Contract Documents & Technical Specifications for:

2023 Cornersville CDBG Sidewalk Improvements
Town of Cornersville, Tennessee
CDBG Contract 16147

July 2025

Board of Mayor & Aldermen
John Luna, Mayor
Sherry McClintock, Vice Mayor
Doris Arthur
Mary Johnson
Janice Kerber
Taylor Pickett

Town Administrator
Taylor Brandon

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Morrison Engineering, LLC
PO Box 7
Chapel Hill, TN 37034

MORRISON ENGINEERING

Set Number: _____

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Appendices

ADVERTISEMENT FOR BIDS

Project No. 16099

Town of Cornersville (Owner)

Separate sealed bids for 2023 Cornersville CDBG Sidewalk Improvements for the Town of Cornersville will be received by Taylor Brandon, Town Administrator at the office of Cornersville Town Hall, Care of Taylor Brandon, 118 South Main Street, Cornersville, TN 37047 until 10:00 AM o'clock A.M./P.M., C.S.T./E.S.T. November 4, 2025, and then at said office publicly opened and read aloud.

The Information for Bidders, Form of Bid, Form of Contract, Plans, Specifications, and Forms of Bid Bond, Performance and Payment Bond, and other contract documents may be examined at the following:

Cornersville Town Hall, 118 South Main Street, Cornersville, TN 37047

Can be digitally sent by Morrison Engineering upon request info@morrison.engineering

Copies may be obtained at the office of Taylor Brandon located at 118 South Main Street, Cornersville, TN 37047 upon payment of $ 140 for each set. Any unsuccessful bidder, upon returning each set promptly and in good condition, will be refunded his payment, and any non-bidder upon so returning such a set will be refunded $ 0.00.

The owner reserves the right to waive any informalities or to reject any or all bids.

Each bidder must deposit with his bid, security in the amount, form and subject to the conditions provided in the Information for Bidders.

All bidders must be licensed General Contractors as required by the Contractor's Licensing Act of 1994 of the General Assembly of the State of Tennessee, and qualified for the type of construction being bid upon.

Attention of bidders is particularly called to the requirements as to conditions of employment to be observed and minimum wage rates to be paid under the contract, Section 3, Segregated Facility, Section 109 and E.O. 11246.

No bidder may withdraw his bid within 60 days after the actual date of the opening thereof.

_____ (Date) _____

INFORMATION FOR BIDDERS

1. Receipt and Opening of Bids

The Town of Cornersville (herein called the "Owner), invites bids on the form attached hereto, all blanks of which must be appropriately filled in. Bids will be received by the Owner at the office of Taylor Brandon until 10:00 AM o'clock A.M./P.M., C.S.T/E.S.T, November 4, 2025, and then at said office publicly opened and read aloud. The envelopes containing the bids must be sealed, addressed to Town of Cornersville at 118 South Main Street, Cornersville, TN 37047 and designated as bid for 2023 Cornersville CDBG Sidewalk Improvements.

The Owner may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within 60 days after the actual date of the opening thereof.

2. Preparation of Bid:

Each bid must be submitted on the prescribed form and accompanied by Certification of Bidder Regarding Equal Employment Opportunity, Acknowledgment Regarding Bidder SAM Registration, Certification of Bidder Regarding Section 3 and Segregated Facilities, and Drug-Free Workplace Affidavit. All blank spaces for bid prices must be filled in, in ink or typewritten, in both words and figures, and the foregoing Certifications must be fully completed and executed when submitted.

Each bid must be submitted in a sealed envelope bearing on the outside the name of the bidder, his/her address, the name of the project for which the bid is submitted, license number, expiration date thereof, and license classification of the contractors applying to bid for the prime contract, and for the electrical, plumbing, heating, ventilation, and air conditioning contracts, and all other information required by State law..

All bidders must be licensed General Contractors as required by the Contractor's Licensing Act of 1994 of the General Assembly of the State of Tennessee, and qualified for the type of construction being bid upon. Each bidder shall write on the outside of the envelope containing its bid: 1) its Contractor's license number; 2) that part of the classification applying to the bid. If this is not done, the bid will not be opened.

3. Subcontracts:

The bidder is specifically advised that any person, for, or other party to whom it is proposed to award a subcontract under this contract:

a. Must be acceptable to the owner; and

b. Must submit Certification by Proposed Subcontractor Regarding Equal Employment Opportunity, and Certification of Proposed Subcontractor Regarding Section 3 and Segregated Facilities. Approval of the proposed subcontract award cannot be given by the owner unless and until the proposed subcontractor has submitted the Certifications and/or other evidence showing that it has fully complied with any reporting requirements to which it is or was subject.

Although the bidder is not required to attach such Certifications by proposed subcontractors to his/her bid, the bidder is here advised of this requirement so that appropriate action can be taken to prevent subsequent delay in subcontract awards.

4. Telegraphic Modification:

Any bidder may modify his/her bid by telegraphic communication at any time prior to the scheduled closing time for receipt of bids provided such telegraphic communication is received by the Owner prior to the closing time, and, provided further, the Owner is satisfied that a written confirmation of the telegraphic modification over the signature of the bidder was mailed prior to the closing time. The telegraphic communication should not reveal the bid price but should provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened. If written confirmation is not received within two days from the closing time, no consideration will be given to the telegraphic modification.

5. Method of Bidding:

The Owner invites the following bid(s):

Unit Price Bids

6. Qualification of Bidder:

The Owner may make such investigations as s/he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

7. Bid Security:

Each bid must be accompanied by cash, certified check of the bidder, or a bid bond prepared on the form of bid bond attached thereto, duly executed by the bidder as principal and having as surety thereon a surety company approved by the Owner, in the amount of 5% of the bid. Such cash, checks or bid bonds will be returned to all except the three lowest bidders within three days after the opening of bids, and the remaining cash, checks or bid bonds will be returned promptly after the Owner and the accepted bidder have executed the contract, or, if no award has been made within 60 days after the date of the opening of bids, upon demand of the bidder at any time thereafter, so long as he/she has not been notified of the acceptance of his/her bid.

8. Liquidated Damages for Failure to Enter into Contract:

The successful bidder, upon his/her failure to refusal to execute and deliver the contract and bonds required within 10 days after she/he has received notice of the acceptance of his/her bid, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the security deposited with his/her bid.

9. Time of Completion and Liquidated Damages:

Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" of the Owner and to fully complete the project within ___270___ consecutive calendar days thereafter. Bidder must agree also to pay as liquidated damages, the sum of $__$500_____ for each consecutive calendar day thereafter as hereinafter provided in the Supplemental General Conditions.

10. Condition of Work:

Each bidder must inform him/herself fully of the conditions relating to the construction of the project and the employment of labor thereof. Failure to do so will not relieve a successful bidder of his/her obligation to furnish all material and labor necessary to carry out the provisions of his/her contract. Insofar as possible, the contractor, in carrying out the work, must employ such methods as will not cause any interruption of or interference with the work of any other contractor.

11. Addenda and Interpretations:

No interpretation of the meaning of the plans, specifications or other pre-bid documents will be made to any bidder orally.

Every request for such interpretation should be in writing addressed to Jonathan Morrison, PE at Morrison Engineering, LLC and to be given consideration must be received at least five days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be mailed by certified mail with return receipt requested or emailed to all prospective bidders (at the respective addresses furnished for such purposes), not later than two days prior to the date fixed for the opening of bids. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his/her bid as submitted. All addenda so issued shall become part of the contract documents.

12. Security for Faithful Performance:

Simultaneously with his/her delivery of the executed contract, the Contractor shall furnish a surety bond or bonds as security for faithful performance of this contract and for the payment of all persons performing labor on the project under this contract and furnishing materials in connection with this contract, as specified in the General Conditions included herein. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner.

13. Power of Attorney:

Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

14. Notice of Special Conditions:

Attention is particularly called to those parts of the contract documents and specifications which deal with the following:

a. Inspection and testing of materials.
b. Insurance requirements.
c. Wage rates.
d. Stated allowances.

15. Laws and Regulations:

The bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full.

16. Method of Award - Lowest Qualified Bidder:

After receiving bids and determining the amount of funds estimated by the OWNER as available to finance the contract, the OWNER will award the contract to the lowest responsible bidder. The lowest responsible bidder will be determined upon the basis of the lowest base bid or lowest base bid combined with alternates (additive or deductive). If the contract is to be awarded based on the lowest base bid with alternates, alternates will be accepted in the numerical order in which they are listed in the Form of Bid.

17. Obligation of Bidder:

At the time of the opening of bids each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the plans and contract documents (including all addenda). The failure or omission of any bidder to examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect of his/her bid.

18. Safety Standards and Accident Prevention: With respect to all work performed under this contract, the Contractor shall:

a. Comply with the safety standards provisions of applicable laws, building and construction codes and the "Manual of Accident Prevention in Construction" published by the Associated General Contractors of America, the requirements of the Occupational Safety and Health Act of 1970 (Public Law 91-596), and the requirements of Title 29 of the Code of Federal Regulations, Section 1518 as published in the "Federal Register", Volume 36, No. 75, Saturday, April 17, 1971.

b. Exercise every precaution at all times for the prevention of accidents and the protection of persons (including employees) and property.

c. Maintain at his/her office or other well known place at the job site, all articles necessary for giving first aid to the injured, and shall make standing arrangements for the immediate removal to a hospital or a doctor's care of persons (including employees), who may be injured on the job site. In no case shall employees be permitted to work at a job site before the employer has made a standing arrangement for removal of injured persons to a hospital or a doctor's care.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____

_____

as Principal, and _____

as Surety, are hereby held and firmly bound unto the Town of Cornersville

as owner in the penal sum of Five Percent (5%) of the Bid Amount for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed, this _____ day of _____, 20 25 .

The condition of the above obligation is such that whereas the Principal has submitted to the Town of Cornersville a certain Bid, attached hereto and hereby made a part hereof to enter into a contract in writing for the

2023 Cornersville CDBG Sidewalk Improvements

CBDG Project #16147

NOW, THEREFORE,

(a) If said Bid shall be rejected, or in the alternate.

