simultaneously.

11.2.4 *Capabilities*

The RDS shall be a true presence detector. It shall be suitable for mounting on roadside poles or on overhead structures and provide the following:

1. Presence indication of moving or stopped vehicles in either direction in its detection zones, provided by contact closure to existing controllers.
2. Traffic data, periodically accumulated over user defined time intervals in a 20 to 600 sec range, shall be transmitted via serial RS-485 communications lines to a serial port on a programmable logic controller, traffic signal controller, Video Encoder at a CCTV location, or serial terminal server as shown in the Plans.
3. Traffic data shall be available simultaneously with detection zone contact closures and serial communications.
4. Side-fired configuration data shall include the following in each of up to twenty (20) detection zones (lanes):
    a. Volume
    b. Lane occupancy
    c. Per vehicle speed by dual radar speed trap
    d. Vehicle classification by length in a minimum of 8 user defined classes.
5. RDS in forward-looking configuration shall monitor traffic in one lane and be capable of providing the following data:
    a. Volume, occupancy, average speed and travel direction in the lane

b. Per vehicle speed and direction
c. Binning of Volume data in up to 15 speed bins

6. RDS shall allow the user to define the contents of transmitted data.

7. RDS shall provide Fail-Safe indication by a contact pair.

8. Furnish the unit with the required software for data collection, processing, configuration and set-up, and data logging and retrieval. An operator shall be able to use the software to set detector count periods, sensitivities, and other operational features and parameters. The software must be capable of providing both manual and automatic setup and calibration.

11.2.5 *Measurement Accuracy*

1. The following error levels shall be achievable and demonstrated during testing:

Parameter	Error Percentage
Presence	5%
Volume	8%
Lane Occupancy	10%
Average Speed	10%
Length Classification limits	10%
Time Event	10 ms
Input Voltage	2%

11.2.6 *Environmental Conditions and Protection*

Except as stated otherwise herein, the equipment shall meet all its specified requirements during and after subjecting to any combination of the following:

1. Ambient temperature range of -37°C to +74° C

2. Relative humidity from 5 to 95 percent, non-condensing

3. Winds up to 90 mph (sustained) with a 30% gust factor

4. Rain and other precipitation up to 2 inches/hr

5. Power surge of ± 1kV (rise time = 1.2 µsec, hold = 50µsec) applied in differential mode to all lines, power and output, as defined by IEC 1000-4-5 and EN 61000-4-5 standards.

6. Printed circuit boards shall be conformal coated for protection against humidity.

7. Except as may be otherwise stated herein for a particular item, no item, component, or subassembly shall emit a noise level exceeding the peak level of 55 dB when measured at a distance of three feet away from its surface.

8. The microwave radar detector shall be resistant to vibration in accordance with IEC 68-2- 30 (test Fc), NEMA TS-1 (Section 2.1.12), or approved equivalent.

9. The microwave detector shall be resistant to shock in accordance with IEC 68-2-27 (test a), NEMA TS-1 (Section 2.1.13), or approved equivalent.

11.2.7 *Mechanical*

1. The microwave radar detector shall be enclosed in a rugged weatherproof box and sealed to protect the unit from wind up to 90 mph, dust and airborne particles, and exposure to moisture (NEMA Type 3R or 4X enclosure).

2. Max. weight of the microwave radar detector assembly: 7 pounds

3. The mounting assembly shall have all coated steel, stainless steel, or aluminum construction, and shall support a load of 20 pounds or more. The mounting assembly shall incorporate a ball-joint, or other approved mechanism that can be tilted in both axes and then locked into place, to provide the optimum area of coverage.

11.2.8 *Electrical*

1. The RDS unit shall be operable from 12 - 24 VDC.

2. The RDS unit shall include Power Management features, allowing remote shutdown or cyclical shutdown of the unit.

3. The RDS unit shall include a Low-Voltage disconnect feature for battery protection.

11.2.9 *Cables*

1. Cable connectorization and termination pin-out on all cables shall be in accordance

with the manufacturer's recommendations.

2. Connection between the RDS and the cabinet equipment shall be provided by a single RDS harness cable that is MS-connector terminated at the RDS and terminated to the RDS communications wiring module in the equipment cabinets or terminal block at the base of the RDS pole. No splices are permitted in the harness cable. The cable shall provide power and the RS-485 serial data interface to the RDS unit.

3. The RDS harness cable shall be outdoor wet/dry rated UV-resistant and provide multiple twisted pairs of stranded AWG #20 or #22 wire with a common shield rated at 300V with a temperature rating of 105oC.

4. The MS connector pins must be crimped to the cable conductors and assembled and tested by the manufacturer prior to installation and pulling of cable on site.

11.2.10 *Electrical Isolation and Surge Protection*

1. All power lines, contact closures and the serial port shall be surge protected within the unit. Contact closures and the serial port shall be isolated.

11.2.11 *Data Interface*

Data communications shall be full duplex asynchronous, configurable as:

1. RS-485 port at rates from 2,400 up to 115,200 bits per second.

2. Serial data format shall be standard binary 8 bits data, 1 stop bit, No parity.

3. Both point-to-point and multi-dropped configurations shall be supported.

11.2.12 *RDS Cable*

1. Provide RDS Cable that is a composite twisted-pair power limited tray cable with UV-resistant PVC or polyethylene outer jacket rated for wet/dry underground use when RDS poles are separated from an equipment cabinet, as shown in the Plans. RDS Cable shall contain a minimum of two shielded twisted pairs of communications conductors designed for RS-485 data signaling and two low voltage power conductors. Individual conductor insulation ratings shall be equal or greater than the outer jacket ratings.

2. Communications conductors shall be a minimum of two twisted pairs and one shield drain wire of #22 AWG 7-strand tinned copper conductors with a continuous foil or braid shield. RS-485 signal ground shall be provided by the shield drain wire, an additional conductor, or an additional shielded pair, in accordance with the RDS unit

manufacturer's recommendations. Twisted pairs shall be identified by separate insulation colors. Communications pairs shall be individually or commonly shielded.

3. Low voltage power conductors shall be two #14 AWG 19-strand tinned copper conductors. One conductor shall have red insulation and the other conductor shall have a black insulation. Low voltage power conductors shall not be shielded in common with the communications pairs.

4. Provide cable with outer jacket marking using the following template:

   Manufacturer's Name – "RDS Cable" – Month/Year of Manufacture - Telephone Handset Symbol – "TDOT"

5. Provide cable labels that meet the following requirements:

   a. self-coiling wrap-around type

   b. PVC or equivalent plastic material with UV and fungus inhibitors

   c. Base materials and graphics/printing inks/materials designed for underground outside plant use including solvent resistance, abrasion resistance, and water absorption

   d. minimum size of 2.5 inches wide by 2.5 inches long

   e. minimum thickness of 0.010 inches

   f. orange label body with pre-printed text in bold black block-style font with minimum text height of 0.375 inches

   g. Pre-print the following text legibly on RDS Cable labels:

      i. RDS CABLE

      ii. TENN DOT

   h. On all cable labels, print the text specified above twice on the label with the text of the second image reversed. The end result shall be text which "reads right" when the label is coiled onto a cable.

11.2.13 *Programmable Logic Controller (PLC)*

The PLC shall process select data from the RDS unit and drive various field devices for turnkey applications.

1. Core requirements:

a. Minimum of 58 MHZ microprocessor

b. Minimum of 1024K of SRAM memory

c. Minimum of 512K of non-volatile flash memory

d. Real-time clock with battery backup

e. Watchdog timers to prevent device lockup

2. Physical requirements:

a. Weight less than 0.5 lb.

b. Din rail mounting

c. Hot-swappable

3. Power requirements:

a. Power supply 9-28 VDC

b. Power consumption: less than 10 W

4. Environmental requirements:

a. Ambient operating temperature: -34°C to +74° C

b. Relative humidity: 95%

5. Connectivity requirements:

a. Four (4) independent physical serial ports (two RS-232 and two RS-485)

b. Two (2) multi-functional digital input ports

c. Two (2) solid state contact closure output ports

6. Communication requirements:

a. Converts RS-232 to RS-485 and vice versa

b. Support the following baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600,
and 115200 bps

7. Contact closure to Ethernet device:

a. Provide a contact closure device that will input contact closure relay signals from the queue detector and output onto the 10/100Base-T Ethernet network to existing Ethernet Switch.

b. Contact closure device shall work in the reverse direction at ramp meter locations that share a queue detector or are not directly connected to the queue detector, at locations shown in Plans.

c. Device shall be rack, DIN rail, or wall mountable.

11.3 Installation Requirements

1. The RDS shall be mounted in side-fired configuration on poles as shown in the Plans, using mounting brackets. The brackets shall be attached with approved ¾-inch wide stainless steel bands. The various mounting configurations include: attaching to new light standard poles where the wiring shall be installed inside the pole; attaching to new CCTV poles where the wiring shall be installed inside the pole, and attaching to existing light poles where conduit risers will be required on the outside of the pole.

2. The Design-Builder shall install the detector unit on a pole at the manufacturer's recommended height above the road surface so that the masking of vehicles is minimized and that all detection zones are contained within the specified elevation angle as suggested by the manufacturer.

3. When installing a detector near metal structures, such as building, bridges, or sign supports, the sensor shall be mounted and aimed so that the detection zone is not under and does not pass through any structure to avoid distortion and reflection.

4. The RDS mode of operation, detection zones, and other calibration and set up will be performed using a Microsoft Windows-based software and a Notebook PC. The software shall allow verification of correct setup and diagnostics. It shall include facilities for saving verification data and collected data as well as saving and retrieving sensor setup from disk file.

5. Unused conductors in the RDS unit harness cable shall be grounded or un-terminated in the cabinet in accordance with the manufacturer's recommendations. Un- terminated conductors shall be individually doubled back and taped, then loosely bundled and secured.

6. Design-Builder shall install a local / remote disconnect switch or a RDS communications wiring module in accordance with Section 6.2.2.12 or 6.2.3.6 and as shown on the plans.

11.3.1 *RDS Cable Shipping and Delivery*

1. Package the cable for shipment on reels. Each package shall contain only one continuous length of cable. Construct the packaging so as to prevent damage to the cable during shipping and handling.

2. Seal both ends of the cable to prevent the ingress of moisture.

3. Include with each reel a weatherproof reel tag attached identifying the reel and cable that can be used by the manufacturer to trace the manufacturing history of the cable. Include with each cable a cable data sheet containing the following information:

    a. Manufacturer name

    b. Cable part number

    c. Factory order number

    d. Cable length

    e. Factory measured continuity and attenuation of each conductor and shield

11.3.2 *RDS Cable Installation*

1. Do not exceed the maximum recommended pulling tension during installation as specified by the cable manufacturer. Continuously monitor pulling tensions with calibrated measuring devices, such as a strain dynamometer.

2. Before cable installation, carefully inspect the cable reels and reel stands for imperfections or faults such as nails that might cause damage to the cable as it is unreeled.

3. Take all necessary precautions to protect reeled cable from vandals or other sources of possible damage while unattended. Any damage to reeled cable or the reel itself shall necessitate replacement of the entire cable section.

4. Whenever unreeled cable is placed on the pavement or surface above a pull box, provide means of preventing vehicular or pedestrian traffic through the area in accordance with the approved Maintenance of Traffic provisions.

5. Keep the cable continuous throughout the pull. Terminate the cable only in equipment cabinets on terminal blocks. Cable splices are not permitted.

11.3.3 *RDS Cable Storage and Labeling*

1. Properly store all cable to minimize susceptibility to damage. Maintain proper bend radius, both short and long term, during cable storage. Storage coils shall be neat in even length coils, with no cross over or tangling. Storage coils of different cables shall be kept completely separate. Storage coils shall be secured to cable racking hardware with tie wraps, Velcro straps, or non-metallic cable straps with locking/buckling mechanism. Do not use adhesive or self-adhering tapes, metal wires and straps, or rope/cord.

2. Unless otherwise noted on the plans, the following are the requirements for cable storage for underground applications:

    a. Cable in Type C pull box – 20 feet

    b. Cable in Type D pull box – 20 feet

    c. Cable in Type E pull box – 20 feet

3. Install cable labels on all RDS Cables. Clean the installed cable of all dirt and grease before applying any label.

4. Label all cables in or at every location where the cable is exposed outside of a conduit, inner-duct, or pole. As a minimum, install cable labels in the following locations:

    a. Within 12 inches of every cable entry to a pull box or equipment cabinet.

    b. Every 10 feet for the entire length of cable in any storage coil in pull boxes.

11.3.4 *RDS Test Requirements*

1. General Requirements

    a. The Design-Builder shall conduct a project testing program for RDS units as required in Section 1.5 of this SP. The project testing program for RDS units shall include but is not limited to the additional specific requirements in this subsection.

    b. All test results shall confirm physical and performance compliance with this SP.

2. Bench Test Component (BTC)

    a. During the bench test, the Design-Builder must demonstrate proper operation of the RDS through the 2nd serial port on the CCTV Video Encoders. Design-Builder is responsible for ensuring compatibility between the devices and for ensuring the data can be transmitted from the RDS to the encoder at the distances shown on the plans.

3. Bench Test System (BTS)

    a. During the bench test system, the Design-Builder must demonstrate the configuration of the device and demonstrate the required operational characteristics of the device including the counting of volume and speed. The bench test system must include operation through the maximum total length of RDS Cable required in this project.

4. Standalone Acceptance Test (SAT)

    a. During the standalone tests, the Design-Builder must demonstrate the accuracy requirements specified in Section 12.2.5.

11.3.5 *RDS Cable Test Requirements*

1. General Requirements

    a. The Design-Builder shall conduct a project testing program for all RDS Cable as required in Section 1.5 of this SP. The project testing program for RDS Cable shall include but is not limited to the additional specific requirements in this subsection.

    b. All test results shall confirm physical and performance compliance with this SP.

    c. In addition to the notification requirements of Section 1.5, provide the tentative date, time and location of RDS comm. cable testing no less than 7 days in advance to the test. Provide confirmed date, time and location of RDS Cable testing no less than 48 hours before conducting the test.

    d. Provide test results documentation in printed (3 copies) format. Printed copies shall be bound and organized by cable segment.

    e. Provide all test results in English units of measure of length.

    f. Submit all test results documentation to the Engineer within 14 days of completion of the tests. The Engineer will review test documentation in accordance with the Submittal Review Process in Section 1.8

    g. All RDS Cables under test shall be removed from all wiring termination devices until testing is completed. All RDS Cables conductors shall be connected to ground immediately after testing to ensure elimination of all capacitive charges and potentials.

2. Pre-Installation Test (PIT)

a. Perform a PIT on all RDS Cables prior to any cable removal from the shipping reels. Perform a PIT on each cable reel delivered to the job site.

b. The PIT for RDS Cables shall include but is not limited to:

i. A visual inspection of each cable and reel

ii. A Continuity Test on all conductors and shield in the cable.

3. Standalone Acceptance Test (SAT)

a. Perform a SAT on all RDS Cables on this project after field installation is complete but without cable termination.

b. An SAT for each conductor and each shield in each cable shall include but is not limited to Continuity Tests and Insulation Resistance Tests.

c. All RDS comm. cables shall be tested from termination point to termination point. Complete all RDS Cable SATs for all cables prior to implementing any RDS communications or power service.

d. All test results shall confirm compliance with this SP and the manufacturer's published specifications.

e. Test documentation shall include but is not limited to:

i. RDS Cable Identification

- Cable ID and Location – physical location (device ID and station number of equipment cabinet) and conductor/pair/shield ID for both the beginning and ending point.
- Operator Name
- Engineer's Representative
- Date & Time

ii. Setup and Test Conditions Parameters

- Battery charge and proper operation of ohmmeter
- Battery charge and proper operation of insulation resistance tester
- Ambient Temperature

iii. Test Results for Continuity Test

- Conductor continuity
- Resistance (ohms)
- Measured Length (Cable Marking)

iv. Test Results for Insulation Resistance Test

- Measured Cable Length
- Insulation resistance (exceeds manufacturer's specifications for at least 60 seconds.)

11.4 Measurement

11.4.1 *Radar Detection System*

The Radar Detection System (RDS) will be measured in units of each and paid for at the contract price per each. The price bid shall include furnishing, installing, system integration, and testing of a complete RDS including the unit, the RDS harness cabling, all conduit, risers, and weatherhead between the RDS and the cabinet, interconnection wiring to the video encoder serial port or terminal server port, connections to support structures (includes all incidental components, attachment hardware, mounting brackets, mounting arms, bolts, or any other items to mount the RDS as intended), satisfactory completion of testing and training requirements and all work, equipment, and appurtenances as required to effect the full operation including remote and local control of the RDS site complete in place and ready for use. The price bid shall also include all system documentation including: shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams, and other material necessary to document the operation of the RDS. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

In locations where a Radar Detection System is connected back to an existing cabinet via RDS Cable, the price bid for the Radar Detection System shall include furnishing, installing, and testing of a RDS communication subsystem inside the existing cabinet. This RDS communications subsystem shall meet the specifications in Section 5.2.3.5.

11.4.2 *RDS Cable*

RDS Cable will be measured in units of linear feet and paid for at the contract price

per linear feet of actual cable installed as measured from the cable sequential length markings. The price bid shall include furnishing, installing, system integration, and testing of a complete RDS cable installation with operational RDS units and shall include cable labels and all ancillary and incidental materials, testing, documentation and all labor and equipment necessary to complete the work. No measurement for payment will be made for cable storage amounts in excess of that required in this SP or the Plans. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

11.5 Payment

The contract unit price shall be full compensation for all work specified in this

section. Payment will be made under:

Item No.	Description	Unit
725-21.91	RADAR DETECTION SYSTEM	EACH
725-21.96	RDS COMM CABLE	LF

Radar Detection System (RDS) will be paid per each as follows:

1. 50% of the contract unit price upon approval of Bench Test Component, Bench Test System and Pre-installation test results.

2. Additional 20% of the contract unit price upon approval of Stand Alone Site Test results.

3. Additional 20% of the contract unit price upon approval of Conditional System Acceptance Test results.

4. Final 10% of the contract unit price upon Final System Acceptance.

RDS Cable will be paid per linear foot as follows:

1. 25% of the contract unit price upon delivery and reel test.

2. Additional 35% of the contract unit price for complete installation of cables.

3. Additional 30% of the contract unit price for successful completion of Standalone Acceptance Testing of the complete cable in any lineal foot between terminations in equipment cabinets and Stand Alone Site Testing of all RDS units communicating through this section of cable.

4. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 12
WIRELESS RADIO COMMUNICATIONS

12.1 Description

This section specifies the minimum requirements for the wireless communications to be furnished and installed on this project. The radios will provide one communications link for various RDS, DMS and CCTV sites on this project for the temporary ITS phase of this project. The work includes complete Federal Communications Commission (FCC) licensing services and all documentation necessary to operate and maintain the equipment. The radio link shall transmit data and multicast video across the link with no degradation to the video image, and no added delay to data transmitted across the link.

The radio equipment in this contract includes the following type:

1. Ethernet Radio & Antenna (Type D): This is a 4.9 GHz Ethernet Transceiver Link that is used as the backbone of the temporary ITS to support video and data to the Network along I-40.

12.2 Materials

The radio and antenna equipment shall comply with the following minimum material specifications:

12.2.1 *Ethernet Backbone Radio Transceiver (TYPE D)*

1. The radio transceiver shall directly interface with the field Ethernet Gigabit port at the radio field hub sites. Software to remotely control the radios will be provided and included in the price of the Radio's. No additional payment will be made for configuration and troubleshooting software.

2. The Radios will be a truly point to point link system that delivers a 300 Mbps data rate link at distances of over 5 miles (8 km). The link shall supply very low latency of not more than 3 ms over long distances.

3. The Design-Builder is responsible for the propagation study and assessment of the wireless link prior to submitting the product and desired frequency. The Design-Builder shall perform this study with industry approved test equipment and submit the study to the Engineer for review and approval. Should a frequency other than 4.9 GHz be submitted, the Design-Builder shall fully justify the use of this frequency through testing documentation.

4. Security

    a. Tiered security layering

    b. Use of AES-CCM 128 bit Encryption

    c. Internal MAC Address Control List, Radius based Authentication

5. Network Gateway Features:

    a. DHCP Server & relay

    b. NAT with Standard ALGs

    c. Bridging

    d. Routing (RIP v2 and IP tunneling)

    e. Syslog

    f. SNTP

6. Network QoS:

    a. Asymmetric Bandwidth Control

    b. Packet Classification

    c. Scheduling

7. The radio shall adhere to the 802.1Q Management VLAN with Transparent, Access and Trunk mode

8. Wired Ethernet Interface

    a. Two auto MDI-X RJ45 10/100/1000 Mbps Ethernet ports, one being PoE in + data, and the second with PoE out + data

    b. Industrial Weatherproof Ethernet Connector

c. Cat6 Industrial outdoor rated cable

9. Channel Size of 40 MHz, 20 MHz, and capable of 10 MHz and 5 MHz

10. Management

    a. Local RS-232 serial port with capability to interface via DB9

    b. Telnet

    c. SSH

    d. SNMPv3

    e. SSL

    f. TFTP

    g. Web GUI

11. Wireless Modulation shall utilize OFDM with BPSK, QPSK, QAM16, QAM64, and Enhanced MIMO techniques for non-line-of-sight and near- line-of-site capability.

12. Radio Transmit Power

    a. Up to 18 dBm

13. Antenna Configurations

    a. Integrated 23dBi panel or external as needed

14. Power

    a. 7 Watt typical, 17 Watt max

    b. POE power injector with PoE Surge Arrestor and power cords to allow the radio to be powered from a standard 120 VAC outlet.

15. Environmental

    a. Hardened

    b. Operating Temperature: -40oF to 140oF (-40oC to 60oC)

    c. Operating Humidity: 100% maximum relative humidity, non- condensing

d. 125 MPH wind loading

e. Meets IP67 requirements

f. Mean Time Between Failure shall not be less than 80,000 hours.

12.3 Installation

1. Before submitting poles or wireless radio units and antennas, the Design-Builder shall verify all wireless links for proper frequency, height and line of site, based on the plan design and specifications. Should the Design-Builder encounter interference in the path, or immoveable objects that interfere with the wireless path, the Design-Builder shall prepare and submit a solution for review and acceptance by the Engineer.

2. The Design-Builder shall furnish, install, and integrate Ethernet radio transceivers between receive and transmit sites shown in the Plans. Antenna alignment shall be performed in accordance with the manufacturer's installation requirements. Testing of the link and attached Ethernet switches shall happen before cutover of all existing devices to the radio link and the cutting of the trunk fiber optic cable for termination in the field radio hub cabinet.

3. The Design-Builder shall furnish and install all supports, clamps, cables, connections and other materials to secure the Ethernet radio transceiver and antenna at the selected locations for a complete installation. All cables shall be permanently labeled at all access points. Label identification shall be stamped or engraved on metal tags, or neatly and legibly lettered with permanent ink on nylon tags. Each cable shall have a unique identifier. Cables shall be labeled immediately upon installation.

4. The type of mounting poles to be supplied and the location of their installation shall be as depicted in the Plans unless otherwise approved by the Engineer.

5. The Design-Builder shall coordinate with the existing TDOT Region 4 Network Maintenance representative for all necessary configuration of the radio link. The radio link shall be configured to operate in the current network configuration and shall allow all existing video and data to transmit across the link with no degradation. After coordinating with the Network Maintenance representative, the Design-Builder shall submit the network configuration to the representative and Engineer for approval.

6. Design-Builder will also install a Battery backup system for the field radio. See electrical section 5.2.5 for specifications

12.3.1 *Testing*

1. General Requirements

a. The Design-Builder shall conduct a project testing program for Radio and Antenna equipment as required in Section 1.5 of this SP. The project testing program for Radio and Antenna Equipment shall include but is not limited to the additional specific requirements in this subsection.

b. All test results shall confirm physical and performance compliance with this SP.

12.4 Measurement

Radio & Antenna (Type D) will be measured in units of each and paid for at the contract price per each, but shall act as one seamless pair of point to point radios. The prices bid shall include furnishing, installing, system integration and testing of the unit and shall include the radio transceiver/ modem unit, Battery backup system, mounting hardware, RF coaxial cables, cables and connectors, power control unit, surge suppressors, antenna with mounting accessories, SWR/wattmeter test equipment and all work, equipment and appurtenances as required to provide a fully functioning radio and antenna. The price bid shall also include all configuration and system software and documentation including; shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams, and other materials necessary to document the operation of the unit. Price shall include installation and removal of wireless equipment, including the pole and all wiring associated with the temporary installation. This equipment shall be turned over to TDOT. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

12.5 Payment

The Contract unit price shall be full compensation for all the work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-20.84	RADIO & ANTENNA (ETHERNET BACKBONE RADIO)	EACH

The Radio and Antenna will paid per each as follows:

1. 50% of the contract unit price upon Design-Builders Pre-installation test results.

2. 20% of the contract unit price upon approval of Stand Alone Site Test results.

3. Additional 20% of the contract unit price upon approval of Conditional System Acceptance Test results.

4. Final 10% of the contract unit price upon Final System Acceptance

SECTION 13
FIELD VIDEO ENCODER UNIT

13.1 Description

This section specifies the minimum requirements for Field Video Encoder Units furnished and installed on this project.

The Field Video Encoder Unit will provide for the encoding and transmission of digital video signals from new CCTV units to the TMC installed at locations shown in the Plans.

13.2 Materials

13.2.1 *General Capabilities and Performance Requirements*

Furnish a field-hardened video encoder designed for unheated/uncooled "outdoor" applications such as roadside control cabinets. The video encoder shall be installed in traffic signal controller cabinets and shall allow for the encoding and transmission of digital video signals from new CCTV units that will be provided under this Project.

The unit shall be shelf-mountable, and shall allow for converting digital video signals from new CCTV units into two digital video streams, one in H.264 format (high-resolution) and one in MPEG-4 format (low-resolution), that can be transported over Ethernet. High resolution streams shall allow video bit rates from 1 to 3 Mbps and the low resolution stream shall allow video bit rates from 64 kbps to 2 Mbps. The Design-Builder shall initially configure these formats for 2 Mbps and 64kbps, respectively. The video encoder shall also transmit pan-tilt-zoom control data from all CCTV control points to the CCTV camera via a serial connection to the CCTV camera resident on the CODEC.

The video encoder shall support the following digital transport standards at a minimum: RTP/IP, UDP/IP, TCP/IP, and unicast/multicast IP. The Design-Builder shall initially use UDP/IP for video transport and TCP/IP for camera control transport unless otherwise approved by the Engineer.

The video shall support resolutions of CIF (352 (H) x 240 (V)), 1/2 D1 (352 (H) x 480 (V)), and D1 (720 (H) x 480 (V)) at a minimum. The video encoder units shall provide a display showing diagnostic data such as data rate, quality level, frame rate, and video status on the front panel. All supporting user interface software shall be provided with each encoder unit.

The video encoder shall be equipped with at least one NTSC video input, two RS-232/422 serial ports and one 10/100BaseTX Ethernet port. The 10/100BaseTX port shall support half-duplex or

full-duplex and provide auto negotiation, and shall be initially configured for full-duplex.

The video encoder shall be remotely manageable using standard network applications such as telnet, SNMP monitors, and/or web interface administration. The video encoder shall be equipped with LED or other approved indicators for the following functions:

1. Power
2. Link
3. Activity
4. Port Speed (10/100 Mbps)

13.2.2 *Electrical Requirements*

The video encoder shall operate from 115 VAC (+/-10%) input power at 60 Hz. The Design-Builder shall furnish any external step-down transformers, power converters, and/or regulation equipment needed to operate the video encoder.

13.2.3 *Physical and Environmental Requirements*

The video encoder enclosure shall be constructed of non-corrosive materials (galvanized steel or an approved equal). For Design-Builder-supplied cameras, the video encoder shall be installed in equipment t cabinets and secured to the cabinet in a manner that is approved by the Engineer. The video encoder enclosure, including adapters/connectors, shall fit neatly within the confines of the equipment cabinet. All necessary mounting hardware shall be provided by the Design-Builder.

The video encoder shall meet or exceed NEMA TS-2 requirements for shock, temperature, humidity, and vibration. The video encoder shall operate at ambient temperatures from -40° to 158° F (-40° to 70° C) and ambient relative humidity from 0% to 90% (non-condensing). No cooling airflow shall be required.

13.2.4 *Communication Interface Requirements*

The video encoder shall comply with the 10/100BaseTX standard and have at least one standard RJ-45 interface. The 10/100BaseTX port shall operate as half-duplex or full-duplex and provide auto negotiation. The video encoder shall have at least two serial ports – one for pan-tilt-zoom camera control and the other for local maintenance or other data transport. The two serial ports shall support RS-232 and RS-422 data transmission and shall be transparent to the central system using TCP/IP network access methods. Interconnection with camera control receivers with or without adapters or converters (i.e. RS-422/232 for compatibility with CCTVs) shall provide opto-isolated surge suppression. The optical isolation shall provide an isolation of no

greater than 2000 VAC for data signals and ground.

13.2.5 *Cables and Connectors*

The Design-Builder shall furnish and install all cables and connectors necessary for video encoder installation. This shall include at a minimum CAT 5E cables with RJ-45 connectors to connect the Video Encoder to the Field Ethernet Switch in the equipment cabinet or traffic controller cabinet and standard serial data cables to connect the Video Encoder to the CCTV camera for pan-tilt-zoom functions and local configuration administration.

13.3 Installation Requirements

Field Video Encoders shall be configured for transmitting video to the Ethernet switch at a data rates listed above in Section 13.2.1. MPEG-4 video resolution parameters shall be configured for 720x480 pixels unless otherwise approved by the Engineer. The Design-Builder shall demonstrate CCTV command/control using vendor software upon completion of each Video Encoder installation.

13.4 Measurements

Field Video Encoder Units will be measured in units of each and paid for at the contract price per each. The price bid shall include furnishing, installing, system integration, training, documentation, and testing of a complete Field Video Encoder Unit including the video encoder, power supply, power cable, attachment hardware and brackets and all incidental items to provide and install the Field Video Encoder as intended, satisfactory completion of all testing requirements and all work, equipment and appurtenances as required for a full Field Video Encoder installation. The price bid shall also include all system documentation including: shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams, and other materials necessary to document the operation of the Field Video Encoder Units. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

13.5 Payment

The contract unit price shall be full compensation for all the work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-20.99	VIDEO ENCODER	EACH

The Field Video Encoder Unit will be paid per each as follows:

1. 50% of the contract unit price upon approval of Bench Test Component, Bench Test System and Pre-Installation test results.

2. Additional 20% of the contract unit price upon approval of Stand Alone Site Test results.

3. Additional 20% of the contract unit price upon approval of Conditional System Acceptance Test results.

4. Final 10% of the contract unit price upon Final System Acceptance

SECTION 14
TERMINAL SERVERS

14.1 Description

This section specifies the minimum requirements for Terminal Servers furnished and installed on this project. The work shall consist of providing all labor, materials, equipment, and incidentals necessary to furnish, install, and test Terminal Servers.

The Terminal Server device, also commonly referred to as a Port Server device, will be used to communicate bi-directionally between IP-based Ethernet network systems and existing field devices that communicate or are controlled via a full-duplex serial interface.

14.2 Materials

The equipment and software shall comply with the following minimum material specifications:

14.3.1 *General Capabilities and Performance Requirements*

The Terminal Server shall meet the following general requirements:

1. 10/100 Base-TX Ethernet port connection
2. RS-232/485 selectable or programmable serial connections
3. Baud rates up to 230 Kbps
4. TCP/IP protocol
5. SNMP protocol
6. HTTP protocol
7. Remote TELNET connection

8. ARP-Ping for IP address assignment

9. LED status for link and power

10. All terminal servers shall be mechanically and electrically interchangeable within the network.

14.3.2 *Data Interface Requirements*

The minimum data interface requirements include the following:

1. The Terminal Server shall support a minimum of two (2) bi-directional serial communication channels over an Ethernet 10/100 Base-TX uplink.

2. Each Terminal Server shall have a minimum of two (2) EIA-232/485 Serial interface ports. These ports shall be individually and independently configurable, directly by switching or over the network, to EIA-232/485 mode of operation as defined by the EIA for data format, data rate, and data structure (e.g., the number of bits, parity, stop bits, etc.). Each serial port shall support up to 230 Kbps.

3. Each serial port shall support IP addressing, and shall not use proprietary encapsulation methods, which would restrict the use of standards-based virtual COM port connectivity software.

4. The equipment shall provide the capability to establish an IP connection directly from a workstation to any device IP address.

5. Each Terminal Server shall have an Ethernet Interface (10/100Base-TX protocol, Full/Half-Duplex, Auto Sense (802.3), RJ-45).

14.3.3 *Physical and Environmental Specifications*

The minimum physical and environmental requirements include:

1. Each Terminal Server shall have the following ports:
    a. Network Ethernet Port: Minimum one (1) 10/100 Mbps RJ-45.
    b. Serial Data Interfaces: Two (2) 232/485 9 pin ports.
2. Operate in a temperature range of -35°C to 74°C.
3. Operate in relative humidity of 5% to 95% non-condensing.
4. Maximum Dimensions: 8”W x 6”D x 3”H.
5. Provide external markings:
    a. All connectors, indicators, and replaceable components shall be permanently marked and traceable to the supplied documentation, including schematics and parts list.

b. The external markings shall include the product function name, model number, serial number and manufacturer's name.

6. Terminal Servers shall be shelf mountable or rack mountable. Shelf for the cabinet shall be provided if needed. Other mounting options may be submitted for review and approval by the Engineer.

14.3.4 *Management Capabilities*

The minimum management system requirements shall include:

1. Remote Management and Port Configurable.

2. SNMP compatible.

3. Local Configuration Port.

4. Port Configurable via Telnet.

14.3.5 *Electrical*

The minimum electrical/power requirements include:

1. 120 VAC.

2. External power supply unit is acceptable.

14.3 Installation Requirements

All equipment shall be installed according to the manufacturer's recommendations, the Plans, this SP, and as follows:

1. Materials and associated accessories/adapters shall not be applied contrary to the manufacturer's recommendations and standard practices.

2. The Design-Builder shall furnish all tools, equipment, materials, supplies and manufactured hardware, and shall perform all operations and equipment integration necessary to provide complete, fully operational communications equipment as specified herein, within the Plan set, and/or in the Contract Documents. It is the responsibility of the Design-Builder to ensure DCE/DTE conflicts are addressed and that the equipment performs its required function when installed.

3. The Design-Builder shall provide the Department with a written inventory of items received and the condition in which they were received. Once received, the equipment

becomes the Design-Builder's responsibility. The Design-Builder shall provide all labor and equipment necessary to move inventory out of the designated storage facility and to transport it to the installation location. All equipment shall be installed according to the manufacturer's recommendations or as directed by the Department.

14.3.1 *Testing Requirements*

Testing shall include, but not be limited to, the following:

1. General Requirements:

    a. The Design-Builder shall conduct a project testing program for all Terminal Servers as required in Section 1.5 of this SP. The project testing program shall include but is not limited to the additional specific requirements in this subsection.

    b. All test results shall confirm physical and performance compliance with this SP.

    c. The Design-Builder shall submit all test results documentation to the Engineer within 14 days of completion of the tests. The Engineer will review test documentation in accordance with the Submittal Review Process in Section 1.8.

2. Bench Test System (BTS) and Standalone Acceptance Test (SAT)

    a. The Design-Builder shall also demonstrate the ability of the Terminal Server to communicate with the attached RDS's through the serial port.

14.4 Measurement

The Terminal Servers will be measured in units of each and paid for at the contract price per each. The price bid shall include furnishing, installing warranties, full operation and configuring the Terminal Server in accordance with applicable Standards, Specifications, and requirements. The price bid shall also include the mounting hardware, Cat-6e patch cords, serial port cables or connectors, power cable, power adapters, user manuals, testing, warranties, and any and all other equipment required to complete installation of the unit. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

14.5 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-21.21	TERMINAL SERVER	EACH

The Terminal Servers Equipment will be paid per each as follows:

1. 50% of the contract unit price upon approval of Bench Test Component, Bench Test System and Pre-Installation Test results.

2. Additional 20% of the contract unit price upon approval of Stand Alone Site Test results.

3. Additional 20% of the contract unit price upon approval of Conditional System Acceptance Test results.

4. Final 10% of the contract unit price upon Final System Acceptance.

SECTION 15
LOCAL AREA NETWORK

15.1 Description

15.1.1 *Overview*

1. The Region 2 Rural SmartWay ITS will communicate with the Region 2 TMC predominately via combinations of leased circuits comprised of T-1 data circuits and Plain Old Telephone Service (POTS). Individual or combinations of T-1 circuits will be converted into an Ethernet environment via Ethernet bridge devices.

2. Segments of the project deployment will have multiple ITS field devices concentrated via agency owned fiber optic network. The Design-Builder will furnish and install new L2 Field Ethernet Switches at these locations identified in the Plans. The Design-Builder shall integrate the L2 Field Ethernet Switches with the Ethernet bridge devices.

15.1.2 *Virtual Local Area Networks (VLANS)*

1. For the L2 Field Ethernet Switches installed in the field, VLANs shall be developed to group devices by type. Where utilized, the management VLAN will be logically separate from all other VLANs to ensure manageability during network events and to provide additional security.

2. Common/consistent ports shall be used for the edge devices for common devices. Up to two ports shall be reserved for future device classes. One port shall be reserved for network connection by a laptop computer at the equipment cabinet. This shall be the only port configured with access to the management VLAN.

15.1.3 *Requirements Definition Document*

1. Prior to commencing work, the Design-Builder shall develop a Requirements Definition Document (RDD) that will form the basis for the overall network architecture and design.

It is expected that the Design-Builder will work closely with TDOT IT to define the network. The document will contain:

a. Complete description of the proposed implementation of the access, distribution and core layers for the ITS network as described in the Plans and these Project Special Provisions.

b. Development of an IP Design Scheme with ranges assigned to each node to be integrated by the Design-Builder using guidance from TDOT (e.g. address ranges, geographic distribution, standards for addresses within each cabinet).

c. Proposed IP subnet definition and addressing including any and all masks

d. Proposed IP multicast configuration including multicast routing (i.e., PIM sparse or dense) and Rendezvous Point (RP) designation as necessary

e. Proposed recommendations for failover and redundancy including network device power, supervisor cards, and network ports

f. Proposed configuration and guidelines for L3 routing (OSPF, VRRP, EIGRP, RIP, etc.);

g. Proposed configuration and guidelines for Virtual LAN assignments including management VLANs, device VLANs and routing VLANs; and

h. Proposed configuration and guidelines for L2 broadcast storm prevention, loop prevention and fault tolerance mechanisms. (Spanning Tree diagram with designated, blocking and forwarding ports indicated. Root bridge and backup root bridge must also be specified.) Incorporation of Multiple Spanning Tree Protocol.

i. Proposed configuration and guidelines to mitigate common security threats such as denial of service, man in the middle, MAC/IP spoofing and brute force dictionary attacks.

j. Proposed configuration and guidelines for 802.1p Class of Service (COS) queue assignments

k. Proposed configuration and guidelines for specific port assignments on each of the L2 and Ethernet bridge device.

2. The Engineer will provide the Design-Builder with an IP address range or ranges from which the Design-Builder will develop the IP address scheme. The RDD shall be prepared by a qualified networking professional (minimum CCNA or a manufacturer-approved equivalent based on the approved hardware vendor) and will be approved by the Engineer. The Qualified network professional will be present during the installation and testing of the local area network as well as during system testing

15.2 Materials

15.2.1 General

1. Furnish equipment for the LAN that complies with IEEE standard 802. Furnish Ethernet LAN switches that are fully compatible and interoperable with the network monitoring software, the existing network architecture and configuration, and the existing firewall and switch at the TMCs.

2. Furnish Ethernet Switches that comply with the following electrical safety requirements: UL60950 or CSA C22.2 No. 60950 (safety requirements for IT equipment) and FCC Part15 Class A for EMI emissions.

15.2.2 Network Switch (Type A) (L2 Field Ethernet Switch)

1. L2 Field Switches will be placed in locations shown on the Plans. L2 Field Switches fabricated for use in traffic signal controller cabinets shall meet or exceed NEMA TS- 2 requirements for temperature, shock, humidity, and vibration.

2. Furnish L2 Field Ethernet Switches that have the option for din rail mounting as well as rack mounting.

3. Furnish Field Ethernet switches with internal Power Supply meeting the following power supply requirements:

    a. 85 to 264 VAC (50/60Hz)/ 88 to 300VDC.

    b. Power supply shall have two stage isolation accomplished via two transformers: first steps down from primary AC/DC to 48VDC; the second steps down from 48VDC to the final DC voltage required by the switch.

    c. A power cord of not less than 5 feet in length shall be supplied

4. Furnish Field Ethernet Switches that weigh no more than 15 lbs. and are no more than 250 cubic inches in volume.

5. Furnish field Ethernet switches with the following minimum characteristics and features:

    a. Minimum of Eight (8) 10BASE-T/100BASE-TX ports

    b. Minimum of two (2) 1000 BaseX Optical uplink ports that utilize SFP plugs

c. Furnish SFP modules rated to service the Field Ethernet to Field Ethernet optical uplinks and Field Ethernet to Gig-E Hub Uplink rated for optical attenuation required to service the link. Use SFP modules that are LX or ZX and are matched and compatible with the SFP module it is mated with. Furnish attenuators if required to service link without saturating receiving optics.

d. Furnish SFP modules rated for use with the optical cable furnished under this project

e. Furnish SFP modules with LC connector or other connector approved by the Engineer

f. Furnish fiber jumper cables with appropriate connectors to connect with switch and adjacent drop cable connectors and/or other switches.

g. SFP modules shall be considered incidental to the field Ethernet switch

h. Management console port

i. 10/100BaseTX ports:

    i. RJ45 connectors

    ii. Cable type: Category 6, unshielded twisted pair (CAT 6 UTP)

    iii. Auto-negotiation support (10/100Mbps)

    iv. Auto MDIX crossover capability

    v. Full Duplex operation (IEEE 802.3x)

    vi. SPD (Surge Protective Device) between Line +/-, Line +/ground, and Line –ground to protect the circuitry

j. Networking Requirements

    i. The switch shall support automatic address learning of up to 8000 MAC addresses

    ii. The switch shall support the following advanced L2 functions:

        - IEEE 802.1Q VLAN, with support for up to 4000 VLANs
        - IEEE 802.1p priority queuing
        - IEEE 802.1w rapid spanning tree

- IEEE 802.1s multiple spanning tree
- IEEE802.1AD link aggregation
- IEEE 802.3x flow control
- IGMPv2 with 256 IGMP groups
- Port Rate Limiting
- Configuration via test file which can be modified through standard text editor
- Forwarding/filtering rate shall be 14,880 packets per second (PPS) for 10Mps,148,800 for 100Mps, 1,488,000 for 1000Mps
- DHCP Option 82

iii. Network Management Functionality Requirements

- Shall be interoperable with the existing network infrastructure (Cisco core multi-layer switches, distribution multilayer switches, firewalls, and routers)
- Shall have the ability to run container applications
- SNMPv2 and SNMPv3
- RMON
- GVRP, or VTP
- Port Mirroring
- 802.1x port security
- Radius Server and TACACS+ Server
- SSL - Secure Socket Layer
- SSH - Secure Shell
- TFTP
- Network Time Protocol (NTPv3)
- Simple Network Time Protocol (SNTPv3)
- Management via web only if HTTPS SSL and SSH

15.2.3 *Ethernet Bridge*

1. The field bridge shall provide bridging Ethernet across one or more T-1 leased lines through Multilink Point-Point Protocol (MLPPP). The functions of the field bridge shall be to:

    a. Provide physical and link layer protocol compatibility for bridging

    b. Support virtual extension and integration of field CCTV cameras with the TMC Ethernet LAN via one or more T-1 communication links. The field bridge shall provide multilink bonding of multiple T-1 links to form a single aggregate data channel between the wireless Ethernet radio system and the TMC router

    c. Combine all Ethernet messages into a common Ethernet at the physical, link, and network level

    d. Incorporate TCP/IP, supporting network bridging

    e. Buffer data as required to accommodate input/output data rates without loss of data and without causing transfer delays

    f. Transparently manage lower level protocols

    g. Accommodate full-duplex data transmissions on all T-1 interfaces

    h. Conduct built-in test and report failures via alarms and indicators

2. The field bridge shall be required to bridge between Ethernet and T-1 protocols. The Ethernet bridges shall provide an Ethernet LAN virtually extended via one or more T-1s from TMC- to-CCTV demarcation and vice versa using telephone service provider T-1 circuits (MLPPP).