(b) If said Bid shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said Bid) and shall furnish a bond for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation shall be void, otherwise the same shall remain in force and effect, it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The surety for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____ (L.S.)
Principal

_____
Surety

SEAL By: _____

BID FOR UNIT PRICE CONTRACTS

Place The Town of Cornersville, TN
Date _____
Project No. 16147

Proposal of _____ (hereinafter called "Bidder")[1] a corporation, organized and existing under the laws of the State of _____, partnership, or an individual doing business as _____.

To the Town of Cornersville, TN (hereinafter called "Owner")

Gentlemen:

The Bidder, in compliance with your invitation for bids for the construction of a

2023 Cornersville CDBG Sidewalk Improvements,

having examined the plans and specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all labor, materials, and supplies, and to construct the project in accordance with the contract documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this proposal is a part.

Bidder hereby agrees to commence work under this contract on or before a date to be specified in written "Notice to Proceed" of the Owner and to fully complete the project within 270 consecutive calendar days thereafter as stipulated in the specifications. Bidder further agrees to pay as liquidated damages the sum of $500 for each consecutive calendar day thereafter as hereinafter provided in Paragraph 3.c. of the Supplemental General Conditions.

[1] Insert corporation, partnership or individual as applicable.

Bidder acknowledges receipt of the following addendum:

_____

_____

_____

Bidder agrees to perform all the 2023 Cornersville CDBG Sidewalk Improvements work described in the specifications and shown on the plans, for the following unit prices:

Item #	TDOT Pay Item #	Item	Estimated Quantity	Unit	Unit Price	Total
1	303-01	Mineral Aggregate, Type A Base, Grading D	68	CY		
2	701-01.01	Concrete Sidewalk (4")	60	CY		
3	702-02	Concrete Driveway	12	CY		
4	702-03	Concrete Combined Curb and Gutter	67	CY		
5	716-02.03	Plastic Pavement Marking (Cross-walk)	44	LF		
6	713.15-40	Sign Installation	0	LS		
					Total Bid	

(Amounts are to be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

The above unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, etc., to cover the finished work of the several kinds called for.

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

The bidder agrees that this bid shall be good and may not be withdrawn for a period of 60 days after the scheduled closing time for receiving bids.

Upon receipt of written notice of the acceptance of this bid, bidder will execute the formal contract attached within 10 days and deliver a Surety Bond or Bonds as required by Article 5 of the General Conditions. The bid security attached in the sum of

Five Percent (5%) of the Bid Amount

($_____) is to become the property of the Owner in the event the contract and bond are not executed within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Respectfully submitted:

By: _____
(Title)

(SEAL - if bid is by a corporation)

CLEARANCE OF LOREC NOTATIONS for P&S APPROVAL

Project Name 2023 Cornersville CDBG Sidewalk Improvements

Contract Number 16147

Agency, Date and Notation 1:

Tennessee Historical Commission State Historic Preservation Office on December 5th, 2023:
We have no objections to your proceeding with your undertaking. If your agency proposes any modifications in current project plans or discovers any archaeological remains during the ground disturbance or construction phase, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act.

Response to Notation 1:

Any modifications in current project plans or discovers any archaeological remains during the ground disturbance or construction phase will be reported to the Tennessee Historical Commission State Historic Preservation Office in compliance with Section 106.

Agency, Date and Notation 2:

U.S. Fish and Wildlife Service on September 27th, 2024:
We certify that use of the online project review process in strict accordance with the instructions provided as documented in the enclosed project review package results

Response to Notation 2:

If any candidate species, listed species, proposed or designated critical habitat, or bald eagles are discovered during the project, the U.S. Fish and Wildlife Service will be immediately notified for recommended action.

Agency, Date and Notation 3:

TDEC Division of Remediation on October 2nd, 2024:
The TDEC Division of Remediation has not identified any known DOR sites that would impact this project.

Response to Notation 3:

The TDEC Division of Remediation will be notified if any DOR sites are discovered during this project.

This form must accompany Plans and Specifications sent to ECD.

CLEARANCE OF LOREC NOTATIONS for P&S APPROVAL

Project Name 2023 Cornersville CDBG Sidewalk Improvements

Contract Number 16147

Agency, Date and Notation 4:

TDEC Division of Natural Areas Natural Heritage Program on November 13th, 2024:
The Division of Natural Areas - Natural Heritage Program has reviewed the location of the proposed project workspace with respect to rare plant species. Based on the absence of observations of rare plant species within four miles of project area we do not anticipate any impacts to occurrences of rare, threatened, or endangered plant species from this project.

Response to Notation 4:

If any rare, threatened, or endangered plant species are discovered at any point during this project, the TDEC Division of Natural Areas - Natural Heritage Program will be notified to give guidance on how to proceed.

Agency, Date and Notation 5:

TDEC Division of Water Resources on January 21st, 2025:
The project, including staging areas, will disturb less than one acre of land, such that a construction stormwater permit (CGP) should not be required. The Division does encourage erosion control measures be taken on projects with less than one acre of land disturbance, where appropriate. No significant environmental impact is anticipated.

Response to Notation 5:

The project will follow TDEC Division of Water Resources guidance.

Agency, Date and Notation 6:

Tennessee Wildlife Resources Agency on January 28th, 2025:
It is my understanding that no aquatic features will be impacted by construction. Therefore, we do not anticipate adverse impacts to state listed species under our authority due to the proposed construction; provided that best management practices to address erosion and sediment are implemented and maintained during construction activities.

Response to Notation 6:

The project will follow Tennessee Wildlife Resources Agency guidance.

This form must accompany Plans and Specifications sent to ECD.

CLEARANCE OF LOREC NOTATIONS for P&S APPROVAL

Project Name 2023 Cornersville CDBG Sidewalk Improvements

Contract Number 16147

Agency, Date and Notation 7:

TDEC Division of Underground Storage Tanks on October 2nd, 2024:
As we discussed, the only known underground storage tanks between 323 North Main Street, Cornersville, TN and the intersection of North Main Street and Underpass Road, Cornersville, TN are:
- Facility ID #6590114 located at 400 North Main Street, Cornersville, TN (directly across the road from the elementary school) and
- Facility 10#6590032 located at 424 North Main Street, Cornersville, TN (at the V-intersection)

Both facilities are located on the eastern side of North Main Street. The 2 registered USTs at facility ID #6590114 are temporarily out-of-service. At facility ID #6590032, there is 1 registered UST (with 3 compartments) that is currently in use and there are 5 registered USTs that are permanently out-of-service (POS). All 5 POS USTs were removed from the ground in 1996. There are no known or registered USTs on the western side of that stretch of North Main Street....

~~**Response to Notation 7:**~~ **Continuation of Notation 7:**

...Please note that abandoned tanks or tanks not required to be registered with the State could pose an unidentified hazard related to past operations on or near the property. The Division is typically unaware of abandoned and unregulated tanks (such as farm or residential tanks of <1, 100-gallons storing motor fuel for non-commercial purposes; tanks used for storing heating oil for consumption on the premises where stored; or septic tanks). No requirement exists in the UST Act for owners of tanks taken out of operation on or before January 1, 1974 or removed from the ground before July 1, 1988 to notify the Division of the existence of such tanks. If contractors will be preparing for and/or completing any work they should be made aware of the potential risk of encountering unexpected petroleum contaminated soil and provisions made to manage such material including notification to the Division of Underground Storage Tanks, Division of Remediation, and/or the Division of Solid Waste Management.

~~**Agency, Date and Notation 8:**~~ **Response to Notation 7:**

The 2 identified sites are outside of the proposed project limits. However, if any unknown or abandoned tanks are discovered at any phase of this project, the TDEC Division of Underground Storage Tanks will be immediately for guidance.

Response to Notation 8:

Agency, Date and Notation 9:

Response to Notation 9:

Principal

Signature, Title

7-25-2025

Date

This form must accompany Plans and Specifications sent to ECD.

ACKNOWLEDGEMENT REGARDING BIDDER SAM REGISTRATION

Pursuant to 2 CFR Parts 183 and 215 and the requirement of the U.S. Department of Housing and Urban Development (HUD), contractors procured directly by grantees, sub-grantees, and/or sub-recipients of HUD funds, including CDBG are required to have an active registration in the System of Award Management (SAM). This document shall be completed and submitted as part of the bid proposal.

1. By submitting this proposal, the prospective bidder acknowledges that it must have an active SAM UEI (Unique Entity ID) to be awarded this contract and that without an active SAM UEI the bidder's proposal may be disallowed.

2. By submitting this proposal, the prospective bidder certifies neither it, its principals nor affiliates, is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

3. 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 an erroneous certification was rendered, in addition to other remedies available to the Federal Government, the Department or agency with which this transaction originated may pursue available remedies.

4. Further, the prospective bidder shall provide immediate written notice to the person to which this proposal is submitted if at any time the Participant learns that this certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

5. By submitting this proposal, it is agreed that should the proposed covered transaction be entered into, the prospective bidder will 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 agency with which this transaction originated.

6. It is further agreed that by submitting this proposal, the prospective bidder will include Certification of Subcontractor Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion without modification, in all lower-tier covered transactions and in all solicitations for lower-tier covered transactions.

Provide the following information as detailed in the prospective bidder's SAM registration:

Entity Name: _____

Address: _____

City: _____ State: _____ Zip: _____

SAM Entity ID: _____ Expiration Date: _____

Active Exclusions: ☐ Yes ☐ No

CERTIFICATION OF BIDDER REGARDING EQUAL EMPLOYMENT OPPORTUNITY

This certification is required pursuant to Executive Order 11246 (30 F. R. 12319-25). The implementing rules and regulations provide that any bidder or prospective contractor, or any of their proposed subcontractors, shall state as an initial part of the bid or negotiations of the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and, if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicates that the bidder has not filed a compliance report due under applicable instructions, such bidder shall be required to submit a compliance report within seven calendar days after bid opening. No contract shall be awarded unless such report is submitted.

Certification by Bidder

Bidder/Firm: _____

Address: _____

City: _____ State _____ Zip _____

1. Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. ☐ Yes ☐ No
2. Compliance reports were required to be filed in connection with such contract or subcontract. ☐ Yes ☐ No
3. Bidder has filed all compliance reports due under applicable instructions, including SF-100. ☐ Yes ☐ No ☐ None Req.
   .
4. Have you ever been or are you being considered for sanction due to violation of Executive Order 11246, as amended? ☐ Yes ☐ No

Bidder Name: _____ Title: _____

Signature: _____ Date: _____

CERTIFICATION OF BIDDER REGARDING USE OF FEMALE/MINORITY SUBCONTRACTORS

This certification is required for the contractor to demonstrate that when subcontractors are to be used on this project, an attempt will be made to utilize female/minority owned firms.

Documentation must be on file to show who has been contacted.

Certification by Bidder

Bidder/Firm: _____

Address: _____

City: _____ State _____ Zip _____

I, _____, certify that every attempt was made to utilize female/minority contractors on this project.

Bidder Name: _____ Title: _____

Signature: _____ Date: _____

CERTIFICATION OF SUBCONTRACTOR REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND EXCLUSION

Pursuant to 2 CFR Parts 183, 215, and 2424, and the requirement of the U.S. Department of Housing and Urban Development (HUD), subcontractors for projects that are funded in whole or in part by HUD funds must provide information concerning the entity's debarment, suspension, ineligibility or exclusion status. This document shall be completed and provided to the prime contractor.

1. By signing and submitting this proposal, the prospective lower-tier participant certifies that neither it, its principals nor affiliates, is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency. Further, the Participant provides the certification set out below:

2. 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 an erroneous certification was rendered, in addition to other remedies available to the Federal Government, the Department or agency with which this transaction originated may pursue available remedies.

3. Further, the Participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the Participant learns that this certification was erroneous when submitted or has become erroneousby reason of changed circumstances.

4. By submitting this document, it is agreed that should the proposed covered transaction be entered into, the Participant will 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 agency with which this transaction originated.

The subcontracting entity may satisfy the requirement of this document via one of the two options below:

Option 1: SAM.gov Active Registration

Entity Name: _____

Address: _____

City: _____ State: _____ Zip: _____

SAM Entity ID: _____ Expiration Date: _____

Active Exclusions: ☐ Yes ☐ No

Option 2: Signed Certification

Entity Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Entity Representative: _____ Title: _____

Signature: _____

CERTIFICATION OF BIDDER REGARDING SECTION 3 AND SEGREGATED FACILITIES

NAME OF PRIME CONTRACTOR: _____

PROJECT NUMBER: _____

The undersigned hereby certifies that

- Section 3 provisions are included in the Contract.

- This grant project exceeds $200,000 of CDBG assistance, and the contractor will comply with all Section 3 requirements detailed in the CDBG Manual, including:
  - reporting total labor hours worked,
  - reporting total labor hours worked by Section 3 workers,
  - reporting total labor hours worked by Targeted Section 3 workers,
  - Providing documentation of Section 3 worker status as required for all workers for the project under the covered contract.

- No segregated facilities will be maintained as required by Title VI of the Civil Rights Act of 1964.

_____
Name & Title of Signer (Print or Type)

_____ _____
Signature Date

DRUG-FREE WORKPLACE AFFIDAVIT

STATE OF _____

COUNTY OF _____

The undersigned, principal officer of _____, an employer of five (5) or more employees contracting with _____ government to provide construction services, hereby states under oath as follows:

1. The undersigned is a principal officer of _____ (hereinafter referred to as the "Company"), and is duly authorized to execute this Affidavit on behalf of the Company.

2. The Company submits this Affidavit pursuant to T.C.A. § 50-9-113, which requires each employer with no less than five (5) employees receiving pay who contracts with the state or any local government to provide construction services to submit an affidavit stating that such employer has a drug-free workplace program that complies with Title 50, Chapter 9, of the Tennessee Code Annotated.

3. The Company is in compliance with T.C.A. § 50-9-113.

Further affiant saith not.

_____
Principal Officer

STATE OF _____

COUNTY OF _____

Before me personally appeared _____, with whom I am personally acquainted (or proved to me on the basis of satisfactory evidence), and who acknowledged that such person executed the foregoing affidavit for the purposes therein contained.

Witness my hand and seal at office this _____ day of _____, 20___.

_____
Notary Public

My commission expires: _____

CERTIFICATION BY PROPOSED SUBCONTRACTOR REGARDING EQUAL EMPLOYMENT OPPORTUNITY

NAME OF PRIME CONTRACTOR: _____

PROJECT NUMBER: _____

This certification is required pursuant to Executive Order 11246 (30 F. R. 12319-25). The implementing rules and regulations provide that any bidder or prospective contractor, or any of their proposed subcontractors, shall state as an initial part of the bid or negotiations of the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and, if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicates that the subcontractor has not filed a compliance report due under applicable instructions, such subcontractor shall be required to submit a compliance report before the owner approves the subcontract or permits work to begin under the subcontract.

SUBCONTRACTOR'S CERTIFICATION

Subcontractor Name: _____

Address: _____

City: _____ State _____ Zip _____

1. Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. ☐ Yes ☐ No
2. Compliance reports were required to be filed in connection with such contract or subcontract. ☐ Yes ☐ No
3. Bidder has filed all compliance reports due under applicable instructions, including SF-100. ☐ Yes ☐ No ☐ None Req.
   .
4. Have you ever been or are you being considered for sanction due to violation of Executive Order 11246, as amended? ☐ Yes ☐ No

Name: _____ Title: _____

Signature: _____ Date: _____

CERTIFICATION OF PROPOSED SUBCONTRACTOR REGARDING SECTION 3 AND SEGREGATED FACILITIES

NAME OF SUBCONTRACTOR: _____

PROJECT NUMBER: _____

The undersigned hereby certifies that

- Section 3 provisions are included in the Contract.
- If contract equals or exceeds $200,000, the contractor will comply with all Section 3 requirements detailed in the CDBG Manual, including:
    - reporting total labor hours worked,
    - reporting total labor hours worked by Section 3 workers,
    - reporting total labor hours worked by Targeted Section 3 workers,
    - Providing documentation of Section 3 worker status as required for all workers for the project under the covered contract.

- No segregated facilities will be maintained as required by Title VI of the Civil Rights Act of 1964.
-

_____
Name & Title of Signer (Print or Type)

_____ _____
Signature Date

STATEMENT OF COMPLIANCE CERTIFICATE
ILLEGAL IMMIGRANT

EACH CONTRACTOR BIDDING SHALL FILL IN AND SIGN THE FOLLOWING

Bidder Name: _____

Address: _____

City: _____ State _____ Zip _____

This is to certify that _____ have fully complied with all the requirements of T.C.A. § 12-3-309, stating:

(1) No state governmental entity shall contract to acquire goods or services from any person who knowingly utilizes the services of illegal immigrants in the performance of a contract for goods or services entered into with a state governmental entity;

(2) No person may contract to supply goods or services to a state governmental entity if that person knowingly utilizes the services of illegal immigrants in the performance of a contract to supply goods or services entered into with the state or a state entity.

All Bidders for construction services on this project shall be required to submit an affidavit (by executing this compliance document) as part of their bid, that attests that such Bidder shall comply with requirements of T.C.A. § 12-3-309.

Name: _____ Title: _____

Signature: _____ Date: _____

CERTIFICATION OF NON-BOYCOTT OF ISRAEL

The Bidder certifies that it is not currently engaged in, and will not for the duration of the contract engage in, a boycott of Israel as defined by Tenn. Code Ann. § 12-4-119. This provision shall not apply to contracts with a total value of less than two hundred fifty thousand dollars ($250,000) or to contractors with less than ten (10) employees.

According to the law, a boycott of Israel means engaging in refusals to deal, terminating business activities, or other commercial actions that are intended to limit commercial relations with Israel, or companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel to do business, or persons or entities doing business in Israel, when such actions are taken:

1) In compliance with, or adherence to, calls for a boycott of Israel, or

2) In a manner that discriminates on the basis of nationality, national origin, religion, or other unreasonable basis, and is not based on a valid business reason. Tenn. Code Ann. § 12-4-119.

I certify this statement to be true and correct.

_____ _____
Bidder Name Printed Date

_____ _____
Signature of Bidder Company

IRAN DIVESTMENT ACT

In compliance with the Iran Divestment Act (State of Tennessee 2016, Public Chapter No. 817), which became effective on July 1, 2016, certification is required of all bidders on contracts over $1,000.

By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party hereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each bidder is not on the list created pursuant to T.C.A. § 12-12-106.

I affirm, under the penalties of perjury, this statement to be true and correct.

_____ _____

Date Signature of Bidder

_____ _____

Company

A bid shall not be considered for award nor shall award be made where the foregoing certification has been complied with; provided, however, that if in any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefor. The **City/County of** _____ may award a bid to a bidder who cannot make the certification, on case-by-case basis, if:

1. The investment activities in Iran were made before July 1, 2016, the investment activities in Iran have not been expanded or reviewed on or after July 1, 2016, and the person has adopted, publicized, and is implementing a formal plan to cease the investment activities in Iran and to refrain from engaging in any new investments in Iran; or
2. The **City/County of** _____makes a determination that the goods or services are necessary for the **City/County of** _____to perform its functions and that, absent such an exemption, the political subdivision will be unable to obtain the goods or services for which the contract is offered. Such determination shall be made in writing and shall be a public document.

Department of General Services | Central Procurement Office

NOTICE

Tenn. Code Ann. § 12-12-106 requires the chief procurement officer to publish, using credible information freely available to the public, a list of persons it determines engage in investment activities in Iran, as described in § 12-12-105.

For these purposes, the State intends to use the attached list of "Entities determined to be non-responsive bidders/offerers pursuant to the New York State Iran Divestment Act of 2012."