3. Ethernet bridges installed at each communication hub/concentrator shall include a minimum of two T-1 interfaces (expandable to four T-1s), and shall also include at least three 10/100Mbps full-duplex auto-sensing switched Ethernet ports with auto-negotiation capabilities. Each bridge shall be equipped with internal CSU/DSUs for direct termination of the telephone service provider T-1 circuits. To prevent the loss of data during extended power outages, Ethernet bridge configuration settings, commands, and programming shall be stored in non-volatile memory, and forwarded to the network according to pre-defined criteria.

4. The Design-Builder shall assure that compatible bridging and network management protocols are used in all Ethernet bridges. The Ethernet bridges shall sustain throughput over the aggregate T-1 links of at least 1.5 Mbps for each T-1 link. Field bridges shall be fully communications- compatible with the video encoders and wireless Ethernet radios supplied per these Special Provisions.

5. The Ethernet bridge chassis shall be provided with slides that allow the electronic drawer to be removed from the rack and be locked into a maintenance position. The slides also shall allow the drawer to be completely removed from the field cabinet by activating mechanical unlocking devices. The chassis shall be constructed from non-corrosive materials. The front panel shall be of ergonomic design for ease of use and include indicators that display Power, Self-Test, and Alarm status.

6. The TMC Ethernet Bridge will include all requirements of the Multi-T1 Ethernet Bridge devices except shall provide instead a T-3 interface.

7. All switches, indicators, and connectors shall be clearly and permanently marked as to identity and function and all removable components shall be identified by appropriate markings. All printed circuit boards shall have permanent markings, including a part number and functional name. Each removable module shall, as a minimum, include a permanently attached (e.g., stamped, etched, etc.) part number. Each removable module shall also include a permanently attached serial number. All component identifications shall correctly correspond to schematics, parts lists, and written narratives included in maintenance manuals.

8. All software required to operate and update network configuration/bridging, and to maintain the field Ethernet bridge shall be provided with the equipment. If the field Ethernet bridge requires loadable software for either operations or maintenance, the software shall be provided on a magnetic media compatible with the delivered equipment.

15.2.4 *Electrical Requirements*

Each Ethernet bridge shall operate subject to the following electrical power specifications:

1. Input Voltage: 115 VAC +/-10% at 60Hz

2. The Ethernet bridges shall include a power-on switch and a power status indicator. Any required power conversion shall be contained within the bridge, the router chassis, or facilitated by a power adapter provided as an integral part of the bridge power-interconnect cable. The Ethernet bridge power input circuitry shall be designed to protect the electronics from damage by a power surge or an under voltage condition. The Ethernet bridges shall automatically recover from an over or under voltage condition when the prime power has returned to values defined by this specification, and in turn re-acquire signal. The Ethernet bridges shall include surge protection designed to react within one second of the occurrence of over voltage conditions and shall provide protection for the duration of the disturbance.

3. Where surge protection is not internally provided, the Design-Builder may provide external surge protection. The input power cable shall be no less than 5’.

15.2.5 *Physical and Environmental Requirements*

1. Each Ethernet bridge shall be rack or shelf mountable in a 19" EIA-310 style equipment rack, and shall not exceed 2 rack units in height (3.5") and shall fit sufficiently within the depth of the field cabinet. These dimensions shall be inclusive of any required external devices including, but not limited to power supplies. Each Ethernet bridge shall be industrially hardened for application in a non-environmentally controlled cabinet.

2. The field Ethernet bridge shall operate within temperatures ranging from -4°F TO 149°F (- 20°C to 65°C) with a relative humidity between 0% and 90%.

15.2.6 *Network Management and Remote Monitoring Software (NMS)*

1. TDOT currently uses an existing NMS platform to monitor the field network. The existing platform is SNMPc by CastleRock. Network Configuration Management and Network Performance Monitoring modules are monitored using Orion by SolarWinds.

2. Design-Builder shall coordinate with TDOT IT to update the NMS with the Design-Builder's proposed changes.

15.3 Installation Requirements

15.2.1 *General*

1. Coordinate all work at, near, or inside buildings with the Engineer. Do not work on buildings or enter buildings without prior, written authorization from the Engineer. Coordinate and obtain approval from Engineer regarding allowable working time in buildings. Obtain necessary permits and inspections. Work shall not commence until the necessary permits are issued, posted on site, and approved plans are available on site. The Design-Builder shall coordinate installation with TDOT staff at least two (2) weeks in advance of needing access to the installed cable(s)/network equipment.

2. Furnish MAC addresses in a spreadsheet for all equipment utilized as part of this project, in addition to the equipment models, serial numbers, and firmware revisions. Equipment shall be registered in the name of TDOT. Affix a MAC Address label to each device utilized. Furnish IP addresses for all equipment utilized as part of this project. Affix final IP address to each device utilized. Use labels that do not smear or fade.

3. In field equipment cabinets, fully integrate new Ethernet switches with the fiber optic termination panels. Integrate all field equipment as called for in Plans.

4. Fully integrate proposed switches with existing TMC Core switches and computer and central system hardware to form a complete local area network that allows users from TDOT TMC as shown on the Plans to access applications on application servers and the CCTV central hardware and the proposed field communication network.

5. Fully integrate upgraded LAN to accomplish/maintain L2 Field Switch, L3 Aggregation Switch, and L3 Core Switch failover and fault tolerance.

6. Fully integrate LAN equipment to provide user authentication and security functions to prevent unauthorized users and data from entering the freeway system LAN.

7. No Ethernet switch purchase, configuration, or deployment can occur until the Design-Builder's RDD has been approved in final form by the Engineer.

15.2.2 *Ethernet Bridge*

All equipment shall be installed according to the manufacturer's recommendations these specifications and the Plans.

1. Each T-1 service port shall be protected from line surges from telephone-company outside plant cables. Each bridge shall be provisioned to support streaming video over the aggregate bandwidth back to the TMC. At the TMC a central switch/router will be the primary destination for receiving all field camera video feeds over one telephone service provider multiple T-1 circuits. The Design-Builder shall be responsible for establishing the MLPPP parameters to interface with the telephone service provider T-1 circuits for communication with the TMC central system. Each communication hub shall be configured initially to accept up to four (4) T-1, with an aggregate total of 1.544 Mbps per T-1.

2. The video encoder's data port associated with the CCTV control shall each be configured to transmit at a minimum of 9600bps (or higher data rates as compatible with the CCTVs).

3. Under this contract, the Design-Builder shall be required to submit an IP addressing convention to the Engineer for approval, prior to configuring the Ethernet Bridge and video encoder addresses. The non-volatile configuration files for each Ethernet bridge, when appropriate, shall be provided electronically (CD-ROM, USB drive, or approved equal) to the Engineer as part of the as-built documentation for the system configuration.

15.2.3 *Coordination with Central System Provider / Integrator*

1. The Design-Builder shall coordinate his/her efforts with those of the TDOT's Central System Provider (SwRI's SCS platform). The Design-Builder shall accommodate the System Provider's work in every way including planning and testing support for system

integration. In general, the Design-Builder shall install and test the field equipment and accompanying communication infrastructure. The Design-Builder shall also provide software and firmware, which is not already available to the System Provider, necessary for proper operation of the equipment the Design-Builder supplies as part of this Contract. Additionally, the Design-Builder shall provide testing computers and appropriate software that shall be used to test and demonstrate proper and acceptable operation of all equipment and communications infrastructure provided and/or installed by the Design-Builder. The Design-Builder shall coordinate device locations and settings with the Provider and notify the Provider in the event any settings are changed as a result of direction from the Engineer and/or installation problems in the field.

15.4 Measurement and Payment

1. Network Switch (Type A) L2 Field Ethernet Switch will be measured in units of each and paid for at the contract price per each unit furnished, installed, and accepted. All SFP modules, optics, cabling, jumper cables, patch cables, attenuators, configuration, and testing or other labor or materials required to install and integrate the field Ethernet Switch will be considered incidental and not be paid for separately. Partial payments will be made based on the following schedule: 80% upon completion and acceptance of the standalone switch test; 20% upon completion of the channel system testing.

2. Ethernet Bridge will be measured in units of each and paid for at the contract price per each. The price bid shall include furnishing, installing, system integration, training, documentation, and testing of a complete Ethernet Bridge including the Ethernet bridge, modules, power supply, power cable, ancillary cabling between the Ethernet bridge and the radio and/or video encoder, hardware and brackets and all incidental items to provide and install the Ethernet Bridge as intended, satisfactory completion of all testing requirements and all work, equipment and appurtenances as required for a full Ethernet Bridge installation. The price bid shall also include all system documentation including: shop drawings, operations and maintenance manuals, wiring diagrams, block diagrams, and other materials necessary to document the operation of the Ethernet Bridge. This price shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work.

3. Network Configuration Update will be paid for and measured as lump sum. LAN integration includes configuration and integration of all LAN hardware, firmware, and software to complete the LAN architecture, and submittal of the RDD. Integration of Design-Builder-provided network equipment with the existing TDOT firewall and integration of Internet based software applications with TDOT's existing Internet connection infrastructure shall be incidental and not paid for separately. All cabling, hardware, accessories, labor, and materials not provided with TDOT furnished network equipment required to make the unit function as part of this project shall be considered incidental and not paid for separately. Coordinating/updating/configuring TDOT's existing LAN

Network Management and Remote Monitoring Software (NMS) shall be included as part of the LAN integration and not paid for separately. Partial payments for this item will be made on the following schedule: 30% upon completion and acceptance of the RDD; 30% upon installation, integration and acceptance of LAN equipment at L3 Aggregation Switch locations including integration with the TMC Core Switches, 10% upon acceptance of the NMS configuration updates, and 30% upon installation, integration and acceptance of the entire project furnishing of and acceptance of network as-built documentation.

4. Payment for all cabling, jumpers, adapters, sockets, LAN patch panels, wall outlets, and other hardware shall be considered incidental and no separate payment will be made. Payment will be made under:

Item No.	**Description**	**Unit**
725-21.11	NETWORK SWITCH (TYPE A)	EACH
725-21.14	NETWORK CONFIGURATION	LS
725-21.16	ETHERNET BRIDGE (FIELD)	EACH
725-XX	ETHERNET BRIDGE (TMC)	EACH

L2 Field Ethernet Switch and Ethernet Bridge will be paid per each as follows:

1. 50% of the contract unit price upon completion Bench Test Component, Bench Test System, Pre-installation test results.

2. 20% of the contract unit price upon completion of Stand Alone Testing at the demarcation cabinet.

3. 20% of the contract unit price upon Conditional System Acceptance test results.

4. Final 10% of the contract unit price upon Final System Acceptance.

Network Configuration Update will be paid on a lump sum basis as follows:

5. 100% of the contract unit price upon Conditional System Acceptance.

SECTION 17
PROJECT ACCEPTANCE

17.1 Description

This section specifies the minimum requirements for acceptance procedures and tasks that must be completed prior to project acceptance. These items include the project testing program, burn-in period, training, warranties, project submittals, system documentation, and as-built documentation.

17.2 Task Requirements

17.2.1 *Project Testing Program*

1. The project testing program requirements and acceptance procedures are outlined in Section 1 of this SP. Additional specific testing requirements are detailed in the individual SP sections.

2. The burn-in period requirements are outlined in Section 1 and Section 18 of this SP.

17.2.2 *Training*

1. The training requirements are outlined in Section 1 of this SP. Additional specific training requirements are detailed in the individual SP sections.

17.2.3 *Warranties*

1. The warranties requirements are outlined in Section 1 of this SP. Additional specific warranty requirements are detailed in the individual SP sections.

17.2.4 *Project Submittal Program*

1. The project submittal program requirements are outlined in Section 1.8 of this SP. Additional specific submittal requirements are detailed in the individual SP sections.

17.2.5 *System Documentation*

1. The system documentation requirements are outlined in Section 1.9 of this SP. Additional specific system documentation is detailed in the individual SP sections.

17.2.6 *As-Built Documentation*

1. Prior to the Conditional System Acceptance Tests, all Department approved changes shall be incorporated by the Design-Builder into all submitted documents and drawings, including the project Plans. Copies of the updated drawings shall be submitted to the Department to serve as the final as-built configuration drawings. In the Project Plans, each drawing shall be identified under the sheet number block, with the words "AS-BUILT", the date and the approval. The as-built drawings shall consist of a neatly marked-up set of plans using a red permanent marker. The drawing shall indicate the as-built location of all equipment including, but not limited to: poles, cabinets, conduit, pull boxes, gates, etc. As part of the as-built drawings, the Design-Builder shall use a hand-held GPS unit to determine the GPS coordinates (in a format approved by the engineer) for all standalone devices, structures, and outside plant infrastructure including field devices, poles and sign structures, pull boxes, equipment cabinets, signs, etc. These coordinates shall be summarized in a GPS Coordinates Database in a Microsoft Excel or Access table that indicates the following minimum information:

    a. Device/equipment name and number (where applicable)

    b. Roadway name and station number

    c. Sheet number in Plans

    d. GPS coordinates

    This information shall also be included in the equipment inventory and maintenance database described in Section 18.

2. In addition to submitting an original hardcopy of the AS-BUILT drawings, the Design-Builder shall submit a PDF file (with markups created using digital entries) of each AS-BUILT sheet. High Quality marked sheets shall be submitted electronically in a PDF format. The Design-Builder shall also submit AS-BUILT plans in a MicroStation. The as-built drawings shall consist of a neatly marked-up set of plans using a red font in a

MicroStation file. The Design-Builder must contact TDOT and request the original plans in MicroStation so that they may be edited for the As-Builts.

3. As-built documentation shall be prepared and submitted in the following two stages:

    a. Preliminary as-built documentation shall include all materials, devices, and infrastructure included in this contract. Preliminary as-built documentation shall be submitted and approved prior to requesting the Conditional System Acceptance Test.

    b. Final as-built documentation shall be an update reflecting any changes that occurred during the burn-in period. Final as-built documentation shall also include installation data forms provided by TDOT to the Design-Builder throughout the project that shall be completed by the Design-Builder. These forms require various information such as cable length IDs into and out of each pull box, site specific information, etc. Final as-built documentation shall be submitted and approved as part of the Final Inspection.

4. As part of the as-built drawings, the Design-Builder shall also submit a complete System Equipment Inventory of all equipment utilized on the project. The Design-Builder shall create and maintain the System Equipment Inventory as a Microsoft Access database. The System Equipment Inventory shall include GPS coordinate information from the as-built documentation. As an alternate, the GPS Coordinates Database and the System Equipment Inventory may be combined in one relational database provided that all required data components are maintained.

    As a minimum, the System Equipment Inventory shall include the following information about each equipment item:

    a. Device/equipment item name

    b. Pay item number

    c. Location (station and device ID)

    d. Sheet number in Plans

    e. GPS coordinates

    f. Make, model and mfr part number

    g. Serial number

    h. Barcode equipment ID

    i. Barcode location ID

j. Revision ID

k. Firmware ID

l. Purchase date

m. Installation date

n. Manufacturer contact information

5. The Design-Builder shall provide project submittals for as-built documentation in accordance with the requirements in Section 1.8 of this SP. The project submittals for as-built documentation shall include but are not limited to, the following:

    a. GPS Coordinates Database (template shall be submitted for approval)

    b. System Equipment Inventory (template shall be submitted for approval)

6. Beginning with the first activities of field construction, all as-built documentation, including, but not limited to, updated drawings, completed installation data forms, GPS Coordinates Database, and System Equipment Inventory, shall be kept up-to-date on a weekly basis and shall be made available for review by the Engineer upon request.

17.3 Measurement

17.3.1 *Project Testing Program*

Project testing shall be included in the cost of other pay items and will not be measured separately for payment, except for burn-in period as specified herein.

17.3.2 *Training*

The Training item shall be a lump sum item and shall include all labor, equipment, materials, travel, facilities, production and reproduction, and miscellaneous items needed to conduct the training as specified.

17.3.3 *Warranties*

Warranties shall be included in the cost of other pay items and will not be measured separately for payment.

17.3.4 *Project Submittal Program*

Project submittals shall be included in the cost of other pay items and will not be measured separately for payment.

17.3.5 *System Documentation*

System documentation shall be included in the cost of other pay items and will not be measured separately for payment.

17.3.6 *As-Built Documentation*

As-built plans shall be a lump sum item and shall include all labor, equipment, materials, production and reproduction, and miscellaneous items needed to produce the as-built plans as specified.

17.4 Payment

The contract unit price shall be full compensation for all work specified in this section.

Payment will be made under:

Item No.	Description	Unit
725-24.55	AS-BUILT PLANS	LS
725-24.61	TRAINING	LS

1. As-Built Documentation will be paid on a lump sum basis as follows:

    a. 90% of the contract unit price for approved as-built documentation prior to Conditional System Acceptance.

    b. Final 10% of the contract unit price upon Final System Acceptance.

2. Training will be paid on a lump sum basis as follows:

    a. 100% of the contract unit price upon completion of required training.

SECTION 18
SYSTEM MAINTENANCE REQUIREMENTS

18.1 Description

The purpose of this Section is to describe the required maintenance activities that the Design-Builder must provide during the Burn-in period with an option for a period up to 6 months following Final System Acceptance by the Engineer. The Design-Builder will provide these maintenance activities for all equipment installed as part of this Contract. The maintenance requirements described in the Section shall include all necessary labor, materials, equipment, tools, transportation, supplies, and incidentals required to complete the work. The maintenance period is divided into Preventative Maintenance and Unscheduled Maintenance. The duration of the maintenance period will be subject to the exercising of the Annual Maintenance options at the discretion of TDOT.

18.1.1 *Definitions*

Preventive Maintenance (PM) for the System consists of regularly scheduled activities such as, but not limited to, electrical testing, replacement of necessary parts, cleaning, and lubrication. The Design-Builder shall perform all preventive maintenance activities recommended by this SP as well as the equipment manufacturer within the periodic intervals recommended. This shall include the periodic inspection and cleaning of the equipment and updating the resulting documentation of this inspection.

Repair maintenance consists of responding to the various failures reported concerning the various field components of the system. Repair maintenance will include the reactive, day-to-day repair, replacements, and diagnostic work necessary to keep the System fully operational.

Both Preventive Maintenance and Repair Maintenance shall be included in the cost of the Burn-in Period pay item (725-24.41).

A repair maintenance response is defined as the Design-Builder receiving notice from the TDOT of a failure and the Design-Builder responding with a field assessment of the problem, preparation of a plan and schedule for repair and submission of that report to the TDOT. The response report may be via email or fax.

Failures after Conditional Acceptance caused by acts of God or other construction activities outside the control of the Design-Builder shall be defined as Unscheduled Maintenance and the Design-Builder shall be compensated separately for those activities. Unscheduled maintenance may also include other special requests from TDOT. If these special requests require additional equipment or expertise beyond a normal maintenance activity, the Design-Builder may negotiate a different rate for those special requests.

18.1.2 *General Requirements*

The Design-Builder shall manage all ITS assets within the project limits and will perform work that produces end results in accordance with the Department Specifications including all Supplemental Specifications and Special Provisions. These include, but are not limited to:

1. TDOT Standard Specifications for Road and Bridge Construction (Latest Edition).

2. Manual on Uniform Traffic Control Devices (Latest Edition).

3. TDOT Roadway and Structure Drawings (Latest Revised).

Proper health and safety measures will be taken to ensure safety for the traveling public, TDOT employees, and Design-Builder employees.

Maintenance of traffic is solely the responsibility of the Design-Builder. Under no circumstances will maintenance of traffic be an additional pay item.

TDOT will pay all monthly electric & leased line communication bills. Responsibility for maintaining power to devices will be as follows:

1. From the utility to the demarcation point - Local Utility Companies

2. From the demarcation point to the control cabinet or breaker and from the control cabinet or breaker to and within the devices - Design-Builder.

The Design-Builder shall maintain an electronic maintenance log which shall detail all maintenance action items and the dispositions of the items contained in the log. The log will be kept on the maintenance computer within the TMC. Prior to the beginning of the burn-in period, TDOT will provide the Design-Builder an empty Microsoft Access database file that contains the required formatting for the database.

All overhead work over impacted traffic lanes shall include proper lane closures in accordance with MUTCD, except when the Design-Builder is working inside a DMS enclosure. TDOT must approve all lane closures in advance. Requests for lane closures shall be submitted at least seven days in advance of work for all preventative maintenance activities.

The Design-Builder is required to provide all operational crews with working cell phones at all times. In addition, the Design-Builder shall provide a single phone contact for the Design-Builder's supervisor. The Design-Builder shall provide to the TDOT and keep current all cell phone contact numbers. It is essential that the operating crews can contact the TMC to ensure correct operation of equipment and verify equipment status in the control center.

TDOT will appoint a representative that will act as contract administrator with the responsibility of ensuring that work is done to a specified standard defined in this SP. This representative will be responsible for verifying that the Design-Builder satisfactorily completes the work. The TDOT representative will be responsible for the overall monitoring of the Design-Builder's work.

18.1.3 *Form of Contract*

Under the terms of this Contract there are several requirements:

The first requirement will be for performing the preventive maintenance for the System. This will be included in the price bid for the burn-in period. Preventive maintenance consists of regularly scheduled activities such as, but not limited to, communications and electrical testing, replacement of necessary parts, cleaning, and lubrication. The Design-Builder shall perform all preventive maintenance activities recommended by this SP as well as the equipment manufacturer within the periodic intervals recommended. This shall include the periodic inspection and cleaning of the equipment and the resulting documentation of this inspection.

The second requirement is for performing Repair Maintenance. Repair Maintenance consists of responding to the various failures reported concerning the various field components of the system. Repair Maintenance will include the reactive, day-to-day maintenance, replacements, and diagnostic work necessary to keep the System operational. The Design-Builder must provide all necessary labor, tools, equipment, and engineering for the repair maintenance work. A response report containing the items identified must be submitted to TDOT within the time frames noted below. Notice of a failure will be communicated to the Design-Builder via a phone call and a follow up email or fax.

The Repair Maintenance during the Burn-in Period shall be included in the cost bid for the Burn-in Period. With the exception of acts of God as described below, no separate payment will be made for keeping the system operational during the burn-in period. Repair Maintenance beyond the Burn-in Period will be considered "Unscheduled Maintenance".

Work items generated by failures caused by acts of God, other construction activities, or other special requests from TDOT shall be considered Unscheduled Maintenance. The Design-Builder must provide the required number of personnel and all necessary tools, equipment, and engineering for the unscheduled maintenance work. All labor and material items described above shall be included in hourly unit price as described in the payment section.

If a failure involves a DMS Sign, multiple cameras, or poses a safety threat to the motoring public as determined by TDOT, the Design-Builder shall respond on-site within four (4) hours of

notice of a failure by TDOT. This four-hour response requirement applies 24 hours a day, 7 days a week.

For other failures that do not include a DMS sign, multiple cameras, or do not pose a safety threat, the Design-Builder shall respond on-site within eight (8) hours of notice of a failure by TDOT. This eight hour response requirement is limited to normal business hours (8:00 am to 5:00 pm) Monday thru Friday.

The Design-Builder and TDOT will work together to develop a tracking system to document and track all Unscheduled Maintenance Labor. Once a repair task is complete, the Design-Builder shall submit final paperwork within three (3) business days. Failure to submit this paperwork within the specified time is subject to non-payment.

The third requirement is for the purchasing and storing of spare parts. The amount of required spare parts by equipment type is defined in this document. The initial Spare Parts will be paid at the lump sum price bid (based on the quantities shown in the Spare Parts section). The cost of storing and maintaining the inventory of spare parts and equipment should be included in the lump sum cost of the spare parts. The cost for replenishing used spare parts for under the Equipment Replacement pay item. A 15% markup on the invoice price shall be allowed on direct material costs.

In addition to the items of work described above, there may be special circumstances where TDOT requests work that cannot be adequately covered by one of the pay items included in this contract. (Example situations may include pole knock downs, re-location of facilities to accommodate other construction activities, minor system modifications or expansions, etc.). If and when those situations occur, the Design-Builder will be asked to submit a separate cost proposal and schedule to TDOT for consideration and approval. Once approved the Design-Builder shall start the work within 10 days of approval and prosecute the work with due diligence according to the schedule agreed upon. It will be TDOT's sole decision to determine whether or not a specific item of work can be completed within the existing pay items.

18.2 Schedule of Work

TDOT will permit access to facilities as required by the Design-Builder for the purposes of maintenance. The Design-Builder shall provide the Maintenance Activities throughout the entire contract period.

The TDOT reserves the right to either cancel this Maintenance Agreement in part, or in its entirety without liability to the TDOT on thirty (30) days written notification to the Design-Builder or at the end of an option period. The TDOT shall direct that the work under this Maintenance Agreement be performed by the Design-Builder in one-year increments with each yearly increment being exercised at the sole option of the TDOT. Failure of the TDOT to exercise an option will terminate the Contract. The Department shall have no obligation in excess of the amount contracted for, or for services rendered by the Design-Builder, which are not performed within the specified period.

18.2.1 *Monthly Status Meetings*

Each month the Design-Builder shall hold a status meeting with TDOT. At these meetings the Design-Builder shall discuss the previous month's repairs, anticipated work for the next month, spare purchases for the month, and other operational problems that may arise. The Design-Builder is responsible for taking and distributing the minutes of these meetings. These minutes must be transmitted to TDOT within seven days for approval by TDOT. Progress payments for Annual Maintenance may be withheld until meeting minutes are submitted to TDOT. Note that on some occasions more frequent meetings may be warranted for special conditions. No additional costs will be allowed for these additional meetings.

18.3 Equipment to be Maintained

All equipment installed by the Design-Builder as part of this project shall be subject to the preventive and unscheduled maintenance procedures through the burn-in period until Final Acceptance is given. Following Final System Acceptance, the Design-Builder will enter into an Annual Maintenance contract that will be renewable in one year increments at TDOT's discretion. The Design-Builder will continue to be responsible for preventative and unscheduled maintenance during the Annual Maintenance period for all subsystems listed above.

18.4 Maintenance Procedures

For each major equipment type there are defined minimum preventive maintenance procedures. These minimum procedures are defined in Appendix A – Preventive Maintenance Procedures. Each equipment's preventive maintenance procedure has a fixed period between procedures. These are defined in Appendix A. It is also the Design-Builder's responsibility to obtain and submit to TDOT the preventive maintenance procedures recommended by the equipment manufacturers, including, but not limited to, all requirements to meet warranty standards.

Maintenance procedures performed under repair maintenance shall use materials and installation procedures as specified in this SP for new construction. At the sole discretion of the Engineer, certain repairs that are not possible to complete to the same standard as the new construction may be made utilizing materials and procedures as directed by the Engineer.

Should the Design-Builder perform an unscheduled maintenance action and within five (5) days the same fault is reported on the same piece of equipment, it is the Design-Builder's responsibility to make the second and any subsequent same-fault repairs at no cost to TDOT. Should a particular device persist in its failures, upon TDOT's instruction, such device shall be replaced and paid for by TDOT under the unscheduled maintenance procedures.

Upon completion of any maintenance activity, the work shall be subject to a random inspection by the TDOT. Work that is determined to be unacceptable shall be re-performed by the Design-Builder at the Design-Builder's expense.

For damage caused by acts of God, other contractors, or TDOT personnel, the Design-Builder is responsible for photographing all damaged structures and equipment; obtaining crash reports and/or driver information; and for submitting this information to TDOT.

18.5 Record Keeping Procedures

The Design-Builder shall use an existing database that will be provided by TDOT to the Design-Builder to track all preventive, repair, and unscheduled maintenance activities. The required format for each input will be provided to the Design-Builder prior to Conditional System Acceptance. The Design-Builder shall prepare a separate database to track the inventory of current spares. The database files shall be updated and emailed to TDOT weekly. This email shall also include a summary of the next week's planned maintenance activities.

The records for both preventative maintenance and an unscheduled maintenance response report on the database shall at a minimum include the following information. Additional information may also be required as requested by TDOT:

1. Date and time of failure report or date of unscheduled maintenance
2. Person or source of the report
3. Location of device
4. Description of failure or symptom
5. Name of person responding
6. Arrival time at location of reported failure
7. Weather and condition of the site
8. Actions taken
9. Schedule of initiating corrective work and estimated completion of work
10. Date and time of completion of work
11. Spare part details
12. Any consequential events – such as, but not limited to, failure to operate or secondary failure.

The Design-Builder shall maintain accurate and complete records of all work activities, status reports, meeting notes, cost proposals, invoices, inventory records, etc. The project As-Built Documentation, including the System Equipment Inventory, shall be updated if any information contained therein is changed due to scheduled or unscheduled maintenance activity. As-Built Documentation shall consist of, but not be limited to, modifying cabinet drawings, wiring diagrams, or installations. As-Built Documentation during maintenance shall be in accordance to the standards and requirements in this SP. All project records will be the property of TDOT and shall be returned to TDOT prior to final payment of the Contract.

18.6 Equipment Control

The Design-Builder shall maintain a sufficient inventory of spares to ensure the repair response time specified in the Appendix. The minimum amount of required spare parts by equipment type is defined below. These spares will be purchased by the Design-Builder and owned by TDOT. As equipment is used from the spare parts inventory during burn-in and device warrantee period, the Design-Builder shall replace at his own expense.

However, if the need to use spare parts equipment is due to acts of God, other special requests by TDOT, or repairs beyond the device warrantee period during the Annual Maintenance Period, the Design-Builder may invoice TDOT for replacement spares added back to the inventory. However, the cost of the replacement spares shall be submitted to TDOT for approval prior to ordering. A 15% markup will be allowed on direct material costs of the replacement spares needed due to acts of God or other special requests by TDOT. Shipping, insurance, and purchase costs should be paid directly by the Design-Builder and billed to TDOT. TDOT must give prior written approval for each monthly order made by the Design-Builder. The Design-Builder shall maintain a spares record and make readily available to TDOT. Spares records are to include as a minimum:

1. Manufacturer
2. Model number
3. Descriptive title
4. Serial number
5. Location
6. Purchase date
7. Date installed – when applicable
8. Location of installation – when applicable

The Design-Builder is fully responsible for these spares. The Design-Builder shall ensure the inventory of spares against all hazards or loss and name TDOT as the beneficiary in the case of loss. A copy of the insurance documents must be provided to TDOT. TDOT has the right to audit the inventory at any time by providing the Design-Builder with a five day notice. When items from the Spare Parts inventory are used, the Design-Builder shall replenish the inventory within 30 days of use. Contract payments will be held if this is not done within 30 days.

In addition to maintaining the spare parts inventory, the Design-Builder shall also ensure the availability and access to all vehicular equipment (trucks, bucket trucks, backhoes, front end loaders, and diagnostic equipment, etc.) and engineering/technical equipment needed to respond to and repair equipment failures and malfunctions. All equipment that is typically needed for an ITS maintenance contract shall be available and on-site within the required response time frame requirement outlined. If typical maintenance equipment is not available within this timeframe, the Design-Builder shall be considered to have missed the required response requirement. If specialty equipment is needed that is not typical, the Design-Builder shall notify TDOT of this need and TDOT will determine if an exception can be made in that situation.

18.7 Required Spare Parts Inventory

The Design-Builder shall have available and maintain the listed quantity of spare parts and modules to provide the required maintenance. Spares will be replenished as used, so that the following quantities in working orders are available at all times and will be delivered to TDOT at the conclusion of the maintenance contract. Note that only the major items are listed below, but each item listed below includes all equipment that was included in the original pay item for that particular item. All supporting, incidental, ancillary, and peripheral items necessary for a fully populated and complete installation shall also be maintained in the inventory. (For example, conduit would also require couplers, pull tape, tone wire, blank duct plugs, cable duct plugs, etc.). Prior to conditional system acceptance, the Design-Builder shall submit a full spare parts inventory list including the incidental items.

All items in the spare parts inventory measured by linear foot shall be single continuous unspliced lengths. If a portion of a length in inventory is used for repair, the remainder of the original length shall remain TDOT property in the inventory and the Design-Builder shall procure a replacement continuous length of the minimum above.

Only replacement parts provided by or functionally equivalent to those provided by the original manufacturer shall be allowed. Functional equivalency shall be approved at the sole discretion of the Engineer. The Design-Builder shall provide conveniently located secure premises to store all spare parts inventory.

18.8 Bar Code System

TDOT has an existing bar code system. The Design-Builder shall ensure that all new and replacement equipment has bar code labels attached using this existing equipment supplied

by TDOT. The purpose of the bar code system is to track the equipment inventory and to be able to determine the various maintenance activities that have occurred with that piece of equipment. The Design-Builder shall initially install bar code labels on all equipment prior to installation during the construction phase. The cost of installing the initial bar code labels shall be included in the cost of other items. Data corresponding to each equipment item must be recorded in the barcode system at TDOT. The implementation of the bar code system must be completed by the Design-Builder prior to the installation of any electronic equipment. The Design-Builder shall follow TDOT's existing bar code system structure, but shall provide the bar code labels needed for the equipment.

18.9 Staffing / Management Plan

The Design-Builder must provide a minimum of one technician for the duration of maintenance related contract periods to ensure satisfactory completion of all maintenance and repair activities. Before the start of Burn-in Period, the Design-Builder shall submit a Staffing/Management Plan defining the key staff for ITS Maintenance and the Project Management Team for approval by the Engineer. Resumes for the key staff must be provided. Changes to the key staff and Project Management Team shall require approval of the TDOT or the Department's authorized designee prior to use of the staff on the project. The TDOT shall have the right to reject any proposed replacement staff and request another replacement.

The staffing/management plan should include:

1. Proposed plan for communication and coordination among the Team and key staff.

2. Qualifications of all personnel. All staff must be qualified for the various types of devices and equipment they will be working on. Qualifications must include at least one year of installing and/or maintaining the types of ITS devices in this contract, or equivalent experience as approved by the Engineer. If qualified personnel are not available on Design-Builder's staff, work must be performed by a factory trained manufacturer representative.

18.10 Staffing Qualifications

All staffing associated with this project must be qualified for the work that is to be performed. Specifically, technicians that are responsible for the electronic components, must have a minimum of a two year associate degree plus two years relevant work experience or equivalent. An equivalent to this qualification would be more than three years of relevant experience. Any proposed equivalent must be approved by TDOT. The Design-Builder will furnish staff that is familiar with the equipment that is installed in this project.

18.11 Safety Plan

The Design-Builder is required to follow all applicable safety laws, regulations, and TDOT standard safety procedures. This includes compliance to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), OSHA, and others as appropriate. Appropriate safety attire for personnel in the field, clear markings, and functional yellow lights on vehicles must be part of the safety plan.

18.12 Design-Builder's Responsibility for Utility, Property and Service

At points where the Design-Builder's operations are adjacent to the properties of any utility, including railroads, and damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until arrangements necessary for the protection thereof have been completed.

The Design-Builder shall cooperate with owners of utility lines so that removal and adjustment operations may progress in a reasonable manner, duplication of adjustment work may be reduced to a minimum, and services rendered by those parties will not be unnecessarily interrupted.

Should the Design-Builder cause a cut in any communications media it is the Design-Builder's responsibility to repair that cut within one hour of the cut occurring.

If any utility service is interrupted as a result of accidental breakage or of being exposed or unsupported, the Design-Builder shall promptly notify the proper authority and shall cooperate with the authority in the restoration of service. If utility service is interrupted, repair work shall be continuous until service is restored. No work shall be undertaken around fire hydrants until the local fire authority has approved provisions for continued service.

18.13 Performance of the Design-Builder

Throughout this Contract, TDOT will conduct a review of the various works performed by the Design-Builder. These reviews shall be to determine the compliance of the Design-Builder's operations with the maintenance requirements, the terms of the Contract, and the policies and procedures of TDOT. The Design-Builder shall fully cooperate with these reviews. If deficiencies are found, TDOT shall inform the Design-Builder of this in writing. The Design-Builder shall take immediate remedial action to cure any deficiencies. No additional compensation will be due to the Design-Builder associated with such remedial actions. Payments may be withheld, or the burn-in period may be extended, if the Design-Builder fails to take immediate remedial action to cure any deficiencies.

The Design-Builder is required to maintain the devices uniformly and consistently throughout the Burn-in and Annual Maintenance periods, meeting both TDOT and, as appropriate, the manufacturer's performance specifications, as well as respond to failures identified by TDOT. Continued poor performance of work or failure to perform shall cause the Design-Builder to

be declared in default of the Contract. Failure to meet the maintenance requirements specified in this Contract shall result in a written notice from TDOT. This information shall inform the Design-Builder of non-compliance, as well as the withholding of progress payments that will occur, or an extension of the burn-in period if non-compliance continues. Progress payments will be withheld under the following conditions.

1. Regarding Preventive Maintenance: If any devices are found to be behind schedule for the regularly scheduled maintenance procedures, all progress payments will be withheld until all devices are verified back on schedule.

2. Regarding Repair Maintenance: All repair maintenance requests should be responded to within the timeframes outlined. A response is defined as being on site and beginning to diagnose the problem. When the response times exceed the requirements on more than two requests during any given month, the current monthly progress payment will be withheld until the following month. Items where the failure to respond is beyond the control of the Design-Builder, will not be included in this calculation.

3. Regarding Access Maintenance Database: If database is not updated weekly and is more than one week behind schedule, all progress payment will be withheld until database is current.

It is not the intent of TDOT to unfairly penalize the Design-Builder for events beyond his control such as acts of God, vehicle hits, severe weather conditions, major power failure, etc. Failure to perform either repair maintenance or preventive maintenance during such periods will not be used to penalize the Design-Builder, provided the Contactor returns to standard operations after such periods have ended.

The Design-Builder must ensure that all warranties remain valid. To achieve this, the Design-Builder shall perform all the preventive work specified by the manufacturer within the periods specified by the manufacturer for all equipment. If these tasks are covered by the standard preventive maintenance then both conditions apply.

The Design-Builder shall provide vehicular equipment such as, but not limited to, bucket trucks, inspection trucks, field engineering equipment, tools, materials, cellular phones, and other equipment necessary to perform the work. An approved vendor as per the equipment specification requirements shall calibrate all electronic maintenance and measurement equipment.

The Design-Builder shall provide conveniently located secure premises to store all test equipment. The Design-Builder shall provide workbench facilities to enable diagnostic testing and remedial work.

18.14 Measurement

18.14.1 *Burn-In Period*

The burn-in period item shall be a lump sum item and shall include all labor, materials, tools, equipment, and engineering necessary to maintain the system as specified in Section 1.5.8. The burn-in period item also includes all labor, materials, tools, equipment, and engineering necessary for all maintenance work as described in accordance with this SP. The bid price for the Burn-in Period shall also include the labor and bar code labels for the bar code system described in Section 18.8. The burn-in period pay item is the only payment that will be made during the burn-in period with the exception of items described below.

18.14.2 *Preventative Maintenance for System*

Preventive Maintenance shall not be measured separately and shall be included in the price bid for the Burn-in Period. This shall include all labor, tools, vehicles, equipment, and engineering necessary to perform preventive maintenance on the System in accordance with the provisions of the Contract.

18.14.3 *Repair Maintenance for System*

Repair Maintenance shall not be measured separately and shall be included in the price bid for the Burn-in Period. This shall include, but is not limited to, all labor, overhead, bucket trucks, inspection trucks, field engineering equipment, tools, materials, cellular phones, and other equipment necessary to perform the work in accordance with the provisions of the Contract.

For work items resulting from acts of God or other special requests from TDOT, the Design-Builder shall be compensated his hourly labor costs for such operations at the hourly rate bid for Unscheduled Maintenance Labor. This hourly rate includes but is not limited to, all labor, overhead, bucket trucks, inspection trucks, field engineering equipment, tools, materials, cellular phones, and other equipment necessary to perform the work. Hours shall be based on actual time on task plus a maximum of two hours travel time, or actual travel time if less than two hours. No further labor costs will be allowed. The price bid shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work. The price bid per hour includes all labor charges regardless of the number of people at the site.

18.14.4 *Unscheduled Maintenance Labor*

During Burn-in, the Design-Builder shall be compensated his hourly labor costs for such operations at the hourly rate bid for Unscheduled Maintenance Labor only for work items resulting from acts of God or other special requests from TDOT. This hourly rate includes but is not limited to, all labor, overhead, bucket trucks, inspection trucks, field engineering equipment, tools, materials, cellular phones, and other equipment necessary to perform the work. Hours shall be based on actual time on task plus a maximum of two hours travel time, or actual travel time if less than two hours. No further labor costs will be allowed. The price bid shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the

work. The price bid per hour includes all labor charges regardless of the number of people at the site.