While inclusion on this list would make a person ineligible to contract with the state of Tennessee, if a person ceases its engagement in investment activities in Iran, it may be removed from the list.

If you feel as though you have been erroneously included on this list please contact the Central Procurement Office at CPO.Website@tn.gov.

Tennessee Tower, 3rd Floor • 312 Rosa L. Parks Avenue • Nashville, TN 37243
615-741-1035 • Fax: 615-741-0684 • tn.gov/generalservices

List Date: May 4, 2022
Source: https://www.ogs.ny.gov/iran-divestment-act-2012

1. Ak Makina, Ltd.
2. Amona
3. Bank Markazi Iran (Central Bank of Iran)
4. Bank Mellat
5. Bank Melli Iran
6. Bank Saderat Iran
7. Bank Sepah
8. Bank Tejarat
9. China Precision Machinery Import- Export Corporation (CPMIEC)
10. ChinaOil (China National United Oil Corporation)
11. China National Offshore Oil Corporation (CNOOC)
12. China National Petroleum Corporation (CNPC)
13. Indian Oil Corporation
14. Kingdream PLC
15. Naftiran Intertrade Co. (NICO)
16. National Iranian Tanker Co. (NITC)
17. Oil and Natural Gas Corporation (ONGC)
18. Oil India, Ltd.
19. Persia International Bank
20. Petroleos de Venezuela (PDVSA Petróleo, SA)
21. PetroChina Co., Ltd.
22. Petronet LNG, Ltd.
23. Sameh Afzar Tajak Co. (SATCO)
24. Shandong FIN CNC Machine Co., Ltd.
25. Sinohydro Co., Ltd.
26. Sinopec Corp. (China Petroleum & Chemical Corporation)
27. SKS Ventures
28. SK Energy Co., Ltd.
29. Som Petrol AS
30. Unipec (China International United Petroleum & Chemicals Co., Ltd.)
31. Zhuhai Zhenrong Co.

WAGE RATE DETERMINATION

Appropriate Wage Rates shall be inserted here.

"General Decision Number: TN20250147 01/03/2025

Superseded General Decision Number: TN20240147

State: Tennessee

Construction Type: Highway

Counties: Tennessee Statewide.

HIGHWAY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $17.75 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 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the

Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2025

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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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($17.75) or 13658 ($13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

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 https://www.dol.gov/agencies/whd/government-contracts.

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) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate 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. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the 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. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests

for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail 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 an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail 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 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.

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END OF GENERAL DECISION"

AGREEMENT

THIS AGREEMENT, made this _____ day of _____, 20____, by and between _____, herein called "Owner", acting herein through its _____
_____, and
_____
STRIKE OUT INAPPLICABLE TERMS (a corporation) (a partnership) (an individual doing business as _____)
of _____, County of _____, and State of _____, hereinafter called "Contractor".
WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the OWNER, the CONTRACTOR hereby agrees with the OWNER to commence and complete the construction described as follows:
hereinafter called "the project", for the sum of _____

_____ Dollars ($_____) and all extra work in connection therewith, under the terms as stated in the General and Special Conditions of the Contract; and at this (its or their) own property cost and expense to furnish all the materials , supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said project in accordance with the conditions and prices stated in the Proposal, the General Conditions, Supplemental General Conditions and Special Conditions of the Contract, the plans, which include all maps, plats, blue prints, and other drawings and printed or written explanatory matter thereof, the specifications and contract documents therefore as prepared by _____, herein entitled "the Architect/Engineer", and as enumerated in Paragraph 1 of the Supplemental General Conditions, all of which are made a part hereof and collectively evidence and constitute the contract.

The Contractor hereby agrees to commence work under this contract on or before a date to be specified in a written "Notice to Proceed" of the Owner and to fully complete the project within _____ consecutive calendar days thereafter. The Contractor further agrees to pay, as liquidated damages, the sum of $_____ for each consecutive calendar day thereafter as hereinafter provided in Paragraph 3 of the Supplemental General Conditions.

The OWNER agrees to pay the CONTRACTOR in current funds for the performance of the contract, subject to additions and deductions, as provided in the General Conditions of the Contract, and to make payments on account thereof as provided in Paragraph 3, "Payments to Contractor", of the Supplemental General Conditions.

IN WITNESS WHEREOF, the parties to these presents have executed this contract in six (6) counterparts, each of which shall be deemed an original, in the year and day first above mentioned.

(Seal)
ATTEST: _____
(Owner)

_____	By: _____
(Secretary)	
_____	_____
(Witness)	*(Title)*

(Seal)

	_____
	(Contractor)
_____	By: _____
(Secretary)	
_____	_____
(Witness)	*(Title)*

_____

(Address, City, State, and Zip Code)

BONDING AND INSURANCE

1. This Attachment sets forth bonding and insurance requirements for grants. No other bonding and insurance requirements shall be imposed other than those normally required by the grantee.

2. Except as otherwise required by law, a grant that requires the contracting (or subcontracting) for construction or facility improvements shall provide for the grantee to follow its own requirements relating to bid guarantees, performance bonds, and payment bonds unless the construction contract or subcontract exceeds $150,000 (See 2 CFR 200.88). For those contracts or subcontracts exceeding $150,000, the Federal agency may accept the bonding policy and requirements of the grantee provided the Federal agency has made a determination that the Government's interest is adequately protected. If such a determination has not been made, the minimum requirements shall be as follows:

   a. A bid guarantee from each bidder equivalent to five percent of the bid price. The "bid guarantee" shall consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of his bid, execute such contractual documents as may be required within the time specified.

   b. A performance bond on the part of the contractor for 100 percent of the contract price. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.

   c. A payment bond on the part of the contractor for 100 percent of the contract price. A "payment bond" is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

3. Where the Federal Government guarantees or insures the repayment of money borrowed by the grantee, the Federal agency, at its discretion, may require adequate bonding and insurance if the bonding and insurance requirements of the grantee are not deemed adequate to protect the interest of the Federal Government.

4. Where bonds are required in the situations described above, the bonds shall be obtained from companies holding certificates of authority as acceptable sureties (31 CFR 223).

NOTE: AIA Document A311 is acceptable for use as Performance and Payment Bonds.

CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned, _____, the duly authorized and acting legal representative of _____ do hereby certify as follows:

I have examined the attached contract(s) and surety bonds and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions and provisions thereof.

Date: _____ _____

CERTIFICATION OF COMPLIANCE WITH THE BUILD AMERICA, BUY AMERICA ACT (BABA)

This document is used to certify that, as required by the Build America, Buy America (BABA) Act, all of the iron, steel, manufactured products, and construction materials incorporated into an infrastructure project are produced in the United States, unless exempted by a HUD general waiver or a project-/product-specific waiver approved by the Made in America Office (MIAO) at the Office of Management and Budget (OMB).

For covered materials not otherwise exempted from the Buy America Preference (BAP), the undersigned certifies the following:

- All iron and steel used in the project are produced in the United States. This means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;

- All manufactured products used in the project are produced in the United States. This means the manufactured product was manufactured in the United States, and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard that meets or exceeds this standard has been established under applicable law or regulation for determining the minimum amount of domestic content of the manufactured product;

- All construction materials used in the project are manufactured in the United States. This means that all manufacturing processes for the construction material occurred in the United States.

All BAP covered materials are noted within these plans and specifications. The signatory shall provide a list of all covered materials using the provided “BABA Covered Materials and Manufactured Goods List” document.

I hereby certify this information is complete and accurate and agree to provide documentation collected on the country of origin for all covered materials I caused to be incorporated into or affixed to an infrastructure project.

_____ _____

Bidder Name Printed Date

_____ _____

Signature of Bidder Company

RESOLUTION NUMBER: 21-267

A RESOLUTION TO ESTABLISH STREET REPAIR GUIDELINES

WHEREAS, the Town has the responsibility of maintaining the streets of the Town; and

WHEREAS, when the streets of the Town are damaged by the acts of another entity, said entity becomes responsible for the repair thereof; and

WHEREAS, the quality of any street repair will affect the longevity of said repair; and

WHEREAS, there is a need to establish requirements and guidelines to ensure that any repairs made to the streets of the Town are conducted in manner that will result in a quality repair of the street.

NOW THEREFORE BE IT RESOLVED BY THE BOARD OF MAYOR AND ALDERMEN OF THE TOWN OF CORNERSVILLE, TENNESSEE AS FOLLOWS:

SECTION 1. That prior to any street within the Town of Cornersville being cut or repairs to any street, in accordance with this resolution being initiated, permission MUST be obtained from the Public Works Department of the Town of Cornersville.

SECTION 2. These guidelines shall apply to any situation where a third party is making a repair to the streets of the Town of Cornersville. Instances that would cause a need for the referenced repairs include, but are not limited to the following:

a) Cutting of the streets due to water line issues, such as leaks, busted pipes, or the installation of new water/sewer lines that run under existing streets.
b) Damage to the streets by heavy trucks and/or equipment caused by unnecessary or reckless driving actions.
c) Damage to streets as a result of the boring under the street by utilities such as Lewisburg Water and Wastewater, Duck River Electric, AT&T, TDS, Internet providers, Fiber-Optic companies, or any similar company that bores under any street.

SECTION 3. All repairs to streets of the Town of Cornersville MUST comply with the following:

a) Cutting lines where the street will be cut must be marked before repairs begin. All cutting lines must be a minimum of six (6) inches from the damaged area and the cutting lines must be straight lines. No round patches are permitted.

b) Patch Description: The patch must be a full-depth patch. This means that a minimum of six (6) inches of concrete must be backfilled on top of the compacted area (described below). No Quikrete or similar product may be used.

c) Compacted Area: The area below the concrete patch must be properly compacted. The compaction must extend a minimum of six (6) inches below the bottom of the concrete patch. All material in the cut must be properly compacted. A vibratory-plate compactor or jumping-jack compactor is excellent for small patches and mandatory for compacting corners. A medium-sized roller may be more practical for large patch areas.