After a successful Burn-in Period and Final Acceptance of the system by TDOT, if unscheduled maintenance operations or modifications are required to repair, modify, or replace system components due to no fault of the Design-Builder and wholly outside his control, the Design-Builder will be compensated his hourly labor costs for such operations at the hourly rate bid for Unscheduled Maintenance Labor. This hourly rate includes but is not limited to, all labor, overhead, bucket trucks, inspection trucks, field engineering equipment, tools, materials, cellular phones, and other equipment necessary to perform the work. Hours shall be based on actual time on task plus a maximum of two hours travel time, or actual travel time if less than two hours. No further labor costs will be allowed. The price bid shall be full compensation for all labor, tools, materials, equipment, and incidentals necessary to complete the work. The price bid per hour includes all labor charges regardless of the number of people at the site.

18.14.5 *Spare Parts and Equipment Replacement*

Spare Parts will be paid at the lump sum price bid for Spare Parts. The price bid shall include the furnishing of the specified parts only. Any install costs are covered elsewhere at a later time. The price bid shall be full compensation for all labor, tools, materials equipment, and incidentals to furnish the spare parts. The cost of storing and maintaining the inventory of spare parts and equipment should also be included in the lump sum cost of the spare parts.

Prior to the conditional system acceptance of the project, the Design-Builder shall submit to TDOT an itemized breakdown of the lump sum cost indicating the amount for each item in the spare parts inventory. Should changes during construction require a change in the number or type of spare parts needed, this breakdown of the initial bid price will be used to determine the appropriate change in the lump sum bid price. As spare parts are used, replacements to the inventory will be at the Design-Builder's expenses unless the additional equipment is needed due to an act of God or other special request from TDOT. In these cases, the replacements will be reimbursed at invoice price plus 15%.

Compensation for materials requested by TDOT, in addition to the spare parts listed, will also be at the rate of actual invoice cost including tax plus 15 percent for procurement expenses. Any extraordinary costs to the Design-Builder will not be paid unless approved in advance by the TDOT.

Equipment Replacement is a pay item that will be used to reimburse the Design-Builder invoice cost plus 15% for replacement parts needed throughout this Contract. The bid price shall be $25,000.00 which will establish a base amount that will be used as needed as replacement parts are ordered and invoiced by the Design-Builder. The required bid amount of $25,000.00 is meant only to establish a base amount and does not guarantee that the entire amount will be needed or used. Any unused funds in this pay item at the end of the contract will remain the property of TDOT.

18.15 Payment

Payment will be made under:

Item No.	Description	Unit
725-24.21	PREVENTATIVE MAINTENANCE FOR SYSTEM	LS
725-24.25	UNSCHEDULED MAINTENANCE LABOR	HOUR
725-24.31	SPARE PARTS	LS
725-24.32	EQUIPMENT REPLACEMENT	LS
725-24.41	BURN-IN PERIOD	LS

1. Unscheduled Maintenance Labor (where requested by TDOT) will be paid at the hourly rate upon completion and acceptance of a repair or modification.

2. Spare Parts will be paid at the lump sum price upon complete delivery to TDOT.

3. Burn-in Period will be paid on a lump sum basis as follows:

    a. 50% of the contract unit price upon successful completion of 3 months of the burn-in period.

    b. Final 50% of the contract unit price upon Final System Acceptance.

4. Annual Maintenance Labor (for quarters authorized by TDOT) will be paid on a lump sum basis of 1/3rd of the contract unit price upon successful completion of a month of the preventative maintenance activity.

5. Equipment Replacement will be paid at invoice cost plus 15% as replacement parts are ordered and invoiced by the Design-Builder.

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

(Rev. 01-08-2015)
(Rev. 09-06-2016)
(Rev. 06-26-2017)

SPECIAL PROVISION

REGARDING

RIGHTS-OF-WAY MOWING

Description. This work shall consist of mowing of the rights-of-way for vegetation control in accordance with the Plans, Specifications and as directed by the Engineer. A mowing cycle shall be one complete mowing of the areas along state highways and interstates designated within this contract and shall be completed within twenty (20) working days that are suitable for mowing.

Definitions.

Mowing. The work associated with cutting or trimming vegetation primarily consisting of, but not limited to, grasses and invasive weeds to provide a consistent and aesthetically pleasing standing vegetation height as directed by the Engineer.

Mowable Acres. All areas within rights-of-way where mechanical mowers can cut vegetation and safely traverse slopes without significant damage to existing ground.

Mechanical Mower. A piece of equipment which is capable of mowing vegetation in excess of 2 acres per hour at least five (5) hours per day.

Continuous Mowing Operation. A Continuous Mowing Operation is an operation conducted for a minimum of five (5) hours per day over a twenty (20) working day cycle which consists of one or more mechanical mowers working independently or in coordination to cut vegetation on state right-of-way deemed Mowable Acres by the Engineer.

Hand Trimming. The work associated with cutting or trimming vegetation in proximity to objects in areas not accessible to conventional mowers in an attempt to prevent damage and provide a consistent vegetation height by means other than a mechanical mower.

Working Day. A calendar day, exclusive of Sundays and State recognized holidays, which weather or other conditions not under the control of the Contractor, will permit mowing operations to proceed for at least five (5) hours of the day with the normal working force engaged in performing the controlling item or items of work which are normal to progress at the time, as determined by the Engineer.

General. All mowing shall be performed to the satisfaction of the Engineer. Standing vegetation shall be cut to a height of 4 inches while maintaining a consistent vegetation profile within all mowing limits adjacent to the roadway. The Contractor shall mow only those areas that are designated as mowable acres, including, if present, a minimum of 5 feet up the back slope from the bottom of the ditch, and 5 feet behind all guardrails as shown in The Typical Mowing Diagram on sheet 7. Vegetation including small trees, shrubs, and bushes with a stem diameter of up to 2 inches which are inside of and encroaching upon the established mowing limits shall be cut by the contractor using a mower or hand trimming methods as directed by the Engineer. Areas that were recently cleared or chipped will be included in mowable acres. Extreme care shall be taken not to damage the trees, plants, and shrubs, which are designated by the Engineer to remain. Hand trimming may be required as directed by the Engineer for areas of vegetation inside the designated mowable acres which are not accessible to mechanical mowers. As work progresses mowing and trimming shall be conducted in such a manner to provide a consistent standing vegetation height in all mowing limits adjacent to the roadway (see sheet 7 for Typical Mowing Diagram). The Contractor shall mow as close as practicable to all fixed objects. Hand trimming is required atop earth berms, within all rip rap areas, and around all fixed objects, including but not limited to earth berms, guardrails, cable barrier rail, utility installations, utility poles, mailboxes, delineators, sign posts, wildflower plots, bridge abutments and bridge piers. Guardrail and cable barrier rail located on interstates will be sprayed by TDOT personnel with the exception of those located in the following counties: Davidson, Hamilton, Knox, and Shelby. Spraying by TDOT does not relieve the Contractor from hand trimming if needed. The Contractor shall not apply herbicides on state rights-of-way. See the Special Notes regarding the special types of mowing, the number of cycles and incidentals. See sheet 7 for a typical mowing diagram detailing the required mowing limits. Actual dimensions & mowing limits shall be discussed at the Preconstruction Conference.

The Department reserves the right to perform spot mowing with its own forces on all State right-of-way as necessary. Minor quantity adjustments may be made due to the Tennessee Department of Transportation's Wildflower Program, Adopt a Plot Program, designated research areas, environmental no-mow areas, and Adopt A Highway Program.

Time and Frequency Mowing. The number of mowing cycles will be indicated in the Special Notes, but may be decreased by one mowing cycle. Also, the Engineer may require a partial mowing cycle at certain locations. A notice to begin work will be issued to the Contractor at least five (5) working days prior to the date the mowing cycle is to begin. Work shall begin on the date specified in the notice. Mowing operations shall proceed in the same route sequence as performed during litter operations. A failure to begin mowing operations on the date specified in the notice will result in the assessment of liquidated damages (See SP108B). The mowing cycle shall be 20 working days suitable for mowing unless otherwise documented in the Special Notes.

Mowing shall be performed only during the hours of daylight Monday through Friday, or as directed by the Engineer. If work is performed on Saturday the Contractor will be charged a Working Day. No work shall be conducted on Sunday.

Mowing Operations. Work shall begin for each mowing cycle on the date specified in the Notice to begin work. Once a mowing cycle begins the contractor shall maintain a Continuous Mowing Operation until the mowing is complete. A mowing cycle will be considered complete when all mowing and hand trimming is complete to the satisfaction of the Engineer. Hand trimming shall be performed as close to mowing operations as practically possible.

Failure to complete hand trimming within five (5) working days of the termination of mechanical mowing represents a failure to maintain a continuous mowing operation.

When mowing within twelve (12) feet of the edge of pavement, mechanical mowers shall not discharge vegetation and debris toward the roadway. When mowing is required in proximity to the roadway, any vegetation or debris deposited on the roadway as a result of the mowing operation will be removed from edge of pavement to edge of pavement, or between curb and gutter, whichever applies, at the end of each working day. Any cost associated with the removal of vegetation clippings, foreign objects, or gravel that is deposited on the roadway, the shoulder, or in a curb and gutter section as a result of the mowing operation shall be included in the unit price bid for mowing (item no. 806-01).

Equipment. Prior to beginning work, the Contractor shall provide the Engineer a schedule of equipment which will be used to accomplish work under the terms of the contract. The Contractor shall certify to the Engineer that the equipment to be used on this project is suitable for mowing along public highways at all locations designated herein to be mowed as per the equipment manufacturer's recommendations, and further that all equipment used in the work will be maintained in safe operating condition at all times. Any equipment that the Engineer determines to be unsuitable for use or hazardous to highway users shall not be used in the work. The Contractor shall provide sufficient equipment and accessory items necessary for an efficient operation and the completion of the mowing cycle in the designated time. Any special equipment requirements will be noted in the Special Notes.

All rotary mowers must be equipped with safety chains to prevent damage to property caused by flying debris propelled out from under the mower. No disc type mowers will be allowed. Chains shall be a minimum of 5/16 inch in size, and links spaced side by side around the mower's front, sides, and rear. Chains shall be spaced at no less than twelve (12) strands of chain per foot and shall be laced horizontally one row from the bottom with 1/4" steel cable secured by cable clamps on each end. When sitting on level ground, at a level cutting height of seven (7) inches, the chains shall be long enough to drag the ground. Flaps or semi-rigid guards will not be allowed as a substitute for chains. Maximum cutting widths for rigid frame rotary mowers shall be l20 inches (10 ft.). Maximum cutting widths for all other mower types shall not exceed 180 inches (15 ft.) without the approval of the Engineer.

Tractors shall be equipped so as to conform to prevailing Occupational Safety Health Act Standards, including flashing amber lights and slow moving equipment emblems. While equipment is not in use, it shall be parked or stored off the pavement or shoulder of the highway in an inconspicuous place more than 30 feet from edge of pavement or as directed by the Engineer. Under no circumstances shall mowers be parked or stored on medians less than 100

feet wide. When batwing mowers are being moved from one site to another under their own power with the mowers raised, the mower shall be disengaged.

Handheld, pushed, or riding trimmers using string or blades are not considered mechanical mowers under the terms of this special provision.

The Contractor shall be required to have the company name and phone number on all tractors and work zone support vehicles on the left and right sides in a location that is visible to the public. The lettering for the company name and phone number shall consist of a reflectorized material with a minimum height of three inches (3") or five inches (5") in height if non-reflectorized.

Equipment Cleaning. The Contractor will be required to clean any piece of equipment moved into Tennessee if the equipment is moving from an area infested with invasive species of concern listed below:

1. Cogon Grass

Prior to moving equipment into Tennessee, the Contractor shall notify the Engineer of the location of the equipment's most recent operation. The Contractor shall not move any equipment that last operated in an area infested with an invasive species of concern into Tennessee without having cleaned such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds. If the Contractor cannot verify the location of its most recent operation, then the Contractor shall assume that the location is infested with invasive species of concern.

Prior to moving from an area identified as infested with invasive species of concern to, or through Tennessee, the Contractor shall clean such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds, and shall notify TDOT prior to moving any equipment subject to the cleaning requirements set forth above. The Contractor shall advise TDOT of its cleaning measures and make the equipment available for inspection. TDOT shall have two (2) days, excluding weekends and state holidays, to inspect and approve for use equipment after it has been made available. After satisfactory inspection, the Contractor may move the equipment as planned. Equipment shall be considered clean when a visual inspection does not disclose seeds, soil, vegetative matter, and other debris that could contain or hold seeds. The Contractor shall not be required to disassemble equipment.

Traffic Control. The Contractor shall maintain traffic and all traffic control devices for mobile mowing operations according to the requirements contained herein, the State of Tennessee's currently adopted edition of the Manual on Uniform Traffic Control Devices (MUTCD) defined under the Rules of Tennessee Department of Transportation Chapter 1680-3-1, and the Standard Specifications. Although Traffic Control may be included in the cost of other items, the contractor will be responsible for submitting certifications per Materials & Tests Division Standard Operating Procedures.

Warning Signs. The Contractor shall furnish portable signs in accordance with the "Manual on Uniform Traffic Control Devices" to notify the traveling public of the operations of mowing equipment. The Contractor shall place these signs on the highway during the operation of mowers and remove them immediately after the operation ceases. Signs at the beginning point shall be 48" by 48" in size; diamond shaped with black letters on an orange background with a black border with eight inch high letters. These signs shall be dual mounted, one on each shoulder, for both directions of travel.

Damage to Property. The Contractor shall carry on his operation in such a manner that he does not damage the existing ground areas, trees, shrubs, guardrail, utilities, delineators or other structures. The Contractor shall not mow during wet conditions where turf damage or ruts would occur. In the event damage occurs to the right-of-way because of mowing operations, the Contractor shall replace or repair same, at his own expense, in like kind, and as directed by the Engineer. If damaged property resulting from the Contractor's operations has to be repaired or replaced by the Department, the cost of such work shall be deducted from monies due the Contractor.

The Contractor shall take all necessary precautions to prevent damage to passing vehicles and to both public and private property. This shall include, but is not limited to trees, shrubs, fences, mail boxes, structures, delineators, utility poles, guardrail, cable barrier rail, signs, vehicles and any other property which may be damaged by the mowing operation. Payment for work may be withheld until damaged property has been repaired or replaced.

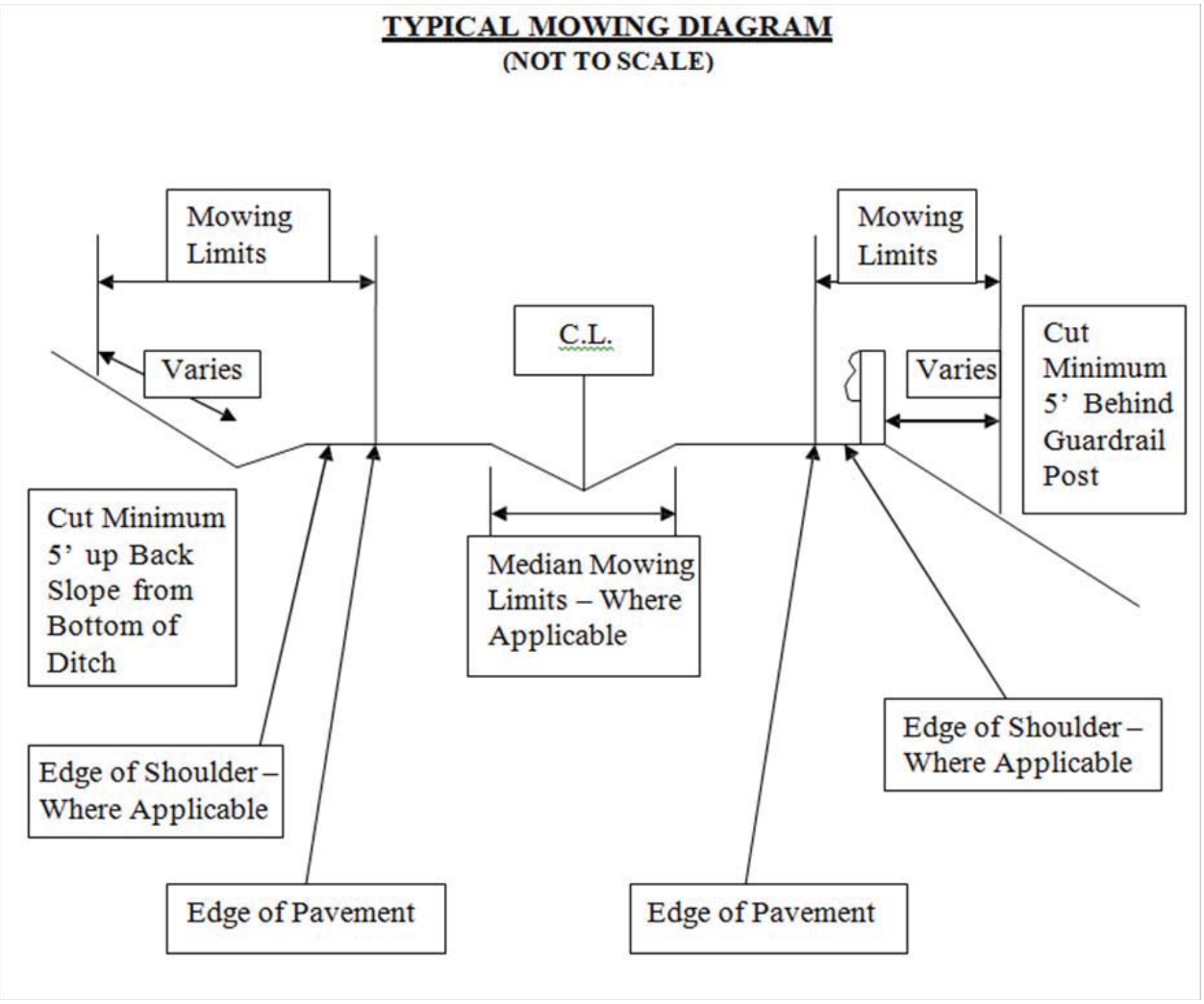
The Contractor shall respond to all claims of damage from the public within 72 hours after notification of damage. Failure to settle claims for damages in a timely manner may result in actions by the Department to preclude the Contractor from performing work on future projects.

Additional Work. The Contractor may be required to mow in areas not specifically detailed in the Special Notes under the direction of the Engineer. Additional work shall be limited to the counties and systems which are designated in the Special Notes. Payment for additional work will be made at the contract unit price for mowing (item no. 806-01)

Method of Measurement. Mowing shall be measured by the acre based on the quantities shown in the Special Notes for each mowable area. Each mowing cycle or partial cycle will be measured separately. A mowing cycle includes the mowing of all tabulated areas shown in the Special Notes one time.

Basis of Payment. The accepted quantities of mowing will be paid for at the contract unit price per acre. All costs for traffic control as defined above shall be included in the unit bid price for mowing Item No. 806-01.

TYPICAL MOWING DIAGRAM
(NOT TO SCALE)



S T A T E O F T E N N E S S E E

January 1, 2015

SPECIAL PROVISION

REGARDING

EQUAL EMPLOYMENT OPPORTUNITY

Reference:
Federal-Aid Highway Program Manual
Transmittal 147, June 26, 1975
Replaces FHWA Order Interim 7-2(1)

Specific Equal Employment Opportunity Responsibilities

GENERAL

a) Equal employment opportunity requirements not to discriminate and to take affirmative action to assure equal employment opportunity as required by Executive Order 11246 and Executive Order 11375 are set forth in Required Contract Provisions (Form FHWA-1273 or PR-1316, as appropriate) and these Special Provisions which are imposed pursuant to Section 140 of Title 23, U.S.C., as established by Section 22 of the Federal-Aid Highway Act of 1968. The requirements set forth in these Special Provisions shall constitute the specific affirmative action requirements for project activities under this contract and supplement the equal employment opportunity requirements set forth in the Required Contract Provisions.

b) The contractor will work with the Tennessee Department of Transportation and the Federal Government in carrying out equal employment opportunity obligations and in their review of his/her activities under the contract.

c) The contractor and all his/her subcontractors holding subcontracts not including material suppliers, exceeding $10,000, will comply with the following minimum specific requirement activities of equal employment opportunity: (The equal employment opportunity requirements of Executive Order 11246, as set forth in Volume 6, Chapter 4, Section 1, Subsection 1 of the Federal-Aid Highway Program Manual, are applicable to material suppliers as well as contractors and subcontractors). The contractor will include these requirements in every subcontract exceeding $10,000 with such modification of language as is necessary to make them binding on the subcontractor.

Equal Employment Opportunity Policy

The contractor will accept as his operating policy the following statement which is designed to further the provision of equal employment opportunity to all persons without regard to their age, race, color, religion, sex, national origin or disability and to promote the full realization of equal employment opportunity through a positive continuing program:

> It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment opportunity officer (hereinafter referred to as the EEO Officer) who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of equal employment opportunity and who must be assigned adequate authority and responsibility to do so.

Equal Employment Opportunity Officer

The contractor will designate and make known to the Tennessee Department of Transportation contracting officers an equal employment opportunity officer (hereinafter referred to as the EEO Officer) who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of equal employment opportunity and who must be assigned adequate authority and responsibility to do so.

Dissemination of Policy

(a) All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's equal employment opportunity policy and contractual responsibilities to provide equal employment opportunity in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

(1) Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's equal employment opportunity policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer or other knowledgeable company official.

(2) All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer or other knowledgeable company official covering all major aspects of the contractor's equal employment opportunity obligations within thirty days following their reporting for duty with the contractor.

(3) All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer or appropriate company official in the contractor's procedures for locating and hiring minority group employees.

(b) In order to make the contractor's equal employment opportunity policy known to all employees, prospective employees and potential sources of employees, i.e., schools, employment agencies, labor unions (where appropriate), college placement officers, etc., the contractor will take the following actions:

(1) Notices and posters setting forth the contractor's equal employment opportunity policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

(2) The contractor's equal employment opportunity policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

Recruitment

(a) When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be published in newspapers or other publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

(b) The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants, including, but not limited to, State employment agencies, schools, colleges and minority group organizations. To meet this requirement, the contractor will, through his EEO Officer, identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the contractor for employment consideration.

(c) In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with equal employment opportunity contract provisions. (The U.S. Department of Labor has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Executive Order 11246, as amended).

(d) The contractor will encourage his present employees to refer minority group applicants for employment by posting appropriate notices or bulletins in areas accessible to all such employees. In addition, information and procedures with regard to referring minority group applicants will be discussed with employees.

Personnel Actions

Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to age, race, color, religion, sex, national origin or disability. The following procedures shall be followed:

(a) The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

(b) The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

(c) The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

(d) The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of his avenues of appeal.

Training and Promotion

(a) The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.

(b) Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event the Special Provision Regarding Training Program Requirements is provided under this contract, this subparagraph will be superseded as indicated therein.

(c) The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

(d) The contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

Unions

If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

(a) The contractor will use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

(b) The contractor will use best efforts to incorporate an equal employment opportunity clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their age, race, color, religion, sex, national origin or disability .

(c) The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the Tennessee Department of Transportation and shall set forth what efforts have been made to obtain such information.

(d) In the event the union is unable to provide the contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to age, race, color, religion, sex, national origin or disability, making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The U.S. Department of Labor has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees). In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the Tennessee Department of Transportation.

Subcontracting

(a) The contractor will use his best efforts to solicit bids from and to utilize minority group subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of minority-owned construction firms from the Tennessee Department of Transportation.

(b) The contractor will use his best efforts to ensure subcontractor compliance with their equal employment opportunity obligations.

Records and Reports

(a) The contractor will keep such records as are necessary to determine compliance with the contractor's equal employment opportunity obligations. The records kept by the contractor will be designed to indicate:

(1) The number of minority and non-minority group members and women employed in each work classification on the project.

(2) The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women. (Applicable only to contractors who rely in whole or in part on unions as a source for their work force).

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees.

(4) The progress and efforts being made in securing the services of minority group subcontractors or subcontractors with meaningful minority and female representation among their employees.

(b) All such records must be retained for a period of 3 years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the of the Tennessee Department of Transportation and the Federal Highway Administration.

(c) Each contractor and subcontractor shall submit to the Tennessee Department of Transportation an annual report for every July during which work is performed indicating the number of minority, women and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form PR 1391 and is to be received by the Department not later than the 20th of the month following the reporting period.

(d) The contractor and/or sub-contractor will be required to complete other reports as instructed by the Engineer.

(e) Current estimates may be withheld by the Project Engineer when reports are not received within the above specified time limits.

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

SPECIAL PROVISION

REGARDING

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY

CONSTRUCTION CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)

1) As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;

   b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

   c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941

   d. "Minority" includes:

      I. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

      II. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish or Portuguese Culture or origin, regardless of race);

      III. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

      IV. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining indentifiable tribal affiliations through membership and participation or community identification).

2) Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation arid which is set forth in the solicitations from which this contract resulted.

3) If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals (including goals and time tables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4) The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a though p of these specifications. The goal set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5) Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specification, Executive Order 11246, or the regulations promulgated pursuant thereto.

6) In order for the nonworking training hours of apprentices and the trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7) The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

   (a) Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the

Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

(b) Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available and maintain a record of the organization's responses.

(c) Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

(d) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(e) Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The contractor shall provide notice of these programs to the sources complied under 7b above.

(f) Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

(g) Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(h) Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

(i) Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screenings procedures, and tests to be used in the selection process.

(j) Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's workforce.

(k) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

(l) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriation training, etc., such opportunities.

(m) Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

(n) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

(o) Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(p) Conduct a review, at least annually, of all supervisor's adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8) Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9) A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women, generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10) The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of age, race, color, religion, sex, national origin or disability.

11) The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12) The Contractor shall carry out such sanctions and penalties for violations of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13) The Contractor, in fulfilling its obligations under these specifications, shall implement' specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14) The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15) Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

S T A T E **O F** **T E N N E S S E E**

Revised 10-19-2012 January 1, 2015

SPECIAL PROVISION

REGARDING

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION

TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work are as follows:

County	Goals for Female Participation in each Trade
All Counties	6.9

County	Goals for Minority Participation for each Trade
Lincoln	11.2
Hamilton, Marion, Sequatchie	12.5
Bledsoe, Bradley, Grundy, McMinn, Meigs, Monroe, Polk, Rhea	8.6
Carter, Hawkins, Sullivan, Unicoi, Washington	2.6
Greene, Hancock, Johnson	3.2
Anderson, Blount, Knox, Union	6.6
Campbell, Claiborne, Cocke, Cumberland, Fentress, Grainger, Hamblen, Jefferson, Loudon, Morgan, Roane, Scott, Sevier	4.5

County	Goals for Minority Participation for each Trade
Montgomery	18.2
Davidson, Cheatham, Dickson, Robertson, Sumner, Williamson, Wilson, Rutherford	15.8
Bedford, Cannon, Clay, Coffee, Dekalb, Franklin, Giles, Hickman, Houston, Humphreys, Jackson, Lawrence, Lewis, Macon, Marshall, Maury, Moore, Overton, Perry, Pickett, Putnam, Smith, Stewart, Trousdale, Van Buren, Warren, Wayne, White	12.0
Shelby, Tipton	32.3
Benton, Carroll, Chester, Crockett, Decatur, Dyer, Fayette, Gibson, Hardeman, Hardin, Haywood, Henderson, Henry, Lake, Lauderdale, McNairy, Madison, Obion, Weakley	26.5

These goals are applicable to all the Contractor's construction work whether or not it is Federal or federally assisted.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in CFR Part 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform through- out the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from Project to Project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Office of Federal Contract Compliance Programs at the following address within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation:

U.S. Department of Labor – Regional Office
Office of Federal Contract Compliance Program
61 Forsyth Street, Room 7B75
Atlanta, GA 30303

The notification shall list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed.

S T A T E **O F** **T E N N E S S E E**

(Rev. 03-23-09) March 1, 2006
(Rev. 05-11-09)

SPECIAL PROVISION

REGARDING

TRAINING PROGRAM REQUIREMENTS

Reference:

Federal-Aid Highway Program
Transmittal 147, June 26, 1975
Replaces FHWA Order Interim 7-2(2)

This Training Special Provision supersedes subparagraph 7b of the Special Provision Regarding Equal Employment Opportunity, and is in implementation of 23 U.S.C. 140(a).

As part of the contractor's equal employment opportunity affirmative action program, training shall be provided as follows:

The contractor shall provide on-the-job training aimed at developing full journeymen in the type of trade or job classification involved.

The number of training hours under this Special Provision will be indicated in the Proposal.
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In the event that a contractor subcontracts a portion of the contract work, he shall determine how many, if any, of the trainees are to be trained by the subcontractor, however, the contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The contractor shall also insure that this training special provision 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 journeymen in the various classifications within a reasonable area of recruitment. Prior to pre-construction conference, the contractor shall submit to the Tennessee Department of Transportation OJT Program Coordinator for approval the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the contractor shall specify the starting time for training in each of the classifications. The contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journeyman status is a primary objective of this Training Special Provision. Accordingly, the contractor shall make every effort

to enroll minority trainees and women (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The contractor will be responsible for demonstrating the steps that he has taken in pursuance thereof, prior to a determination as to whether the contractor is in compliance with this Training Special Provision.

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.

No employee shall be employed as a trainee in any classification in which he has successfully completed a training course leading to journeyman status or in which he has been employed as a journeyman. The contractor should 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 should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the contractor and approved by the Tennessee Department of Transportation and the Federal Highway Administration. The Tennessee Department of Transportation and the Federal Highway Administration shall approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the contractor and to qualify the average trainee for journeyman status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Employment and Training Administration, or with a State apprenticeship agency recognized by the Department of Labor and training programs approved but not necessarily sponsored by the U.S. Department of Labor, Office of Apprenticeship, Employment and Training Administration, shall also 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 the State prior to commencing work on the classification covered by the program. It is the intention of these provisions that training is to be provided in the construction in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the Federal Highway Administration division office. Some offsite training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

Except as otherwise noted below, the contractor will be reimbursed 80 cents per hour of training given an employee on this contract in accordance with an approved training program. As approved by Change Order and the AAPO, reimbursement will be made for training persons in excess of the number specified herein.

This reimbursement will be made even though the contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the contractor from receiving other reimbursement. Reimbursement for offsite training indicated above may only be made to the contractor where he does one or more of the following and the trainees are concurrently employed on a Federal-aid project; contributes to the cost of the training, provides the instruction to the trainee, or pays the trainee's wages during the offsite training period.

No payment shall be made to the contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyman, is caused by the contractor and evidences a lack of good faith on the part of the contractor in meeting the requirements of this Training Special Provision. It is normally expected that a trainee will begin his training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his work classification or until he has completed his training program. It is not required that all trainees be on board for the entire length of the contract. Failure of the contractor to employ a trainee in the classification he has requested by the time 15 percent of that type work has been performed will be just cause for withholding progress estimates unless the contractor has furnished the AAPO a satisfactory explanation in writing of his failure to do so. A contractor will have fulfilled his responsibilities under this Training Special Provision if he has provided acceptable training to the number of trainees specified. 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 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 in an approved existing program are enrolled as trainees on this project. In that case, the appropriate rates approved by the Department of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by this Training Special Provision. However, in no case will the trainee be paid less than the minimum wage shown in the contract for the classification of laborer.

The contractor shall furnish the trainee a copy of the program he 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 performance under this Training Special Provision.

Payment is to be made under item 109-10.01, Trainee, at the unit price of $0.80 per hour, for each hour of approved training provided. In any case the number of training hours for which payment is made will not exceed number of hours specified for the approved classification by the approved Training program.

The contractor shall not be permitted to commence construction without an approved training program**.** Failure of the contractor to provide an approved training program shall not be considered "As a condition not under the control of the contractor" in regards to Contract Time.

S T A T E **O F** **T E N N E S S E E**

(Rev. 06-01-03)
(Rev. 06-23-08)
(Rev. 11-10-08)
(Rev. 02-12-18)

January 1, 2015

SPECIAL PROVISION

REGARDING

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION

The disadvantaged business enterprise (DBE) requirements of 49 CFR Part 26 apply to this contract. Accordingly, Disadvantaged Business Enterprises (DBEs) as defined in 49 CFR Part 26 shall have the maximum appropriate opportunity to participate in the performance of this contract or in the performance of subcontracts to this contract. In this latter regard, the Contractor shall take all necessary and reasonable steps in accordance with 49 CFR Part 26 to ensure that DBEs have the opportunity to compete for and perform subcontracts. The Contractor shall not discriminate on the basis of age, race, color, religion, national origin, sex, or disability in the award of subcontracts.

The Contractor shall submit to the Civil Rights Division Small Business Development Program (CRD-SBDP) copies of any subcontract agreements with DBEs upon execution. The Contractor shall identify all DBE subcontractors at the Preconstruction Conference and indicate the approximate date for each DBE subcontractor's appearance on the project. Before terminating and/or substituting a DBE subcontractor, the Contractor must give notice in writing to the DBE subcontractor, with a copy to TDOT's CRD-SBDP, of its intent to terminate and/or substitute including the reason for the request.

The Contractor shall provide notification to the Project Supervisor at least 24 hours prior to each DBE beginning work. The project supervisor or Inspector must complete a "Commercially Useful Function Checklist" to document the first date of work, work items, equipment, and forces of each DBE. The Contractor shall take full responsibility for the performance of a commercially useful function (CUF) by all DBE subcontractors, manufacturers, and materials suppliers who work on or provide materials for the project.

The Contractor shall provide a monthly payment certification to the Department entitled "Prompt Payment Certification Form." The Department shall provide the Contractor with the Prompt Payment Certification Form. An officer of the Contractor shall provide an electronic signature to the Prompt Payment Certification Form and return in Excel format via email to DBE.Runningtally@tn.gov and to the Project Supervisor concurrently. The Prompt Payment Certification Form shall be submitted monthly beginning no later than sixty (60) days after payment of the first estimate. Payments must abide by the conditions set in T.C.A. § 12-4-707.

Prior to receiving final payment, the Contractor shall provide to the project supervisor and CRD-SBDP certification of the dollars paid to each DBE firm, using Form CC3, "Certification of DBE Accomplishment." The certification shall be dated and signed by a responsible officer of the Contractor and by a responsible officer of the DBE. Falsification of this certification may

result in formal enforcement actions, including civil actions for false claims, suspension and debarment proceedings, or other administrative actions affecting bidder qualifications.

The Contractor and all subcontractors shall retain, for a period of not less than three (3) years after final acceptance of a project, copies of canceled checks or other documentation that substantiates payments to DBE firms. These records shall be available at reasonable times and places for inspection by authorized representatives of the Department and various Federal Agencies.

The Contractor is advised that failure to carry out the requirements as set forth above shall constitute a breach of contract, and after notification by the Department, may result in termination of the contract or other remedy deemed appropriate by the Department.

S T A T E O F T E N N E S S E E

(Rev. 04-17-15)
(Rev. 10-19-15)
(Rev. 02-12-18)
(Rev. 07-02-18)

January 1, 2015

SPECIAL PROVISION

REGARDING

DBE CONTRACT GOAL

All contractors shall pursue affirmative action requirements to encourage and increase participation of firms certified as a Disadvantaged Business Enterprise (DBE) as set forth in this special provision and in accordance with 49 CFR Part 26. The bidder shall arrange for the percentage of the work specified on the cover of the Proposal Contract to be performed by Tennessee Uniform Certification Program (TNUCP) Disadvantaged Business Enterprises (DBEs) or otherwise clearly demonstrate adequate good faith efforts as described herein. All payments must follow the conditions set by the most current T.C.A. § 12-4-707.

The Contractor shall take full responsibility for ensuring the performance of a "commercially useful function" (CUF), as defined in 49 CFR Part 26, by all DBE subcontractors, manufacturers, and materials suppliers who work on the project or provide materials for the project.

A. Disadvantaged Business Enterprise Policy

The Contractor shall abide by the following provision and include in all subcontract agreements the following provision, which is designed to promote full participation of DBEs as suppliers and subcontractors through a continuous, positive result-oriented program on contracts let by the Department:

> *The Contractor, sub-recipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of U.S. Department of Transportation-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the Department deems appropriate.*

B. Counting DBE Participation toward Meeting Goals

The Contractor shall count DBE participation toward goals in accordance with 49 CFR Part 26. If the DBE performs a CUF on the contract including those functions as a

subcontractor, expenditures to a DBE contractor count toward DBE goals. A DBE performs a CUF when it is responsible for execution of some portion of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. To perform a CUF, the DBE must also be responsible, with respect to materials and supplies used on the contract, for negotiating price, determining quality and quantity, ordering the material, installing (where applicable), and paying for the material itself. The work performed by the DBE firm shall be necessary and useful to the completion of the contract, and consistent with normal highway construction industry practices in Tennessee. Work performed by a DBE firm in a particular transaction may be counted toward the goal only if the Department determines that it involves a CUF. The determination is verified by the "Commercially Useful Function Checklist" and the requirements of 49 CFR Part 26.

Note: In accordance with 49 CFR 26.55(c), to determine whether a DBE is performing a CUF, the Department must evaluate the amount of work subcontracted, industry practices, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the DBE credit claimed for its performance of the work, and other relevant factors. A DBE does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of DBE participation. In determining whether a DBE is such an extra participant, the Department must examine similar transactions, particularly those in which DBEs do not participate.

When a DBE is presumed not to be performing a commercially useful function, the DBE may present evidence to rebut this presumption. The Department may determine that the firm is performing a commercially useful function given the type of work involved and normal industry practices.

The bidder may count the following DBE expenditures involving a CUF towards the DBE goal:

1. **Projects where the DBE is the Prime Contractor** – The entire portion(s) of the contract to be completed by certified DBE firm's own forces will be counted toward meeting the goal. This will also include the cost of supplies and materials obtained by the DBE for the work of the contract, including supplies purchased or equipment leased by the DBE. Items of the contract subcontracted to non-DBE firms will not be counted toward the goal.

Note: If a DBE does not perform or exercise responsibility for at least 30 percent of the total cost of its contract with its own work force, or the DBE subcontracts a greater portion of the work of a contract than would be expected on the basis of normal industry practice for the type of work involved, the Department must presume that it is not performing a commercially useful function.

2. **Portions of a Bid from a Joint Venture** – When a DBE performs as a participant in a joint venture, only the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the DBE performs with its own forces will count toward DBE goals. A bid from a joint venture between a DBE and a non-DBE Contractor shall include an explanation of DBE commitments on DBE Form 1247A, which must be approved by the Civil Rights Division - Small Business Development Program (CRD-SBDP) prior to the letting. Only the DBE's portion will be counted toward the goal. Joint venture agreements have to be approved separately from the bid documents, prior to the awarding of the contract.

3. **DBE Subcontractors** – The DBE subcontractor shall assume actual and contractual responsibility for provision of materials and supplies, subcontracted work, or other commercially useful functions of the items of work subcontracted to them. When a DBE subcontracts part of the work of its contract to another firm, the value of the subcontracted work may be counted toward the DBE goal only if the DBE's subcontractor is also a DBE. Work that a DBE subcontracts to a non-DBE firm does not count toward the DBE goal. Cost of materials purchased from or the cost of equipment leased from the non-DBE Contractor will not count toward the project DBE commitment. Prior written approval must be obtained from the CRD-SBDP for any DBE use of the Contractor's personnel or equipment.

4. **DBE Manufacturers** – The Contractor may count toward the DBE goal 100% of its expenditures for materials and supplies required under a contract and obtained from a DBE manufacturer only if the DBE operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications.

5. **DBE Regular Dealers (Material Suppliers)** – The Contractor may count toward the DBE goal 60% of its expenditures for materials and supplies required under a contract and obtained from a DBE regular dealer. For purposes of this section, a regular dealer is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. To be a regular dealer, the firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question. A firm may be a regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business where such products are bought, kept in stock, and regularly sold to the public if the firm owns and operates the distribution equipment for the products. Any supplementing of the regular dealer's own distribution equipment shall be by a long-term lease and not on an ad hoc or contract-by-contract basis. Any lease containing the terms of the agreement shall be made available to and must be approved in writing by CRD-SBDP

6. **Other DBE Suppliers** − With respect to materials or supplies purchased from a DBE which is neither a manufacturer nor a regular dealer, count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site, toward DBE goals; provided, the Department finds the fees to be reasonable and not excessive as compared with fees customarily allowed for similar services. The cost of the materials and supplies themselves shall not count toward DBE goals.

7. **Transportation or Hauling of Materials** – The Contractor may count towards the DBE goal hauling in either DBE-owned trucks or in trucks leased to or by DBE firms. The verification of truck drivers employed by DBE firms will continue to be by submission of payrolls independent from any Davis-Bacon regulations. Use the following factors in determining whether a DBE trucking company is performing a CUF:

    a. The DBE must be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular contract, and there cannot be a contrived arrangement for the purpose of meeting DBE goals.
    b. The DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the contract.
    c. The DBE receives credit for the total value of the transportation services it provides on the contract using trucks it owns, insures, and operates using drivers it employs.
    d. The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services that the lessee DBE provides on the contract.
    e. The DBE may also lease trucks from a non-DBE firm, including an owner-operator. The DBE that leases trucks equipped with drivers from a non-DBE is entitled to credit for the total value of transportation services provided by non-DBE leased trucks equipped with drivers not to exceed the value of transportation services provided by DBE-owned trucks or leased trucks with DBE employee drivers. Additional participation by non-DBE owned trucks equipped with drivers receives credit only for the fee or commission it receives as a result of the lease arrangement. If the DBE chooses this approach, it must obtain written consent from the Department [CRD-SBDP].
    f. The DBE may lease trucks without drivers from a non-DBE truck leasing company. If the DBE leases trucks from a non-DBE truck leasing company and uses its own employees as drivers, it is entitled to credit for the value of these hauling services.
    g. For purposes of this paragraph, a lease must indicate that the DBE has exclusive use of and control over the truck. Leases cannot be Department

contract-specific, must be long term, and must be approved by CRD-SBDP. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE.

h. Prior to hauling, the Contractor and DBE shall provide the project supervisor a complete list of trucks that will be used on the project for DBE goal participation. The Department will provide a form that shall be used by the Contractor and the DBE to identify the trucks. A revised list will be required any time the trucks used changes. The Contractor and DBE must be able to adequately document the actual amount of hauling eligible for DBE goal participation.

8. **Contracted Labor / Temporary Employment Agencies** – The Department will count the entire amount of fees or commissions charged by a DBE firm for providing a bona fide service, such as professional, technical, consultant, or managerial services, or for providing bonds or insurance specifically required for the performance of the contract; provided, however, the Department must find the fee to be reasonable and not excessive as compared to the fees customarily allowed for similar services.

C. Contract Award Procedures

The established DBE goal will be shown on the proposal as a percent of the total amount bid. If the total proposed DBE work submitted with the bid is less than the percentage participation goal set by the Department, the bidder shall, within three (3) business days from the bid openings, either propose sufficient additional DBE participation to meet the goal or clearly demonstrate by documentation that good faith efforts were made to meet the goal.

1. Bidder's Responsibility

It is the bidder's responsibility to determine the level of professional competence and financial responsibility of any proposed DBE subcontractor. The bidder shall ascertain that the proposed DBE subcontractor has suitable experience and equipment to perform a commercially useful function for work that is common industry practice in the Tennessee highway construction industry.

The Contractor shall develop and maintain records of negotiations with DBEs to reach agreeable prices, quotations and work schedules, including but not limited to a record of dates when the Contractor first contacted each DBE.

2. DBE’s Responsibility

Before bidding and subsequently entering into a contract (as a contractor or subcontractor), the DBE should consider the scope and size of the project, as well as whether it is certified to receive credit for the type of work performed. As with any contract, this is a legally binding document and should be performed to the best of one's ability. However, should a DBE ever have to withdraw from a contract, it shall provide the CRD-SBDP and Contractor with written documentation. A DBE should only withdraw when there is no other option, as non-completion of its duties may result in temporary disqualification of a prequalified bidder or subcontractor by suspending the privilege of bidding on Department contracts or becoming an approved subcontractor, as outlined in Chapter 1680-05-03 of the Rules of the Department.

3. Proposals with Established Project DBE Goals

For proposals with established project goals, the bidder will be required to complete DBE Form 1247A. The bidder shall list the following information on each DBE Form 1247A that is submitted:

a. The names and addresses of all DBE firms being used or being considered for use under the contract as part of the bidder's DBE commitment;
b. The work classification(s) for each DBE on the contract;
c. The "Amount to DBE" which has been committed to each DBE firm for use on the contract;
d. Written documentation of the bidder's commitment to use a DBE subcontractor whose participation it submits to meet a contract goal; and
e. Written confirmation from each listed DBE firm that it is participating in the contract in the kind and amount of work provided in the Contractor's commitment.

The completed DBE Form 1247A shall be submitted within three (3) business days after the Letting. Failure to provide a completed form or documentation clearly evidencing a good faith effort, as detailed in Section 4 below, within three (3) business days after the Letting may cause the bid to be rejected as irregular. Only certified DBE firms may be used. Contractor may access certification information by viewing the TNUCP DBE Directory website.

When DBE goal projects are involved and the Contractor subcontracts to a non-DBE, and the non-DBE subcontractor in turn subcontracts to a DBE as a second tier subcontractor, the Contractor must affirm in writing his/her knowledge and approval of such an arrangement. Recognition of a second tier arrangement with a DBE subcontractor for goal work must be forwarded to the CRD-SBDP Director for verification, in writing, prior to any work being performed by the DBE which is intended to be counted toward the goal.

4. Bidder Selection and Good Faith Efforts

a. Bidders shall submit proposals that meet the DBE goal or shall submit documentation clearly evidencing that they made a good faith effort to meet the DBE goal. Contractors who meet or exceed the contract goal will be assumed to have made good faith efforts to utilize DBE firms. DBE firms who bid as Prime Contractors will be considered to have met the goal.

b. In making a fair and reasonable judgment as to whether the bidder has made adequate good faith efforts, the Department shall consider quality, quantity, and intensity of the different kinds of efforts that the bidder has made. The following list of factors is not intended to be a mandatory checklist, nor is it intended to be exclusive or exhaustive. Other factors or types of efforts may be relevant in appropriate cases. In any event, the Department may consider whether the bidder:

    1) Selected portions of the work likely to attract DBE participation. The total dollar value of the portions selected should meet or exceed the contract DBE goal. If it is necessary, the bidder should break down subcontracts into economically feasible units in order to facilitate participation.

    2) Provided notice to a reasonable number of specific DBEs, including those not regularly used by the bidder, that their participation in the contract is being solicited in sufficient time to allow them to participate effectively.

    3) Provided interested DBEs with adequate information about the plans, specifications and requirements of the contract.

    4) Advertised in trade association publications or minority-focused media concerning participation opportunities.

    5) Effectively used the services of available minority community organizations, minority contractors groups, local, state, or federal minority business assistance offices, or other organizations that provide assistance in the recruitment and placement of DBEs.

    6) Negotiated in good faith with interested DBEs, including not rejecting DBEs as unqualified lacking sound reasons based on a thorough investigation of their capabilities.

    7) Made efforts to assist interested DBEs in obtaining bonding or insurance required by the bidder.

    8) Submitted all quotations received from DBEs, and for those quotations not accepted, an explanation of why the DBE was not accepted including price comparisons. Receipt of a lower quotation

from a non-DBE will not in itself excuse a bidder's failure to meet the contract goal.

9) Has adequate records of its contacts and negotiations with DBEs.

c. If the Contractor has not met the DBE goal or submitted documentation clearly evidencing good faith efforts within three (3) business days after the bid opening, the Contractor's bid will be considered non-responsive and may be cause for the forfeiture of the Proposal Guaranty which shall become the property of the Department, not as penalty, but as liquidated damages. The Department then may consider the next lowest responsive bid for award.

As soon as practical after contract award, the Contractor shall submit copies of all binding subcontracts and purchase orders with DBEs to the respective Project Supervisor and to CRD-SBDP.

No progress estimate shall be processed until copies of all binding subcontracts and purchase orders with DBEs have been received.

5. Joint Checking Allowance for DBE

A DBE must receive pre-approval by the Department before using a joint check. Joint check requests shall be submitted by the DBE to CRD-SBDP prior to the subcontract agreement.

The following are some general conditions that must be met regarding joint check use:

a. The second party (typically the Contractor) acts solely as a guarantor.
b. The DBE must release the check to the supplier.
c. The use of joint checks must be a commonly recognized business practice in the industry.
d. The DBE remains responsible for all other elements of 49 CFR Part 26.55(c)(1)
e. The DBE is not required to use a specific supplier nor the Contractor's negotiated unit price.
f. The DBE shall submit receipt/copy of cancelled checks to CRD-SBDP.

D. Construction Requirements

1. Preconstruction Conference

The Contractor shall identify all DBE subcontractors and indicate the approximate dates for their appearance on the project. The Department will review the contract information to verify the actual work to be performed by the DBE contractors and will review any lease agreements allowed as part of the DBE commitment.

Information submitted shall match Form 1247A.

2. Process for Removal of a DBE

At no time shall a DBE be terminated or substituted without prior written consent from CRD-SBDP. This includes, but is not limited to, instances in which the Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. The Contractor shall utilize the specific DBEs listed to perform the work and supply the materials for which each is listed unless the Contractor obtains the CRD-SBDP's written consent as provided herein. Absent such written consent, the Contractor shall not be entitled to any payment for work or material unless it is by the listed DBE. The CRD-SBDP may provide such written consent only if it agrees that the Contractor has good cause to terminate the DBE firm, as further described below.

Before terminating and/or substituting a DBE subcontractor on a project that includes SP1247 in the Contract Proposal, the Contractor must give notice in writing to the DBE subcontractor, with a copy to the CRD-SBDP, of its intent to request to terminate and/or substitute including the reason for the request.

The Contractor must then give the DBE five (5) days to respond to the Contractor's notice. The DBE shall then advise the CRD-SBDP and the Contractor of the reasons, if any, why it objects to the proposed termination of its subcontract and why the CRD-SBDP should not approve the Contractor's action. If required in a particular case as a matter of public necessity (e.g., safety), the CRO-SBDP may provide a response period shorter than five (5) days.

If approval is granted for removal, CRD-SBDP will submit a letter to the Contractor and the DBE. Good faith efforts shall then be directed at finding another DBE to perform at least the same amount of work under the contract as the DBE that was terminated, to the extent needed to meet the contract goal established. The good faith efforts shall be documented by the Contractor. If requested by the CRD-SBDP, the Contractor shall submit the documentation within seven (7) days, which may be extended for an additional seven (7) days if necessary at the request of the Contractor, and the CRD-SBDP shall provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated.

The Contractor has the responsibility to comply with 49 CFR Part 26.53(f) and all applicable policies and regulations.

Reasons for termination and/or substitution of a DBE subcontractor must meet the reasons for good cause as outlined in the current 49 CFR Part 26.53(f), which include, but are not limited to, circumstances in which the listed DBE subcontractor:

a. Fails or refuses to execute a written contract;
b. Fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the Contractor;
c. Fails or refuses to meet the Contractor's reasonable, nondiscriminatory bond requirements;
d. Becomes bankrupt, insolvent, or exhibits credit unworthiness;
e. Becomes ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215 and 1,200 or applicable state law;
f. Is not a responsible contractor, as determined by the Department;
g. Voluntarily withdraws from the project and provides written notice to the Contractor of its withdrawal;
h. Is ineligible to receive DBE credit for the type of work required;
i. Is unable to complete its work on the contract as a result of death or disability of an owner; and/or
j. For other documented good cause, the Department may elect to compel the termination of the DBE subcontractor; provided that good cause does not exist if the Contractor seeks to terminate a DBE it relied upon to obtain the contract so that the Contractor can self-perform the work for which the DBE was engaged, or so that the Contractor can substitute another DBE or non-DBE contractor after contract award.

3. Brokering of work by DBEs is not allowed and is a material breach of contract. A DBE firm involved in brokering of work may result in removal or suspension of DBE certification and/or formal enforcement actions, including civil actions for false claims, suspension and debarment proceedings, or other administrative actions affecting bidder qualifications Any firm involved in brokering of work that engages in willful falsification distortion, or misrepresentation with respect to any facts related to the project shall be referred to the U. S. Department of Transportation's Office of the Inspector General for prosecution under Title 18, U. S. Code, Section 641. Contractor shall place this provision in all subcontracts with DBEs.

4. The Contractor shall provide notification to the Project Supervisor at least 24 hours prior to each DBE beginning work. A Department Project Supervisor/Inspector must complete a Commercially Useful Function (CUF) Checklist to document the first date of work, work items, equipment, and forces of each DBE.

5. The Contractor shall enter monthly prompt payment certification to the Department through external access to AASHTOWare Project Civil Rights & Labor (CRL) The Contractor is responsible for ensuring all subcontractors, any tier, and material suppliers or haulers are registered for access with the Department. In addition, the

Contractor shall require subcontractors, material suppliers, and haulers to review payment information monthly and respond in CRL when discrepancies or disputes are present.

Prompt Payment data shall be submitted monthly beginning no later than sixty (60) days after payment of the first estimate.

6. The Department will hold estimate payment if previously listed information is not submitted. Reasons for non-payment to a DBE could include the following:

    a) Whether the DBE is performing satisfactorily;
    b) Whether the Contractor has reason to believe the DBE is not performing a commercially useful function, and if so, why and what steps the Contractor is taking to rectify the situation.

In the event the Contractor reports questions in relation to prompt payment regarding whether a DBE is independent and performing a commercially useful function and takes appropriate steps promptly to address the issue, then the Department will take this effort into account when considering Contractor compliance measures as described below. Payments must abide by the conditions set in TCA 12-4-707.

E. Post Construction Requirements

Prior to receiving final payment, the Contractor shall provide to the Project Engineer and CRD-SBDP certification of the dollars paid to each DBE firm, using Form CC3, "Certification of DBE Accomplishment." The certification shall be dated and signed by a responsible officer of the contractor and by a responsible officer of the DBE. Falsification of this certification may result in removal or suspension of DBE certification and/or formal enforcement actions, including civil actions for false claims, suspension and debarment proceedings, or other administrative actions affecting bidder qualifications. The final estimate will not be paid to the Contractor until proper certifications including CC-3 have been made.

F. Required Records

The Contractor and all subcontractors shall retain, for a period of not less than three (3) years after final acceptance of a project, copies of canceled checks or other documentation that substantiates payments to DBE firms. These records shall be available at reasonable times and places for inspection by authorized representatives of the Department and various Federal Agencies. Copies shall be provided to the Department if requested.

G. Contractor Compliance

1. If the Contractor fails to comply with Special Provision 1247 and/or 49 CFR Part 26, resulting in failure to obtain goal where a good faith effort was not accepted, the Department shall take one or a combination of the following steps:

1) The Department may withhold from the Contractor the monetary value of the unattained goal percentage plus an additional 10% for engineering costs, not as penalty but as liquidated damages.

2) Suspend the Contractor from participation in Department bid lettings pursuant to rules promulgated by the Department.

3) For repeated failures to comply, debar the Contractor pursuant to rules promulgated by the Department.

4) Invoke other remedies available by law and/or in the contract.

5) Invoke any other lawful remedy agreed upon by the Commissioner and the Contractor in writing.

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under

this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are

applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurance Required by 49 CFR 26.13(b):

a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor

will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 “Contract provisions and related matters” with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b.(1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or

will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b.(1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency..

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility.

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term “perform work with its own organization” refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

(1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
(2) the prime contractor remains responsible for the quality of the work of the leased employees;
(3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
(4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

T h i s p r o v i s i o n i s applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

T h i s p r o v i s i o n i s applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1**. Instructions for Certification – First Tier Participants:**

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. **Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the

department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

ATTACHMENT A - EMPLOYMENT AND MATERIALS PREFERENCE FOR APPALACHIAN DEVELOPMENT HIGHWAY SYSTEM OR APPALACHIAN LOCAL ACCESS ROAD CONTRACTS

This provision is applicable to all Federal-aid projects funded under the Appalachian Regional Development Act of 1965.

1. During the performance of this contract, the contractor undertaking to do work which is, or reasonably may be, done as on-site work, shall give preference to qualified persons who regularly reside in the labor area as designated by the DOL wherein the contract work is situated, or the subregion, or the Appalachian counties of the State wherein the contract work is situated, except:

a. To the extent that qualified persons regularly residing in the area are not available.

b. For the reasonable needs of the contractor to employ supervisory or specially experienced personnel necessary to assure an efficient execution of the contract work.

c. For the obligation of the contractor to offer employment to present or former employees as the result of a lawful collective bargaining contract, provided that the number of nonresident persons employed under this subparagraph (1c) shall not exceed 20 percent of the total number of employees employed by the contractor on the contract work, except as provided in subparagraph (4) below.

2. The contractor shall place a job order with the State Employment Service indicating (a) the classifications of the laborers, mechanics and other employees required to perform the contract work, (b) the number of employees required in each classification, (c) the date on which the participant estimates such employees will be required, and (d) any other pertinent information required by the State Employment Service to complete the job order form. The job order may be placed with the State Employment Service in writing or by telephone. If during the course of the contract work, the information submitted by the contractor in the original job order is substantially modified, the participant shall promptly notify the State Employment Service.

3. The contractor shall give full consideration to all qualified job applicants referred to him by the State Employment Service. The contractor is not required to grant employment to any job applicants who, in his opinion, are not qualified to perform the classification of work required.

4. If, within one week following the placing of a job order by the contractor with the State Employment Service, the State Employment Service is unable to refer any qualified job applicants to the contractor, or less than the number requested, the State Employment Service will forward a certificate to the contractor indicating the unavailability of applicants. Such certificate shall be made a part of the contractor's permanent project records. Upon receipt of this certificate, the contractor may employ persons who do not normally reside in the labor area to fill positions covered by the certificate, notwithstanding the provisions of subparagraph (1c) above.

5. The provisions of 23 CFR 633.207(e) allow the contracting agency to provide a contractual preference for the use of mineral resource materials native to the Appalachian region.

6. The contractor shall include the provisions of Sections 1 through 4 of this Attachment A in every subcontract for work which is, or reasonably may be, done as on-site work.

S T A T E **O F** **T E N N E S S E E**

January 1, 2015

(Rev. 09-08-14)
(Rev. 01-06-15)
(Rev. 01-11-16)
(Rev. 01-06-17)
(Rev. 01-05-18)
(Rev. 05/24/18)

SPECIAL PROVISION

REGARDING

TENNESSEE DEPARTMENT OF TRANSPORTATION

2018 MINIMUM WAGE SCALES FOR FEDERAL-AID CONSTRUCTION

& 2018 MINIMUM WAGE SCALES FOR STATE FUNDED CONSTRUCTION

This Contract contains "Tennessee Department of Transportation 2018 Minimum Wage Scales for State Funded Construction", Tennessee Department of Labor Decision No. T-40263, dated May 24, 2018, and Tennessee Department of Transportation 2018 Minimum Wage Scales for Federal-Aid Highway Construction, U. S. Department of Labor Decision No. TN180148 (dated January 5, 2018).

The Contractor is required to pay the greater of the two (2) rates for each classification

Note: Minimum Wage Scales for Federal-Aid Heavy Construction are on file with the Department, and will be included in all applicable Contract Proposals

(Rev. 01/05/18)

STATE OF TENNESSEE

TENNESSEE DEPARTMENT OF TRANSPORTATION

MINIMUM WAGE SCALES FOR FEDERAL AID HIGHWAY CONSTRUCTION

General Decision Number: TN180148 01/05/2018 TN148

Superseded General Decision Number: TN20170148

State: Tennessee

Construction Type: Highway

Counties: Tennessee Statewide.

HIGHWAY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2018

SUTN2016-001 07/13/2016

	Rates	Fringes
BRICKLAYER	$ 14.26	
CARPENTER	$ 17.52	

CEMENT MASON/CONCRETE FINISHER...$ 15.55

ELECTRICIAN.....$ 24.08

IRONWORKER
- Reinforcing.....$ 16.29
- Structural.....$ 16.89

LABORER
- Common/Unskilled.....$ 13.11
- Skilled
  - Air Tool Operator, Asphalt Raker, Chain Saw Operator, Concrete Mixer (less than 1 yd), Concrete Rubber, Edger, Fence Erector, Form Setter (steel), Guard Rail Erector, Mechanic's Tender (tire changer or oiler), Mortar Mixer, Nozzleman or Gun Operator (gunite), Pipelayer, Sign Erector.....$ 15.27

PAINTER (INCLUDES SANDBLASTER)...$ 26.36

POWER EQUIPMENT OPERATOR:
- GROUP 1
  - Backhoe/Hydraulic Excavator (3/4 yd & over), Crane (less than 20 Tons), End Loader (3 yd & over), Motor Patrol (finish),Piledriver, Dragline.....$ 19.14
- GROUP 1A
  - Drill Operator (Caisson)...$ 25.26
  - Farm Tractor Operator (Power Broom).....$ 13.50
- GROUP 2
  - Backhoe/Hydraulic Excavator (less than 3/4 yd), Bulldozer or Push Dozer, End Loader (less than 3 yd), Motor Patrol (rough), Tractor (crawler/ utility), Truck Driver (Heavy Duty, Off Road) Scraper, Shovel, or Trenching Machine.....$ 17.08

GROUP 3
Asphalt Paver, Concrete Finishing Machine, Concrete Paver, Scale, Spreader (self-propelled), Concrete Grinder, Asphalt Milling Machine, Boring Machine (horizontal).....$ 17.75

GROUP 4
Bobcat, Central Mining Plant, Concrete Pump, Concrete Saw, Curb Machine (automatic or manual), Dozer or Loader (stockpile), Drill (piling), Mulcher or Seeder, Rock Drill (truck mounted), Roller (asphalt), Roller (compaction self-propelled), Soil Stabilization Machine, Tractor (boom and hoist), Bituminous Distributor Machine, pump, Track Drill, Striping Machine....$ 16.48
Heavy Duty Mechanic.....$ 20.33
Light Duty Mechanic.....$ 19.53
Sweeping Machine (Vacuum) Operator.....$ 15.56

GROUP 5
Crane (over 20 Tons).....$ 20.44

TRUCK DRIVER
2 axles.....$ 15.36
3-4 axles.....$ 14.86
5 or more axles.....$ 16.27

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours

they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

S T A T E O F T E N N E S S E E

TENNESSEE DEPARTMENT OF TRANSPORTATION

2018 MINIMUM WAGE SCALES FOR STATE FUNDED CONSTRUCTION

May 24, 2018 **Tenn. DOL Decision No. T-40263**

CLASSIFICATION (ENGLISH)	CLASSIFICATION (SPANISH)	Basic Hourly Rates	Craft No.
Bricklayer	**Ladrillero**	15.47	**01**
Carpenter / Leadsperson	**Carpintero o Lider**	19.01	**02**
Class "A" Operators	**Operador Clase A**	20.77	**03**
Class "B" Operators	**Operador Clase B**	18.53	**04**
Class "C" Operators	**Operador Clase C**	19.26	**05**
Class "D" Operators	**Operador Clase D**	17.88	**06**
Concrete Finisher	**Terminador de Cemento**	16.87	**07**
Drill Operator (Caisson)	**Operador de Perfordora**	27.40	**08**
Electrician	**Electricista**	27.66	**09**
Farm Tractor Operator (Power Broom)	**Operador de Tractor de Rancho**	14.65	**10**
Ironworkers (Reinforcing)	**Herrero**	17.67	**11**
Ironworkers (Structural)	**Herrero de Estructura**	18.33	**12**
Mechanic (Class I) Heavy Duty	**Mecanico Clase 1**	23.29	**13**
Mechanic (Class II) Light Duty	**Mecanico Clase 2**	20.91	**14**
Painter / Sandblaster	**Pintor o Lajador**	28.60	**15**
Powder Person / Blaster	**Proveedor de Explosivos**	21.46	**16**
Skilled Laborer	**Obrero Diestro**	16.57	**17**
Survey Instrument Operator	**Operador de Agrimensor**	21.95	**18**
Sweeping Machine (Vacuum) Operator	**Operador de Barredora**	16.89	**19**
Truck Driver (2 axles)	**Camionero (2 ejes)**	16.66	**20**
Truck Driver (3/4 axles)	**Camionero (3 o 4 ejes)**	16.12	**21**
Truck Driver (5 or more axles)	**Camionero (5 o más ejes)**	17.83	**22**
Laborer /Unskilled , Flagger, Traffic Control, Pickup Driver	**Obrero no Diestro**	14.22	**23**
Worksite Traffic Coordinator	**Coordinar de Trafico en el Lugar de Trabajo**	18.32	**24**
Crane Operator	**Operador de la Grua**	22.18	**25**

CLASSIFICATION **CRAFT NO.**

SKILLED LABORER: **17**

Air Tool Operator, Asphalt Raker, Chain Saw Operator, Concrete Mixer Operator (less than 1 yard), Concrete Rubber/Edger, Fence Erector, Form Setter (Steel Road), Guardrail Erector, Mechanic's Helper (Tire Changer or Oiler), Mortar Mixer, Nozzelman or Gun Operator (Gunite), *Pipelayer, Sign Erector

CLASS "A" OPERATORS: **03**

Backhoe/Hydraulic Excavator (3/4 yard and over), Crane (less than 20 tons see Crane Operator below), End Loader (3 yards and over), Motor Patrol (Finish), Pile Driver, Dragline

CLASS "B" OPERATORS: **04**

Backhoe/Hydraulic Excavator (less than 3/4 yard), Bull Dozer or Push Dozer, End Loader (less than 3 yards), Motor Patrol (Rough), Tractor (Crawler/Utility), Scraper, Shovel, Trenching Machine

CLASS "C" OPERATORS: **05**

Asphalt Paver, Concrete Finishing Machine, Concrete Paver, Scale, Spreader (Self-Propelled), Concrete Grinder, Asphalt Milling Machine, Boring Machine Operator (Horizontal)

CLASS "D" OPERATORS: **06**

Bobcat, Central Mixing Plant, Concrete Pump, Concrete Saw, Curb Machine (Automatic or Manual), Dozer or Loader (Stockpile), Drill (Piling), Mulcher or Seeder, Rock Drill (Truck Mounted), Roller (Asphalt), Roller (Compaction Self-Propelled), Soil Stabilization Machine, Tractor (Boom & Hoist), Bituminous Distributor Machine, Pump, Track Drill, Striping Machine Operator, Ditch Paving Machine

CRANE OPERATOR: **25**

Means one who operates boom-type equipment equal to or greater than 20 tons to hoist and move materials, raise and lower heavy weights and perform other related operations; may oil, grease or otherwise service and make necessary adjustments to equipment as needed; and may perform other related duties. (Note: The equipment is used for such work as pouring concrete and setting steel. This work is subject to strict inspection and must conform closely to specifications. The equipment may also be used for other miscellaneous tasks for which crane or stick-type equipment is required which may include hoist operations and pile driving operations.)

***Skilled Laborer - Pipelayer Classification**

For any work where prevailing wage rates apply which is located five feet or more outside the actual building if building construction is involved:

AND

(a) which consists of the building, rebuilding, locating, relocating or repairing any street, highway, bridges, water lines, sewer lines, gas lines, force mains or other related utilities

OR

(b) which involves the construction or upgrading of industrial parks or sites and is located outside the five foot limitation.

The classification of pipelayer shall be applicable and the description of work under this classification shall be as follows:

Lays, connects, inspects and tests water lines, force mains, gas lines, sanitary or storm sewers and drains, underground telephone and electric ducts or other utilities manufactured from clay, concrete, steel, plastic, cast iron pipe or other similar materials.

May smooth bottom of trench to proper elevation by scooping with a shovel; receives pipe lowered from top of trench; inserts spigot end of pipe into bell end of last laid pipe; adjusts pipe to line and grades, caulks and seals joint with cement or other sealing compound; may connect threaded or flanged joint pipe; may assemble and place corrugated metal or plastic pipe and performs other related duties.

Additional Information :
Wage Rates : http://www.tennessee.gov/labor-wfd/prevail.html

Poster Page : http://www.state.tn.us/labor-wfd/poster.htm

Note: Adobe Acrobat Reader is required in order to download & print. If you do not have this software a link is provided at the bottom of the Poster Page for a free download.

Tenn.Dept. of Labor & Workforce Development (Labor Standards Division) : (615) 741-2858.

APPRENTICESHIP REGULATIONS:
Under T.C.A., §12-449, the Prevailing Wage Commission has promulgated Rule 0800-3-2-.04 which provides that: "Apprentices shall mean those persons registered individually under a bona fide apprenticeship program registered with the Bureau of Apprentiship and Training in the United States Department of Labor. The state agency contracting officer shall require the contractor or sub-contractor using the apprentice to submit evidence of his indenture and/or apprenticeship registration when the apprentice's name first appears on a submitting payroll."

AUTHORITY: T.C.A., §12-449. Administrative History: Original Rule filed June 4, 1976. Effective: July 14, 1976.

APPENDIX C

CONTRACT BOOK 2 (DESIGN-BUILD CONTRACT) FORMS

FORM NAME	FORM DESIGNATION
ATTESTATION RE PERSONNEL USED IN CONTRACT PERFORMANCE	FORM AT
CONFLICT OF INTEREST DISCLOSURE STATEMENT	FORM COI
CONTRACT PAYMENT AND PERFORMANCE BOND	FORM CP&PB
LOBBYING CERTIFICATE	FORM LC
TECHNICAL PROPOSAL SIGNATURE PAGE	FORM TPSP

ATTESTATION RE PERSONNEL USED IN CONTRACT PERFORMANCE
FORM AT

DESIGN-BUILD CONTRACT NUMBER:	**DB1801**
LEGAL ENTITY NAME:	
FEDERAL EMPLOYER IDENTIFICATION NUMBER: (or Social Security Number)	

The Entity, identified above, does hereby attest, certify, warrant, and assure that the Entity shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor who will utilize the services of an illegal immigrant in the performance of this Contract.

SIGNATURE & DATE:

NOTICE: This attestation **MUST** be signed by an individual empowered to contractually bind the Design-Builder. If said individual is not the chief executive or president, this document shall attach evidence showing the individual's authority to contractually bind the Design-Builder.

CONFLICT OF INTEREST DISCLOSURE STATEMENT
FORM COI

DB1801

Background

The integrated nature of Design-Build creates the potential for conflicts of interest. Disclosure, evaluation, and management of these conflicts and of the appearance of conflicts, require attention to State and federal Laws in the contracting process. The Tennessee Department of Transportation ("TDOT") has developed *Conflict of Interest Disclose Guidelines* ("COI Disclosure Guidelines"). The COI Disclosure Guidelines are intended to summarize the key governing standards of State and Federal Laws, include definitions of key terms, and describe the COI Disclosure Process.

Federal Standards

Pursuant to 23 USC 112(b)(3), the Federal Highway Administration (FHWA) has promulgated administrative rules that affect federally-funded Design-Build procurements and related procurements. These rules, which are in 23 Code of Federal Regulations (CFR) Parts 635 and 636, are used as the basis for TDOT's guidelines on the subject. The main rule on organizational conflicts of interest in Design-Build transactions is 23 CFR § 636.116. This rule affects not only Design-Build procurements, but also "any contract for engineering services, inspection or technical support in the administration of the Design-Build contract."

These rules specifically regulate both organizational and individual conflicts of interest. The federal rules define "organizational conflict of interest" as follows:

> "*Organizational conflict of interest* means that because of other activities or relationships with other persons, a person is unable or potentially unable to render impartial assistance or advice to the owner, or the person's objectivity in performing the contract work is or might be otherwise impaired, or a person has an unfair competitive advantage." (23 CFR § 636.103)

Organizational Conflict of Interest Policy

TDOT may disqualify the Design-Builder if any of its Major Participants belong to more than one Design-Builder organization. If any Major Participants of different Design-Builder organizations belong to the same parent company, each Design-Builder must describe how the participants have avoided conflicts of interest during the procurement phase of the Project.

The Design-Builder agrees that, if after award, an organizational conflict of interest is discovered, an immediate and full disclosure in writing must be made to TDOT that must include a description of the action that the Design-Builder has taken or proposes to take to avoid or

mitigate such conflicts. If an organizational conflict of interest is determined to exist, TDOT may, at its discretion, cancel the Contract. If the Design-Builder was aware of an organizational conflict of interest prior to the award of the Contract and did not disclose the conflict to TDOT, TDOT may terminate the Contract for default.

Disclosure Pursuant to Section 636.116(2)(v)

In the space provided below, and on supplemental sheets as necessary, identify all relevant facts relating to past, present, or planned interest(s) of Design-Builder which may result, or could be viewed as, an organizational conflict of interest in connection with the RFP.

The Design-Builder shall disclose:

a. any current contractual relationships with TDOT (by identifying TDOT contract number and project manager);

b. present or planned contractual or employment relationships with any current TDOT employee;

c. any current relationships between the Major Participants, Key Personnel. Design Professionals, or Subcontractors of the Design-Builder on other TDOT projects; and

d. any other circumstances that might be considered to create a financial interest in the contract for the Project by any current TDOT employee if the Design-Builder is awarded the contract.

The foregoing is provided by way of example, and shall not constitute a limitation on the disclosure obligations.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

Explanation

In the space provided below, and on supplemental sheets as necessary, identify steps that have been or will be taken to avoid, neutralize, or mitigate any organizational conflicts of interest described herein.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

Certification

The undersigned hereby certifies that, to the best of his or her knowledge and belief, no interest exists that is required to be disclosed in this Conflict of Interest Disclosure Statement, other than as disclosed above.

_____

Signature

_____

Name

_____

Title

_____

Company Name

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION
CONTRACT PAYMENT AND PERFORMANCE BOND
FORM CP&PB

DB1801

Be it known that _____, as Design-Builder, and_____, as Surety(ies), all authorized to do business in the State of Tennessee, hereby bind themselves to the State of Tennessee, Department of Transportation, and other potential claimants, for all obligations incurred by the Design-Builder under its contract with the State of Tennessee, Department of Transportation, for the construction of the above identified contract; in the full contract amount of _____ ($_____).

The obligations of the Design-Builder and Surety(ies) under these payment and performance bonds shall continue in full force and effect until all materials, equipment and labor have been provided AND all requirements contained in the Contract Documents, plans and specifications have been completed in a timely, thorough and workmanlike manner. The parties agree that these bonds are statutory in nature and are governed by the provisions contained in Title 12, chapter 4 and Title 54, chapter 5 of the Tennessee Code Annotated relating to bonds required of contractors and that those provisions constitute a part of this bond.

By this instrument, the Design-Builder and Surety(ies) specifically bind themselves, their heirs, successors, and assigns, *in solido*, under the following bonds:

Payment Bond. To the Tennessee Department of Transportation and all "Claimants," as contemplated by T.C.A. Title 54, chapter 5, in the full contract amount of

_____

_____ ($_____), in order to secure the payment in full of all timely claims under the Project.

Performance Bond. To the Tennessee Department of Transportation in the full contract amount of _____

_____ ($_____),

in order to secure the full and faithful performance and timely completion of the project according to its scope, plans and specifications, inclusive of overpayments to the contractor and liquidated damages as assessed.

Upon receipt of notice that the Design-Builder is in default under the contract, the Surety(ies) shall undertake to complete performance, without regard to cost. If the Surety(ies) fail or refuse

to complete performance of the contract, the Department may then proceed with the work in any lawful manner that it may elect until it is finally completed. When the work is thus finally completed, the total cost of the same will be computed. All costs and charges incurred by the Department in completing the work will be deducted from any monies due or which may become due to the Design-Builder. If the total costs of completion exceeds the sum which would have been payable under the Contract, then the Principal and the Surety(ies), *in solido*, shall be liable for and shall pay to the Department the amount of such excess.

In witness whereof we have signed this instrument as dated.

Design-Builder (1) _____

By: _____ Date: _____

_____

Printed Name and Title

Design-Builder (2)* _____

By: _____ Date: _____

_____

Printed Name and Title

Surety 1 _____ Surety 2* _____

By: _____ By: _____

Attorney-in-Fact Attorney-in-Fact

_____ _____

Printed Name and Title Printed Name and Title

_____ _____

Agency Name Agency Name

Street Address	Street Address
City/State/Zip	City/State/Zip
(Seal)	(Seal)

Subsequent correspondence/communication from TDOT with respect to monthly progress reports and/or the contract bonds should be directed to:

Surety 1	Surety 2*
By:	By:
Attorney-in-Fact	Attorney-in-Fact
Printed Name and Title	Printed Name and Title
Agency Name	Agency Name
Street Address	Street Address
City/State/Zip	City/State/Zip

*NOTE: The signature and information for Design-Builder (2) and Surety (2) is to be provided when there is a joint venture.

LOBBYING CERTIFICATE
FORM LC

PROJECT
DESCRIPTION: I-75 at I-24 Interchange Modification, Hamilton County

DB1801

The undersigned certifies, to the best of his or her knowledge and belief, that **CHECK ONE**:

☐ **No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned**, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of **ANY** Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan or cooperative agreement.

☐ **If any funds other than Federal appropriated funds have been paid or will be paid** to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with **THIS** Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying", in accordance with its instructions [as amended by "Government-wide Guidance for New Restrictions on Lobbying," 61 Federal Regulations 1413 (1/19/96). Note: Language in paragraph (2) herein has been modified in accordance with Section 10 of the Lobbying Disclosure Act of 1995 (P.L. 104-65, to be codified at 2 U.S.C. 1601, et seq.)].

The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. §1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each expenditure or failure.]

The Design-Builder, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Design-Builder understands and agrees that the provisions of 31 U.S.C. §3801, et seq., apply to this certification and disclosure, if any.

Date

Company Name

Signature

Name and Title

NOTE: DESIGN-BUILDER IS REQUIRED PURSUANT TO FEDERAL LAW TO INCLUDE THE ABOVE LANGUAGE IN SUBCONTRACTS OVER $100,000 AND TO OBTAIN THIS LOBBYING CERTIFICATE FROM EACH SUBCONTRACTOR BEING PAID $100,000 OR MORE UNDER THIS CONTRACT.

TECHNICAL PROPOSAL SIGNATURE PAGE
FORM TPSP

DESIGN-BUILDER:_____ TELEPHONE No. (___) _____

ADDRESS: _____

CONTRACTOR'S LICENSE No. _____

LICENSE CLASSIFICATION_____

PROJECT: I-75 at I-24 Interchange Modification, Hamilton County (the "Project")

DB CONTRACT No.: DB1801

TO THE TENNESSEE DEPARTMENT OF TRANSPORTATION:

FIRM OFFER; SCOPE OF FIRM OFFER. The Design-Builder hereby submits this its Firm Offer in response to that Request for Proposals (RFP) issued _____,____20___, as amended by Addenda

Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____
Addendum No.	_____	Dated	_____

to execute the Contract, consisting of the Contract Documents, as those terms are defined in the **DB Standard Guidance**, within the time period stipulated in the Contract Documents if awarded the Contract, and upon Contract execution to perform the Contract in accordance with its terms. Such Firm Offer shall remain open for a minimum of 180 Calendar Days from the original Proposal Due Date, or for such longer period to which the Design-Builder may consent. Notwithstanding the foregoing, the Design-Builder's execution of the Contract shall constitute evidence that its Firm Offer was held open to date of Contact execution.

The following portions of the Design-Builder's Technical Proposal and Price Proposal (collectively, its "Proposal") are included in this Firm Offer in accordance with the criteria established in the Design-Build Contract and all associated Contract Documents:

Technical Proposal: Those portions of the Proposal that meet or exceed TDOT's minimum Contract requirements, as determined by TDOT in its sole discretion, shall be incorporated into the resulting Contract as if fully set forth therein, and shall constitute additional minimum Contract requirements. Upon incorporation, such portions of the Proposal shall amend the minimum Contract requirements they exceed. Those portions of the Technical Proposal that do not meet or exceed the minimum Contract requirements established by TDOT shall **not** be incorporated into the Contract.

Price Proposal: The total of prices proposed in the Price Proposal "Schedule of Items" (the "Proposal Price"), shall be incorporated into the resulting Contract as if fully set forth therein.

EQUAL OPPORTUNITY CLAUSE. The Design-Builder, hereby certifies that **(CHECK ONE)** it has [ ] has not [ ], participated in a previous contract or subcontract subject to the equal opportunity clause, as required by Executive Orders 11246, 10925 and 11114 as amended, and that **(CHECK ONE)** it has [ ] has not [ ], filed with the Office of Federal Contract Compliance Program all reports due under the applicable filing requirements.

PROPOSAL SECURITY. By submitting this Proposal, the undersigned Design-Builder hereby agrees to be bound by the award of the Contract and, if awarded the Contract on this Proposal, to execute the required Contract and the required Contract Payment and Performance Bond within ten (10) days after receipt of notice of the award. The undersigned Design-Builder submits herewith the required Proposal guaranty in an amount of not less than five (5%) percent of the total amount of the Price Proposal drawn to the order of the Tennessee Department of Transportation offered and agrees and consents that the Proposal guaranty shall immediately be at the disposal of the Department, not as a penalty, but as an agreed liquidated damage if the required Contract and Contract Payment and Performance Bond are not executed within ten (10) days from receipt of the notice of award.

DBE PROJECT UTILIZATION GOAL is **10%**.

GOOD FAITH EFFORTS. The Design-Builder will either meet the DBE utilization goals identified herein or will make good-faith efforts to meet such goals. **(CHECK ONE)** YES [ ] NO [ ] or N/A [ ].

DESIGN-BUILDER DBE STATUS. The Design-Builder affirms that the Design-Builder is certified as a DBE under Tennessee Law: **(CHECK ONE)** YES [ ] NO [ ] or N/A [ ]. The Design-Builder affirms that one or more joint-venture partners of the Design-Builder is certified as a DBE under Tennessee Law: **(CHECK ONE)** YES [ ] NO [ ] or N/A [ ].

If the Design-Builder or a joint-venture partner of the Design-Builder is a DBE, answer the following:

Indicate both type of work to be performed by the DBE Design-Builder and **percent** of total Proposal Price represented by such work

_____.

Identify by name each joint venture partner certified as a DBE under Tennessee Law and include both type of work to be performed by each such joint venture partner and **percent** of total Proposal Price represented by such work

_____.

DESIGN-BUILDER AFFIRMATIONS.

The undersigned Design-Builder, its authorized representative, acknowledges, represents, attests, warrants and certifies that:

(1) By submitting this Proposal, the Design-Builder represents that it has carefully examined the Contract, which includes **Contract Book 1 (ITBD - Instruction to Design-Builders), Contract Book 2 (Design-Build Contract), Contract Book 3 (Project Specific Information)** and all referenced documents**,** the **DB Standand Guidance,** ;has carefully examined any Plans provided by the Department, the Standard Specifications for Road and Bridge Construction (January 1, 2015) adopted by the State of Tennessee, Department of Transportation, with subsequent revisions which are acknowledged to be a part of this Proposal, the Special Provisions, the Standard Drawings, the Proposal Form, the Form of Contract, All Contract Documents and Addenda; and thoroughly understands their stipulations, requirements, and provisions. The Design-Builder, acting through its authorized representatives, has read and understands, and agrees to be bound by and comply with all RFP instructions, terms and conditions, together with all Addenda, if any, issued.

(2) The Design-Builder, acting through its authorized representatives, has made a proper examination of the Project Site work described herein and all work locations and has become familiar with local conditions and the character and extent of the work.

(3) The Design-Builder, acting through its authorized representatives, has read and understands, and agrees to be bound by and comply with the terms of the Contract identified, included, or incorporated by reference into the RFP before submitting its Proposal.

(4) The Design-Builder has determined the quality and quantity of materials required; has investigated the location and determined the sources of supply of the materials required; has investigated labor conditions; and, has arranged for the continuous prosecution of the work herein described.

(5) By submitting this Proposal, the Design-Builder agrees to provide all necessary equipment, tools, labor, incidentals, and other means of construction, to do all the work, and furnish all the materials of the specified requirements which are necessary to complete the work in accordance with the Plans, the Specifications and all Contract Documents, and agrees to accept as payment in full therefor described in the Contract that are set forth in this Proposal. Compensation for "Extra Work" which may be required by the Department in connection with the construction and completion of the work but which was not reflected in the Proposal scope at the time of bidding, will be made in the following manner: work will be compensated in accordance with the applicable Contract Documents.

(6) The Proposal was prepared independently from all other Design-Builders, and without collusion, fraud, or other dishonesty.

(7) Neither the Design-Builder nor anyone representing the Design-Builder offered or gave any advantage, gratuity, bonus, discount, bribe or loan of any sort to TDOT or its agents, employees, or anyone representing TDOT, or engaged in any other type of anti-competitive conduct at any time during this procurement.

(8) If awarded the Contract, the Design-Builder shall utilize in performance of the Contract all resources indicated in its Proposal, including Major Participants, Key Personnel, and Design Professionals, to the extent within the Design-Builder's control and through application of the Design-Builder's best efforts.

(9) If awarded the Contract, the Design-Builder shall make all Personnel, including Design

Professionals, identified in its Proposal available at all times and places required under the terms of the Contract, and shall ensure that such Personnel devote all efforts necessary for all periods of time necessary or required under the terms of the Contract, to timely fulfill all Contract obligations.