*If there was a water line, fiber-optic cable, or other line run under the street in the repair area, that line must be lowered so that it runs completely beneath the Compacted Area. If said line cannot be lowered to below the Compacted Area, that line may have to be completely re-bored at a different location.

SECTION 4. This Resolution shall take effect from and after its passage, the public welfare requiring it.

Resolved this 4 day of February, 2021.

John Luna
JOHN LUNA,
Mayor

Scotty Brock
SCOTTY BROCK,
Town Administrator/Town Recorder

APPROVED AS TO LEGALITY AND FORM:

B Ostermann
BILLY W. OSTERMANN,
Town Attorney

RESOLUTION 23-306

A RESOLUTION REQUIRING CONCRETE HEADWALLS FOR DRIVEWAY CONNECTIONS ON ALL NEW CONSTRUCTION

WHEREAS, inadequate drainage systems endanger public safety with the inundation of water on public roads, and;

WHEREAS, inadequate drainage systems can undermine the integrity of roads;

NOW, THEREFORE BE IT RESOLVED BY THE BOARD OF MAYOR AND ALDERMEN OF THE TOWN OF CORNERSVILLE, TENNESSEE AS FOLLOWS:

SECTION 1. Any new driveway connection where a drainage ditch runs parallel to a road requires a culvert and concrete headwall.

SECTION 2. A double-walled plastic culvert is the preferred type of culvert. The culvert diameter must be of sufficient size to accommodate upstream run-off and will depend on the depth of the drainage ditch.

SECTION 3. The concrete headwall must extend a minimum of six inches above the top of the culvert. The upstream side of the headwall must have wings extending from the culvert, the size of which depend on the width of the drainage ditch.

SECTION 4. A concrete or asphalt apron must extend from the paved portion of the roadway for a minimum of five linear feet. Depending on the distance from the paved portion of the roadway across the drainage ditch, the concrete or asphalt apron may be longer than five linear feet.

SECTION 5. If a certificate of occupancy is issued before the adoption of this Resolution, the driveway connection does not require a concrete headwall.

SECTION 6. If new construction has begun before adoption of this Resolution, a certificate of occupancy cannot be issued without a concrete headwall as prescribed above.

SECTION 7. If any section, clause, provision or portion of this Resolution is for any reason declared invalid or unconstitutional by any Court of competent jurisdiction, such holding shall not affect any other section, clause, provision or portion of this Resolution that is not itself invalid or unconstitutional.

This Resolution shall be effective immediately upon passage this 5th day of October, 2023, the public welfare requiring it.

John Luna, Mayor

Taylor Brandon, Town Recorder

Approved as to legality and form:

Billy Ostermann, Town Attorney

RESOLUTION 25-341

A RESOLUTION ADOPTING THE TOWN OF CORNERSVILLE US 31A CORRIDOR STUDY DATED JANUARY 2025

WHEREAS, Town of Cornersville Staff and stakeholders have met to discuss and provide input in the development of the study; and,

WHEREAS, the Tennessee Department of Transportation funded the study through a Community Transportation Planning Grant, and,

WHEREAS, the Town of Cornersville desires to improve the safety and operations of US 31A and adjacent streets in downtown for all road users; and,

WHEREAS, the Town of Cornersville will implement the components of the Corridor Study to the extent possible as resources are available; and,

WHEREAS, the Town of Cornersville Planning Commission recommended adoption of the US 31A Corridor Study on January 28, 2025; and,

NOW, THEREFORE BE IT RESOLVED BY THE BOARD OF MAYOR AND ALDERMEN OF THE TOWN OF CORNERSVILLE, TENNESSEE AS FOLLOWS:

SECTION 1. The Cornersville Board of Mayor and Aldermen approve the Tennessee Department of Transportation, Transportation Planning Grant US 31A Corridor Study.

SECTION 2. If any section, clause, provision or portion of this Resolution is for any reason declared invalid or unconstitutional by any Court of competent jurisdiction, such holding shall not affect any other section, clause, provision or portion of this Resolution that is not itself invalid or unconstitutional.

SECTION 3. All resolutions or parts of resolutions in conflict herewith are hereby repealed.

This Resolution shall be effective immediately upon passage this 6th day of February, 2025, the public welfare requiring it.

John Luna, Mayor

Taylor Brandon, Town Recorder

Approved as to legality and form:

Billy Ostermann, Town Attorney

RESOLUTION 25-349

A RESOLUTION SOLICITING BIDS FOR SMALL JOB EXCAVATION, DIRT MOVING, STREET WIDENING, HAULING, AND CULVERT WORK

WHEREAS, The Town of Cornersville will require multiple, small construction jobs relating to street improvements in the coming years.

WHEREAS, The Town wants to contract with one entity instead of bidding individual jobs.

NOW, THEREFORE BE IT RESOLVED BY THE BOARD OF MAYOR AND ALDERMEN OF THE TOWN OF CORNERSVILLE, TENNESSEE AS FOLLOWS:

SECTION 1. Taylor Brandon is authorized to request bids consistent with the Town's purchasing policy.

SECTION 2. If any section, clause, provision or portion of this Resolution is for any reason declared invalid or unconstitutional by any Court of competent jurisdiction, such holding shall not affect any other section, clause, provision or portion of this Resolution that is not itself invalid or unconstitutional.

This Resolution shall be effective immediately upon passage this 1st day of May, 2025, the public welfare requiring it.

John Luna, Mayor

Taylor Brandon, Town Recorder

Approved as to legality and form:

Billy Ostermann, Town Attorney

Cut/Fill Report

Generated: 2025-07-19 13:47:35

By user: Tyler Bagwell

Drawing: C:\Users\Tyler Bagwell\OneDrive - Southern Mapping & Drafting LLC\02 - Private Clients\0002 - Morrison Engineering\10 - Cornersville SW Extension\03 - Engineering\02 - CAD\01_XREFs\C:\Users\Tyler Bagwell\OneDrive - Southern Mapping & Drafting LLC\02 - Private Clients\0002 - Morrison Engineering\10 - Cornersville SW Extension\03 - Engineering\02 - CAD\01_XREFs\C00_Surface.dwg

Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Volumetric Surface	full	1.000	1.000	13394.06	42.50	89.86	47.36<Fill>

Totals

	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	13394.06	42.50	89.86	47.36<Fill>

* Value adjusted by cut or fill factor other than 1.0

Status of Land Acquisition

All permanent easements, land purchases, city/county/state right of ways, Department of Transportation, Corps of Engineers and railroad permits and any other land access agreements must be obtained and recorded (if applicable) with the appropriate agencies prior to ECD approval of plans and specifications.

Please check the following boxes and sign below:

Yes	No	N/A	
☐	☐	☐	All permanent easements necessary for the construction of this project have been acquired and recorded with the appropriate agency.
☐	☐	☐	All land acquisition necessary for the construction of this project has been acquired and recorded with the appropriate agency.
☐	☐	☐	All right-of-ways, permits, and land access agreements necessary for the construction of this project have been acquired and recorded with the appropriate agency(s).

OR

☑	☐	☐	The construction of this project requires no acquisition of land, permanent easements, right-of-ways, permits or land access agreements.

Signature of grantee, engineer/architect, or project administrator

7-25-2025
Date

This form must be sent to ECD before we can approve plans and specifications.

Community Development Block Grant Program
GENERAL CONDITIONS

1. Contract and Contract Documents

The project to be constructed and pursuant to this contract will be financed with assistance from the Tennessee Community Development Block Grant Program and is subject to all applicable Federal laws and regulations.

The Plans, Specifications and Addenda, hereinafter enumerated in Paragraph 1 of the Supplemental General Conditions shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light on the interpretation of the provisions to which they refer.

TABLE OF CONTENTS OF GENERAL CONDITIONS

GENERAL CONDITIONS

ARTICLE 1--DEFINITIONS

Wherever used in these General Conditions or in the other Contract

Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the Contract Documents.

1.2. *Agreement*--The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.3. *Application for Payment*--The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

1.5. *Bid*--The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6. *Bidding Documents*--The advertisement or invitation to Bid, instructions to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

1.7. *Bidding Requirements*--The advertisement or invitation to Bid, instructions to bidders, and the Bid form.

1.8. *Bonds*--Performance and Payment bonds and other instruments of security.

1.9. *Change Order*--A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

1.10. *Contract Documents*--The Agreement, Addenda (which pertain to the Contract Documents). CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER's written interpretations and classifications issued pursuant to paragraphs 3.5, 3.6.1, and 3.6.3 on or after the Effective Date of the Agreement. Shop Drawing submittals approved pursuant to paragraphs 6.26 and 6.27 and the reports and drawings referred to in paragraphs 4.2.1.1 and 4.2.2.2 are not Contract Documents.

1.11. *Contract Price*--The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

1.12. *Contract Times*--The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13.

1.13. *CONTRACTOR*--The person, firm or corporation with whom the OWNER has entered into the Agreement.

1.14. *defective*--An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

1.15. *Drawings*--The drawings which show the scope, extent and character of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents. Shop drawings are not Drawings as so defined.

1.16. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

1.17. *ENGINEER*--The person, firm or corporation named as such in the Agreement.

1.18. *ENGINEER's Consultant*--A person, firm, or corporation having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

1.19. *Field Order*--A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Times.

1.20. *General Requirements*--Sections of Division 1 of the Specifications.

1.21. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

1.22. *Laws and Regulations: Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

1.23. *Liens*--Liens, charges, security interests or encumbrances upon real property or personal property.

1.24. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

1.25. *Notice of Award*--The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

1.26. *Notice to Proceed*--A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR's obligations under the Contract Documents.

1.27. *OWNER*--The public body or authority, corporation, association, firm or person with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

1.28. *Partial Utilization*--Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

1.29. *PCBs*--Polychlorinated biphenyls.

1.30. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.

1.31. *Project*--The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

1.32. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

1.33. *Resident Project Representative*--The authorized representative of ENGINEER who may be assigned to the site or any part thereof.