(10) The Design-Builder has the power and authority to enter into and perform the Contract to be awarded, and the Contract, when executed and delivered, shall be a valid and binding obligation enforceable according to its terms.

(11) If the Design-Builder is a joint venture or partnership, each joint venturor or partner has signed this Technical Proposal Signature Page on behalf of both itself and the Design-Builder, and each joint venturor or partner and the Design-Builder shall be jointly and severally liable for performing all of the duties and meeting all of the obligations of the Design-Builder under the terms of the RFP, Proposal and Contract to be entered into.

(12) The Design-Builder acknowledges that TDOT has the right to modify the Contract prior to execution to (a) correct typographical errors, (b) reconcile inconsistencies within and among the Contract Documents, (c) conform terminology used throughout the Contract, (d) include omitted terms clearly contemplated by the language in the Contract, (e) add terms required under State or federal law, and (f) incorporate those portions of the Technical Proposal and Price Proposal, as set forth under, if so, as may be authorized under applicable statutes and rules.

(13) The Design-Builder intends its Proposal Price to constitute full compensation for performance of all Contract obligations, including those additional minimum Contract requirements proposed in the Technical Proposal and incorporated in the Design-Build Contract.

(14) The Design-Builder agrees to be bound by and will comply in all respects with the terms of the resulting Contract upon award.

(15) TDOT will not be liable for any expenses incurred by the Design-Builder in preparing and submitting its Proposal or in participating in the Proposal evaluation/selection process.

(16) In the event the Design-Builder has engaged in unlawful anti-competitive conduct or behavior prohibited under the terms of the RFP during this procurement or lacks power or authority or fails for any reason to execute the Contract if awarded to it within the time period specified in the RFP or agreed to by the Parties, the Design-Builder shall forfeit its Proposal Security and be disqualified from further consideration for Contract award and eligibility for receipt of a Proposal stipend.

(17) The Design-Builder certifies that it is not under the control of any person, firm, partnership, or corporation, which has or exercises any control of any other person, firm, partnership, or corporation, which is submitting a Proposal on this Contract.

BEFORE ME APPEARING THE UNDERSIGNED AND BEING BY ME DULY SWORN, UPON HIS/HER OATH INDIVIDUALLY AND IN HIS/HER REPRESENTATIVE CAPACITY ON BEHALF OF THE DESIGN-BUILDER, DEPOSES AND STATES:

I, the undersigned, am a duly-authorized representative of the Design-Builder and have been authorized by the Design-Builder (a) to make in the name of and on behalf of the Design-Builder all acknowledgments, representations, attestations, warranties, and certifications contained herein and elsewhere in the Proposal, (b) to execute this Technical Proposal Signature Page and (c) by my signatures to bind the Design-Builder to the terms of its Proposal.

And further, that (a) the acknowledgments, representations, attestations, warranties, and certifications contained herein and elsewhere in the Proposal are true and correct, and (b) all copies of the Technical Proposal and Price Proposal submitted with the originals are true and correct copies of the originals. This is an official document that is required or authorized by law to be made under oath and is presented in an official proceeding. A person who makes a false statement in this certification is subject to the penalties of perjury.

_____
Design-Builder (1)

Sworn to and subscribed before me this _____ day of _____, _____

By: _____

_____
Printed Name and Title

_____
Notary Public

My commission expires _____

(Seal)

- -

_____
Design-Builder (2)*

Sworn to and subscribed before me this _____ day of _____, _____

By: _____

_____
Printed Name and Title

_____
Notary Public

My commission expires _____

(Seal)

*NOTE: The signature and information for Design-Builder (2) is to be provided when there is a joint venture.

***THIS TECHNICAL PROPOSAL SIGNATURE PAGE MUST BE SIGNED IN BLUE INK. ANY ALTERATIONS, INTERLINEATIONS, OR ERASURES TO THE PROPOSAL MUST BE INITIALED ON THE ORIGINAL COPY IN INK BY THE SIGNATORY TO THIS TECHNICAL PROPOSAL COVER SHEET AND SIGNATURE PAGE.*

DESIGN-BUILD
RFP CONTRACT BOOK 3
PROJECT SPECIFIC INFORMATION

TENNESSEE DEPARTMENT OF TRANSPORTATION

Interstate 75 at Interstate 24 Interchange Modification

Hamilton County- TENNESSEE

CONTRACT NUMBER: DB1801

July 27, 2018

Addendum #1 August 24, 2018

Addendum #2 September 26, 2018

Addendum #3 November 13, 2018

Addendum #4 November 16, 2018

Addendum #5 November 19, 2018

TABLE OF CONTENTS

APPENDIX A: PAVEMENT DESIGN

APPENDIX B: REFERENCE DOCUMENTS

1. GENERAL

This **Contract Book 3 (Project-Specific Information)** contains the requirements and conditions by which the Design-Builder shall design and construct the Project, except for any portions of the work that may be stipulated within this **Contract Book 3 (Project-Specific Information)**to be performed by the Tennessee Department of Transportation (TDOT, or "the Department").

The order of precedence of **Contract Book 3 (Project-Specific Information)** with the other contract documents is described in **Contract Book 2 (Design- Build Contract)**.

The Definition of Terms corresponding with this **Contract Book 3 (Project-Specific Information)** can be found in the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction and/or **Design-Build Standard Guidance** (**DB Standard Guidance**):

https://www.tn.gov/content/dam/tn/tdot/construction/design-build_projects/Design-Build_Guidance_01-31-17.pdf.

All work shall be completed in accordance with the most current version of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction at the time of the Proposal Due Date, unless specifically stated herein.

The Functional Plans, roll plots, and pertinent reference information are listed in **Appendix B** and provided on the Project website.

0 *GENERAL PROJECT DESCRIPTION; SCOPE OF WORK*

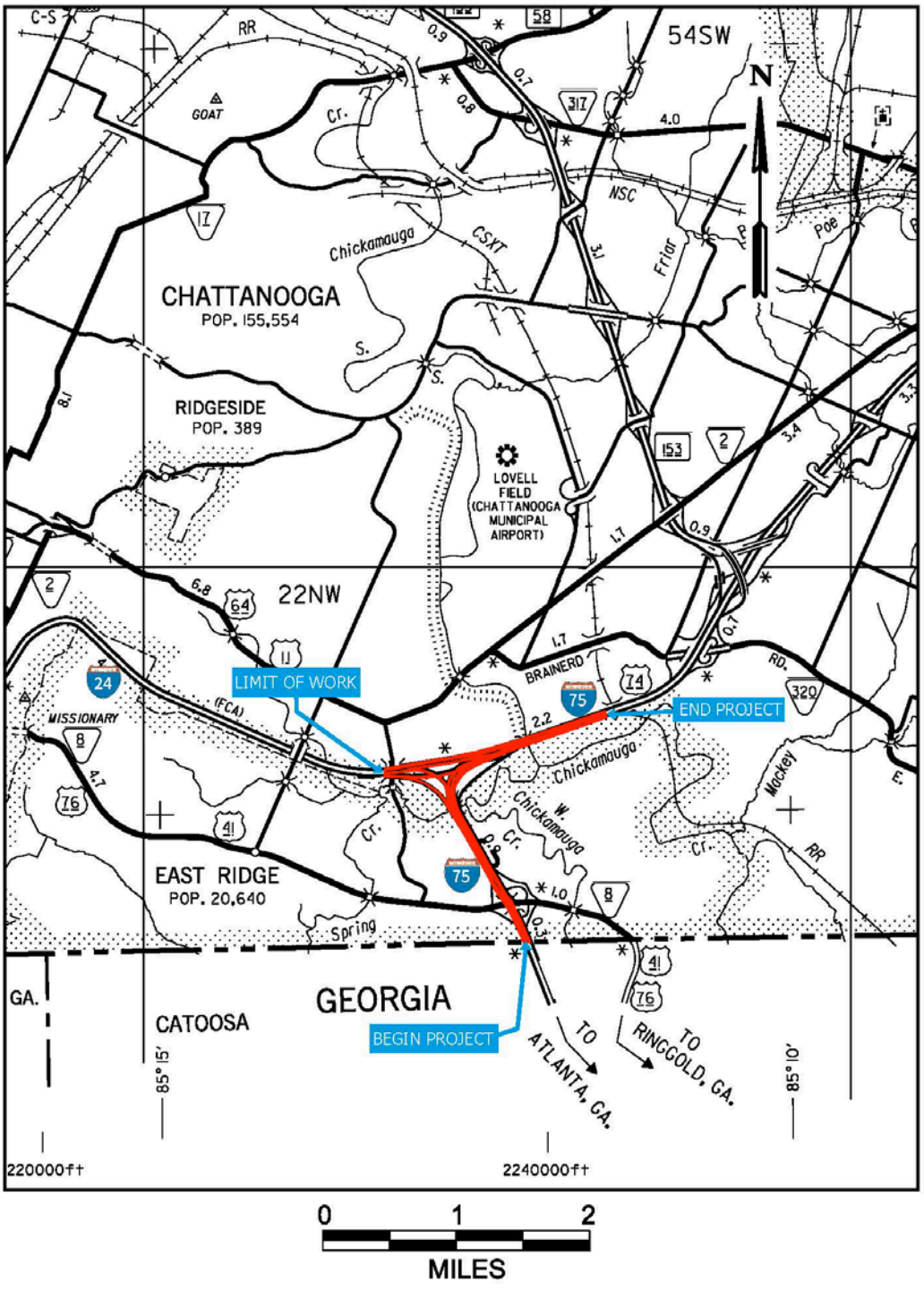
The Design-Builder shall perform all surveying, design and construction services necessary to construct (roadway and structures) the I-75 Interchange at I-24 Project (the "Project").

The Project shall consist of the modification and reconstruction of the I-75 Interchange at I-24 in Hamilton County. The roadway improvements shall begin at the Georgia state line and extend on I-75 to a point approximately 455 feet south of the existing I-75 bridge over the CSX railroad, and to a point just west of the I-24/Spring Creek Road bridges as depicted on the Functional Plans.

The Project shall include the widening of the I-75 roadway to include an additional lane in each direction, widening of all interstate-to-interstate ramps to three lanes, modifications to I-24 ramps to enter and exit I-75 from the right side, and modifications to the Ringgold Road and Welcome Center traffic pattern.

An overview of the project is shown in the figure below.

PROJECT LOCATION MAP



The Design-Builder's general responsibilities with respect to the scope of work for the Project shall include without limitation the following, as more particularly described within this **Contract Book 3 (Project-Specific Information)**:

- Replacing the existing median barrier with a 51-inch high median barrier from the Georgia State Line to south of Spring Creek;
- Replacing the storm sewer system on I-75 from the Georgia State Line to south of Spring Creek;
- Adding an additional lane on I-75 as shown on the Functional Plans;
- Meet or exceed a minimum 50-mph design speed for all system interchange;
- Widening I-75 to add an additional lane from S. Chickamauga Creek to a point south of the CSX Railroad as shown on the Functional Plans using concrete pavement with concrete shoulders.
- Rehabilitating the existing concrete pavement from S. Chickamauga Creek to a point south of the CSX Railroad as shown on the Functional Plans;
- Constructing new bridges and widening the existing bridge over S. Chickamauga Creek;
- Widening the I-75 southbound to I-24 westbound interstate-to-interstate ramp and I-24 eastbound to I-75 northbound interstate-to-interstate ramp from two to three lanes;
- Realigning and widening the I-75 northbound to I-24 westbound interstate-to-interstate ramp and the I-24 eastbound to I-75 southbound interstate-to-interstate ramp from two to three lanes;
- Adding sidewalk and curb and gutter along both sides of Spring Creek Road;
- Adding new noise walls;
- Removing and replacing all guardrail. Installing new guardrail in locations shown on the Functional Plans;
- Resurfacing all existing asphalt pavement within the project limits;
- Modifying existing drainage structures and installing proposed drainage improvements; including replacing the storm sewer system on I-75 from the Georgia State Line to south of Spring Creek;
- Replacing all lighting within the project limits;
- Relocating utilities;
- Relocating and improving ITS facilities;
- Installing new overhead signs and sign structures as shown in the roll plots; and
- Replacing control access fence at locations detailed in this RFP.

0 *PROJECT GOALS*

The Project's primary purposes are to provide present and future congestion relief, reduce high crash rates and address deficiencies of the existing interchange to meet the intent of the approved Interstate Access Request (IAR). The following goals have been established for the Project (not listed in any specific order):

- Minimize inconvenience to the public during construction.
- Provide a management system or approach that ensures the requirements of the Project will be met or exceeded.
- Provide a high-quality project that minimizes future maintenance.
- Provide a solution consistent with the Department's Roadway Design Standards.
- Adhere to local, state, and federal environmental regulations and/or permits required in executing and/or completing the Project.
- Incorporate Best Management Practices (BMPs) to control sediment, storm water runoff/discharge, or other environmental parameters established for the Project.
- Implement innovative solutions to maximize the return on taxpayer investment by reducing costs or improving quality of the transportation system.
- Complete construction as quickly as possible and not later than August 31, 2023.
- Incorporate safety into all aspects of design and construction with the goal of zero incidents and accidents.
- Provide a visually pleasing finished product.

0 *DEPARTMENT-PROVIDED MATERIALS*

The Functional Plans and Department-supplied materials are listed in **Appendix B**.

All documents have been published on the Department's project website:

https://www.tn.gov/tdot/tdot-construction-division/transportation-construction-alternative-contracting/transportation-construction-division-alternative-contracting-design-build-i.html

The Design-Builder shall acknowledge that materials furnished by the Department are preliminary and provided solely to assist the Design-Builder in the development of the project design. The Design-Builder shall be fully responsible for the accuracy and completeness of all work performed under this contract. The Design-Builder shall be fully liable and hold the Department harmless for any additional costs and all claims against the Department which may arise due to errors, omissions and negligence of the Design-Builder in performing the work required by this contract.

The Design-Builder is responsible for verifying all information provided by the Department.

0 *DBE GOAL*

The assigned Disadvantaged Business Enterprise (DBE) goal for this Project is 10%. The Design-Builder shall exercise all necessary and reasonable steps to ensure that DBEs participate in at least the percent of the total project cost set forth above as the goal. The Design-Builder shall require all Subcontractors to also comply and make good faith efforts in achieving this goal and shall comply with all requirements of 49 Code of Federal Regulations (CFR) part 26.

0 *ON-THE-JOB/APPRENTICESHIP TRAINING*

On-the-Job/Apprentice Training is required on this Project and shall be included in the bid document and special provision. See for further information §7.2.11 of the Design-Builders (DB) Standard Guidance.

2. PROJECT MANAGEMENT

The Design-Builder shall prepare and administer a Project Management Plan (PMP) containing the Design-Builder's approach to managing the design and construction activities of the Project in accordance with the **DB Standard Guidance** and the specific requirements defined herein.

The PMP shall contain, at a minimum, the following component parts:

- Organizational Structure and Staffing Plan
- Critical Path Method (CPM) Schedule
- Quality Management Plan
- Environmental Compliance Plan
- Safety and Health Plan
- Public Relations and Public Information Plan
- Records Management Plan

Within 30 Days of Contract Award, the Design-Builder shall meet with the Department at the Post-Award Meeting to discuss development of the components of the PMP for Review and Acceptance by the Department prior to the start of any Work.

The Design-Builder shall use the Project Understanding and Approach, and the Project Management and Approach submitted with the Proposal as a foundation to prepare the PMP component plans. The Design-Builder shall implement all elements of the PMP.

The successful Design-Builder is required to utilize PlanGrid software for the project. The Design-Builder shall contact PlanGrid directly to obtain usage license and service information. Information about PlanGrid and contact information for purchasing licenses at TDOT's special rate can be found at the following link: https://www.tn.gov/tdot/tdot-construction-division/transportation-construction-division-resources/plangrid.html

0 *ORGANIZATIONAL STRUCTURE AND STAFFING PLAN*

The Design-Builder shall prepare an Organization Structure and Staffing Plan for the purpose of ensuring that appropriate qualified staff are employed by the Design-Builder to perform the Work and are able to carry out the Work in a manageable and safe manner.

The plan shall identify the Key Personnel and key management staff including the Key Personnel level 1 and level 2 identified in the Statement of Qualifications (SOQ) and on the Response Category 2 form.

The Design-Builder shall provide an organizational chart that graphically represents the hierarchy and functional interaction of the Key Personnel, and indicates the functional responsibilities of each. The organizational chart shall be part of the PMP.

The organization shall be monitored and the chart updated and provided to the Department when changes to the Design-Builder's organizational chart occur.

Staffing Requirements

The Design-Builder shall provide to the Department, within 15 calendar days after the initial Notice to Proceed (NTP), a list of the contacts (and contact details) of Key Personnel on site and Key Personnel on call who are available 24 hours per day during the executions of the Work.

The Design-Builder shall include a procedure for a structured and managed replacement of Key Personnel on the project team of the Design-Builder.

Any licenses or certifications that are required to meet the requirements of the Request For Qualifications (RFQ) and RFP shall be in place by the time the first NTP is issued.

0 *PROJECT SCHEDULE AND COST MANAGEMENT*

CPM Schedule Submittal

The Design-Builder shall prepare a Critical Path Method (CPM) Schedule, in accordance with Chapter 3 of the **Design-Build Standard Guidance** and the requirements herein, for review at the Post-Award Meeting.

The Design-Builder shall use the preliminary CPM Schedule submitted with the Proposal as a foundation to prepare a Project CPM Schedule and shall submit it to the Department for Review and Acceptance. Acceptance of the initial Project CPM Schedule by the Department shall be a condition of starting any Work. The Design-Builder shall submit an updated Project CPM Schedule on a monthly basis for the Department's Review and Acceptance. Failure to submit an updated Project CPM Schedule may result in the withholding of progress payments.

The Design-Builder shall provide a narrative with each CPM Schedule submittal, which shall include:

- A detailed description of the status of the Project and changes to the CPM;
- Identification of strategies for mitigation of Project risks or issues impacting the CPM Schedule describing constraints and discussing contingencies;
- How the proposed project phasing and sequence of work and allocation of resources enables the Design-Builder to progress the work to achieve the contractual completion dates;
- How the phasing ensures timely deliveries of materials to achieve the CPM Schedule milestones;
- Identification of categories of work performed by Design Builder's own direct labor force and those performed by Subcontractors; and
- Pay Item activities and all work included in the Pay Item activities corresponding to totals as reflected on the Schedule of Items.

The Design-Builder shall include all Design Reviews submittals and any resubmittals in the CPM Schedule in order for the Department to appropriately allocate resources for performing the reviews

and to track and document any possible schedule impacts. Ten (10) business days shall be allocated in the CPM Schedule for activities requiring the Department's Review and Acceptance, or Review and Comment.

Schedule and Cost Controls

The Design-Builder shall develop procedures for schedule and cost control on the Project, including the cost control and schedule management system to be used to control and coordinate the cost and schedule of the work.

The cost-control approach shall include a description of the proposed approach for calculating progress performance for preparing the monthly payment requests using the Pay Item activities, Schedule of Items and CPM Schedule.

The Design-Builder shall include a procedure for re-scheduling of its work to achieve schedule recovery objectives and how these objectives will be enforced with its work force and subcontractors.

Liquidated Damages for Failure to Meet Completion Deadline

The Design-Builder shall complete the Project within the time limitations set forth in **Contract Book 2 (Design-Build Contract)** and Special Provision 108B.

If the Design-Builder fails to complete the Project within the time limitations set forth in the Contract, then the Department will suffer substantial losses and damages. The Contract therefore provides that a sum shall be deducted from monies due the Design-Builder, not as a penalty, but as Liquidated Damages, if such completion is delayed.

If Design-Builder fails to complete all work specified in the contract on or before the Design-Builder's completion date, set forth in RFP Book 2 Section D.3, a sum of money equal to **$30,000** per Calendar Day for the first 30 calendar days after the Design-Builder's completion date shall be deducted from monies due to the Design-Builder, not as penalty, but as liquidated damages. For each calendar day thereafter, a sum of money equal to **$100,000** shall be deducted from monies due to the Design-Builder, not as a penalty, but as liquidated damages.

The Time Value (B) used for calculation of selection is **$30,000**.

0 *QUALITY MANAGEMENT PLAN*

The Design-Builder shall prepare a Quality Management Plan (QMP) in accordance with Section 2.5 of the **DB Standard Guidance** and the requirements herein.

The QMP shall consist of a:

- Design Quality Management Plan
- Construction Quality Management Plan

Design Quality Management Plan

The Design Quality Management Plan (DQMP) shall describe the quality roles and responsibilities of the Design-Builder's design quality management team and procedures for implementing the

design work in accordance with Chapter 5 of the DB Standard Guidance. The DQMP shall be submitted for the Department's Review and Acceptance prior to starting any design work. The DQMP shall describe the design development, submittal and design review process for preparation of final signed and sealed construction plans used to construct the proposed improvements. The processes and procedures in the DQMP shall be developed in accordance with TDOT's Design Guidelines and Chapter 5 of the **DB Standard Guidance** for the Department's Review and Acceptance prior to starting any design work.

The DQMP shall include quality control and quality assurance procedures for ensuring the quality of the design work and conformance with the requirements in the **DB Standard Guidance,** including design-quality checks and certifications, and independent Design Reviews prior to submittal for the Department's Review and Acceptance.

The Design-Builder shall provide all Design Documents and perform Design Reviews in accordance with the Design Review schedule established in the Critical Path Method (CPM) Schedule, and in accordance with Contract requirements. Ten (10) business days shall be allocated in the CPM Schedule for activities requiring the Department's Review and Acceptance, or Review and Comment.

The Design Manager shall be responsible for design QC and ensuring that the design submittals and design reviews are performed in accordance with the DQMP and the Contract Documents. The Design-Builder shall provide a Design Quality Manager (DQM) to perform quality assurance activities and audits of the QC activities and QC program. The DQM shall be independent of the production work and shall certify to the Design-Builder and the Department that the design Work Product conforms to the requirements of the Contract Documents.

Construction Quality Management Plan

The Construction Quality Management Plan (CQMP) shall describe the quality roles and responsibilities of the Design-Builder's construction quality management team and procedures for implementing the construction work in accordance with Chapter 7 of the **DB Standard Guidance**. The CQMP shall be submitted for the Department's Review and Acceptance prior to starting any construction work.

Although the Department will provide Construction Engineering and Inspection (CEI) and Quality Assurance Testing, the Design-Builder is responsible for ensuring the quality of the work and shall prepare procedures in the CQMP for quality control of materials and how the Design-Builder plans to inspect the project to ensure compliance with the Contract Documents.

The Construction Manager shall be responsible for QC during construction and ensuring that QC testing and inspections are performed in accordance with the CQMP and the Contract Documents. The Design-Builder shall provide a Construction Quality Manager to oversee, manage, certify and perform construction quality assurance and audit activities. The CQM shall independently review the submittals for the Department, and upon completion shall certify to the Department that the information is accurate and complete. The CQM shall certify that all Work Product has been checked and/or inspected by the CQM's quality staff, and that all work complies with the Contract Documents. The CQM shall also certify to the Department that the CQMP and all measures, protocols, and procedures provided therein, are functioning properly and are being followed.

The Design-Builder shall guarantee and provide full cooperation in relation to CEI, audits, reviews, request for information etc.

o *ENVIRONMENTAL COMPLIANCE PLAN*

The Design-Builder shall prepare an Environmental Compliance Plan (ECP) in accordance with Section 2.5.4 of the DB Standard Guidance.

o *SAFETY AND HEALTH PLAN*

The Design-Builder shall prepare a Safety Plan in accordance with Section 2.5.5 of the **DB Standard Guidance**.

o *PUBLIC RELATIONS AND PUBLIC INFORMATION PLAN*

The Design-Builder shall comply with Section 7.2.8 of the **DB Standard Guidance** and address the following the project-specific requirements:

Internal and External Communications

The Design-Builder shall describe the internal and external communication process between the Design-Builder and the Department, the Department's staff, external stakeholders, third parties and public affected by the work.

The Design-Builder shall provide all information required for communication purposes. The communication activities are mainly intended for the Department and Department staff (internal stakeholders) but shall also focus on neighboring public and communities (e.g., City of East Ridge), companies and organizations, emergency services, Hamilton County, City of Chattanooga, environmental agencies and other external services.

The focus on the construction communication shall support the following goals:

- Ensure that the entire project is executed in the least disruptive and positive manner possible for the Department.
- Maintain the best possible long-term relations with all relevant external stakeholders.
- Ensure that the work is performed in the most effective and efficient way.

Handling Complaints

The Design-Builder shall process complaints that result from performing the work, whether received directly or through the Department to the Design-Builder, as soon as possible and react in a proactive way.

The Design-Builder shall notify the Department within two hours after receiving a complaint and inform what actions will be taken in order to resolve the cause of the complaint.

The Design-Builder shall keep a complete and updated complaint register of all complaints received, addressed directly to the Design-Builder or through the Department.

The complaint register shall include all relevant information in relation to the complaint (who, when received, contents), the actions planned concerning the complaint, the person(s) responsible for the communication and the status of the complaints (open, closed).

The Design-Builder shall coordinate all public communication with the Department.

Provide Information for Project Website

The Design-Builder shall coordinate with the Department and provide Project-related information to the Department for Review and Acceptance including:

- Contact information;
- Project maps;
- Current Project activities and progress;
- Timing of street and interstate ramp closures and openings;
- Recommended route alternatives during closures, with maps;
- Newsletters and meeting materials; and
- Calendar of, and announcements for, meetings and special events.

Liaison with the Media

Unless otherwise specifically authorized in writing by the Department, the Design-Builder shall provide no news release, press release, or any other statement to a member of the news media regarding this Project without the Department's prior written authorization. The Design-Builder shall require this clause within all Subcontractors agreements.

0 *RECORDS MANAGEMENT PLAN*

The Design-Builder shall describe procedures for managing and maintaining Project record documents in accordance with Sections 5.2.11 and Chapter 7 of the **DB Standard Guidance** and the project-specific requirements herein.

The Department will perform a combination of Audits, Reviews, Inspections etc. to assess whether the Design-Builder's integrated project management is functioning properly and determine whether its records and information are reliable and up to date.

Upon completion of the Project, the Design-Builder shall provide the Alternative Contracting Office a transmittal letter, an electronic copy (CAD and signed PDF's) of the As-Built drawings, and final foundation type, including footing elevations and lengths of individual piles, prior to final payment of funds to the Design- Builder.

The Professional Engineer in charge of the development of the Project plans shall place his seal, including signature and date, on the right side of the title sheet. All plans sheets shall contain the seal, including signature and date, of the Professional Engineer in charge of its development.

The As-Built Plans and the Design-Builder Specifications following construction completion shall incorporate any changes to the Readiness-for-Construction Design Review Plans and

Specifications, changes made during construction as well as all utility locations within ROW as described in the **DB Standard Guidance.**

Upon completion of the Project, the Design-Builder shall provide TDOT Structures Division a final revised set of plans for all structures (bridges, walls, etc.). The plans shall be delivered on CD (each sheet an individual PDF file).

3. ROADWAY

The roadway shall be designed to adhere to the latest editions of all appropriate TDOT Roadway Standard Drawings, TDOT Roadway Design Guidelines and Instructional Bulletins, TDOT Drainage Manual, TDOT Traffic Design Manual, TDOT Design CADD Standards, TDOT Survey Manual and the Department accepted AASHTO *Policy on Geometric Design of Highways and Streets,* and *Manual on Uniform Traffic Control Devices (MUTCD).*

Microstation and Geopak shall be used in the preparation of CADD and design files.

0 *GENERAL*

The Design-Builder shall provide new aggregate underdrains with pipe as specified in the Pavement Designs, within the limits of full-depth pavement replacement and widening. The Design-Builder shall provide appropriate outlets of the underdrains as specified in the Department's Standard Drawings. The Project shall consist of the following I-75 Segments:

Segment 1 (from the Georgia state line to just north of Ringgold Road – approx. 1,710 LF total) shall consist of removing the existing median barrier wall and the inside shoulder pavement, modifying or reconstructing existing cross drains, installing new storm drainage system along the shoulders, constructing full-depth inside shoulders, installing new 51-inch-tall single slope median barrier wall, milling and overlaying existing asphalt pavement, signing and pavement marking.

Segment 2 (from just north of Ringgold Road to approx. 1,130' north of the existing Welcome Center off ramp – approx. 3,340 LF total) shall consist of removing the existing median barrier wall and the inside shoulder pavement, modifying or reconstructing existing cross drains, installing new storm drainage system along the shoulders, installing new 51-inch-tall single slope median barrier wall, milling and overlaying existing asphalt pavement, widening the existing roadway and outside shoulders with full-depth asphalt pavement, signs and pavement markings.

Segment 3 (from approx. 1130' north of the existing Welcome Center off ramp to approx. 112' west of S. Chickamauga Creek bridge – approx. 5,260 LF total) (Includes I-75 Interchange @ I-24 to a point just west of the I-24/Spring Creek Road bridges) shall consist of constructing proposed roadway and shoulders on a new alignment with new full-depth pavement, drainage systems, 51-inch-tall single slope median barrier wall, bridges, retaining walls, guardrail, signing and pavement marking.

Segment 4 (from approx. 112' west of S. Chickamauga Creek bridge to 455' west of the CSX Railroad bridge – approx. 3,725 LF total) shall consist of widening the existing roadway and outside shoulders with concrete, rehabilitating the existing concrete pavement, extending existing cross-drain culverts, widening the Chickamauga Creek bridge, and constructing retaining walls, guardrail, signs and pavement markings. The roadway and shoulders shall be widened to full-width and match the Ultimate Phase with the exception of approximately 650 LF of asphalt outside shoulder to allow for guardrail transition on the north end of the project (I-75 northbound); the travel lanes shall be transitioned to match the existing lanes (to the north) using pavement markings. The following concrete repair quantities are anticipated:

Concrete Repair (Partial Depth): 20 S.Y.

Concrete Repair (Full Depth): 900 C.Y.

Concrete repairs shall be performed in accordance with Special Provision SP502A and Standard Drawing RP-J-23.

All existing concrete pavement on I-75 shall be ground and the joints sawed, cleaned, and sealed in accordance with Special Provisions SP502J and SP503.

Payment for Select Quantity Overruns

The following table is provided to cover select quantities that are above those anticipated in the scope. Additional repair areas/quantities shall be pre-approved (in writing) by the Department prior to commencing work or no payment will be received, see Design Build Standard Guidance section 2.11.2 for additional details. No payment will be provided for repairs required due to work being performed by the Design-Builder. When the Design-Builder utilizes any item in the table below, he must provide the Department with an invoice detailing the location, purpose, and quantity used, for tracking purposes. Failure to provide invoices throughout the progress of the project may result in non-payment for overrun quantities.

ITEM	TYPE	UNIT	UNIT PRICE	QUANTITY
Uniformed Police Officer	As specified by Special provision	HOUR	$50	Hours exceeding 2,500
Temporary Traffic Control	Changeable Message Sign Unit	EACH	$6,500	Signs exceeding 15
Concrete Repairs	FULL DEPTH PCC PAVEMENT REPAIR	C.Y.	$475	Quantity that exceeds 900 C.Y.
	PARTIAL DEPTH PCC PAVEMENT REPAIR	S.Y.	$200	Quantity that exceeds 20 S.Y.
Bridge Repairs	Concrete Repairs	S.F.	$130	Quantity that exceeds 25 S.F.
	Epoxy Injection Repair (Complete and In Place)	L.F.	$120	Quantity that exceeds 1,150 L.F.

Reference DB Standard Guidance: § 9.2.6, 9.2.7 & 2.11.2

Design Requirements

The proposed horizontal and vertical alignments of I-75 and the interstate-to-interstate ramps shall be designed and constructed to meet or exceed a minimum 50-mph design speed for a rolling urban freeway.

All other proposed ramps shall be designed and constructed to match the design speeds shown on the Functional Plans.

Traffic lanes on I-75, interstate-to-interstate ramps, and ramps with 2 or more lanes shall be 12 ft. wide. One-lane ramps shall be 16 ft. wide.

Interstate-to-interstate ramps: Inside and outside shoulders shall be 12 ft. wide (10 ft. stabilized).

I-75 (station 303+42 to station 325+00): Existing 16.5 ft. +/- inside shoulder (stabilized) to be reconstructed. Outside shoulder shall be 12 ft. wide (10 ft. stabilized).

I-75 (station 327+00 to station 352+54.04): Existing 14.0 ft. +/- inside shoulder (stabilized) to be reconstructed. Outside shoulder shall be 12 ft. wide (10-ft. stabilized).

I-75 (station 352+54.04 to station 404+50): Inside shoulder shall be 14 ft. (14-ft. stabilized). Outside shoulder shall be a minimum of 12 ft. wide (10-ft. stabilized).

I-75 (station 406+50 to station 443+85): Existing 11 ft. inside shoulder (stabilized) to remain. Outside shoulder shall be 12 ft. wide (10-ft. stabilized).

Ramps (A, B, C, E, F, G, and H): Inside shoulders shall be 6 ft. (4-ft. stabilized). Outside shoulders shall be 8 ft. (6-ft. stabilized).

Ramp (D): Inside shoulder shall be 6 ft. (4-ft. stabilized). Outside shoulder shall be 12 ft. (10-ft. stabilized).

Spring Creek Road: Typical section shall consist of 5 @ 12-ft. traffic lanes, 4-ft. bicycle lane on both sides of the roadway, 2.5-ft. curb and gutter on both sides of the roadway, and 5-ft. sidewalks on both sides of the roadway.

Vertical clearances for all alignments (entire roadway width including the full shoulder width) and all existing overhead structures along I-75, interstate-to-interstate Ramps, and Ramps shall have a minimum 16 ft., 6 in. minimum vertical clearance. The 16 ft., 6 in. minimum clearance shall be maintained during all construction phases of the project. This requirement shall include all temporary roadway surfaces used during construction. The Design-Builder shall submit plans as outlined in the TDOT Design Guidelines to the TDOT Structures Division for Grade Approval.

I-75 and interstate-to-interstate ramps including all structures shall be designed and constructed for the ultimate number of lanes as shown on the Functional Plans and Interstate Access Request (IAR)-Ultimate Design. All lanes, shoulders, structures, roadway embankments, retaining walls, and overhead sign structures shall be constructed to the ultimate configuration. Signing and striping shall be constructed for the initial phase as shown in the signing and striping Functional Plans and roll plots.

The Design-Builder shall be responsible for preparation of final signed and sealed construction plans used to construct the proposed improvements. They shall be prepared in accordance with TDOT's Design Guidelines and the previous design standards referenced in this section.

If the Design-Builder wishes to change the horizontal or vertical alignment or deems that additional ROW is needed outside of the secured ROW, they shall be responsible for any and all additional environmental technical studies and completion of the re-evaluation of the NEPA document,

modification and approvals to the Interstate Access Request (IAR), ROW appraisals and acquisitions, utilities coordination/relocation and any permits necessary.

The Design-Builder shall be responsible for the design and construction of all proposed overhead structures within the Project limits. The Design- Builder shall ensure minimum vertical clearance is provided throughout the duration of construction and upon completion of the project as defined in the TDOT Roadway Design Guidelines. The Design-Builder shall submit plans as outlined in the TDOT Roadway Design Guidelines to the TDOT Structures Division for Grade Approval.

The ramp construction and closures shall be phased in accordance with Special Provision 108B. Access to all side roads shall be maintained throughout the duration of construction.

The Design-Builder shall identify the need for any special roadway design details (i.e. any special drainage structures, rock embankment, special guardrail, retaining walls, concrete barrier designs, etc.) and shall provide special design drawings to the Department for Review and Acceptance.

The Design-Builder shall ensure that all applicable "General and Special Notes" found in Section VI of the current edition of the TDOT Roadway Design Guidelines are adhered to during construction.

The geometric configurations of all roadway components shall be designed to provide adequate drainage and prevent hydroplaning (during construction and when complete). Cross slopes shall be in accordance with the requirements of the roadway typical section as shown in the Functional Plans. Design-Builder to provide hydraulic calculations (including spread calculations) to the Department.

All proposed slopes associated with the roadway shall be sodded.

All existing access-control fence located within the following limits shall be replaced with the exception of that which is within a wetland area as designated on the survey provided by the Department.

- I-75 Northbound from Spring Creek to South Chickamauga Creek
- I-75 Southbound from South Chickamauga Creek to I-24 Westbound at Spring Creek Rd.

All permanent and temporary safety appurtenances (sign supports, guardrail, barrier rail, impact attenuators, etc.) shall meet current TDOT standards and shall have all required Department certification documents.

Portions of the City of Chattanooga are protected from flooding by a system that includes levees, walls, pumps and other earthworks. The area along the northern boundary of this project that stretches from South Chickamauga Creek to west of Spring Creek Road is in close proximity or contains several of these flood control measures. The pump station at Cornelison Road and the pump station at Spring Creek Road along with all required piping must remain fully functional at all times during and after this project. No modification or excavation of the levee will be allowed. Portions of the ramp from I-75 South to I-24 West also serve as part of the flood control system. Therefore, any work on this ramp must result in a finished grade elevation equal to, or higher than, the existing. Earthworks along right of way between Spring Creek Road and Eastgate Loop that are part of the flood control system are not to be disturbed. The Design-Builder shall not impact the existing Brainerd Levee Pump Station System located within the existing right-of-way. Any impacts to the facility shall be the responsibility of the Design-Builder.

Deviations and Exceptions

The functional design of the project is based upon an approved Interstate Access Request (IAR). Any deviations from the approved IAR including ingress and egress points will require coordination the Federal Highway Administration (FHWA) and may require a revision and approval from the Federal Highway Administration to the IAR.

The Design-Builder shall be responsible for any IAR modifications and approvals. All proposed modifications require an Alternative Technical Concept (ATC) subject to Department approval.

To insure connectivity to future construction phases at the I-75 north project limits and I-24 project limits, any deviations from the Functional Plans and IAR shall require an ATC and approval from the Department. Deviations from horizontal (greater than 5.0 feet) as shown on the Functional Plans will require an Alternative Technical Concept (ATC) with Department approval. The Design-Builder is responsible for any impacts result from deviations from the Functional Plans or IAR.

The existing 11-ft. inside shoulders on Segment 4 of I-75 will not require a design exception. No other areas have been identified requiring a design exception.

No design exceptions will be allowed without Department approval.

Guardrail and Barriers

All existing guardrails along I-75, interstate-to-interstate ramps, and ramps shall be removed and replaced. The Design-Builder shall only remove sections of existing guardrail adjacent to traffic as specified in the Design-Builder plans when necessary and only after the Department concurs in the necessity of removal due to construction requirements and after appropriate warning devices are installed. The proposed guardrail, including any anchor system, shall be installed quickly to minimize traffic exposure to any hazard. Guardrail shall be removed and replaced in accordance with the current editions of TDOT Standard Drawings and TDOT Standard Specifications, as amended, Section 909. Guardrail is to be complete and in place before the roadway (including all ramps) is opened to traffic.

All permanent and temporary safety appurtenances (sign supports, guardrail, barrier rail, impact attenuators, etc.) shall meet current TDOT standards and shall have all required Department certification documents.

Where new guardrail or barrier ties to existing concrete barrier and bridge parapet, the Design-Builder shall develop special tie-in details and submit prior to installation for the Department's Review and Acceptance.

All proposed median barriers shall be in accordance with the TDOT Standard Drawings for Median Concrete barriers, and shall adjust the barrier shape as necessary to accommodate bridge piers and sign supports located within the median. Median barrier wall shall be a 51-inch-tall single slope wall per TDOT Standard Specifications unless noted otherwise in the Functional Plans.

The Design-Builder shall propose a MASH-compliant TL-3 guardrail attachment to bridge ends and retaining walls detail. This attachment detail shall be submitted prior to installation for the Department's Review and Acceptance.

All new guardrail and end terminals shall be MASH compliant and be on the Department's Qualified Products List.

0 *DRAINAGE*

The Design-Builder shall be responsible for design and construction of the entire stormwater management system within the Project limits, including bridges, stormwater conveyances (open-channel and closed-conduit), stormwater inlets, and stormwater collection systems.

All stormwater runoff that flows through the Project, whether originating within or outside of the Project, must be accounted for in the design of the Drainage System.

The analysis, design, and construction of all components of the stormwater management system shall address the interim conditions during construction of the Project and the final design.

For reference, a preliminary drainage analysis has been completed and the resulting design is included on the Project website.

Design Requirements

All drainage analysis and design shall be in accordance with the Department's Drainage Manual.

The Design-Builder shall use a 50-year design storm for all new (and existing to remain) storm sewer systems in accordance with the Department's Drainage Manual.

The design is intended to convey the 50-year design without overtopping of any existing or proposed catch basin elements.

The Design-Builder shall design culvert outfalls, channels and ditches within the project limits in accordance with requirements of the Drainage Manual. Appropriate energy dissipaters shall be designed at culvert outlets to prevent scouring and appropriate channel linings shall be designed such that erosion within and downstream of the channels and ditches is minimized. Energy dissipaters shall be designed to fit within the existing right-of-way.

The Design-Builder shall provide aggregate pipe underdrains as specified in the pavement design and shall provide appropriate outlets for the underdrains as specified by the TDOT Standard Drawings.

The Design-Builder shall re-grade existing ditches to remain in-place and disturbed by construction by creating a straight-line profile along the centerline of the channel, as measured along the flow line.

The Design-Builder shall re-establish drainage in situations where sedimentation has changed the flow line from the existing profile. No work should be done to Waters of the State or US, which might appear to be a ditch, without proper permits.

The Design-Builder shall provide erosion control for the construction project per the guidelines specified in the Department's Drainage Manual.

The Design-Builder shall design the drainage system to accommodate construction staging. The design shall include temporary erosion control, sediment basins, and other BMPs needed to satisfy the NPDES and other regulatory requirements. All environmental approval commitments related to drainage design and erosion control shall be included as "notes" on the plans for each stage of construction.

Existing Drainage Systems

The Design-Builder shall obtain the Department's acceptance during the Design-Build Period to utilize any existing stormwater system (any and all pipe, structure, ditch, detention/retention system, or any other component necessary for the conveyance of stormwater) outside of the Project limits.

The design of stormwater management facilities shall be compatible with existing or any known proposed improvements to drainage systems on adjacent properties, and shall preserve existing drainage patterns wherever possible.

If existing drainage patterns must be altered due to a temporary or permanent aspect of the design of the Project, the Design-Builder shall provide documentation of any/all impacts to downstream and/or adjacent properties and/or road crossings for approval prior to alteration of existing drainage patterns. Survey data shall be collected for all downstream/adjacent properties that are impacted, such as road crossing information, structure damage elevations, and channel cross sections (at a minimum), and shall be used in support of hydraulic calculations for the offsite drainage systems. Engineering analyses and certifications shall be provided to the Department and the local jurisdiction for approval prior to performing the alteration.