1.34. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

1.35. *Shop Drawings*--All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

1.36. *Specifications*--Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.37. *Subcontractor*--An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.38. *Substantial Completion*--The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.39. *Supplementary Conditions*--The part of the Contract Documents which amends or supplements these General Conditions.

1.40. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.41. *Underground Facilities*--All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

1.42. *Unit Price Work*--Work to be paid for on the basis of unit prices.

1.43. *Work*--The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

1.44. *Work Change Directive*--A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2 or 4.3 or to emergencies under paragraph 6.23. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times as provided in paragraph 10.2.

1.45. Written Amendment--A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the nonengineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

ARTICLE 2--PRELIMINARY MATTERS

Delivery of Bonds:

2.1. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds

as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2. OWNER shall furnish to CONTRACTOR up to ten copies (unless otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Times; Notice to Proceed:

2.3. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

Starting the Work:

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run, but no Work shall be done at the site prior to the date on which the Contract Times commence to run.

Before Starting Construction:

2.5. Before undertaking each part of the Work, CONTRACT-OR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents, unless CONTRACTOR knew or reasonably should have known thereof.

2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2.6.2. a preliminary schedule for Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing and processing such submittal;

2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.7. Before any Work at the site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with paragraphs 5.4, 5.6 and 5.7.

Preconstruction Conference:

2.8. Within twenty days after the Contract Times start to run, but before any Work at the site is started, a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.6, procedures for handling Shop Drawings and other submittals, processing Applications for Payment and maintaining required records.

Initially Acceptable Schedules:

2.9. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.6. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until the schedules are submitted to and acceptable to ENGINEER as provided below. The progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within any specified Milestones and the Contract Times, but such acceptance will neither impose on ENGINEER responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefore. CONTRACTOR's schedule of Shop Drawing and Sample submissions will be acceptable to ENGINEER as providing a workable arrangement for reviewing and processing the required submittals. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance.

ARTICLE 3--CONTRACT DOCUMENT: INTENT, AMENDING, REUSE

Intent:

3.1. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for. When words or phrases which have a well-known technical or construction industry or trade meaning are used to describe Work, materials or equipment, such words or phrases shall be interpreted in accordance with that meaning. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3. Reference to Standards and Specifications of Technical Societies; Reporting and Resolving Discrepancies:

3.3.1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

3.3.2. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any such Law or Regulation applicable to the performance of the Work or of any such standard, specification, manual or code or of any instruction of any Supplier referred to in paragraph 6.5, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.23) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.5 or 3.6; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

3.3.3. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement thereto issued by one of the methods indicated in paragraph 3.5 or 3.6, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and:

3.3.3.1. the provisions of any such standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

3.3.3.2. the provisions of any such Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

No provision of any such standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's Consultants, agents or employees any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.13 or any other provision of the Contract Documents.

3.4. Whenever in the Contract Documents the terms" as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.13 or any other provision of the Contract Documents.

Amending and Supplementing Contract Documents:

3.5. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.5.1. a formal Written Amendment.

3.5.2. a Change Order (pursuant to paragraph 10.4), or

3.5.3. a Work Change Directive (pursuant to paragraph 10.1).

3.6. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

3.6.1. a Field Order (pursuant to paragraph 9.5),

3.6.2. ENGINEER's approval of a Shop Drawing or Sample (pursuant to paragraphs 6.26 and 6.27), or

3.6.3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.7. CONTRACTOR, and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER.

ARTICLE 4--AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

Availability of Lands:

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a correct statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws and Regulations. OWNER shall identify any encumbrances or restrictions not of general application but

specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR and OWNER are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in OWNER's furnishing these lands, rights-of-way or easements, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2. Subsurface and Physical Conditions:

4.2.1. *Reports and Drawings*: Reference is made to the Supplementary Conditions for identification of:

4.2.1.1. *Subsurface Conditions*: Those reports of explorations and tests of subsurface conditions at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents; and

4.2.1.2. *Physical Conditions*: Those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) that have been utilized by ENGINEER in preparing the Contract Documents.

4.2.2. *Limited Reliance by CONTRACTOR Authorized: Technical Data*: CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data." CONTRACTOR may not rely upon or make any claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

4.2.2.1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto, or

4.2.2.2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or

4.2.2.3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

4.2.3. *Notice of Differing Subsurface or Physical Conditions*: If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the site that is uncovered or revealed either:

4.2.3.1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is materially inaccurate, or

4.2.3.2. is of such a nature as to require a change in the Contract Documents, or

4.2.3.3. differs materially from that shown or indicated in the Contract Documents, or

4.2.3.4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then

CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.23), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such conditions or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

4.2.4. *ENGINEER's Review*: ENGINEER will promptly review the pertinent conditions, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

4.2.5. *Possible Contract Documents Change*: If ENGINEER concludes that a change in the Contract Documents is required as a result of a condition that meets one or more of the categories in paragraph 4.2.3., a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document the consequences of such change.

4.2.6. *Possible Price and Times Adjustments*: An equitable adjustment in the Contract Price or in the Contract Times, or both, will be allowed to the extent that the existence of such uncovered or revealed condition causes an increase or decrease in CONTRACTOR's cost of, or time required for performance of, the Work; subject, however, to the following:

4.2.6.1. such condition must meet any one or more of the categories described in paragraphs 4.2.3.1 through 4.2.3.4, inclusive;

4.2.6.2. a change in the Contract Documents pursuant to paragraph 4.2.5 will not be an automatic authorization of nor a condition precedent to entitlement to any such adjustment;

4.2.6.3. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of paragraphs 9.10 and 11.9; and

4.2.6.4. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Times if;

4.2.6.4.1. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a bid or becoming bound under a negotiated contract; or

4.2.6.4.2. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test or study of the site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

4.2.6.4.3. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.2.3.

If OWNER and CONTRACTOR are unable to agree on entitlement to or as to the amount or length of any such equitable adjustment in the Contract Price or Contract Times, a claim may be made therefore as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.3. Physical Conditions--Underground Facilitates:

4.3.1. *Shown or Indicated*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

4.3.1.2. The cost of all of the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for: (i) reviewing and checking all such information and data, (ii) locating all Underground Facilities shown or indicated in the Contract Documents, (iii) coordination of the Work with the owners of such Underground Facilities during construction, and (iv) the safety and protection of all such Underground Facilities as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work.

4.3.2. *Not Shown or Indicated*: If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.23), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence of the Underground Facility. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued as provided in Article 10 to reflect and document such consequences. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, to the extent that they are attributable to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or the amount or length of any such adjustment in Contract Price or Contract Times, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12. However, OWNER, ENGINEER and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses or damages incurred or sustained by CONTRACTOR on or in connection with any other project or anticipated project.

Reference Points:

4.4. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

4.5. Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material:

4.5.1. OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. OWNER shall not be responsible for any such materials brought to the site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible.

4.5.2. CONTRACTOR shall immediately: (i) stop all Work in connection with such hazardous condition and in any area affected thereby (except in an emergency as required by paragraph 6.23), and (ii) notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such hazardous condition or take corrective action, if any. CONTRACTOR shall not be required to resume Work in connection with such hazardous condition or in any such affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a claim therefore as provided in Articles 11 and 12.

4.5.3. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such hazardous condition or in such affected area to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a claim therefore as provided in Articles 11 and 12. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

4.5.4. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all

claims, costs, losses and damages arising out of or resulting from such hazardous condition, provided that: (i) any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting there from, and (ii) nothing in this subparagraph 4.5.4 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

4.5.5. The provisions of paragraphs 4.2 and 4.3 are not intended to apply to Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site.

ARTICLE 5--BONDS AND INSURANCE

Performance, Payment and Other Bonds:

5.1. CONTRACTOR shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within ten days thereafter substitute another Bond and surety, both of which must be acceptable to OWNER.

5.3. Licensed Sureties and Insurers; Certificates of Insurance:

5.3.1. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.3.2. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to purchase and maintain in accordance with paragraph 5.4. OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7 hereof.

CONTRACTOR's Liability Insurance:

5.4. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and furnished and as will provided protection from claims set forth below which may arise out of or result from CONTRACTOR's performance and furnishing of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

5.4.1. claims under workers' compensation, disability benefits and other similar employee benefit acts;

5.4.2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;

5.4.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;

5.4.4. claims for damages insured by customary personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR , or (ii) by any other person for any other reason;

5.4.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting there from; and

5.4.6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The policies of insurance so required by this paragraph 5.4 to be purchased and maintained shall:

5.4.7. with respect to insurance required by paragraphs 5.4.3. through 5.4.6 inclusive, include as additional insured (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insured, and include coverage for the respective officers and employees of all such additional insured;

5.4.8. include the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

5.4.9. include completed operations insurance;

5.4.10. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.12, 6.16 and 6.31 through 6.33;

5.4.11. contain a provision or endorsement that the coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.3.2 will so provide);

5.4.12. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing *defective* Work in accordance with paragraph 13.12; and

5.4.13. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).

OWNER's Liability Insurance:

5.5. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.4, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Property Insurance:

5.6. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

5.6.1. include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.6.2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work and Work in transit and shall insure against at least the following perils fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils as may be specifically required by the Supplementary Conditions;

5.6.3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.6.4. cover materials and equipment stored at the site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER; and

5.6.5. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

5.8. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.11.

5.9. OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount, will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraphs 5.6 or 5.7, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

5.11. Waiver of Rights:

5.11.1. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraphs 5.6 and 5.7 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds in such policies and will provide primary coverage for all losses and damages caused by the perils covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants and all other persons or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds under such policies for losses and damages so caused. None of the above waivers shall extend to the

rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11.2. In addition, OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them, for:

5.11.2.1. loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of or resulting from fire or other peril, whether or not insured by OWNER; and

5.11.2.2. loss or damage to the completed Project or part thereof caused by, arising out of or resulting from fire or other insured peril covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.10, after substantial completion pursuant to paragraph 14.8 or after final payment pursuant to paragraph 14.13.

Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in this paragraph 5.11.2 shall contain provisions to the effect that in the event of payment of any such loss, damage or consequential loss the insurers will have no rights of recovery against any of CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees and agents of any of them.