The Design-Builder shall acquire all applicable municipal drainage plans, watershed management plans, and records of citizen concerns. The Design-Builder shall acquire all pertinent existing storm drain plans, bridge hydraulic studies, and/or survey data, including data for all culverts, drainage systems, storm sewer systems, and bridge sites within the Project limits. The Design-Builder shall also identify existing drainage areas and calculate the estimated runoff to the highway drainage system.

If documentation is not available for certain components of the existing drainage system within the Project limits and these components are planned to remain in place, the Design-Builder shall investigate and video record or photograph these components to determine condition, size, material, location, and other pertinent information.

Within the Project limits, there are eight (8) major outfalls that the Design-Builder shall use to discharge the surface runoff from the Project ROW. These include the following:

- An existing 42-in. reinforced concrete pipe at STA. 902+65.48 +/-, 98.92-ft. RT +/-, which collects runoff from the Brainerd Road area and is metered by an existing storm water pump station operated by the City of Chattanooga (identified as Pump Station #3 in original TVA construction plans), which ultimately drains to Spring Creek. The drainage area at the outfall of the 42-inch pipe is 49.16 Acres.
- An existing 30-in. reinforced concrete pipe at STA. 629+92.59 +/-, 17.29-ft. LT +/-, which collects runoff from the I-24/I-75 Interchange and ultimately drains into area wetlands that drain into to Spring Creek. The drainage area at the outfall of the 30-inch pipe is 11.91 Acres.
- An existing 48-in. reinforced concrete pipe at STA. 314+97.46 +/-, 125.28-ft. RT +/-, which collects runoff from west of the I-75 southbound on-ramp at Ringgold Road and drains into the eastern cloverleaf for Ringgold Road, ultimately flowing to West Chickamauga Creek. The drainage area at the outfall of the 48-inch pipe is 46.49 Acres.

- An existing 24-in. reinforced concrete pipe at STA. 328+45.91 +/-, 104.94-ft. RT +/-, which collects runoff from the I-75 southbound off-ramp at Ringgold Road and ultimately drains into the drainage system surrounding Bass Pro Shops. The drainage area at the outfall of the 24-inch pipe is 3.99 Acres.
- An existing 60-in. storm sewer system at STA. 2306+29.11 +/-, 353.02-ft. RT +/-, which collects runoff from west of the I-75 southbound on-ramp at Ringgold Road and the eastern cloverleaf for Ringgold Road and drains into the drainage system surrounding Bass Pro Shops, ultimately draining to West Chickamauga Creek. The drainage area at the outfall of the 60-inch pipe is 27.85 Acres.
- An existing 18-in. reinforced concrete pipe at STA. 2357+46.25 +/-, 24.01-ft. RT +/-, which collects runoff from the I-24/I-75 interchange and drains southeast into a low wetland area, ultimately draining into West Chickamauga Creek. The drainage area at the outfall of the 18-inch pipe is 5.22 Acres.
- An existing 54-in. reinforced concrete pipe at STA. 929+97.62 +/-, 90.48-ft. RT +/-, which collects runoff from the I-24/I-75 interchange, as well as, receives outflow from another 54-in. reinforced concrete pipe draining the Eastgate Towncenter area and is metered by an existing storm water pump station operated by City of Chattanooga (identified as Pump Station #1 in original TVA construction plans). Combined flows drain southeast into a low wetland area, ultimately draining into West Chickamauga Creek. The drainage area at the outfall of the 54-in. pipe is 159.10 Acres.
- An existing 8-foot x 8-foot reinforced concrete box at STA.442+27.59 +/-, 122.93-ft. RT +/- which collects runoff from a portion of Brainerd Subdivision as well as the CSX Railroad ROW and drains southeast, ultimately flowing into South Chickamauga Creek. The drainage area at the outfall of the 8-ft. x 8-ft. box is 72.87 Acres.
- A potential outfall that may be used by the Contractor is located at an existing 48-in. reinforced concrete pipe at Sta. 693+66.27 +/-, 78.54-ft. LT +/-, which collects runoff from west of the Spring Creek Road area and runoff from I-24 at Spring Creek Road crossing and ultimately drains south to Spring Creek. The drainage area at the outfall of the 48-inch pipe is 49.25 Acres.

The re-use of existing drainage structures, pipes, etc. (except underdrains) within the Project limits is encouraged by the Department provided the facilities meet the requirements of the Contract and are not impacted by construction activities.

The use of blind junctions and/or non-accessible structures shall not be allowed unless otherwise approved in writing by the Department. The Design-Builder shall not install and/or utilize longitudinal storm sewer pipes under travel lanes unless otherwise approved in writing by the Department. If no modification or upgrading of the existing stormwater management system is required, the Design-Builder shall, at a minimum, maintain the existing system. This maintenance includes, but is not limited to, silt removal from any pipe, ditch, or structure, and removal of any debris prior to the use of any existing stormwater system. This maintenance shall be at the Design-Builder's expense.

Damage to existing infrastructure due to the Design-Builder's operation shall be immediately repaired to maintain existing system capacity at all times. This permanent repair shall be at the Design-Builder's expense.

The Design-Builder shall video inspect and verify existing drainage systems that are to remain, are clean, operable and structurally adequate. Any repairs, replacements, debris removal and/or deficiencies shall be corrected by the Design-Builder. The most current information available to the Department for the existing drainage systems for the Project include a field-run topographic survey of the existing horizontal and vertical alignments, storm pipe inverts, and pipe material type.

The Design-Builder shall analyze existing storm drainage systems, culverts (boxes and cross pipes), and open channels impacted or affected by the Project design.

The Design-Builder shall replace or supplement any pipes or culverts that are deemed hydraulically or structurally deficient in the existing condition or as a result of this Project.

Only pipes within the defined Project limits are subject to be replaced or supplemented.

The Design-Builder shall replace damaged, destroyed, missing, or permanently attached castings on existing drainage structures. This shall include, but is not limited, to any structure located within the proposed roadway that is not already being modified or addressed within the proposed drainage work or a structure which is within the resurfacing limits, which is not being affected by any proposed drainage work.

Floodplain Requirements

The Project will impact multiple FEMA-regulated special flood hazard areas (SFHAs) situated within two separate participating FEMA Communities: East Ridge and Chattanooga. The Design-Builder shall make every effort to design the Project to follow FEMA regulations in FEMA-regulated floodplains, according to requirements listed in Code of Federal Regulations (CFR) Parts 59, 60, 65, and 70. This design may include but is not limited to: bridge structures over streams, culverts over streams, increasing the tie slope, and/or utilizing retaining walls to reduce fill in the floodplain.

The Design-Builder shall make every effort to design the project to meet conditions of CFR Part 60.3 and 65.12, which state that encroachments to regulatory floodways must not cause increases to Base Flood Elevations (BFEs), floodway elevations, or floodway widths greater than 0.00 feet. A preliminary hydraulic modeling analysis was performed based on the design shown in the Functional Plans. It was determined that minimal increases to Base Flood Elevations (BFEs) can be achieved compared to Updated Existing Conditions and Proposed Conditions BFEs are lower than Effective Conditions. If, during the design process, it becomes apparent that due to environmental or other design constraints, the requirements listed in of CFR Part 60.3 and 65.12 cannot be met by the Design-Builder, then minor increases in BFEs up to 0.05 feet may be allowed if it can be demonstrated by the Design-Builder that flood damages to adjacent properties or structures will not be caused by the increases. All floodplain hydraulic analyses and Hydraulic Reports shall be reviewed by the Department and courtesy copies shall be provided to the local communities. If determined by the Department and/or local Floodplain Administrators that a Conditional Letter of Map Revision (CLOMR) is required, local community approval and the subsequent submission to FEMA shall occur as early in the Project timeline as possible, and the Design-Builder shall be responsible for engineering fees and application fees. The Design-Builder shall allow up to one year in the schedule for FEMA approval of any required CLOMR review. Regardless of whether a CLOMR is required, the Design-Builder shall submit an application for a Letter of Map Revision (LOMR) to FEMA within six (6) months of completion of construction in order to document final changes to BFEs and floodways. The LOMR submittal shall be based on certified as-built survey

data of the completed project, and the Design-Builder shall be responsible for engineering fees and application fees.

Hydraulic Design File Report for Hydraulic Structures

The Design-Builder shall prepare a Hydraulic Design File (HDF) Report and any other required documentation for all existing and/or proposed bridge-class structure crossing sites, and for culverts that convey at least 500 cubic feet per second for the design storm. All aspects of the drainage design must meet all criteria listed in the latest edition of the TDOT Design Procedures for Hydraulic Structures, the Department's Drainage Manual, and any Environmental Commitments identified in the NEPA Approval. Additional required documentation may include, but not be limited to, the preparation and submittal of any CLOMR or LOMR required for community and/or FEMA coordination. The HDF Report shall further include the detailed calculations with electronic and printed copies of the computer software input and output files, as well as a discussion about hydrologic and hydraulic analysis and reasons for the design recommendations. At a minimum, for each bridge-class crossing or structure conveying more than 500 cubic feet per second for the design storm, the HDF Report shall include:

- Correspondence in chronological order.
- Maps- located on a portion of the county map or city map and 7.5-minute USGS quadrangle (preferably color).
- Hydraulic report summary.
- Photographs - See TDOT Hydraulic Manual-Chapter 10 for minimum requirements. Aerial photographs should be included if available.
- Analysis
    - Discharge calculations.
    - Frequency discharge relationship.
    - Stage discharge relationship.
    - Supporting hydraulic information (previous flood studies, gage data, etc..).
    - Existing structure analysis, with cross sections plotted (if applicable).
    - Natural water surface model with no bridge or road fill
    - Proposed structure analysis, with cross sections plotted and any alternatives.
    - Scour analysis, if applicable.
    - Deck drainage analysis.
    - On-site inspection report.
    - Other information.

Where multiple structures occur on a single project, the correspondence section should not be repeated. The cover of the design file should include the project description, PIN, and/or project number as indicated in Department schedules. Also, each stream crossings station, stream name, and associated bridge identification number (if available) should be indicated on the cover. Survey data should be included in the file for future reference.

The hydraulic design file will be reviewed, approved, and filed in the Hydraulic Design Section's files.

0 *PAVEMENT MARKINGS*

The Design-Builder shall prepare pavement marking plans for the Department's concurrence. Pavement markings shall be constructed for the initial phase as shown in the signing and striping Functional Plans and roll plots. The design and installation of permanent pavement markings shall be in strict accordance with the current edition of the Manual on Uniform Traffic Control Devices (MUTCD), TDOT Roadway Design Guidelines, TDOT Standard Drawings, TDOT Standard Traffic Operations Drawings, TDOT Traffic Design Manual, and the current edition of the TDOT Standard Specifications. All pavement marking removal on final surfaces shall be accomplished by water blasting or another non-marring method. Any damage to the pavement surface caused by the selected method shall be removed and replaced at the contractor's expense.

Permanent pavement line markings shall be thermoplastic installed to permanent standards at the end of each day's work. Short unmarked sections shall not be allowed. Temporary pavement markings to be utilized for less than seven (7) working days may be painted. Temporary pavement markings to be utilized for seven (7) working days or more shall be spray thermoplastic or tape. On the final surface, the Design-Builder shall have the option of using temporary pavement markings installed to permanent standards at the end of each day's work and then installing the permanent markings after the paving operation is completed. All pavement markings beyond the immediate work area that are affected by the Work shall be reapplied to permanent standards.

Pavement markings depicting interstate shields shall be placed on the pavement at locations shown on the Signing and Marking Roll Plots. Any modifications to the locations shall be approved by the Department.

Contrast striping shall be used for all permanent striping on concrete pavement/structures along I-75.

See Phase 1 and Ultimate Signing and Marking Roll Plots as provided on the Project Website for guidance.

0 *SIGNING*

The Design-Builder shall prepare signage plans for the Department's concurrence/review prior to ordering. Signs shall be constructed for the initial phase as shown in the Signing and Marking Roll Plots. In addition, the Design-Builder shall ensure all signs beyond the project limits are consistent with new alignments and travel lanes.

The design and installation of permanent roadway signs shall be in strict accordance with the current edition of the MUTCD, TDOT Roadway Design Guidelines and TDOT Standard Drawings, the current edition of the Standard Highway Signs, the TDOT Supplemental to the Standard Highway Signs, the current edition of the TDOT Standard Specifications, and TDOT Traffic Design Manual.

All Cantilever Sign Structures shall be removed and shall be replaced with new Overhead Sign Structures. All Overhead Sign Structures shall be designed per LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and reviewed and concurred with by TDOT Structures Division prior to construction/installation.

After the permanent sign locations have been staked, but prior to ordering any material for supports, there shall be a Field Review and Acceptance by the Department.

All existing sign footings shall be removed 12 inches below ground line or 12 inches below top of subgrade if located within the proposed roadway or shoulder.

The Design-Builder shall verify all support lengths at the site prior to erection.

All guide signing shall be mounted on new Overhead Sign Structures. The Design-Builder shall design the structure to support signs across the entire length of the travel way.

All sign sheeting shall be Type 3 Prismatic or better. All existing signs that do not meet the retro-reflectivity requirements shall be replaced. All yellow reflective warning signs on I-75, interstate-to-interstate ramps, and ramps shall be fluorescent yellow.

The Design-Builder shall furnish layout drawings of all extruded panel signs with spacing of all letters, numerals, shields, and arrows. The layout drawings shall be reviewed by TDOT Traffic Operations Division prior to construction/installation.

All permanent signing plans; Signing Layouts, Sign Schedules, Overhead Structures Drawings & Miscellaneous Detail Sheets shall be reviewed by the Department prior to ordering and construction/installation.

Emergency Reference Markers shall be installed on Project per details provided by the Department.

All existing post-mounted signing shall be removed and replaced with new sign faces and new breakaway supports (refer to Signing and Marking Roll Plot for guidance).

Emergency Reference Markers shall be installed on Project per details provided by the Department.

See Phase 1 and Ultimate Signing and Marking Roll Plots as provided on the Project Website for guidance.

Overhead Sign Structures

All overhead sign structures shall be constructed to meet the ultimate design configuration. See Phase 1 and Ultimate Signing and Marking Roll Plots.

All guide signing shall be mounted on new Overhead Sign Structures. The Design-Builder shall design the structure to support signs across the entire length of the travel way.

All Cantilever Sign Structures shall be removed and shall be replaced with new Overhead Sign Structures.

All Overhead Sign Structures shall be designed per LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and reviewed and concurred with by TDOT Structures Division prior to construction.

All existing Overhead Sign Structures shall be replaced with new Overhead Sign Structures.

See Phase 1 and Ultimate Signing and Marking Roll Plots as provided on the Project Website for guidance.

0 *TRAFFIC SIGNALS*

No new traffic signals or signal modifications are proposed under this scope of work. In the event that the Design-Builder impacts any existing traffic signals during project construction or for

maintenance of traffic related to the construction of this project, the Design-Builder shall be required to repair and/or replace the affected traffic signal systems (including but not limited to cabinet, controller, traffic signal heads, wiring, detection equipment, conduit and pull boxes, traffic signal poles and associated traffic signal timing and all other materials and methods to provide a fully functional and operational traffic signal). The signal shall be the same signal system as the existing signal. The Design-Builder shall coordinate with the cities of East Ridge and Chattanooga regarding any impacts to their signals, including signal timings.

0 *LIGHTING*

All lighting shall be LED lighting. The Design-Builder shall prepare lighting designs/plans in accordance with TDOT Standard Specifications for Road and Bridge Construction, TDOT Standard Drawings, TDOT Standard Traffic Operations Drawings, TDOT Traffic Design Manual, Chapter 15, and the latest edition to the National Electric Code, National Fire Protection Association (NFPA) 70.

All existing light standards located within the project limits along I-75 and I-75/I-24 interchange shall be removed. New lighting standards and luminaires shall be designed to replace any existing lighting removed by the Design Builder to assure that I-75, interchange to interchange ramps, and ramps have adequate lighting to meet TDOT standards. All existing lighting located within the project limits shall be replaced. Power to existing lighting located outside the project limits affected by the project shall be restored so that no existing luminaires are inoperable.

The Design-Builder shall submit lighting photometrics for proposed roadway lighting sections (including underpass lighting) to the Department for concurrence prior to ordering materials or beginning construction/installation.

If the Design-Builder elects to remove the lighting system prior to construction, temporary lighting will be required at all locations where existing lighting is taken out of service. All temporary lighting shall be provided in accordance with TDOT standards.

The Design-Builder shall not allow light pollution/light hindrance into residential areas during construction.

All wiring shall be concealed underground in 2-inch schedule 40 PVC rigid conduit. The conduit shall be installed a minimum depth of 26 inches as measured from finished subgrade.

The ground wire shall be run inside conduit within structures, shall be colored green and have THW insulation.

Existing foundations shall be removed a minimum of twelve inches below ground line.

Light standards shall be round tapered poles. Length shall be determined by required mounting height.

All proposed roadway light standards shall be designed in accordance with the requirements of the latest edition of the LRFD Standard Specifications For Structural Support For Highway Signs, Luminaires and Traffic Signals published by the American Association of State Highway and Transportation Officials.

The Design-Builder shall coordinate with TDOT's Traffic Operations Division and Electric Power Board of Chattanooga to determine the proposed lighting fixture type (i.e. mast arm, offset, etc.) to be used on the project and any specific design parameters.

All proposed roadway light standards shall be mounted on bases with an access door. Transformer bases shall meet AASHTO specifications and have FHWA approval. Standards shall aluminum with transformer bases.

Bracket arms (if used) shall be round tapered truss type with strap mounting and lengths as scheduled. Bracket arm upsweep shall be the same for all light standards of the same type.

See Lighting Roll Plot as provided on the Project Website for guidance in regard to proposed lighting facilities.

0 *GROUND SURVEY*

The ground survey including survey control will be provided by the Department.

The Design-Builder shall verify the ground survey and survey control before utilizing in the design of the project. In addition, the Design-Builder shall be responsible for field surveys and support activities, such as, but not limited to geotechnical investigations, ROW stakeout, construction stakeout, etc.

If the Design-Builder's design footprint extends beyond the limits of the survey provided by the Department, the Design-Builder shall be responsible for securing the necessary additional survey.

All field survey activities shall be performed in accordance with the latest version of the TDOT Survey manual and any other applicable design standards previously referenced.

0 *PAVEMENT DESIGN REPORT*

The Pavement Design Report for this Project has been developed by the Department.

Proposed asphalt and concrete pavements shall be constructed utilizing the pavement designs provided in this report unless otherwise approved in advance by the Department.

For Segments 1, 2, and 3, paving on inside shoulders shall be full depth pavement.

Segment 4, work on inside concrete shoulders shall include concrete pavement repair and joint repair.

The Pavement Design and minimum criteria for pavement related Alternative Technical Concepts (ATC) are located in **Appendix A**.

4. STRUCTURES

The Design-Builder shall be responsible for the design and construction of all structures within the Project limits including interstate and interchange ramp bridges, retaining walls and noise walls, as further described below.

The Design-Builder shall be responsible for the removal and disposal of all deficient structures, or portions thereof.

Upon completion of the Project, the Design-Builder shall provide TDOT Structures Division a final revised set of plans for all structures (bridges, walls, etc.). The plans shall be delivered on CD (each sheet an individual PDF file).

0 *BRIDGES*

The Design-Builder shall be responsible for the design and construction of one (1) widened bridge on I-75 at Chickamauga Creek and thirteen (13) new bridges on the Mainline I-75, ramps to I-24, ramps for the Welcome Center, and Spring Creek Road over I-24 WB/EB. The northbound and southbound bridges on mainline I-75 are treated as separate bridges except the bridge widening, which is considered one bridge.

The Design-Builder shall be responsible for the design and construction of all remaining structures necessary to complete the Project.

The Design-Builder shall also be responsible for needed repairs of existing bridges as noted on the Functional Plans.

New bridge elements shall be designed using the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Eighth Edition (2017), and the AASHTO Guide Specifications for LRFD Seismic Bridge Design, Second Edition (2011) with all interims.

The Design-Builder shall adhere to the Department's Standard Specifications for Road and Bridge Construction (2015 Edition) for construction materials and methods.

Design Requirements

Accelerated Bridge Construction (ABC) methods may be used, but must be approved in writing by the Department.

Girders shall be continuous for live loads for pre-stressed girders, and continuous for all loads for structural steel girders. Structural steel shall be A709 (50 kilo pound per square inch [ksi] minimum yield strength) weathering steel for the I-75 bridges and Spring Creek Road bridges, and either I-girders or tub girders may be used. The girder types on the pre-stressed beam bridges shall match the existing type (bridge widening only). The minimum final concrete beam strength shall be 5,000 pounds per square inch (psi).

The new bridges and bridge widenings shall be designed for HL-93 live loading. The bridge design shall include 35 pounds per square foot (psf) for a future wearing surface.

The new 51-inch bridge median barriers shall be in accordance with Standard Drawing STD-1-3SS. The new bridges on mainline I-75 shall have a split 51-inch bridge median barrier. The modified 51-inch barrier shall be detailed on the bridge plans. An applied texture finish is required on the inside (traffic) face and top of the parapet rail. The color shall be white, AMS STD-595 color No. 37886.

ITS conduits shall be provided inside the barriers when required. The Department will determine if additional conduits will be required for future needs.

For all bridges, the Design-Builder shall perform a hydraulic analysis for bridge deck drainage and shall meet the criteria in the TDOT Design Procedures for Hydraulic Structures.

Bearing conditions for bridge widenings are to match existing bearing conditions (bridge widening only).

Existing utility conduits attached to existing bridges are to be removed and replaced. Relocated utilities shall not be placed on the cantilevers of new structures. They shall be placed between the beams so they are out of view from the traveling public and protected against vehicular impact. The utilities shall be relocated as indicated by other sections in this RFP.

The replacement bridges for Spring Creek Road over I-24 shall have under bridge lighting to properly light I-24.

The Design-Builder shall submit shop drawings for bridge components, erection plans and calculations for concurrence by the Department. For demolition of the existing Spring Creek Road bridges and existing ramp bridges over traffic, the Design-Builder shall submit demolition plans and calculations for concurrence by the Department. The shop drawings, erection plans, and demolition plans shall be submitted in a timely manner allowing ten (10) calendar days for the Department's review.

The Design-Builder shall conduct and submit a load rating analysis for each of the bridges to be widened and new bridges that are to be constructed. The load ratings are to be completed and approved before completion of the project. They shall be submitted in a format to be concurred with by the Department.

The Design-Builder shall propose a MASH TL-3 guardrail attachment to bridge end detail (to be concurred with by the Department) for locations where the existing guardrail is attached to bridges.

The Design-Builder shall perform repairs to existing bridges as shown in the TDOT Bridge Inspection Reports and Deck Surveys included on the Project website. The Design-Builder is to verify the information shown in the above referenced documents.

Match super-elevation of approach roadway on widened portion of bridge.

Maintain a 16-foot, 6-inch minimum vertical clearance at all times.

Place a 51-inch concrete median barrier (reference TDOT Standard Drawing STD-1-3SS).

Place concrete parapets on widened portions of the bridges (reference TDOT Standard Drawing STD-1-1SS).

All exposed surfaces of the parapets, slab cantilevers, concrete beams surfaces, abutment beams, end walls, wing walls, bent caps, and columns of the bridges shall receive a texture finish, mountain

grey, AMS STD-595 Color No. 36440 except the top and traffic face of the parapets which shall be white, AMS STD 595 Color No. 37886.

Drilled shafts shall be constructed according to Special Provision 625 Drilled Shaft Specifications.

The bridges shall be constructed while maintaining the minimum number of lanes open to traffic during construction as specified in this RFP. The minimum vertical and horizontal clearances shall be maintained during construction as specified in this RFP and TDOT's Standard Specifications for Road and Bridge Construction.

Temporary rolling road blocks, lane closures, and detours will be permitted during the setting of beams for the bridges. This RFP includes details and submittal requirements for temporary traffic disruptions.

Bridges shall be designed and detailed according to current TDOT Structures Policies.

On mainline I-75 bridges and ramps, a special split barrier could be used to account for the difference in elevation between the northbound and southbound bridges. In order to utilize split barriers, they shall be approved by the Department prior to construction and detailed on the bridge drawings where used.

Bridge 4, Widening I-75 Over South Chickamauga Creek

The golf cart path and greenway shall have adequate protection for pedestrians, proper lighting, and remaining open at all times during project duration. The Design Builder shall field verify the location of all elements of existing bridge before geometry is developed on the widened portion. Permanent under bridge lighting is required on the proposed bridge widening to properly light the greenway and the golf paths. The entire bridge deck and approach slabs for Bridge 4 shall receive a thin epoxy overlay friction course topping.

0 *NOISE WALLS*

The Design-Builder shall be responsible for the design and construction of Noise Barrier Walls as per the NEPA document, the Noise Barrier Evaluation dated October 30, 2018, and plans. The noise barrier walls shall be designed using the AASHTO LRFD Bridge Design Specifications, Eighth Edition (2017), Section 15. The Noise Barrier Evaluation includes the preliminary noise barrier design information based on the functional plans. The FHWA TNM files are included in the Reference Documents and should be used by the Design-Builder to assess proposed design changes. TDOT will use the TNM files to evaluate any modifications to the noise barrier proposed by the Design-Builder.

The Design-Builder shall ensure that all proposed work is completed within existing right-of-way limits utilizing any measures necessary. If the Design Builder deems that ROW and/or easement acquisitions are unavoidable, the Design Builder shall be responsible for all ROW and easement activities including but not limited to appraisals, appraisal reviews, and acquisitions.

The top of wall elevation shall not be less than the top of wall elevation as shown in the noise analysis. The bottom of the wall shall not provide any gaps between the wall and the final grade except as required to accommodate drainage.

Ground-mounted barriers and barriers on bridges shall be connected to ensure no gaps.

The traffic face of the walls shall be reflective and meet the following requirements:

- Concrete formliners shall be used to achieve the specified pattern and texture on both the highway and community sides of the barrier. Methods that involve rolling of any kind to achieve the specified pattern and texture shall not be permitted.
- A minimum 1-inch depth of reveal at joints shall be achieved on both the highway and community sides of the noise barrier.
- Top noise barrier panels shall include a 12-inch wide smooth band across the top of each panel on both sides.
- All posts shall be cut flush with the highest adjacent panel.
- The formliners for both the highway and community sides of the noise barrier shall be approved by the TDOT Environmental Division (Tammy Sellers, 615.741.5367), TDOT Structures Division (Houston Walker, 615.741.3351), and TDOT Region 2 prior to the manufacture of the noise wall panels.
- The highway side of the noise barrier shall be Custom Rock Pattern #1102 Rectangular Cut Stone or an approved equal. Four custom form liners, each with a unique pattern, (5' X 10') shall be developed with 20" tall coursing and 2" average joint relief.
- The Design-Builder shall apply an Anti-Graffiti product to the highway side of the Noise Wall. The product must be on TDOT's QPL 26 list and be intended for wall applications. It must be applied in accordance with the manufacturer's specifications.
- The highway side of the noise barrier (including posts) shall be texture coated to match other structures.
- The formliner used on the community side shall be Random Cut Stone #1106 manufactured by Custom Rock or an approved equal.
- The community side of the noise barrier (including posts) shall be texture coated using Federal Standard Color 36373.
- Texture coating shall be applied to ensure all panels and posts appear uniform in color. Several applications shall be applied to ensure all color uniformity. The Design-Builder shall obtain approval from TDOT Region 2 that the noise barrier surfaces are uniform in color before ceasing texture coating operations.
- The Design-Builder shall cast a sample barrier panel with the approved formliners and colors. If the sample meets the requirements of this provision, TDOT will approve the panel and this panel shall serve as a standard for acceptance of subsequent noise barrier panels. If accepted, the demonstration panel can be incorporated into the completed project.
- The demonstration panel shall be delivered to the project site. The delivery location shall be approved in advance by the TDOT Region 2 Construction Division (423.510.1217).
- The Design-Builder shall insure all panels are protected during all aspects of truck loading/unloading and transport to the project installation location.

- The panels shall be flush with one another; gaps between barrier panels shall not be permitted.
- The horizontal joints between panels shall line up from one bay of panels to the next. Horizontal joints shall have tongue-and-groove configurations.
- No gaps shall exist between the base of the barrier panels and the ground.
- Prior to installation, the Design-Builder shall inspect delivered products for any defects.
- Panels that exhibit deficiencies or damage after installation shall be replaced or repaired by the Design-Builder at the discretion of TDOT and to the satisfaction of TDOT at the expense of the Design-Builder. Deficiencies include, but are not limited to, crumbling, cracking, crazing, scaling, spalling, efflorescence and segregation.
- After installation, the Design-Builder shall remove dirt from panels with water.

The location of the posts shall consider the location of any drainage structures, utilities, or other obstructions that would interfere with post placement.

The new noise walls shall be constructed using concrete posts and concrete panels. The post spacing shall not exceed 20 feet. Ground mounted noise wall posts shall be embedded into drilled shaft foundations. Bolted connections will not be allowed.

The panels shall be a minimum of 2 feet into ground. The bottom panels in a bay may be tapered in height with a minimum height of 1 foot.

The posts and panels shall be flush at the top. The top of wall elevation shall vary by no more than 2 feet in adjacent bays.

Only the minimum amount of vegetation necessary for the placement of the walls may be removed as directed by the Department. Where possible, stumps and roots are to remain to prevent ground disturbance. Any damage to vegetated areas outside the limits of construction shall be repaired at the Design-Builder's expense. These areas are to be returned to their pre-construction state as directed and concurred with by the Department.

The Design-Builder shall notify the Department and all adjoining properties and stakeholders thirty (30) days prior to proposed noise barrier wall clearing, or construction.

0 *RETAINING WALLS*

Retaining walls shall be built in accordance with Special Provision 624, Retaining Walls.

All retaining wall finish requirements for retaining walls visible to the public and traffic shall receive an ashlar stone finish. Retaining walls not visible to the public or traffic shall receive a Class II, Rubbed Finish as specified in the TDOT specifications.

The retaining wall locations, wall lengths, and the beginning and end stations of walls, as shown on the Functional Plans are approximate. The final locations and wall lengths shall be determined by the Design Builder.

Retaining walls being constructed in sensitive environmental areas or areas close to existing streams shall adhere to the environmental requirements set forth in the RFP.

5. INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

The Design-Builder shall prepare ITS design/plans and install ITS related equipment/structures as described herein in accordance with the TDOT Standard Drawings, TDOT Standard Traffic Operations Drawings, TDOT Standard Specifications, TDOT Traffic Design Manual, TDOT ITS Project Development Guidelines and TDOT Special Provision 725 in RFP Book 2 (Design-Build Contract).

o *FIELD INVESTIGATIONS*

The Design-Builder shall be responsible for verification of existing conditions, including research of all existing TDOT Intelligent Transportation System (ITS) records/plans and all other ITS related information.

The Design-Builder shall conduct the field survey and provide a complete list of all ITS field devices tracked by the Department, that includes, but not limited to make, model, and serial number, within the Project limits and beyond if those ITS field devices are to be taken out of service, altered or upgraded by the Design-Builder.

The list shall be provided within sixty (60) calendar days of NTP.

The Department shall provide a complete list of all assets being tracked by the Department and what information is needed for each ITS field device type. The Design-Builder shall submit the list to the Department for Review and Acceptance.

The Design-Builder shall coordinate with the electrical power companies and provide electrical power for all ITS devices included in the project. The Design-Builder shall pay all costs for providing electrical power service. In addition, the Design-Builder shall pay all electric service recurring costs for the ITS until Substantial Completion.

See ITS Roll Plot as provided on the Project Website for guidance in regard to proposed ITS facilities.

o *DESIGN REQUIREMENTS*

Fiber and Electrical Power for ITS devices

The Design-Builder shall maintain the existing fiber conduit, electrical conduit and communications to the greatest extent possible. If fiber conduit relocation is required, the Design-Builder shall design and install the relocated fiber line and splice it into the existing fiber line prior to the start of any roadway construction.

All fiber and electrical conduit shall be designed to minimize conflicts with or damage to other roadway items such as drainage structures, foundations, signing, lighting, guardrail, retaining walls, and landscaping.

The proposed conduit relocation is shown on the ITS Roll Plot as provided on the Project Website.

The proposed fiber and power relocation designs shall be reviewed and receive concurrence from the Traffic Operation Division prior to ordering materials or beginning relocation.

Pull boxes for fiber optic trunk line shall be placed every 1200 feet. Pull boxes must meet all requirements set forth in the TDOT Fiber Optic Standard Drawings. The ITS system redundancy shall be tested with TDOT TMC IT prior to fiber and power relocation.

CCTV

The Design-Builder shall maintain the existing CCTV cameras to the greatest extent possible.

If relocation of CCTV cameras is required, then CCTV cameras within the project limits shall be removed and replaced with proposed CCTV cameras meeting the requirements of Special Provision 725.

All CCTV camera poles located in the median shall be removed unless otherwise directed by the Department. All proposed CCTV camera poles shall be located outside of clear zone unless guardrail or barrier is present. Proposed CCTV camera poles shall not be placed in the median.

Dynamic Message Signs (DMS)

Design-Builder shall remove and replace the existing structures with proposed DMS support structures meeting the requirements of Special Provision 725.

All proposed DMS signs and supporting equipment shown on the ITS Roll Plot shall be new. All existing DMS signs and supporting equipment shall be removed and returned to the Department at a location to be determined.

Radar Detection System (RDS)

The Design-Builder shall remove and replace the existing RDS detection devices and support structures with all new RDS detection devices and support structures that meet the requirements of Special Provision 725. All the existing RDS devices and support structures shall be returned to the Department.

If an existing light standard is utilized as a RDS support structure, the Design-Builder shall not remove the light standard, only the RDS equipment

When appropriate and possible, co-locate RDS detection devices with CCTV cameras or with DMS to reduce the number of support structures to be replaced. The Design-Builder shall ensure desired detection accuracy irrespective of the installation type. If co-locating with CCTV support structure, Design-Builder shall coordinate with TDOT Region 2 to ensure location is easily accessible for maintenance of RDS and does not interfere with lowering device. If co-locating with DMS structure, Design-Builder shall coordinate with TDOT Region 2 to ensure location is easily accessible for maintenance of RDS.

The proposed RDS system design should maximize the use of RDS installations that detect traffic in both directions of travel. All new RDS support structures shall be located outside of clear zone unless guardrail or barrier is present.

0 *MAINTENANCE OF COMMUNICATION AND ELECTRICAL POWER TO ITS DEVICES*

The Design-Builder shall ensure that no loss of power or communications between existing ITS field devices and the Transportation Management Center will occur during construction.

The work may cause the decommissioning of portions of the existing ITS system within the Project limits. The Design-Builder shall be responsible for any temporary power and communications that may be necessary to provide continual communications to all non-decommissioned ITS field devices within the project limits.

The Design-Builder shall implement a Maintenance of Communication (MOC) plan (detailing work to be performed, schedule of work, and a strategy for minimizing downtime) to preserve the ITS operations during the Project construction phase. The MOC plan shall be submitted to TDOT Traffic Operations Division for the Review and Acceptance prior to any change to the existing communication system, decommissioning of existing ITS field devices and supporting equipment, and temporary ITS relocations and/or installations.

The Liquidated Damages associated with temporary loss of power and/or connectivity of each ITS field device and supporting equipment due to construction, installation, integration with the temporary communications systems, or relocation shall be per Special Provision 108B.

0 *ADDITIONAL REQUIREMENTS*

The Design-Builder is required to perform system testing prior to any planned construction activity that would cause a temporary loss of connectivity. The testing is required to determine system wide impacts for mitigation practices that can be deployed.

The Design-Builder shall use specific or compatible ITS software and hardware components to ensure networking and device connectivity and compatibility.

0 *SUBMITTAL REQUIREMENTS*

All ITS submittals, made as part of the project submittal program, shall be concurred with by the Traffic Operation Division.

The Department shall concur with the placement and location of all ITS field devices, structures and support pole locations prior to purchasing, construction or installation.

The Design-Builder shall submit all ITS designs/plans (ITS devices, support equipment, and support structures) to the TDOT Design Division, TDOT Traffic Operations Division, and TDOT Structures Division for concurrence prior to ordering materials or beginning construction/installation. Permitting for utility work shall follow the same process as outlined in Section 9.

In addition to the requirements set forth in Section 17.2.6 of Special Provision 725, as-built project plans shall also be submitted in PDF and DGN formats. The Design-Builder shall provide the TDOT Traffic Operations Division with a survey using Tennessee State Plane Coordinates showing the as-built location of all ITS related items along with any design calculations.

6. GEOTECHNICAL

The Design-Builder shall perform a design level geotechnical investigation to validate and augment the geotechnical information included in this RFP.

0 *GEOTECHNICAL INVESTIGATIONS*

The geotechnical exploration investigations shall be performed in accordance with the current *TDOT Geotechnical Manual* located on the Geotechnical Engineering Sections webpage on the Department's website:

https://www.tn.gov/content/dam/tn/tdot/hq-materials-tests/geotech/2016-10-15-TDOTGeotechManual.pdf

The Design-Builder shall determine the amount and level of the geotechnical investigations to cover geological risks associated with this Project.

The Design-Builder shall perform a slope analysis for all proposed slopes.

The Design-Builder shall be responsible for obtaining the borings for all abutments, bents, piers, retaining wall foundation locations, and noise wall foundation locations where subsurface information is not sufficient or is warranted by variability in the geology. All borings shall be deep enough to show a complete soil and rock profile to the depth of the foundation-supporting layer. Refer to Section 1: Geotechnical Projects with Structural Components, of the current *TDOT Geotechnical Manual*.

The Design-Builder shall collect appropriate field data and samples for geotechnical evaluation of embankments, subgrade, soil and rock cuts, culverts, bridge and retaining wall structures, storm water management structures and ponds, minor structures, including drainage pipes, and any other earth supported structures or elements of highway design and construction relevant to the Project. Refer to Section 2: Geotechnical Projects with Roadway Design Components, of the current *TDOT Geotechnical Manual*.

The prequalified geotechnical firm shall also determine if additional subsurface information, other than that required and noted elsewhere in the Contract Documents, is required based upon the final roadway and structure designs. If a determination is made that additional subsurface information is required; the Design-Builder shall perform all additional subsurface investigation and laboratory testing in accordance with the current *TDOT Geotechnical Manual*.

Notification Requirements

Any required lane, shoulder and/or ramp closures to perform geotechnical investigations must be approved a minimum of seven (7) days in advance by the Department.

The Design-Builder shall notify the Department and all adjoining properties and stakeholders thirty (30) days prior to commencing any activity on private property. Property owner's names and addresses shall be obtained using the latest records available from the county Tax Assessor's office. To promote good relationships, a diligent effort shall be made to contact each property owner or tenant prior to entering the property. However, personal contact is preferable in order to explain that

entry is required, the purpose of the activity, the activities involved and to determine facts pertinent to the activity.

The Department may limit when drilling activities or other geotechnical work including lane closures may occur within the Department's Right-of-Way.

The Department may require the Design-Builder to immediately halt drilling activities or other geotechnical work underway.

The Design-Builder shall be required to provide traffic control for all drilling activities occurring within the Department's Right-of-Way including but not limited to lane closures and shoulder closures.

The Design-Builder shall provide field quality control for all bridge foundations, retaining foundations and noise wall foundations including verifying subsurface conditions for drilled piers and bearing for shallow foundations.

0 *GEOTECHNICAL REPORTS*

The Design-Builder shall provide geotechnical reports, design and construction summaries that contain pertinent subsurface investigations, test, and engineering evaluations.

Prior to any geotechnical design submittal, as outlined in the *TDOT Geotechnical Manual*, the foundation design recommendation reports shall be sealed and signed by a Professional Engineer registered in the State of Tennessee who has completed a minimum of three geotechnical design projects of scope and complexity similar to that anticipated for this Project using the LRFD method and in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications.

7. RIGHT-OF-WAY

The Department has secured NEPA approval and the Department does not anticipate the need for additional Right-of-Way.

If the Design-Builder deems additional ROW is needed outside of the secured ROW, the Design-Builder shall be responsible for performing all acquisition activities, including appraisals, appraisal reviews and acquisitions, and any required utilities coordination/relocation and acquisition of related permits. The Design-Builder shall also be responsible for preparing the additional environmental technical studies and completion of the NEPA document re-evaluation. The following explains the Design-Builder's responsibilities related to any additional right-of-way required.

0 *ACQUISITION SERVICES REQUIREMENTS*

The Design-Builder, acting as an agent on behalf of the Department, shall provide ROW acquisition services for the Project.

ROW acquisition services shall include certified title reports, appraisal, appraisal review, negotiations, relocation assistance services, property management services, parcel closings and all related activities.

All appraiser/s, appraisal reviewer/s and acquisition/relocation firms shall be selected from the Department's ROW Office's pre-qualified list.

The Department will retain authority for approving just compensation, relocation benefits and claims administrative settlements, court settlements and court awards.

The Department must issue a NTP with ROW Acquisition to the Design-Builder prior to any offers being made to acquire the property. This represents a hold point in the Design- Builder's Baseline Schedule.

The Department must also issue a NTP with Construction to the Design-Builder once the property has been acquired prior to commencing construction on the property. This also represents a hold point in the Design-Builder's Baseline Schedule.

The Department will be responsible for the actual purchase price paid to a landowner for ROW, including fee simple, or any and all easements, and for any relocation assistance payments.

The Department will be responsible for actual payments to property owners and certain expenses related to the acquisitions and associated legal costs as well as any additional monies paid the landowners to reach an administrative settlement or pay for court settlements and awards.

The Design-Builder will be responsible for all costs associated with the services provided by the appraiser(s), review appraiser(s), acquisition/relocation firm, title company, engineering and legal services related to the acquisition of ROW, the costs of any public hearings that may be required, and any other cost associated with the services related to the purchase of ROW.

0 *TITLE REPORTS AND CLOSINGS*

The Design-Builder shall provide a current title report (no older than one hundred and eighty (180) days) for each parcel at the time of the initial offer to landowner. Each title examination report shall be prepared by a Department's approved title company (each of the Department's Regional ROW Offices has a list of approved title firms). The Design-Builder shall furnish an original and three legible copies of a title report, including summary of 5 years sale history, on a form to be provided by the Department, designated as ROW Form-49, with copies of all recorded deeds, liens, selloffs, easements, subdivision plats, divorce decrees, wills, judgments, and other pertinent documents attached, for each numbered tract on the ROW plan. The Design-Builder shall furnish one updating of the title report; the process of updating the title report shall be performed as part of the closing.