Receipt and Application of Insurance Proceeds

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

5.13. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

Acceptance of Bonds and Insurance; Option to Replace;

5.14. If either party (OWNER or CONTRACTOR) has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within ten days after receipt of the certificates (or other evidence requested) required by paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work , or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

Partial Utilization--Property Insurance:

5.15. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be cancelled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6--CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1. CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site. Except as otherwise required for the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.4. Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

Progress Schedule:

6.6. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.9 as it may be adjusted from time to time as provided below:

6.6.1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.9) proposed adjustments in the progress schedule that will not change the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

6.6.2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of paragraph 12.1. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

6.7. Substitutes and "Or-Equal" Items:

6.7.1. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be accepted by ENGINEER under the following circumstances:

6.7.1.1. *"Or-Equal"*: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

6.7.1.2. *Substitute Items:* If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under subparagraph 6.7.1.1., it will be considered a proposed substitute item. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. The procedure for review by the ENGINEER will include the following as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall first make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute.

6.7.1.3. *CONTRACTOR's Expense:* All data to be provided by CONTRACTOR in support of any proposed "or-equal" or substitute item will be at CONTRACTOR's expense.

6.7.2. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.7.1.2.

6.7.3. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.7.1.2 and 6.7.2. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without ENGINEER's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in

evaluating substitutes proposed or submitted by CONTRACTOR pursuant to paragraphs 6.7.1.2 and 6.7.2 and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER accepts a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute item.

Concerning Subcontractors, Suppliers and Others:

6.8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organization (including those who are to furnish the principal items of materials or equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's or ENGINEER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be removed on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be adjusted by the difference in the cost occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject *defective* Work.

6.9.1. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between OWNER and ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by Laws and Regulations.

6.9.2. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

6.10. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.6 or 5.7, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

Patent Fees and Royalties:

6.12. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents.

Permits:

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Laws and Regulations:

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

6.14.2. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses and damages caused by, arising out of or resulting there from; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR or CONTRACTOR's obligations under paragraph 3.3.2.

Taxes:

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

Use of Premises:

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. CONTRACTOR shall leave the site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved Samples and a counter part of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection:

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

6.20.1. all persons on the Work site or who may be affected by the Work;

6.20.2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant or anyone employed by any of them or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

Safety Representative:

6.21. CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

Hazard Communication Program:

6.22. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with Laws or Regulations.

Emergencies:

6.23. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.24. ***Shop Drawings and Samples:***

6.24.1. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawings and Sample submittals (see paragraph 2.9). All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.26.

6.24.2. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with said accepted schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.26. The numbers of each Sample to be submitted will be as specified in the Specifications.

6.25. ***Submittal Procedures:***

6.25.1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

6.25.1.1. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar information with respect thereto.

6.25.1.2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and

6.25.1.3. all information relative to CONTRACTOR's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

6.25.2. Each submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

6.25.3. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawings or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals accepted by ENGINEER as required by paragraph 2.9. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed project as a functioning whole as indicated by the Contract Documents. ENGINEER's review and approval will not extend to means, methods, techniques, sequences or procedures of construction (except where particular means, method, technique, sequence or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission as required by paragraph 6.25.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.25.1.

6.28. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submissions accepted by ENGINEER as required by paragraph 2.9, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6.29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.30. ***CONTRACTOR's General Warranty and Guarantee***

6.30.1. CONTRACTOR warrants and guarantees to OWNER, ENGINEER and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be *defective*. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

6.30.1.1. abuse, modification or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors or Suppliers; or

6.30.1.2. normal wear and tear under normal usage.

6.30.2. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

6.30.2.1. observations by ENGINEER;

6.30.2.2. recommendation of any progress or final payment by ENGINEER;

6.30.2.3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

6.30.2.4. use or occupancy of the Work or any part thereof by OWNER;

6.30.2.5. any acceptance by OWNER or any failure to do so;

6.30.2.6. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13;

6.30.2.7. any inspection, test or approval by others; or

6.30.2.8. any correction of *defective* Work by OWNER.

Indemnification:

6.31. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents and other consultants of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused by, arising out of or resulting from the performance of the Work, provided that any such claim, cost, loss or damage: (i) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting there from, and (ii) is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity.

6.32. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.31 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier or other person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.33. The indemnification obligations of CONTRACTOR under paragraph 6.31 shall not extend to the liability of ENGINEER and ENGINEER's Consultants, officers, directors, employees or agents caused by the professional negligence errors or omissions of any of them.

Survival of Obligations:

6.34. All representatives, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

ARTICLE 7--OTHER WORK

Related Work at Site:

7.1. OWNER may perform other work related to the Project at the site by OWNER's own forces, or let other direct contracts therefore which shall contain General Conditions similar to these, or have other work performed by utility owners. If the fact that such other work is to be performed was not noted in the Contract Documents, then: (i) written notice thereof will be given to CONTRACTOR prior to starting any such other work, and (ii) CONTRACTOR may make a claim therefore as provided in Articles 11 and 12 if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the amount or extent thereof.

7.2. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the additional work with OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that render it unavailable or unsuitable

for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure so to report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent or nonapparent defects and deficiencies in such other work.

Coordination:

7.4. If OWNER contracts with others for the performance of other work on the Project at the site, the following will be set forth in Supplementary Conditions:

7.4.1. the person, firm or corporation who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

7.4.2. the specific matters to be covered by such authority and responsibility will be itemized; and

7.4.3. the extent of such authority and responsibilities will be provided.

Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8--OWNER'S RESPONSIBILITIES

8.1. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.3. OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and drawings of physical conditions in existing structures at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents.

8.5. OWNER's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.10.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER's responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8. In connection with OWNER's right to stop Work or suspend Work, see paragraphs 13.10 and 15.1. Paragraph 15.2 deals with OWNER's right to terminate services of CONTRACTOR under certain circumstances.

8.9. The OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.10. OWNER's responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Materials uncovered or revealed at the site is set forth in paragraph 4.5.

8.11. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9--ENGINEER'S STATUS DURING CONSTRUCTION

OWNER's Representative:

9.1. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

Visits to Site:

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER will endeavor for the benefit of OWNER to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and on-site observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against *defective* Work. ENGINEER's visits and on-site observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.13, and particularly, but without limitation, during or as a result of ENGINEER's on-site visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

Project Representative:

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.13 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other person will be as provided in the Supplementary Conditions.

Clarifications and Interpretations:

9.4. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with the intent of and reasonably inferable from Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER or CONTRACTOR believes that a written clarification or interpretation justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree to the amount or extent thereof, if any, OWNER or CONTRACTOR may make a written claim therefore as provided in Article 11 or Article 12.

Authorized Variations in Work:

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR who shall perform the Work involved promptly. If OWNER or CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or the Contract Times and the parties are unable to agree as to the amount or extent thereof, OWNER or CONTRACTOR may make a written claim therefore as provided in Article 11 or 12.

Rejecting Defective Work:

9.6. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be *defective*, or that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraphs 6.24 through 6.28 inclusive.

9.8. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

9.9. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

Determinations for Unit Price:

9.10. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other and to ENGINEER written notice of intention to appeal from ENGINEER's decision and: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in Exhibit GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to ENGINEER's decision, unless otherwise agreed in writing by OWNER and CONTRACTOR. Such appeal will not be subject to the procedures of paragraph 9.11.

Decisions on Disputes:

9.11. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and Claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph. Written notice of each such claim, dispute or other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after the start of such occurrence or event unless ENGINEER allows an additional period of time for the submission of additional or more accurate data in support of such claim, dispute or other matter. The opposing party shall submit any response to ENGINEER and the claimant within thirty days after receipt of the claimant's last submittal (unless ENGINEER allows additional time). ENGINEER will render a formal decision in writing within thirty days after receipt of the opposing party's submittal, if any, in accordance with this paragraph. ENGINEER's written decision on such claim, dispute or other matter will be final and binding upon OWNER and CONTRACTOR unless: (i) an appeal from ENGINEER's decision is taken within the time limits and in accordance with the procedures set forth in EXHIBIT GC-A, "Dispute Resolution Agreement," entered into between OWNER and CONTRACTOR pursuant to Article 16, or (ii) if no such Dispute Resolution Agreement has been entered into, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within thirty days after the date of such decision and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction to exercise such rights or remedies as the appealing party may have with respect to such claim, dispute or other matter in accordance with applicable Laws and Regulations within sixty days of the date of such decision, unless otherwise agreed in writing by OWNER and CONTRACTOR.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 or

9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter pursuant to Article 16.

9.13. Limitations on ENGINEER's Authority and Responsibilities:

9.13.1. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise or performance of any authority or responsibility by ENGINEER shall create, impose or give rise to any duty owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them.

9.13.2. ENGINEER will not supervise, direct, control or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

9.13.3. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

9.13.4. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and Other documentation required to be delivered by paragraph 14.12 will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with, the Contract Documents.

9.13.5. The limitations upon authority and responsibility set forth in this paragraph 9.13 shall also apply to ENGINEER's Consultants, Resident Project Representative and assistants.

ARTICLE 10--CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such additions, deletions or revisions will be authorized by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of a Work Change Directive, a claim may be made therefore as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.5 and 3.6 except in the case of any emergency as provided in paragraph 6.23 or in the case of uncovering Work as provided in paragraph 13.9.

10.4. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

10.4.1. changes in the Work which are (i) ordered by OWNER pursuant to paragraph 10.1, (ii) required because of acceptance of *defective* Work under paragraph 13.13 or correcting *defective* Work under paragraph 13.14, or (iii) agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Times which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11;

provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

ARTICLE 11--CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at CONTRACTOR's expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the start of the occurrence or event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after the start of such occurrence or event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the adjustment claimed covers all known amounts to which the claimant is entitled as a result of said occurrence or event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise

agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3. The value of any Work covered by a Change Order or of any claim for an adjustment in the Contract Price will be determined as follows:

11.3.1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1 through 11.9.3, inclusive);

11.3.2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2);

11.3.3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.3.2, on the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 11.6).