The following terms and conditions shall also apply:

- Preliminary reports of title are required on all tracts for which a taking or an acquisition is shown on the acquisition table.
- Title insurance is not required.
- An original and three (3) legible copies of the "Preliminary Report of Title" (Form 49) are to be submitted. All attachments must accompany the original and all three (3) copies.
- Reports must include information on all contiguous parcels of land which form a single tract under the same ownership.
- In addition to the information to be provided on the R.O.W. Form 49, each preliminary report of title shall contain the tax map, and parcel number for the particular tract as well as the civil district in which the tract is located.In addition, include documentation of all Environmental Liens if they apply.
- The Design-Builder shall furnish the correct mailing address of the property owner for each tract number. If the ROW plan is revised so to add additional tracts from which there will be an acquisition as shown by the acquisition table, all services covered by this agreement are to be provided for those additional tracts.
- Facsimile of title report shall not be accepted.
- Completion and filing of Form 1099 published by the Internal Revenue Service, is required in connection with closing of ROW acquisition.
- Copies of Tax Maps showing all tracts are to be included. These maps are to be complete, full size sheets whenever possible.
- Copies of subdivision plots are to be included when the only deed description of an individual parcel consists of a lot number in the mentioned subdivision.
- Please number the pages of each "Preliminary Report of Title".
- If any instrument is not legible on the provided copy, (attachments) then a typed legible instrument must accompany illegible copies.

The Design-Builder shall close all negotiated tracts on the Project. This service shall include:

- updating the title report to the time of closing;
- the preparation of the warranty deed and any releases;
- the preparation of a closing statement (ROW Form-24 provided by the Department); and
- the preparation of the deed transmittal statement (ROW Form-29 provided by the Department).
- the preparation of the Tax Proration Form
- the preparation of the closing tract map
- the preparation of the W-9 form
- the preparation of the closing log form (ROW Form 17A provided by the Department)

The Design Builder is responsible for the arrangement of and making of such disbursements as may be necessary to cause the removal of property taxes, judgments and instruments constituting liens for money owed, and the recording of the warranty deed.

The Department will be responsible for the reimbursement to the Design-Builder for the recording of releases and/or partial releases and the recording of any other required releases for liens or encumbrances and all cost associated with obtaining any releases and any other such documents.

The Design-Builder agrees to discuss time and location for each proposed closing with the prospective grantor(s) and within reason to accomplish same in accordance with the grantor(s') advice. Normal closings are expected to take place within 45 days after the seller's acknowledgement of sale price and conditions (ROW form 30-A) is executed. Extenuating circumstances requiring more than 45 days shall be reported by letter (or by FAX) no later than the 45th day from the date of the executed agreement of sale with a request for an extension. Requests for extensions beyond the normal accepted time will be considered on a case by case basis. Within 24 hours after closing, the Design-Builder shall notify the Regional Transportation Manager 2 of this fact. All closings are to be done by personal contact, at a time and place that is convenient to the landowner. Where a closing by mail is requested, the written consent of the Department is required, except when the closing involves Out-of-State property owners.

0 *APPRAISAL AND APPRAISAL REVIEWS*

The Design-Builder shall prepare appraisals in accordance with TDOT's Guidelines for Appraisers, Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (the "Uniform Act"), the Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally-Assisted Programs (Part 24 of title 49 CFR), and the Uniform Standards for Professional Appraisal Practice (USPAP). Appraisal and Related Service shall include all or parts of the following: real estate appraisal, real estate appraisal review, real estate consultation, pre-trial conference, deposition, and court testimony, as further defined.

The Design-Builder shall complete all appraisal services and work product to the standards set forth herein. Failure on the part of the Design-Builder to complete each assignment according to said standards by the agreed upon due date shall be considered a material breach of this Contract.

The Design-Builder shall complete all appraisal services in accordance with the Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally-Assisted Programs (Part 24 of title 49 CFR), the Uniform Standards of Professional Appraisal Practice [USPAP (Appraisal Foundation)], [Guidelines For Appraisers (https://www.tn.gov/content/dam/tn/tdot/right-of-way-division/TDOT_Guidelines_for_Appraisers__06-30-15.pdf)] and Federal, State and local laws, rules, and regulations.

The Design-Builder shall furnish an original and two (2) copies of each Market Data Brochure and each Appraisal Report. The Design-Builder shall also furnish one additional copy of each appraisal report together with all exhibits and comparable data write-ups. This copy shall be clearly identified as the landowner's copy. Unless specifically directed otherwise in writing, all appraisal services products are to be delivered to the regional office.

In addition to the standard photos of the subject property and exterior photos of the acquired improvements, the Design-Builder shall provide a typical interior photo of acquired/ affected structures having substantial contributory value (i.e. residences, commercial structures, large barns, etc.) Legible digital images are acceptable.

The Design-Builder shall update the appraisal report(s) on any tract(s) involved in condemnation covered under Work Orders issued hereunder to "date of possession" when requested to do so by the Department. Appraisal updates shall be completed within sixty(60) days after the request is made in writing by the Department. All such updates shall be in compliance with standards set forth above except that the standards in force as of the date of employment to conduct the updated appraisal service shall apply. The "update" appraisal request may require the Design-Builder to consider and include minor plan revisions and changes in market conditions.

Upon request by the Department, the Design-Builder shall testify in any judicial or arbitration proceeding involving the determination of the value of the property, in support of the opinion of value of any and all of the property included in his/her appraisal report. Further, the Design-Builder agrees to attend, as requested by the Department, any pre-trial conferences, meetings, depositions, etc. related to such proceedings. The Design-Builder shall be compensated for these litigation-related services in accordance with the Expert Valuation Witness Rates in effect at the time the service is rendered. The Expert Valuation Witness Rate Schedule may be adjusted periodically.

The Design-Builder shall execute disclaimers of any past, present or contemplated future personal interest in any of the properties included in the proposed agreement, as required by the Department, or if applicable, FHWA.

The Design-Builder shall maintain throughout the term of this Contract Errors and Omissions insurance in the amount of not less than one million dollars ($1,000,000.00), and proof of which shall be made available to the State upon demand.

The Design-Builder shall provide appraisal reviews complying with technical review guidelines found in the Department’s Guidelines for Appraisers, the Uniform Act, and (USPAP), and the Department’s ROW Procedures Manual and make a recommendation of just compensation. Design-Builder's ROW staff that performs acquisition and relocation/property management services shall be from the Department’s pre-qualified consultant list for acquisition and relocation assistance and related services and the Design-Builder shall include a Department’s pre-qualified Fee Appraiser from Department’s prequalified appraiser list. The review appraiser shall be approved

by the Department and shall also be on the Department's prequalified fee appraiser list. The Department shall have final approval of all the Design-Builder's ROW staff.

0 *ACQUISITION, RELOCATION ASSISTANCE, AND PROPERTY MANAGEMENT*

The Design-Builder shall acquire property in accordance with all Federal and State laws and regulations, including but not limited to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (the "Uniform Act") the Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally-Assisted Programs and (Part 24 of title 49 CFR). The acquisition of property shall follow the guidelines as established by the Department's ROW Procedures Manual. The Design-Builder shall execute a certification in its proposal that it has received the Department's ROW Procedures Manual and will comply with the procedures.

The Department has an Appeals Advisory Board to hear any Relocation Assistance appeals.

The Department agrees to assist with any out of state relocation by persons displaced within the rights of way by arranging with such other state(s) for verification of the relocation assistance claim.

The Design-Builder shall establish an acquisition/relocation office at a location that is accessible to the property owners and displacees on or near the project. The purpose of maintaining this office is to ensure effective and responsive service to meet the property owners' and displacees' needs. The office must be operational by the time acquisitions begin. The Design-Builder shall supply relocation and negotiation personnel with substantial experience in highway ROW acquisition, or similar work, in numbers sufficient to accomplish the required work in a timely manner. Design-Builder's ROW staff that performs acquisition and relocation/property management services shall be from the Department's pre-qualified consultant list for acquisition and relocation assistance and related services. All relocation and negotiation personnel are to be approved by the Department for each project hereunder. After the Department has approved the personnel for a project, changes may only be made with the written approval of the Department. This office shall be staffed by persons knowledgeable of the Uniform Act and the Department's ROW Procedures Manual. This office shall be open during normal business hours and after hours by appointment.

The Design-Builder shall submit procedures for handling ROW acquisitions and relocations to the Department for concurrence prior to commencing ROW activities. This represents a hold point in the Design-Builder's Baseline Schedule. These procedures are to show the Design-Builder's methods, including the appropriate steps and workflow required for certified title reports, appraisals, appraisal review, negotiations, acquisition, relocations and parcel closings and all related activities. These procedures shall include the Department's review and concurrence of just compensation, administrative settlements, relocation benefits and claims.

A Department's Representative will be available to make timely decisions concerning establishing review and concurrence of just compensation, concurrence of administrative settlements, concurrence of relocation benefits and claims, on behalf of the Department. The Department's Representative is committed to issuing decisions on approval requests within sixty (60) days. The commitment is based on the plan providing a reasonable and orderly workflow and the work being provided to the Department's Representative as completed.

The Design-Builder shall maintain accurate parcel files and, at the termination of the work on the project, turn over to the Department all relocation and negotiation files, appraisal and appraisal review files, and any other pertinent acquisition files, records or reports. All files shall be documented in accordance with the applicable State and Federal requirements. During the work on the project, the Design-Builder shall make all such files available, upon demand, for inspection by the Department and/or by the FHWA, when applicable.

The Design-Builder shall submit a project specific Conceptual Stage Relocation Plan and an Acquisition Stage Relocation Plan for the Department's Review and Acceptance. The plan shall identify a prioritized schedule of ROW activities including but not limited to appraisal, appraisal review, the specific parcels to be acquired and all relocations. The plan shall allow for the orderly relocation of displaced persons based on time frames not less than those provided by the Uniform Act and/or the

Department's ROW Procedures Manual. This plan shall be updated as necessary during the life of the Project.

The Design-Builder shall make the necessary relocation survey and promptly prepare and submit all required relocation documents in accordance with State and Federal regulations. The Design-Builder shall perform all relocations in accordance with the Uniform Act and the Department's ROW Procedures Manual as applicable.

The Design-Builder shall submit bi-monthly status reports to the Department's ROW Division to manage and track the acquisition process. The status report must include but not be limited to the appraisal, appraisal review, and acquisition and relocation assistance status of all parcels. The Department's standard appraisal, appraisal review, acquisition and relocation assistance and property management forms and documents shall be used as applicable.

The Design-Builder shall provide necessary property management services during the period of the Design-Builders work. Those property management services include, but are not limited to: private property owner utility adjustment cost estimates, salvage appraisals on improvements being acquired, moving cost determination, including the moving of on-premise signs and outdoor advertising devices, and determination and collection of rent after the "90 day" notice to vacate has expired.

The Design-Builder shall coordinate all work through the State's Regional ROW Transportation Manager 2 or his designated representative.

The Design-Builder shall recommend tracts for condemnation. When the Design-Builder recommends a tract for condemnation, the request for condemnation must have the necessary supporting documentation attached to properly completed forms as indicated by the Regional ROW Office. The Regional ROW Office will check these forms and process this information to obtain a voucher. In general all voucher requests for any payment will be handled in this manner.

The Design-Builder shall conduct any public meetings as requested by the Department and as required by the Department's ROW procedures and practices

The Design Builder shall meet and coordinate with public officials of governmental agencies and civic groups as required or as requested by the State.

The Department will be responsible for the costs associated with the payment to property owners for negotiated settlements, administrative settlements, and relocation benefits. The Department is also responsible for the costs associated with the payment to be deposited with the court in condemnation cases. In addition, any payments agreed to by the property owner and the Attorney General's Office during the condemnation process either by settlement or through the courts including court costs and any mediation expenses is the responsibility of the Department. The Design-Builder shall be responsible for disbursement of these payments and providing indefeasible title to the Department. All payments will be made in accordance with the policies and procedures established in the Department's ROW Procedures Manual.

The Design-Builder shall prepare, obtain execution of, and record documents conveying title to such properties to the Department and deliver all executed and recorded general warranty deeds to the Department. For all property purchased in conjunction with the Project, title shall be acquired in fee simple (except for the acquisition of slope, construction or permanent drainage easements, in lieu of fee simple title, with respect to any portion of the ROW, which must be concurred with by the Department's Design Division) and shall be conveyed to the Department, Grantee, by a Departments-approved general warranty deed, free and clear of all liens and encumbrances except encumbrances expressly permitted by the Department in writing in advance. All easements shall be acquired in the name of the Department.

Because these acquisitions are being made on behalf of the Department, the Department shall make the ultimate determination in each case as to whether settlement is appropriate or whether the filing of a condemnation action is necessary, taking into consideration the recommendations of the Design-Builder. When the Department authorizes the filing of condemnation, the Design-Builder shall prepare all required documents necessary to file and forwarded to the appropriate Department Regional ROW Office.

The Design-Builder shall provide the necessary staff and resources as directed by the Department to work with the Department and the Attorney General's Office throughout the entire condemnation process until the property is acquired by settlement, by deed, or by Final Consent Judgment executed by the Department and the appropriate court. The Design-Builder shall provide updated appraisals (i.e., appraisal reports effective as of the date of possession) and expert testimony supporting condemnation proceedings upon request by the Department and/or the Attorney General's Office.

The Design-Builder shall be responsible for all contacts with landowners for ROW and construction items and shall be responsible for properly setting all ROW monuments associated with the Project.

The Design-Builder shall maintain adequate access to all occupied properties to ensure emergency and personal vehicle access. Utility service must be available to all occupied properties at all times prior to and until relocation is complete.

During the acquisition process and for a period of three (3) years after final payment is made to the Design-Builder for any phase of the work, and until the Department has indefeasible title to the property, all Project documents and records not previously delivered to the Department, including but not limited to design and engineering costs, construction costs, costs of acquisition of ROW, and all documents and records necessary to determine compliance with the laws relating to the acquisition of ROW and the costs of relocation of utilities, shall be maintained and made available to the Department for inspection or audit. Throughout the design, acquisition and construction

phases of the Project, copies of all documents/correspondence shall be submitted to both the Department Headquarters Office and the respective Department's Regional Office.

The Design-Builder shall ensure no open burning will occur within 1,000 feet of an occupied dwelling.

The Design-Builder shall maintain a sufficient buffer or hold off zone around parcels which have not been acquired and/or occupied properties to ensure compliance with ROW procedures prior to starting construction activities in these affected areas. There should be no construction- related activities within the hold off zone until the property is acquired and/or vacated. The Department will provide written notification before the contractor can enter the hold off zone.

Fidelity Bond: The Design Builder shall furnish a fidelity bond in the amount of $250,000.00 with the State being made the insured for the period of time from the first offer to the owners until all tracts have a recorded deed or vouchers submitted for condemnation, in such form as approved by the State. The bond shall indicate the State's ROW project number (both Federal and State numbers, if applicable).

8. UTILITIES

As defined in CI/ASCE 38-02, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, the Department has performed a utility quality level B subsurface utility explorations (SUE) for this Project. With the exception of the locations listed in section titled "Coordination Responsibilities", this information is provided to the Design-Builder for use as preliminary estimate of the horizontal and vertical locations of the existing utilities within the Project limits.

A utilities base map of existing utility facilities is provided for reference only on the Project website and reflects the most current information available to the Department. Utilities that may potentially be in conflict with the Project are depicted in the appropriate rainbow color.

o *UTILITY INVESTIGATIONS*

The Design-Builder shall be responsible for identifying any utility conflicts coordinating with the utilities in the design of the relocated facilities, and preparing construction plans for the relocation of the utility facilities as required to accommodate the proposed Project design. Exact locations shall be determined in the field by contacting the utility companies involved and additional SUE investigations as necessary. Notification by calling the Tennessee One Call System, Inc., at 1-800-351-1111 as required by TCA 65-31-106 shall be required.

The Design-Builder shall make all reasonable efforts to design the Project to avoid conflicts with utilities, and minimize impacts where conflicts cannot be avoided.

The Design-Builder shall at all times be responsible for verifying all information related to the survey information as to the location (both vertical and horizontal of the Utilities). The providing of information by the Department shall not relieve the Deign-Builder of this obligation, nor transfer any of that responsibility to the Department.

o *GENERAL REQUIREMENTS*

The Design-Builder shall be familiar with 1680-6-1 Rules and Regulations for Accommodating Utilities within Highway Rights-of-Way, Tennessee Code Annotated (TCA) Part 8 Relocation of Utilities 54-5-801 through 54-5-856, and 23 CFR Part 645 "Utilities". Adherence to the above referenced regulations and procedures are mandatory.

Utility facility relocations shall require the proposed plans to be submitted to the Department as an Application and Utility Use and Occupancy Agreement for review and issuance of permits for the accommodation of utilities within highway right-of-way. The Design Builder with the consent of the utility, can make that submittal on behalf of the utility after the review and approval by the utility of the utility relocation plans.

The Design-Builder must utilize a firm which is prequalified with the Department to perform utility coordination services and the Design Builder must adhere to TDOT policy #301-01 "Standard Procurement of Engineering and Technical Services".

Immediately after submittal of the accepted final Definitive Design Plans, the Design-Builder shall use the "Local Government Guidelines for the Management of Federal and State-Funded Transportation Projects", issued by the Program Development and Administration Division Chapter 6.2 as a guide to utility coordination. In compliance with the statute (TCA 54-5-854), a minimum of 120 -165 calendar days shall be included in the Critical Path Method Schedule for Utility Investigation.

The Design-Builder shall utilize a single dedicated person responsible for managing all utility coordination and required concurrence with the TDOT Utility Office. The Utility Coordination Manager shall have the following knowledge, skills, and abilities:

- A minimum of 4 years of experience performing utility coordination in accordance with TDOT standards, policies, and procedures.
- Knowledge of the Department plans production process and utility coordination practices.
- Knowledge of aforementioned rules, regulations, and codes.

0 *COORDINATION RESPONSIBILITIES*

Prior to submitting the bid, the Design-Builder shall be solely responsible for contacting owners of all affected utilities in order to determine the extent to which utility relocations and/or adjustments will have upon the schedule of work for the Project. While some work may be required in the vicinity of utility facilities that will remain in place, other utility facilities may need to be adjusted concurrently with the Design-Builder's operations.

The Design-Builder shall be responsible for confirming the utility locations, confirming the type of facilities, identifying the utility owners and determining the cost responsibilities in order to coordinate the relocation of any utilities in conflict with the Project with respect to the "General Requirements" section.

The Design-Builder shall notify each individual utility owner of their plan of operation in the area of the utilities. Prior to commencing work, the Design-Builder shall contact the utility owners and request them to properly locate their respective utility on the ground. This notification shall be given at least three (3) business days prior to commencement of operations around the utility in accordance with TCA 65-31-106.

The Design-Builder shall coordinate the relocation or adjustment of the utilities in accordance with the RFP. The Department will process and certify all compensable utilities. The Design-Builder shall process and certify all non-compensable utilities for potential conflict and/or relocations. The Department will be the approving authority for all utility permits, compensable agreements and acceptance of utility relocation plans.

The following Utilities have been identified by the Department as having facilities within the Project corridor for which the Department contemplates an adjustment, protection, or relocation is possible.

Utility	Owner	Contact	Phone Number
Telephone	AT&T	Roger Flood	423-752-9133
Electric	Electric Power Board of Chattanooga	David Henderson	423-648-3257
Water	TN American Water	Grady Stout	423-771-4713
Sewer	Hamilton County W&WW Treatment Authority	Forrest Catron	423-209-7868
	City of Chattanooga, Public Works	Bill Payne	423-643-6160
Gas	Chattanooga Gas	Tawanna Hines	404-584-4461
CATV	Comcast/Xfinity	Tim Gregory	706-252-4185
Petroleum	Kinder-Morgan/Plantation Pipeline Company	Tom Bickel	770-330-1696
	Colonial Pipeline Company	Wally Ryans Kevin Raley	423-413-5549 423-421-3678

The Design-Builder shall give additional detail to two facilities that are in conflict with the Project. The information provided by the Department does not include the facilities listed below.

The Hamilton County Water and Wastewater Treatment Authority (WWTA) has begun design work on a new collector sewer line that will eliminate the number of sewer crossing on I-75. There are currently three sewer lines crossing I-75. The material and age of these lines makes them less than desirable when new construction takes place. It is the intent of the WWTA to retire the existing three lines by installing one new crossing and additional sewer pipelines and manholes along the west side of I-75. As of the publication of this RFP, this project has reached a 60 percent completion and the WWTA has begun the process of obtaining easements.

In addition, the WWTA owns and operates a 42-inch concrete gravity sewer line that crosses Spring Creek at its northern bank. This gravity line once served as the outfall for the City of East Ridge Wastewater Treatment Facility. The facility was converted to a pump station and the line was converted as a conduit to tie into the City of Chattanooga. The exact condition, location, and depth of this line is not known. It is believed that the structural work in this area will be in conflict with this line.

The City of Chattanooga owns and operates a 24-inch force main that crosses I-75. An approximate location was shown on the survey and the depth is unknown. Although it is not known, it is possible that work in this area may conflict with the existing force main.

0 *COMPENSABLE UTILITIES*

The Department shall make the necessary arrangements with the utility owners on compensable utilities identified and submitted by the Design-Builder and the Design-Builder shall make the necessary arrangements with the utility owners for all non-compensable utilities including new installations required for the Project, adjustments, relocations or removals where the Design-Builder and utility company determine that such work is essential for highway safety and performance of the required construction.

The Design-Builder shall be responsible for determining the cost responsibility (compensable or non-compensable utilities) for the utility relocations. The Department will be responsible for non-betterment (compensable utilities) utility relocation cost when the utility company has prior rights-of-way or compensable interest. The utility company shall be responsible for the relocation costs if they cannot furnish evidence of prior rights- of-way or compensable interest (non-compensable utilities) in their facilities. The Design-Builder shall be responsible for all costs associated with utility relocations due to haul roads and/or any other temporary conditions resulting from the Design-Builder's methods of operation or sequence of work.

If the Design-Builder elects to make arrangements with a utility company to incorporate a new utility installation or relocation as part of the highway construction, the utility work done by the Design-Builder and the associated costs for the work shall be negotiated and agreed upon between the Design-Builder and the utility company.

If the Design-Builder is requested, in writing, by an entity to relocate, upgrade or incorporate new facilities as part of the highway construction, designs shall be coordinated with the utility owner, and the Department. The associated design and construction costs shall be negotiated and agreed upon between the Design-Builder and the utility company. Environmental permitting for utility work construction shall follow the same process as outlined in Section 9. Any and all design permits for utility facilities, such as water and sewer permits from TDEC, shall remain the responsibility of the utility to obtain and provide to the Design-Builder.

No additional compensation or time shall be granted for any delays, inconveniences, or damage sustained by the Design-Builder or its Subcontractors due to interference from utilities or the operation of relocating utilities.

0 *ADDITIONAL REQUIREMENTS*

The Design-Builder shall accommodate utility adjustments, reconstruction, new installation and routine maintenance work by others that may be underway or take place during the progress of the contract.

In the event of a utility conflict, the Design-Builder shall request that the utility company submit relocation plans (plans to be provided by the Design-Builder to Utility Owners) that show existing utilities and proposed utility relocations.

The Department will be the approving authority for all utility permits, agreements and acceptance of plans.

The Department Utility Office must execute approved agreements on Design-Build highway projects. The Utility Relocation Agreements (Cost Agreement) and encroachment permit agreements are available from the Department.

Sampling, testing, monitoring and reporting shall be performed by the Design-Builder in accordance with standard industry practices for water, wastewater, oil, and gas and in accordance with the Utility Owners standard specifications and requirements.

0 *CONSTRUCTION REQUIREMENTS*

The Design-Builder shall provide all necessary protective measures to safeguard existing utilities from damage during construction of this Project. In the event that special equipment is required to work over and around the utilities, the Design-Builder shall be required to furnish such equipment.

Any damage to the existing facilities associated with the construction activities shall be the sole responsibility of the Design-Builder to repair the damaged utility at no additional cost to the Department or the respective Utility Owner.

9. ENVIRONMENTAL

The NEPA document has been approved by FHWA and is included on the Project Website. The project commitment sheets and the study area are referenced in these documents. The Design-Builder shall refer to the NEPA document for a complete description of the environmental commitments for the Project.

The Design-Builder shall adhere to all project commitments and requirements included in the NEPA document. If the Design-Builder's design footprint extends beyond the study area and/or changes to impacts to identified resources, the Design-Builder shall be responsible for the additional environmental technical studies and re-evaluation of the NEPA document. . If the proposed project does not go to construction within 3 years of the approval date of the NEPA document, the Design-Builder shall be responsible for the NEPA document re-evaluation.

No additional time will be allotted to the Project schedule for the Design-Builder's preparation of the NEPA document re-evaluation, TDOT Environmental Division staff's review and concurrence of the NEPA document re-evaluation, agency coordination, and subsequent FHWA approval of the NEPA document re-evaluation.

o *ENVIRONMENTAL BOUNDARIES*

The Design-Builder is responsible to make sure all features from the Environmental Boundaries Report (EBR), provided by the Department's Region 2 Environmental Tech Office, are field verified. The Design-Builder shall be responsible for any mitigation for impacts to environmental features included in the EBR or additional features identified prior to and during construction. The Environmental Boundaries Report must be completed in accordance with Department practices; the Design-Builder shall be responsible for obtaining any necessary Documentation Standards from the TDOT Environmental Division.

For impacts to any streams, springs, wetlands, sinkholes or other water resource features identified during construction not included in the original EBR, it shall be the responsibility of the Design-Builder to provide the data sheets and forms listed below to the Department's Region 2, Environmental Tech Office for review prior to submittal to the regulatory agencies:

<u>Streams</u>

- Hydrologic Determination Field Data Sheet (Version 1.4)
    - Ecology Water Resources Field Data Sheet
    - Tennessee Division of Water Resources Moderate Habitat Assessment Field Data Sheet
- A location map, marked up plan sheets, and a U.S. Geological Survey (USGS) Quad map showing the proposed stream(s) using Department-provided map templates

- Photo summary of each feature including photo views of the location of the proposed alteration, upstream, downstream, and along the centerline of the Project.

Wetlands

- Wetland Determination Data Form (U.S. Army Corps of Engineers, (USACE)) – Eastern Mountain and Piedmont Region: Version 2.0
- Tennessee Division of Water Resources: Tennessee Rapid Assessment Methodology (TRAM) documentation for wetlands including: TRAM Decision Key, TRAM Outstanding Natural Resource Water or Exceptional Tennessee Water Decision Table, appropriate HGM field data forms (if applicable) or Non-HGM field data forms (if applicable) for the wetland type being assessed, and TRAM Quantitative Summary Table.
- A location map, marked up plan sheets, and a USGS Quad map showing the proposed wetland(s) using Department-provided map templates.
- Photo summary of each feature including photo views of the location of the proposed alteration and wetland boundaries.

This determination shall be completed by a Tennessee Qualified Hydrologic Professional (TN-QHP). The Tennessee Qualified Hydrologic Professional (TN-QHP) Certification must be submitted along with the Hydrologic Determination Field Data Sheet for the individual preparing the stream data sheets and forms.

All additional environmental field studies are to be performed by Design-Builder's personnel with the required qualifications.

State or Federal Endangered/Threatened Species

Due to concerns for spawning populations of the federally threatened snail darter (Percina tanasi), no work will be allowed in Spring Creek, West Chickamauga Creek, or South Chickamauga Creek during the period from February 1 through April 30 during all years of construction.

Due to concerns for the state threatened Chickamauga crayfish (Cambarus extraneus), the Department will coordinate with TWRA staff to conduct sweeps/surveys prior to any in-stream work. The Design-Builder shall provide at least twenty-one (21) calendar days advance notice to the Region 2 Environmental Tech Office.

If the Design-Builder makes changes to the plans, construction methodology, and/or ROW; this will immediately require additional review(s) of the proposed changes by the U.S. Fish and Wildlife Service (USFWS), Tennessee Wildlife Resources Agency (TWRA), and the Tennessee Department of Environment and Conservation (TDEC) Division of Natural Areas. The Design-Builder shall contact the Department's Region 2 Environmental Tech Office prior to any coordination. If TWRA or USFWS requires any species surveys, sweeps, or transplants, the Department will require the Design-Builder to perform the work. The Design-Builder must provide the following to the Department's Region 2 Environmental Tech Office before starting coordination with the USFWS and TWRA.

- Surveys shall be conducted as appropriate, depending on the species. The Design- Builder's biologist shall prepare a sampling plan as recommended by the USFWS,TWRA, and/or TDEC

Division of Natural Areas. The plan shall include (at a minimum) the techniques, equipment, analytical techniques or metrics (e.g., IBI, TMI), time frame, staff qualifications, and the appropriate collection permits identification numbers (if applicable).

- A sweep is generally associated with fish, mussels, or crayfish; and is typically conducted immediately prior to commencement of construction work in the water. The sweep is performed the same day as installation of the coffer dams or when the work is being done in the water. A plan describing the methods for conducting the sweep shall be required. All sweep methods and procedures must be coordinated with USFWS and TWRA prior to the sweep.
- A translocation plan, if applicable, shall be submitted to the USFWS (for Federal- listed plants) and the TDEC Division of Natural Areas (for State-listed plants) for approval. This shall include, at a minimum, a description of the translocation site including the ownership of the parcel, the technique for moving the plants, the proposed relocation site, the time frame for the move, long term protection strategies at the translocation site, and the qualifications of the staff involved.

The Design-Builder shall (in consultation with the Department) allow time in the CPM for the Department's Region 2 Environmental Tech Office to coordinate with TWRA, USFWS, and the TDEC Division of Natural Areas, if required.

Migratory Birds

The Design-Builder shall perform all construction work in observance of the Migratory Bird Treaty Act (MBTA) of 1918 (last amended in 1998) and the USFWS/TDOT Memorandum of Agreement outlining procedures for addressing cliff and barn swallow nesting sites found on Department projects. MBTA of 1918 (amended 1998) provides protections to all migratory birds, with the exception of pigeons and starlings.

Cliff swallows (Petrochelidon pyrrhonota) and barn swallows (Hirundo rustica) nests, eggs, or birds (young and adults) shall not be disturbed between April 15 and July 31. From August 1 to April 14, nests may be removed or destroyed, and measures may be implemented to prevent future nest building at the site (e.g., closing off area using netting).

Rare Plant Species

If impacts to the rare plant species listed on the Species Form of the EBR or their habitats are unavoidable, the plans must include measures to translocate the species to a suitable, high-quality mitigation site as noted above. Due to the uncommonly high concentration of rare plant species in the wetlands around the project, the Design-Builder must submit the plans to the Department's Region 2 Environmental Tech Office for coordination with TDEC's Division of Natural Areas for their Review and Approval prior to commencing work or translocation in these areas.

Other Natural Resources

The Design-Builder shall ensure identification, survey and monitoring of other natural resources such as sinkholes, caves or specialized habitats. The Design-Builder shall coordinate with the Department's Region 2 Environmental Tech Office for coordination with regulatory agencies (i.e. TDEC) when necessary and obtain any necessary permits for modifications to the natural resources (i.e. TDEC Underground Injection Control Permit, etc.).

GPS/GIS data collection

The Design-Builder's data collection for streams, wetlands, springs, sinkholes or other jurisdictional features shall be with mapping grade accuracy (defined as sub meter).

Mitigation of Streams and Wetlands

The Design-Builder shall be responsible for all stream and wetland mitigation required for the Project including all costs associated with obtaining mitigation, maintenance, and monitoring of the mitigation site. This may include (but is not limited to):

- Planning;
- Design;
- Permitting;
- Construction of on-site/off-site mitigation for stream and/or wetlands impacts;
- Post-construction monitoring and maintenance of the mitigation sites;
- Purchasing of wetland mitigation credits from an approved bank or site; and/or
- Purchasing of stream mitigation from an approved site/organization.

All stream & wetland mitigation shall follow the requirements outlined in the Stream Mitigation Guidelines for the State of Tennessee, prepared by the TDEC, Division of Water Resources Permits Section and federal mitigation requirements of the Department of the Army, Corps of Engineers 33 CFR Parts 325 and 332. All proposed stream and wetland mitigation shall be submitted to and coordinated with the Department's Region 2 Environmental Tech Office for coordination with regulatory agencies prior to the submittal of the permit application. It shall be the responsibility of the Design-Builder to make any and all adjustments deemed necessary by the regulatory agencies to the proposed mitigation plan.

The Design-Builder shall be responsible for all on-site/off-site mitigation requirements listed in the permits and all costs associated with mitigation requirements.

0 *PERMITTING*

The Department has not nor will the Department procure permits for the Design-Builder. The Design-Builder shall determine all of the permits required in order to perform the work.

The Design-Builder shall be solely responsible for and obtain any necessary building, demolition, grading, and environmental permits or approvals, including but not limited to archaeology, ecology, historical, hazardous materials, air and noise, TVA 26a, TDEC ARAP/401, USACE Section 404, and TDEC National Pollution Discharge Elimination System (NPDES) permits, from federal, state and/or local agencies regarding any material and staging areas and the operation of any project-dedicated asphalt and/or concrete plants, and any waste or borrow areas that will be used. Any such permits shall be supplied to the Department's Region 2 Environmental Tech Office prior to the commencement of activities in the permitted area(s).

The Design-Builder is responsible, under the laws and regulations listed above, to avoid and minimize, to the maximum extent practicable, impacts to Waters of the State and/or Waters of the U.S. when designing and constructing the project. Avoidance and minimization of impacts are beneficial to the Design-Builder because such actions avoid or reduce the amount of compensatory mitigation that may be required to obtain water quality permits prior to construction.

If environmental permits are necessary prior to completion of the Definitive Design Plans, the Design Builder shall contact the Department's Alternative Contracting Office immediately for guidance.

The Department's Region 2 Environmental Tech Office and Headquarters Environmental Division Permitting Section shall be included in all correspondence and/or negotiations with agencies.

The Design-Builder shall obtain and pay for all regulatory permits as required by applicable laws, the plans, or contract specifications. This includes stormwater discharges associated with construction support activities including, but not limited to: equipment staging yards, material storage areas, excess excavated materials disposal, demolition disposal (waste) areas, and borrow areas. These areas are to be addressed in accordance with the TDOT Waste and Borrow Manual (May 15, 2017 Version). The Design-Builder shall be cognizant of and adhere to the requirements of the various permits that will be necessary for construction and operation of the Project.

Applying for and Obtaining Permits

The Design-Builder shall be responsible for preparing all documents (permit application package) and attending all public meetings necessary to obtain the environmental permits required for the construction of this Project.

The Design-Builder shall acquire information and prepare permit drawings/sketches that reflect the impacts and minimization efforts resulting from the Design-Builder's design of this Project. If water quality permits are required, there shall be scheduled reviews of permittable plans, application, and permit conditions by the Department's Region 2 Environmental Tech Office and upon request, Headquarters Environmental Division Permitting Section to ensure regulatory practices are consistent.

The Design-Builder shall be responsible for developing the permit application for all jurisdictional water resource impacts. The Design-Builder shall be responsible for all public notice requirements such as documentation to be placed in the local paper and in the field and answering of public notice comments. The Design-Builder shall employ all personnel that it deems necessary in order to provide permit compliance.

The Design-Builder shall submit the permit application in its own name and ensure the permit is issued in its name. If under the applicable laws and regulations, the permit application cannot be submitted in the Design-Builder's name, the Design-Builder shall submit the permit application as an Authorized Agent of the Department and ensure the permits are issued with the Department as the Permittee. The Design-Builder shall attend a final review meeting with the Department to review all permit applications prior to submitting the application to the permitting agencies.

Environmental permits may also be required when activities such as core sampling, seismic exploratory operations, geotechnical investigations, ROW fence replacement, and historic resources surveys are within Waters of the State or Waters of the U.S. These permits may also be required for placement and operations of scientific measurement devices.

The Department's Region 2 Environmental Tech Office and Headquarters Environmental Division Permitting Section shall be invited to any meeting between the Design-Builder and the respective regulatory agency to discuss issues related to the application for (or refusal of) a permit. The Design-Builder shall inform the Department a minimum of ten (10) business days in advance of the time and location such a meeting is to take place.

The Design-Builder shall represent the Department in any proceedings relating to reservations, objections, appeals and/or applications for preliminary injunctions initiated by others against the permit application or by itself against the permit decision. In such proceedings, the Design-Builder shall do everything in its power to defend the submitted application.

If any regulatory agency rejects or denies the permit application, it is the Design-Builder's responsibility to make the necessary revisions to ensure the permit is approved. If revisions are required to obtain permits, there should be scheduled reviews of the revisions by the Department's Regional Environmental Tech Office and upon request, the Headquarters Environmental Division Permitting Section to ensure regulatory practices are consistent. The Design-Builder shall be responsible for preparing designs and proposing construction methods that are permittable. All permits required for a particular construction activity shall be acquired prior to commencing the particular construction activity. All costs and delays associated with incomplete permit packages, agency rejection, agency denials, agency processing time, or any permit violations shall be the responsibility of the Design-Builder, and will not be considered sufficient reason for time extension.

The Design-Builder shall provide the Department with a copy of the draft permit decision and a copy of the final permit immediately upon receipt.

The Design-Builder shall plan, implement, monitor and maintain all applicable
Erosion Prevention and Sediment Control (EPSC) measures and Best Management Practices (BMPs) in accordance with all TDOT standards during construction.

The Design-Builder shall bear all cost and risks associated with applying for, obtaining and complying with permits.

Permit Application Package Contents

The permit application package (applicable for USACE §404 and TDEC ARAPs) shall include, but not be limited to, the following information.:

- Signed application letter to the TDEC Division of Water Resources, Permits Section and USACE listing all water quality impacts.
- The signed application letter shall indicate the following:
    - Alternatives for each impact to environmental features;
    - Proposed methods utilized by the Design-Builder to minimize impacts to each environmental feature; and
    - Proposed mitigation for impacts to environmental features (if required).
- Labeled USGS color quadrangle map. The map shall have the following information shown:
    - Impact areas labeled by permit type;

  - Longitude and latitude (precision to four decimal places) listed for each impact;
  - Quadrangle name and number;
  - Project information (including PIN, State Project Number, project description, County name, nearest city);
  - Scale bar (quad map scale shall be set to 1:24,000); and
  - North arrow.

- Copy of signed CN1091 form (the originally-signed CN1091 form shall be submitted to TDEC).
- Signed DA/TVA form or DA form (if applicable). DA/TVA form must be filled out if an Individual Section 404 Permit is required.
- Individual Section 404 Permit applications require the names and addresses of property owners adjacent to all permit impacts listed on a separate permit sketch.
- Individual permit sketches.
- Hydrologic Determination Field Data Sheet (if applicable).
- Ecology Field Data Sheet (if applicable).
- Habitat Assessment Field Data Sheet (if applicable).
- Wetland Determination Data Form (if applicable).
- TRAM Decision Form (if applicable).
- Quad map showing impact area and listing all environmental features.
- Photographs of all environmental features.
- Marked-up plan sheets from the Environmental Boundaries Report.
- A copy of all coordination correspondence between the Department and the USFWS.
- TDEC Division of Natural Areas, endangered species database search.
- A copy of all coordination correspondence between the Department and the TWRA.
- Federal Emergency Management Agency (FEMA) flood map for the subject project with construction limits labeled.
- FEMA No-Rise Certification letter or Conditional Letter of Map Revision (CLOMR) (if applicable).
- A copy of approved NEPA document (Environment Assessment, Finding of No Significant Impact, Categorical Exclusion, etc.).
- A copy of the State Historic Preservation Office (SHPO) letter (Architectural & Archaeological).

- Mitigation plan/plans for all streams and wetlands (if applicable).
- Half-size copy of the bridge layout(s) (if applicable).
- Half-size set of plans showing all environmental features. The plans shall be highlighted according to the following guidelines:
    - New culvert construction (extensions included) shall be highlighted in orange on the proposed layout.
    - Existing culverts shall be highlighted in blue on the present layout (blue on the proposed layout if sections are remaining).
    - Stream inlet and outlet protection measures and channel transitions shall also be quantified, labeled on the plans, and recorded in the impact table.
    - Streams/springs shall be highlighted in blue on the present and proposed layout.
    - Wetlands shall be highlighted on present layout (green for permanent impacts and yellow for temporary impacts). Be sure to label plans accordingly.
    - Bank stabilization, outfall structures, and sinkholes should be highlighted in pink on proposed layout.

Any temporary construction measures, including de-watering, construction access, haul roads, EPSC measures, temporary crossings, stream diversions, etc. shall be addressed in the permit application. The Design-Builder shall clearly indicate the location of and impacts from haul roads on jurisdictional areas. The Design-Builder shall identify all proposed borrow and waste sites and provide all clearance documentation per the Waste and Borrow Manual (May 17, 2017 edition):

https://www.tn.gov/content/dam/tn/tdot/construction/old_web_page/WasteBorrowManual.pdf

These details shall be included in the permit application data. Further, the Design-Builder shall describe the methods of construction of all structures.

NPDES Permit Specific Requirements

A TDEC National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) for construction stormwater runoff is required for this Project. It shall be the responsibility of the Design-Builder to develop final EPSC sheets, a Storm Water Pollution Prevention Plan (SWPPP) and obtain the NPDES CGP for the Project.

The Design-Builder shall prepare a SWPPP, Documentation and Permits Binder and a Notice of Intent (NOI) using the Department's most current format to be approved by the Department prior to submittal of the NPDES CGP to TDEC. A copy of the SWPPP template used by the Department to develop SWPPPs and the Documentation and Permits Binder can be obtained from the Department's Environmental Division, Ecology and Permits Office.

https://www.tn.gov/tdot/environmental-home/environmental-ecology-and-permits-office/environmental-ecology-and-permits-environmental-permit.html

The SWPPP template and Manual shall be used as a guide in preparation of the SWPPP and the Design-Builder is responsible for complying with all requirements of the CGP.

The SWPPP shall include the EPSC plans for application of coverage under the CGP. The SWPPP and Notice of Intent (NOI) shall be submitted at least forty-five (45) business days prior to beginning construction activities. Once a Notice of Coverage (NOC) is received by the Design-Builder, the EPSC plans and SWPPP shall be kept current for all stages of construction. Any changes in scope subsequent to submitting the SWPPP for coverage under the CGP shall be submitted to both TDEC and the Department for their records.

As outlined in the NPDES CGP, the Department will perform the Environmental Quality Assurance Project Compliance Assessments (QA Inspections) on this Project, which will include any waste and borrow areas.

If at any time, the Design-Builder is not in compliance with any applicable permit regulations, all non-compliance items must be addressed by the Design-Builder within 24 hours of such identification. The Department has the authority to suspend work until such time as the deficiencies have been corrected. The Design-Builder shall not be granted any cost or time compensation for any work suspensions associated with non-compliance. Any monetary fees and/or fines associated with any violations shall be the sole responsibly of the Design-Builder. In the event that a Notice of Violation (NOV) is issues by a regulatory agency, the response to the NOV shall be written by the Design-Builder and approved by the Department's Region 2 Environmental Tech Office prior to submittal to the agency.

The Design-Builder shall prepare EPSC plans detailing BMPs to prevent erosion, control sedimentation, and prevent the discharge of any pollutants from leaving the Department's ROW/easements or entering jurisdictional features, or stormwater conveyances and be transported to receiving waters during the construction of the Project. The Design-Builder shall identify all outfall locations on the EPSC plans with an appropriate numbering or lettering system. The Design-Builder shall revise the SWPPP and the EPSC plans as necessary based on actual construction activities throughout the duration of the Project. All SWPPP and EPSC revisions shall be documented. The Design-Builder shall certify that the individual who prepared and reviewed the EPSC plans and SWPPP is currently certified according to the CGP. The Design-Builder shall also certify that the BMPs are designed so that if properly implemented, installed, and maintained, they will manage erosion and prevent sedimentation to waters of the state and on adjacent property owners, as well as comply with the terms of the TDEC NPDES Construction General Permit.

The Design-Builder shall follow all of the Department's Design Standards/Guidelines when developing the EPSC plans and SWPPP for the subject project.

Water Quality Permits Specific Requirements

The Design-builder assumes all responsibility as the Authorized Agent of the Department (Permittee) as indicated in the permit that relates to protection of the "Waters of the United States" and/or "Waters of the State of Tennessee" pursuant to the following:

- Sections 401 and 404 of the Federal Clean Water Act (33 U.S.C. §1344), and all implementing regulations, including without limitation, regulations of the U.S. Army Corps of Engineers governing permits for discharges of dredged or fill material into waters of the United States in 33 CFR Part 323;

- The Tennessee Water Quality Control Act (T.C.A. §69-3-101, et. seq.) and all implementing regulations, including without limitation the Rules of the Tennessee Department of

Environment and Conservation (TDEC) governing National Pollutant Discharge Elimination System (NPDES) permits in Chapter 1200-4-10, and Aquatic Resource Alteration Permits in Chapter 1200-4-7; Class V Injection Well Permits for work in or near sinkholes;

- Section 26a of the Tennessee Valley Authority (TVA) Act of 1933 as amended (49 Stat 1079, 16 U. S. C. sec. 831y1.) and all implementing regulations, including without limitation the regulations of the Tennessee Valley Authority governing construction in the Tennessee River System in 18 C.F.R., Part 1304.

Permit Register

The Design-Builder shall administer a permit register and provide an updated permit register in every progress report. The permit register shall include an overview of all permits required of the Project.

The permit register requires each permit to be indicated as follows:

- Name and address of the granting authority;
- Purpose of the permit;
- Reference to the document in which the permit conditions are defined;
- Status of permit;
- Date by which the authorization of the specific permit is anticipated;
- Permit conditions relevant for the Work;
- Date by which the permit is required (milestone);
- How the Design-Builder ensures that he shall comply with the permit requirements and conditions; and
- Validity and the expiry date (if any) of the permit.

0 *NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) DOCUMENT*

The Design-Builder shall review, and adhere to all approved NEPA documents and technical reports; specifically any environmental commitments listed on the "Green Sheet" of the approved NEPA documents. These commitments are to be taken into account throughout the design and construction process. All commitments listed with respect to their technical area are to be fulfilled during construction activities and/or prior to completion of the Project.

The NEPA document, including the “Green Sheet” environmental commitments are provided on the Project website.

Should any environmental features within the NEPA study area, not addressed in the NEPA document be uncovered during construction activities, all construction activities shall stop immediately in that area and the Design-Builder shall contact the TDOT Environmental Analysis Office for consultation. All technical study activities must be completed in accordance with Department practices; the Design-Builder shall be responsible for obtaining any necessary Documentation Standards from the TDOT Environmental Analysis Office.

In accordance with the NEPA, a re-evaluation(s) of the approved document may be required to address any additional ROW and/or easements not studied under the original footprint of the proposed project or changes to the Project design that were not covered under the approved NEPA document. The re-evaluation(s) may take place at any time during the development of the Project. Depending on the magnitude of the design changes required, the re-evaluation may require review and approval by FHWA; however, any minor changes may be documented, reviewed and concurred with by the Department's Environmental Division.

Should any changes to the design of the project occur, the Design-Builder shall provide the Environmental Division with a notification and copy of the revised plans. The Design-Builder shall be responsible for any technical studies and the NEPA document re-evaluation required.

0 *DISPOSAL OF MATERIALS*

Design-Builder shall not dispose of any material within interchange areas located within the Project limits. This includes the I-75/ Ringgold Road interchange and the Welcome Center. All disposal activities shall be in accordance with the TDOT Waste and Borrow Manual (May 15, 2017 edition) located at:

https://www.tn.gov/content/dam/tn/tdot/construction/old_web_page/WasteBorrowManual.pdf

Borrow and waste disposal areas shall be located in non-wetland areas and above the 100-year, Federal Emergency Management Agency floodplain. Borrow and waste disposal areas shall not affect any Waters of the State/U.S. unless these areas are specifically covered by an ARAP, §404, and/or NPDES permit, obtained solely by the Design-Builder.

0 *DEPARTMENT INSPECTIONS*

The Department will review and monitor the Project (Quality Assurance Inspections), including all waste and borrow areas, to ensure compliance with all applicable environmental regulations and stormwater management activities throughout the duration of the Project.

If at any time, the Design-Builder is not in compliance with any applicable permit regulations, all non-compliance items must be addressed by the Design-Builder within 24 hours of such identification. The Department has the authority to suspend work until such time as the deficiencies have been corrected.

The Design-Builder shall not be granted any cost or time compensation for any work suspensions associated with non- compliance. Any monetary fees and/or fines associated with any violations, assessed by regulatory agencies, shall be the responsibility of the Design-Builder.

0 *EROSION PREVENTION AND SEDIMENT CONTROL (EPSC)*

All EPSC designs and implementation shall be the responsibility of the Design-Builder.

Sod shall be used for permanent stabilization and be placed at locations to prevent damage to adjacent facilities and property due to erosion on all newly graded cut and fill slopes as work progresses.

- Pre-construction vegetative ground cover shall not be destroyed, removed or disturbed (i.e. clearing and grubbing initiated) more than 14 calendar days prior to grading or earth moving activities unless the area is mulched, seeded with mulch or other temporary cover is applied.

- Clearing, grubbing, and other disturbances to riparian vegetation shall be limited to the minimum necessary for slope construction and equipment operations. Existing vegetation, including stream and wetland buffers (unless permitted), should be preserved to the maximum extent possible. Unnecessary vegetation removal is prohibited.

Temporary stabilization shall be initiated within 14 calendar days when construction activities on a portion of the site are temporarily ceased and earth disturbing activities shall not resume until after 14 calendar days. Permanent stabilization measures in disturbed areas shall be initiated within 14 calendar days after final grading of any phase of construction.

Steep slopes shall be temporarily stabilized not later than 7 calendar days after construction activity on the slope has temporarily or permanently ceased. Steep slopes are defined as natural or created slopes of 35% grade or greater, regardless of height.

Permanent stabilization shall replace temporary measures as soon as practicable. Priority shall be given to finishing operations and permanent EPSC measures over temporary EPSC measures.

Inspection, repair, and maintenance of EPSC structures shall be performed on a regular basis and sediment shall be removed from sediment control structures when the design capacity has been reduced by fifty percent (50%). During sediment removal, the Design-Builder shall take care to ensure that structural components of EPSC structures are not damaged and thus made ineffective. If damage does occur, the Design-Builder shall repair the structures at their own expense.

EPSC controls shall be inspected according to permit requirements to verify measures have been installed and maintained in accordance with TDOT standard drawings, specifications, and good engineering practices. EPSC inspections shall be documented on the TDOT EPSC inspection report and a copy of each inspection report shall be provided to the Department.

Sediment removed from sediment control structures shall be placed and be treated in a manner so that the sediment is contained within the Project limits and does not migrate onto adjacent properties and into Waters of the State/United States.

The Design-Builder shall establish and maintain a comprehensive and proactive method to inspect and prevent the off-site migration or deposit of sediment off the Project limits (e.g. R.O.W., easements, etc.), into Waters of the State/United States, or onto roadways used by the general public. If sediment escapes the construction site, off-site accumulations of sediment that have not reached a stream must be removed at a frequency sufficient to minimize off-site impacts (e.g., fugitive sediment that has escaped the construction site and has collected in a street must be removed so that it is not subsequently washed into storm sewers and streams by the next rain and/or so that it does not pose a safety hazard to users of public streets). Arrangements concerning removal of sediment on adjoining property must be settled with the adjoining property owner before removal of sediment.

Upon conclusion of the inspections, EPSC measures found to be ineffective shall be repaired, replaced, or modified before the next rain event, if possible, but in no case more than 24 hours after the inspection or when the condition is identified. If the repair, replacement or modification is not practical within the 24-hour timeframe, written documentation must be provided in the field diary and EPSC inspection report. An estimated repair, replacement or modification schedule shall be

documented within 24-hours of identification. All costs associated with modifications made to these measures shall be the responsibility of the Design-Builder and all modifications shall be concurred with by the Department.

Temporary EPSC measures may be removed at the beginning of the workday, but must be replaced at the end of the workday or before/during a precipitation event.

Delaying planting of cover vegetation until winter months or dry months should be avoided.

Offsite vehicle tracking of sediments and the generation of dust shall be minimized. A stabilized construction access (a point of entrance/exit to the construction project) shall be provided to reduce the tracking of mud and dirt onto public roads by construction vehicles.

The Design-Builder shall have a plan in place for dust control. The dust control plan shall be developed prior to the start of any construction activities and shall be submitted to the Department for approval.

The EPSC plan shall be updated by the Design-Builder whenever EPSC inspections indicate, or where State or Federal officials determine EPSC measures are proving ineffective in eliminating or significantly minimizing pollutant sources or are otherwise not achieving the general objectives of controlling pollutants in storm water discharges associated with the construction activity.

The accepted EPSC plan shall require that EPSC measures be in place before clearing, grubbing, excavation, grading, culvert or bridge construction, cutting, filling or any other earthwork occurs, except as such work may be necessary to install EPSC measures.

EPSC measures shall be installed and functional prior to any earth moving operations, and shall be maintained throughout the construction period except as such work may be necessary to install EPSC measures.

The Design-Builder shall establish and maintain a proactive method to prevent litter and construction wastes from entering Waters of the State/United States. These materials shall be removed from stormwater exposure prior to anticipated storm events or before being carried offsite by wind, or otherwise prevented from becoming a pollutant source for stormwater discharges. After use, materials used for EPSC shall be removed from the site by the Design-Builder.

10. CONSTRUCTION

The Design-Builder shall meet the requirements of the Department's Standard Specifications for Road and Bridge Construction (Current Edition), contractual Special Provisions, the Manual on Uniform Traffic Control Devices (MUTCD), and the Tennessee Occupational Safety and Health Administration (TOSHA).

The Design-Builder shall ensure that all applicable "General and Special Notes" found in Section VI of the current edition of the State of Tennessee Department of Transportation Design Division Roadway Design Guidelines are adhered to during construction.

Reference Special Provision 108B Project Completion Time and Liquidated Damages as included in Contract Book 2 (Design- Build Contract).

0 *CONSTRUCTION SERVICES*

The Design-Builder shall supervise and administer all construction activities in accordance with Contract requirements.

The Design-Builder shall perform all other construction work required to complete the Project in conformance with all Contract requirements, including Legal Requirements.

The Design-Builder shall comply with all applicable laws.

The Design-Builder shall keep the work location and its vicinity free from accumulation of waste materials and rubbish caused by the Design-Builder's operations.

Any area that is disturbed outside limits of construction during the life of this Project shall be repaired by the Design-Builder at their expense. All repaired areas shall be inspected and be deemed satisfactory by the Department.

The Design-Builder shall coordinate his work with that of other contractors working on or near the Project. The Design-Builder shall consider the schedule of other contractors when developing his schedule to maintain continuity of work and compliance with the Project schedule.

0 *MAINTENANCE DURING CONSTRUCTION*

The Design-Builder shall prepare a maintenance plan for Department Review and Acceptance that meets the requirements herein.

The Design-Builder is responsible for the maintenance of the Project in accordance with the approved maintenance plan until Project completion and acceptance by the Department.

General Requirements

The Design-Builder shall maintain the Project from the date of the Design-Builder's executed contract with the Department until Project completion and acceptance by the Department, in a manner that provides a safe and reliable transportation system.

The Design-Builder shall be fully responsible for maintenance as required by the Department's Standard Specification for Road and Bridge Construction, section 104.05 Maintenance During Construction. The Design-Builder shall be responsible for all components of the transportation system within construction limits to include, but not limited to, asphalt roadway, concrete roadway, signing, ITS, and guardrail until final acceptance of the Project by the Department.

ROW Mowing & Litter Removal

The Design-Builder shall deliver a ROW Mowing & Litter Removal service to provide a consistent vegetation height and a clean non-littered appearance from the date of the Design-Builder's executed contract with the Department until Project completion and acceptance by the Department..

See Special Provision 806 regarding Contract Mowing, Special Provision 719A regarding Removal and Disposal of Litter, and Special Provision 107AQ regarding Air Quality for Mowing for further details.

It shall be the Design-Builder's responsibility to mow and pick up litter on the full ROW from fence to fence including the median and on top of all bluffs and elevated sections of each Mowing and Litter Cycle.

Annually, there will be a minimum of four (4) Mowing & six (6) Litter Cycles. The Department shall direct the Design-Builder with the exact dates for the annual Mowing & Litter Cycle.

Acceptance of the Project

Upon Acceptance of the Project, the Department will assume responsibility for the operation and maintenance of the entire Project. Nothing contained herein shall otherwise limit any warranty obligations of the Design-Builder with respect to any Defect or non-conforming Work.

0 *MAINTENANCE OF TRAFFIC*

The interchange construction and closures shall be phased in accordance with Special Provision 108B. Access to all side roads shall be maintained during construction.

Definitions

- Road Closure: Complete removal of traffic from a section of roadway using a signed detour route.
- Lane Closure: Reduction in the current number of lanes provided to traffic
- Rolling Road Block: Temporarily delaying traffic for a limited amount of time without stopping traffic or providing a detour.

General Requirements

The objective is to ensure a strategic plan for traffic management on the Project, to minimize lane/road closure, and cause the least interference with traffic.

The Design-Builder shall:

- Develop a Transportation Management Plan including a Traffic Control System that addresses major aspects of the work for individual construction areas, phases and stages including temporary traffic control, transportation and information strategies. The Transportation Management Plan shall be in accordance with TDOT Standard Specifications for Road and Bridge Construction, TDOT Standard Drawings, TDOT Standard Traffic Operations Drawings, TDOT Traffic Design Manual, TDOT Design Guidelines, TDOT Work Zone Safety and Mobility Manual, ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features (Current Edition), and the latest edition of the Manual of Uniform Traffic Control Devices.

- Use Traffic Control materials from the Department's Qualified Products List (QPL) (https://www.tn.gov/tdot/materials-and-tests/research---product-evaluation-and-qualified-products-list.html)

- The Design-Builder shall insure drainage spread across all traffic lanes does not exceed allowable spread. Design-Builder shall provide drainage/spread calculations for all phases of traffic control phasing.

The Transportation Management Plan shall describe in detail all accommodations for traffic access and flow during all stages of construction for the life of the Project. The plan shall include the following:

- Detailed proposed sequencing plan that includes each step of the project including all major traffic shifts or changes, minor shifts or changes, closures, alternate traffic patterns.

- Overall goals of the sequencing plan and how the plan aligns with the Project Critical Path.

- Plans for providing Queue Protection during operations requiring temporary lane closures, temporary road closures, rolling roadblocks, traffic pacing, and setting up or removing long-term lane shifts.

- Conceptual construction staging diagrams (scale: 1 inch = 200 feet) including lane configuration and traffic management of the Interstate, State Routes, and local streets during the different stages of construction. Staging areas within the project limits shall be approved by the Department.

- Narrative description of how Design-Builder will schedule and sequence the construction to minimize impacts on the environment, communities and traveling public while still providing acceptable construction performance.

- Brief description of the laydown, recycling, staging, disposal areas, waste and borrow pits, and maintenance locations to be used during construction.

- Description of how the ROW and adjacent roads and properties will be maintained and protected, including the intended measures to be used to mitigate and minimize noise, vibration, light, dust, erosion/run-off and local road damage.

Temporary Lane/Road Closure

The Design-Builder shall maintain the existing numbers of lanes on I-24, I-75, and all interstate-to-interstate ramps throughout construction except for Department-approved night or weekend lane or roadway closures except as noted below. Minimum lane widths shall be eleven (11) feet. Minimum inside and outside shoulder widths shall be two (2) feet.

Road closures will only be allowed on Interstate 75-to-Interstate 24 ramps, Interstate 24-to-Interstate 75 ramps, and the Spring Creek Road over I-24 bridges. Road closures will only be allowed from Friday at 9:00 PM until Monday at 5:00 AM. The Design-Builder shall utilize local uniformed police officers when detouring Interstate Traffic at intersections to assist in flagging.

Rolling road blocks for operations specified in the SP108B other than blasting will only be allowed from 9:00 PM until 6:00 AM with a maximum duration of thirty (30) minutes.

All temporary lane closures and road closures must be approved by the Department in advance. For lane closures on I-24, I-75 and ramps, request for approval must be sent to the Department seven (7) calendar days in advance of the proposed lane closure. Requests for road closures of I-75 ramps and I-24 ramps must be sent to the Department twenty-one (21) calendar days in advance of the proposed closure. Road closures of I-75 ramps and I-24 ramps will be allowed on weekends only.

For local street closures, requests for approval must be sent to the Department, the City of Chattanooga, City of East Ridge, and others as described below. Requests for road closures must also include proposed detour routes and detour signing details. Local streets (non-State Routes) will not be allowed as detour routes for I-24 and I-75 traffic.

No less than seven (7) days prior to the closure of the road, the Design-Builder shall notify the following individuals or agencies completely describing the affected roads and the approximate duration of the construction: these parties include, but are not limited to: i) local law enforcement office, ii) local fire department, iii) ambulance service, iv) U.S. Postal Service, v) local road superintendent, vi) railroad company (if applicable), vi) the City of Chattanooga and Hamilton County's Parks and Recreation Department (if applicable), vii) Hamilton County Public Works, viii) Chattanooga Airport, ix) Parkridge East Hospital, x) local school superintendent, xi) TDOT's Region 2 Traffic Management Center (TMC), and xii) Georgia Department of Transportation's Traffic Management Center.

There will be periods when the Design-Builder will not be allowed to have any type of closures due to holidays as specified in subsection 104.04 of the Standard Specification and during major events. Major events and known periods when lanes cannot be closed include, but are not limited to: Riverbend, 2018 SEC Championship, and Chattanooga marathons/triathlons that use SR29 and/or SR153. The Department may deny any request for lane closures.

The Design-Builder shall notify the Department and the local governmental agency responsible for traffic control maintenance at least seven (7) days in advance of any cold planing activity at signalized intersections where detector loops are on the pavement. The maintaining agency will then be responsible for disconnecting the loop detectors and making any necessary timing adjustments in the signal controller prior to the construction.

Temporary Marking, Detours, Lane Shifts and Median Cross-overs

Temporary marking shall adhere to guidance outlined in Section IV of current edition of the Department's Design Division Roadway Design Guidelines for pavement markings except as noted below. The minimum temporary pavement marking width shall be 8-inches. Temporary pavement markings to be utilized for less than seven (7) working days may be painted. Temporary pavement markings to be utilized for seven (7) working days or more shall be spray thermoplastic or tape.

Temporary pavement line markings on intermediate layers of pavement shall be reflective tape or reflectorized paint installed to permanent standards at the end of each day's work. Short, unmarked sections will not be allowed.

The temporary pavement marking on detours, lane shifts and median cross-overs shall be installed and maintained to the same standards as for permanent markings on the main roadway. These markings shall be in place prior to allowing traffic onto the pavement.

Before opening detours, lane shifts and/or median cross-overs to traffic, the transitional markings on the existing roadway must be in place. All existing markings in the area of these transitional markings shall be obliterated and all existing raised pavement markers shall be removed to eliminate conflicting markings.

All temporary lane shifts and detours shall be paved, striped, signed and the vertical panels are to be in place before it is opened to traffic.

Existing median cross-overs designated "Official Use Only" shall be maintained unless approved otherwise by the Department.

Contrast striping shall be used for temporary striping on concrete pavement/structures located on ramps and along I-75.

All pavement marking removal on final surfaces shall be accomplished by water blasting or another non-marring method. Any damage to the pavement surface caused by the selected method shall be removed and replaced at the contractor's expense.

Temporary Signage

All temporary signage shall be in accordance with TDOT Standard Specifications for Road and Bridge Construction, TDOT Standard Drawings, TDOT Standard Traffic Operations Drawings, TDOT Traffic Design Manual, TDOT Design Guidelines, TDOT Work Zone Safety and Mobility Manual, and the latest edition of the Manual of Uniform Traffic Control Devices.

Changeable Message Signs

Changeable Message Signs shall be used in advance of changed roadway conditions such as lane closures, road closures, lane shifts, or detour routes. The locations of these Changeable Message signs shall be reviewed by the Department prior to implementation. Portable changeable message signs should be used as a supplement to and not as a substitute for conventional signs and pavement markings. Portable changeable message sign trailers should be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.

Emergency Signage

All existing "emergency reference markers" and "hospital signs" shall be maintained within full view of the motoring public throughout all phases of construction.

Tourist Oriented Directional Signs (TODS)

All existing "Tourist Oriented Directional Signs" shall be maintained within full view of the monitoring public throughout all phases of construction.

Detour and construction signage

All detour and construction signing shall be in strict accordance with the current edition of the MUTCD.

Construction Work Zone

Traffic control devices shall not be displayed or erected unless related conditions are present necessitating warning.

Pavement Edge Drop-off Traffic Control

Differences in elevation between adjacent traffic lanes or between the traffic lane and shoulder where the traffic lane is being used by traffic, that is caused by base, paving or resurfacing, shall be handled as follows:

- Differences in elevation between adjacent roadway elements greater than 0.75 inch and not exceeding 1.5 inches:
    - Warning signs, uneven lanes (W8-ll) and/or shoulder drop-off with plaque (W8- 17 and W8-17P), shall be placed in advance of and throughout the exposed area. Maximum spacing between signs shall be 2,000 feet with a minimum of two (2) signs per exposed area. Where uneven pavement is encountered, signs shall be placed on each side of the roadway.
    - Differences in elevation between adjacent traffic lanes being utilized by traffic caused by added pavement shall be eliminated within three workdays.
    - Differences in elevation between adjacent traffic lanes being utilized by traffic caused by cold planing shall be eliminated within three workdays.
    - When the difference in elevation is between the traffic lane being utilized by traffic and shoulder the difference in elevation shall be eliminated within seven workdays after the condition is created.

- Differences in elevation between adjacent roadway elements greater than 2 inches and not exceeding 6 inches: (Traffic is not to be allowed to traverse this difference in elevation):
    - Separation shall be accomplished by drums, barricades or other approved devices in accordance with the following:
        - Where posted speeds are 50 mph or greater, spacing of the protective devices shall not exceed 100 feet.
        - Where posted speeds are less than 50 mph, the maximum spacing of the protective devices in feet shall not exceed twice the posted speed in miles per hour.
    - If the difference in elevation is eliminated or decreased to 2 inches or less by the end of each workday, cones may be used during daylight hours in lieu of drums, barricades or other approved protective devices mentioned in the first list item, provided warning signs are erected. Warning signs (uneven lanes and/or shoulder drop-off) shall be placed in advance of and throughout the exposed area. Maximum spacing between signs shall be 2,000 feet with a minimum of two (2) signs per exposed area. Where uneven pavement is encountered, signs shall be placed on each side of the roadway.
    - When the difference in elevation is between the through traffic lane and the shoulder and the elevation difference is less than 3.5 inches, the Design-Builder may use warning signs and/or protective devices as applicable and concurred with by the Department. See first list item regarding use of drums, barricades or other approved protective devices. Warning signs (uneven lanes and/or shoulder drop-off) shall be placed in advance of and throughout the exposed area. Maximum spacing between signs shall be 2,000 feet with a minimum of two (2) signs per exposed area. Where uneven pavement is encountered, signs shall be placed on each side of the roadway.

      In these situations, the Design-Builder shall limit his operations to one work zone not exceeding 2 miles in length unless otherwise noted on the plans or concurred with by the Department. Once the Design-Builder begins work in a work zone, a continuous operation shall be maintained until the difference in elevation is eliminated. Simultaneous work on separate roadways of divided highways will be considered independently in regard to restriction of work zone activity.
- Differences in elevation between adjacent roadway elements greater than 6 inches but not exceeding 18 inches;
    - The Design-Builder shall accomplish separation by drums, barricades or other approved devices in accordance with the following:
        - Where posted speeds are 50 mph or greater, spacing of the protective devices shall not exceed 100 feet.
        - Where posted speeds are less than 50 mph, the maximum spacing of the protective devices in feet shall not exceed twice the posted speed in miles per hour.

      In order to use this method, the Design-Builder must reduce the difference in elevation to 6 inches or less by the end of the workday that the condition is created.

- The Design-Builder shall provide drums, barricades or other approved separation devices as specified in the first list item, and construct a stone wedge with a 4:1 slope, or flatter, to eliminate the vertical offset if the lower elevation is at or below subgrade at the end of each day.
- The Design-Builder shall provide drums, barricades or other approved separation devices as specified in the first list item and if the lower elevation is base stone or asphalt pavement, placement of subsequent layers of pavement must begin the next work day and progress continuously until the difference in elevation is eliminated or reduced to six inches or less.
- The Design-Builder shall provide separation by portable barrier rail.

  For the preceding three list items, the Design-Builder shall use the shoulder drop- off warning sign with plaque (W8-17 and W8-17p). It shall be placed in advance of and throughout the exposed area. Maximum spacing between the signs shall be 2,000 feet with a minimum of two (2) signs per exposed area. In these situations, the Design-Builder shall limit his operations to one work zone not exceeding 1 mile in length unless otherwise noted on the plans or concurred with by the Department. Once the Design-Builder begins work in a work zone, a continuous operation shall be maintained until the difference is eliminated. Simultaneous work on separate roadways of divided highways will be considered independently in regard to restriction of work zone activity.

  - Differences in elevation between adjacent roadway elements greater than 18 inches, separation shall be provided by use of portable barrier rail.

  In this situation the Design-Builder shall limit his operations to one work zone not exceeding 1 mile in length unless otherwise noted on the plans or concurred with by the Department. Once the Design-Builder begins work in a work zone, a continuous operation shall be maintained until the difference in elevation is eliminated. Simultaneous work on separate roadways of divided highways will be considered independently in regard to restriction of work zone activity.

Difference in elevation is within 30 feet of the nearest traffic lane being used by traffic caused by grading, excavation for utilities, drainage structures, undercutting, etc., differing situations shall be handled as follows:

- Difference in elevation is within 8 feet of the nearest traffic lane with difference in elevation greater than 3/4 inch and not exceeding 2 inches:
- Warning signs (uneven lanes and/or shoulder drop-off) shall be placed in advance of and throughout the exposed area. Maximum spacing between signs shall be 2,000 feet with a minimum of two (2) signs per exposed area. Where uneven pavement is encountered, signs shall be placed on each side of the roadway.

- Difference in elevation is within 8 feet of the nearest traffic lane with difference in elevation greater than 2 inches and not exceeding 6 inches:
    - Separation shall be accomplished by drums, barricades or other approved devices in accordance with the following:
        - Where posted speeds are 50 mph or greater, spacing of the protective devices shall not exceed 100 feet.
        - Where posted speeds are less than 50 mph, the maximum spacing of the protective devices in feet shall not exceed twice the posted speed in miles per hour.
- Difference in elevation is within 8 feet of the nearest traffic lane with difference in elevation greater than 6 inches:
    - Separation shall be accomplished by drums, barricades or other approved devices in accordance with the following:
        - Where posted speeds are 50 mph or greater, spacing of the protective devices shall not exceed 100 feet.
        - Where posted speeds are less than 50 mph, the maximum spacing of the protective devices in feet shall not exceed twice the posted speed in miles per hour.
    - Eliminate vertical offset by constructing a stone wedge or grading to a 4:1 slope, or flatter, or use portable barrier rail.

      The Design-Builder shall schedule the work so as to minimize the time traffic is exposed to an elevation difference. Once the Design-Builder begins an activity that creates an elevation difference within 8 feet of a traffic lane, the activity shall be pursued as a continuous operation until the elevation difference is eliminated.
- Difference in elevation is farther than 8 feet from the nearest traffic lane but not more than 30 feet from the nearest traffic lane:
    - Separation shall be accomplished by drums, barricades or other approved devices in accordance with the following:
        - Where posted speeds are 50 mph or greater, spacing of the protective devices shall not exceed 100 feet.
        - Where posted speeds are less than 50 mph, the maximum spacing of the protective devices in feet shall not exceed twice the posted speed in miles per hour.
    - Eliminate vertical offset by constructing a stone wedge or grading to a 4:1 slope, or flatter, or use portable barrier rail.

  The Design-Builder shall schedule the work so as to minimize the time traffic is exposed to an elevation difference. Once the Design-Builder begins an activity that creates an elevation difference, the activity shall be pursued as a continuous operation until the elevation difference is eliminated.

11. MISCELLANEOUS

0 *WELCOME CENTER*

The Design-Builder shall be expected to minimize disruptions to the normal operations of the Welcome Center located on I-75 north of the Ringgold Road interchange.

- Access and utility service shall be maintained to the Welcome Center at all times except for approved closures by the Department and the Department of Tourism. No closures will be allowed during designated federal or state holidays, special events, or periods designated by the Department suspending road closures.
- The Design-Builder shall submit a plan to the Department a minimum of 90 days prior to closing the Welcome Center to complete ramp connections. The plan shall include the dates the Welcome Center will be closed and reopened, the work that will be performed during the closure, confirmation that all items and personnel are available to complete the work, and a plan for reopening the Welcome Center in the event the work is not completed by the scheduled reopening date. Maximum time of closure shall not exceed 30 consecutive calendar days. The Design-Builder shall not close the Welcome Center between Memorial Day and Labor Day. The plan shall be approved by both the Department and the Department of Tourism.
- Design-Builder shall obtain approval from the Department and the Department of Tourism a minimum or 30 days in advance for any temporary closures or disruption of services at the Welcome Center due to construction activities or utility relocations. Closures shall not exceed 3 days and must be scheduled for Tuesday, Wednesday, and/or Thursday.
- The Design-Builder shall not use the Welcome Center site as a storage or staging area.
- The work area for construction of all ramps and structures at the Welcome Center shall be limited to 30 feet beyond the toe of slope or edge of proposed structure.
- The Design-Builder shall erect a fence or other approved barrier at the edge of the construction area in front of the Welcome Center so that the construction site is not accessible to Welcome Center patrons.
- The Design-Builder shall not use the Welcome Center to park equipment or for parking by employees or subcontractors.
- Tree removal on the Welcome Center site shall be limited to the area required for construction of the proposed ramps and structures and shall not to exceed 10 feet beyond the toe of slope or 36 feet from the edge of the proposed shoulder and excludes areas required to achieve site distance.

0 *CHATTANOOGA AIRPORT – HEIGHT RESTRICTIONS*

The Project is in the immediate proximity of the Chattanooga Airport and in-line with the runway glide slope. Height restrictions may apply to proposed structures including but not limited to bridges, lighting (including poles), ITS devices, utilities, and overhead signing. Height restrictions may also apply to construction equipment including but not limited to cranes.

The Design-Builder shall be responsible for filing notice with the FAA for all construction activities, proposed structures, or alterations that may affect navigable airspace. The Design-

Builder shall file a Notice of Proposed Construction or Alteration (FAA Form 7460-1) and provide copies to the Department of all filings. Guidance can be found on the FAA website.

APPENDIX A - PAVEMENT DESIGN

Required Structural Number = 6.26

DATE: 06/07/18 **FULL DEPTH DESIGN FOR I-75** ROUTE: I-75/I-24

COUNTY: HAMILTON PROJ NO: 33005-0176-44 FED PROJ IM/NH-75-1(131)

DESCRIPTION: I-75 INTERCHANGE MODIFICATION @ I-24

PAVEMENT DESIGN SECTION A

ROADWAY & INSIDE SHOULDER DESIGN

	DESCRIPTION	THICKNESS
411-03.10	ACS (PG76-22) GR "D"	1.25
307-03.08	AC MIX(PG76-22) GR "B-M2"	2.00
307-03.01	AC MIX(PG76-22) GR "A"	7.00
307-01.22	PERF AC (PG76-22)GR"A-S"	3.25
303-01	MINERAL AGG BASE GRADING "D"	12.00
	TOTALS	25.50

OUTSIDE SHOULDER DESIGN

	DESCRIPTION	THICKNESS
411-01.07	ACS (PG64-22) GR "E"	1.25
307-01.08	AC MIX (PG64-22)GR "B-M2"	2.00
303-01	MINERAL AGG BASE GRA "D"	22.25
	TOTALS	25.50

REMARKS: 1) 7" OF PERF."A-MIX" TO BE APPLIED AT TWO EQUAL LIFTS
2)SUBSURFACE DRAINAGE - AGGREGATE UNDERDRAIN W/PIPE
3) MILL 1.25 FROM THE EXISTING PAVEMENT AND OVERLAY WITH 1.25' OF "D" MIX AND 2.0" OF "B-M2" MIX WHERE NEEDED.

DATE: 06/07/18 **CONCRETE DESIGN FOR I-75** ROUTE: I-75/I-24

COUNTY: HAMILTON PROJ NO: 33005-0176-44 FED PROJ IM/NH-75-1(131)

DESCRIPTION: I-75 INTERCHANGE MODIFICATION @ I-24

PAVEMENT DESIGN SECTION B

ROADWAY DESIGN

	DESCRIPTION	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)	13.00
313-03	TREATED PERMEABLE BASE	4.00
303-01	MINERAL AGG BASE GRADING "D"	6.00
	TOTALS	23.00

SHOULDER DESIGN

	DESCRIPTION	COEFFICIENT	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)		13.00
313-03	TREATED PERMEABLE BASE		4.00
303-01	MINERAL AGG BASE GRADING "D"		6.00

REMARKS: 1) SUBSURFACE DRAINAGE - AGGREGATE UNDERDRAIN W/PIPE

DATE: 06/07/18 **RAMPS** ROUTE: I-75 /I-24

COUNTY: HAMILTON PROJ NO: 33005-0176-44 FED PROJ IM/NH-75-1(131)

DESCRIPTION: I-75 INTERCHANGE MODIFICATION @ I-24

PAVEMENT DESIGN SECTION C (Ramps D,F,G, and H)

ROADWAY DESIGN

	DESCRIPTION	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)	10.00
313-03	TREATED PERMEABLE BASE	4.00
303-01	MINERAL AGG BASE GRADING "D"	6.00
	TOTALS	20.00

SHOULDER DESIGN

	DESCRIPTION	COEFFICIENT	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)		10.00
313-03	TREATED PERMEABLE BASE		4.00
303-01	MINERAL AGG BASE GRADING "D"		6.00
	TOTALS		20.00

REMARKS: 1) SUBSURFACE DRAINAGE - AGGREGATE UNDERDRAIN W/ PIPE

DATE: 06/07/18 CONCRETE DESIGN FOR I-24 ROUTE: I-24 /I-75

COUNTY: HAMILTON PROJ NO: 33005-0176-44 FED PROJ IM/NH-75-1(131)

DESCRIPTION: I-24/I-75 INTERCHANGE MODIFICATION

ROADWAY DESIGN

	DESCRIPTION	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)	13.00
313-03	TREATED PERMEABLE BASE	4.00
303-01	MINERAL AGG BASE GRADING "D"	6.00
	TOTALS	23.00

SHOULDER DESIGN

	DESCRIPTION	COEFFICIENT	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)		13.00
313-03	TREATED PERMEABLE BASE		4.00
303-01	MINERAL AGG BASE GRADING "D"		6.00

REMARKS: 1) SUBSURFACE DRAINAGE - AGGREGATE UNDERDRAIN W/PIPE

DATE: 06/07/18 RAMPS ROUTE: I-24 /I-75

COUNTY: HAMILTON PROJ NO: 33005-0176-44 FED PROJ IM/NH-75-1(131)

DESCRIPTION: I-24/I-75 INTERCHANGE MODIFICATION

ROADWAY DESIGN

	DESCRIPTION	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)	10.00
313-03	TREATED PERMEABLE BASE	4.00
303-01	MINERAL AGG BASE GRADING "D"	6.00
	TOTALS	20.00

SHOULDER DESIGN

	DESCRIPTION	COEFFICIENT	THICKNESS
501-01	PORTLAND CEM CONC (PLAIN)		10.00
313-03	TREATED PERMEABLE BASE		4.00
303-01	MINERAL AGG BASE GRADING "D"		6.00
	TOTALS		20.00

REMARKS: 1) SUBSURFACE DRAINAGE - AGGREGATE UNDERDRAIN W/ PIPE

DATE: 09/27/18 FULL-DEPTH DESIGN FOR SPRING CREEK RD. ROUTE: I-75 / I-24

COUNTY: HAMILTON PROJ NO: 33005-0176-44 FED PROJ: IM/NH-75-1(131)

DESCRIPTION: I-75 INTERCHANGE MODIFICATION @ I-24

ROADWAY DESIGN

	DESCRIPTION	THICKNESS
411-02.10	ACS {PG70-22) GR "D"	1.25
307-02.08	AC MIX (PG70-22) GR "B-M2"	2.00
307-02.01	AC MIX (PG70-22) GR "A"	3.25
303-01	MINERAL AGG BASE GRADING "D"	10.00
	TOTALS	16.50

OUTSIDE SHOULDER DESIGN

	DESCRIPTION	THICKNESS
411-01.07	ACS (PG64-22) GR "E"	1.50
303-01	MINERAL AGG BASE GRADING "D"	15.00
	TOTALS	16.50

REMARKS:
1) MILL 1.25" FROM THE EXISTING PAVEMENT AND OVERLAY USING 1.25" OF "D-MIX" IF NEEDED
2) ELIMINATE SHOULDER DESIGN FOR CURB AND GUTTER SECTION
3) IF SHOULDER WIDTH IS 4 FT OR LESS, PLEASE REFER TO ROADWAY DESIGN GUIDELINE SECTION 3.125.05

PAVEMENT DESIGN MAINLINE AND INTERSTATE TO INTERSTATE RAMPS

Alignment	Location	Roadway				Inside Shoulder	Outside Shoulder	Comments
		Overlay		Widening				
		New Alignment			Concrete Repair			
I-75 (Segment 1)	Mainline	N/A	A (2)	A	N/A	A (1)	A	(3)
I-75 (Segment 2)	Mainline	N/A	A (2)	A	N/A	A (1)	A	(3)
I-75 (Segment 3)	Mainline	A	A (2)	A	N/A	A (1)	A	(3)
I-75 (Segment 4)	Mainline	N/A	N/A	B	N/A	N/A	B	(3)
I-24 (Segment 3)	Mainline	N/A	A (2)	A	N/A	A (1)	A	(3)
NB I-75 to WB I-24	Interstate to Interstate Ramp	A	A (2)	A	N/A	A (1)	A	(3)
SB I-75 to WB I-24	Interstate to Interstate Ramp	N/A	A (2)	A	N/A	A (1)	A	(3)
EB I-24 to SB- I-75	Interstate to Interstate Ramp	A	A (2)	A	N/A	A (1)	A	(3)
EB I-24 to NB- I-75	Interstate to Interstate Ramp	A	A (2)	A	N/A	A (1)	A	(3)

(1) Inside shoulder pavement same as full depth roadway
(2) See remarks on pavement design for overlay minimum thickness
(3) Aggregate underdrain w/pipe

PAVEMENT DESIGN RAMPS

Alignment	Location	Roadway	Inside Shoulder	Outside Shoulder	Comments
Ramp 'A'	Ringgold Rd. Interchange	A	A (1)	A	(2)
Ramp 'B'	Ringgold Rd. Interchange	A	A (1)	A	(2)
Ramp 'C'	Ringgold Rd. Interchange	A	A (1)	A	(2)
Ramp 'D'	Ringgold Rd./Rest Area to NB I-75	C	C	C	
Ramp 'E'	Ringgold Rd. Interchange	A	A (1)	A	(2)
Ramp 'F'	Rest Area	C	C	C	
Ramp 'G'	Rest Area	C	C	C	
Ramp 'H'	Slip Ramp	C	C	C	

(1) Inside shoulder pavement same as full depth roadway
(2) Aggregate underdrain w/pipe

APPENDIX B – REFERENCE DOCUMENTS

All documents have been published on the Department's project website:

https://www.tn.gov/tdot/tdot-construction-division/transportation-construction-alternative-contracting/transportation-construction-division-alternative-contracting-design-build-i.html

DOCUMENT

- Functional Design
  - Functional Plans
    - Functional Plans
    - Functional X-Sections
    - Signing and Marking Layout (Phase 1)
    - Signing and Marking Layout (Ultimate Build-out)
    - Lighting Layout
    - ITS Layout
    - Utilities Roll Plot
  - Walls and Bridges
    - I-75 NB over Spring Creek
    - I-75 SB over Spring Creek
    - I-75 NB over I-75 NB to I-24 WB
    - I-75 SB over I-75 NB to I-24 WB
    - I-75 NB over I-24 EB to I-75 NB
    - I-75 SB over I-24 EB to I-75 NB
    - Widening I-75 over South Chickamauga Creek
    - Spring Creek Road over I-24 EB
    - Spring Creek Road over I-24 WB
- Environmental Documents
  - NEPA Document
  - Environmental Commitments
  - TDOT Waste and Borrow Manual (2017)
- Technical Support
  - Geotechnical Reports
  - TDOT Bridge Inspection Reports
  - TDOT Bridge Deck Surveys
  - Traffic Count Data
  - Survey Files
  - Existing ITS Inventory
  - Noise Barrier Evaluation (including TNM file(s))