Cost of the Work:

11.4. The term Cost of the Work means the sum of all costs necessarily incurred and paid by Contractor in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amount no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5:

11.4.1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen and other personnel employed full-time at the site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by OWNER.

11.4.2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3. Payments made by CONTRACTOR to the Subcontractors for Work performed or furnished by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids, if any, will be accepted. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in paragraphs 11.4, 11.5, 11.6 and 11.7. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used but not consumed which remain the property of CONTRACTOR.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof--all in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is

placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1. or specifically covered by paragraph 11.4.4--all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

11.5.2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the site.

11.5.3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9 above).

11.5.5. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of *defective* Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

11.6. The CONTRACTOR's fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee

11.7. Whenever the cost of any Work is to be determined pursuant to paragraphs 11.4 and 11.5, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowance:

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be furnished and performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

11.8.1. the allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR's cost for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances and no demand for additional payment on account of any of the foregoing will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.9. ***Unit Price Work:***

11.9.1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with paragraph 9.10.

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

11.9.3. OWNER or CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 11 if:

11.9.3.1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

11.9.3.2. there is no corresponding adjustment with respect to any other item of Work; and

11.9.3.3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12--CHANGE OF CONTRACT TIMES

12.1. The Contract Times (or Milestones) may only be changed by a Change Order or a Written Amendment. Any claim for an adjustment of the Contract Times (or Milestones) shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Times (or Milestones) shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Times (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. All time limits stated in the Contract Documents are of the essence of the Agreement.

12.3. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a claim is made therefore as provided in paragraph 12.1. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.4. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay. In no event shall OWNER be liable to CONTRACTOR, any Subcontractor, any Supplier, any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from (i) delays caused by or within the control of CONTRACTOR, or (ii) delays beyond the control of both parties including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

ARTICLE 13--TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF *DEFECTIVE* WORK

13.1. *Notice of Defects*: Prompt notice of all *defective* Work of which OWNER or ENGINEER have actual knowledge will be given to CONTRACTOR. All *defective* Work may be rejected, corrected or accepted as provided in this Article 13.

Access to Work:

13.2. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories and governmental agencies with jurisdiction interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

Tests and Inspections:

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.4. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

13.4.1. for inspections, tests or approvals covered by paragraph 13.5 below;

13.4.2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.9 below shall be paid as provided in said paragraph 13.9; and

13.4.3. as otherwise specifically provided in the Contract Documents.

13.5. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection, or approval. CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work, or of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

13.6. If any Work (or the work of others) that is to be inspected, tested or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

13.7. Uncovering Work as provided in paragraph 13.6 shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

Uncovering Work:

13.8. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefore as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12.

OWNER May Stop the Work:

13.10. If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any surety or other party.

Correction or Removal of Defective Work:

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with Work that is not *defective*. CONTRACTOR shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.12. ***Correction Period:***

13.12.1. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with Work that is not *defective*, and (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting there from. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.

13.12.2. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

13.12.3. Where *defective* Work (and damage to other Work resulting there from) has been corrected, removed or replaced under this paragraph 13.12, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

Acceptance of Defective Work:

13.13. If, instead of requiring correction or removal and replacement of *defective* Work OWNER (and, prior to ENGINEER's recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all claims, costs, losses and damages attributable to OWNER's evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness). If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefore as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, of if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors and ENGINEER and ENGINEER's Consultants access to the site to enable OWNER to

exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by OWNER in exercising such rights and remedies will be charged against CONTRACTOR and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefore as provided in Article 11. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies hereunder.

ARTICLE 14--PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1. The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment

14.2. At least twenty days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER's interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

CONTRACTOR's Warranty of Title:

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

Review of Applications for Progress Payment:

14.5. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's on-site observations of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

14.5.1. the Work has progressed to the point indicated.

14.5.2. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation), and

14.5.3. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or (ii) that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

14.6. ENGINEER's recommendation of any payment, including final payment, shall not mean that ENGINEER is responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work, or for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.5. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

14.7.1. the Work is *defective*, or completed Work has been damaged requiring correction or replacement,

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct *defective* Work or complete Work in accordance with paragraph 13.14, or

14.7.4. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.4 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

14.7.5. claims have been made against OWNER on account of CONTRACTOR's performance or furnishing of the Work,

14.7.6. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens.

14.7.7. there are other items entitling OWNER to a set-off against the amount recommended, or

14.7.8. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.71. through 14.7.3 or paragraphs 15.2.1 through 15.2.4 inclusive;

but OWNER must have CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

Substantial Completion:

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefore. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefore. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10. Use by OWNER at OWNER's option of any substantially completed part of the Work which: (i) has specifically been identified in the Contract Documents, or (ii) OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefore. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

14.10.2. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or *defective*. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

Final Application for Payment:

14.12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance required by paragraph 5.4, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.4.13, (ii) consent of the surety, if any, to final payment, and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu of such releases or waivers of Liens and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and (ii) all payrolls, material and equipment bills and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

Final Payment and Acceptance:

14.13. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Waiver of Claims:

14.15. The making and acceptance of final payment will constitute:

14.15.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from *defective* Work appearing after final inspection pursuant to paragraph 14.11, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

14.15.2. a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

ARTICLE 15--SUSPENSION OF WORK AND TERMINATION

OWNER May Suspend Work:

15.1. At any time and without cause, OWNER may suspend the Work, or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes an approved claim therefore as provided in Articles 11 and 12.

OWNER May Terminate:

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as adjusted from time to time pursuant to paragraph 6.6);

15.2.2. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.3. if CONTRACTOR disregards the authority of ENGINEER; or

15.2.4. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if any,) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which Owner has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses and damages sustained by OWNER arising out of or resulting from completing the Work such excess will be paid to CONTRACTOR. If such claims, costs, losses and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses and damages incurred by

OWNER will be reviewed by ENGINEER as to their reasonableness and when so approved by ENGINEER incorporated in a Change Order, provided that when exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of monies due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven day's written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items);

15.4.1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

15.4.2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

15.4.3. for all claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

15.4.4. for reasonable expenses directly attributable to termination.

CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

CONTRACTOR May Stop Work or Terminate:

15.5. If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application of Payment within thirty days after it is submitted or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, and provided OWNER and ENGINEER do not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.4. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within thirty days after it is submitted, or OWNER has failed for thirty days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may upon seven day's written notice to OWNER and ENGINEER stop the Work until payment of all such amount due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.5 are not intended to preclude CONTRACTOR from making claim under Articles 11 and 12 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to CONTRACTOR's stopping Work as permitted by this paragraph.

ARTICLE 16--DISPUTE RESOLUTION

If and to the extent that OWNER and CONTRACTOR have agreed on the method and procedure for resolving disputes between them that may arise under this Agreement, such dispute resolution method and procedure, if any, shall be as set forth in Exhibit GC-A, "Dispute Resolution Agreement," to be attached hereto and made a part hereof. If no such agreement on the method and procedure for resolving such disputes has been reached, and subject to the provisions of paragraphs 9.10, 9.11, and 9.12, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17--MISCELLANEOUS

Giving Notice:

17.1. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Times:

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight will constitute a day.

Notice of Claim:

17.3. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

Cumulative Remedies:

17.4. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon CONTRACTOR by paragraphs 6.12, 6.16, 6.30, 6.31, 6.32, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER thereunder, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

Professional Fees and Court Costs Included:

17.5. Whenever reference is made to "claims, costs, losses and damages," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

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INDEX TO SUPPLEMENTAL GENERAL CONDITIONS

1. ENUMERATION OF PLANS, SPECIFICATIONS AND ADDENDA

Following are the Plans, Specifications and Addenda which form a part of this contract, as set forth in Paragraph 1 of the General Conditions, "Contract and Contract Documents":

DRAWINGS

General Construction:	Nos.	C0.0 to C3.4
Heating and Ventilating:	"	-
Plumbing:	"	-
Electrical:	"	-
N/A:	"	-
N/A:	"	-

SPECIFICATIONS:

General Construction	Page	123	to	677 ,	incl.
	Page	-	to	- ,	incl.
Heating and Ventilating:	Page	-	to	- ,	incl.
Plumbing:	Page	-	to	- ,	incl.
Electrical:	Page	-	to	- ,	incl.
N/A:	Page	-	to	- ,	incl.
N/A:	Page	-	to	- ,	incl.

ADDENDA:

No.	N/A:	Date	-	No.	- Date -
No.	N/A:	Date	-	No.	- Date -

2. STATED ALLOWANCES

Pursuant to Article 11.8 of the General Conditions, the Contractor shall include the following cash allowances in his proposal:

(a) For _____ (Page _____ of Specifications) $

(b) For _____ (Page _____ of Specifications) $

(c) For _____ (Page _____ of Specifications) $

(d) For _____ (Page _____ of Specifications) $

(e) For _____ (Page _____ of Specifications) $

(f) For _____ (Page _____ of Specifications) $ _____

3. A. Payments to Contractor

1. To insure the proper performance of this contract, the Owner shall retain five percent (5%) of the amount of each estimate until final completion and acceptance of all work covered by this contract: Provided that the Contractor shall submit his estimate not later than the first day of the month: Provided further that on completion and acceptance of each separate building, public work, or other division of the contract, on which the price is stated separately in the contract, payment may be made in full, including retained percentages thereon, less authorized deductions.

2. In preparing estimates the material delivered on the site and preparatory work done may be taken into consideration.

3. All material and work covered by partial payments made shall thereupon become the sole property of the Owner, but this provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and work upon which payments have been made or the restoration of any damaged work, or as a waiver of the right of the Owner to require the fulfillment of all of the terms of the contract.

4. Owner's Right to Withhold Certain Amounts and Make Application Thereof: The Contractor agrees that he will indemnify and save the Owner harmless from all claims growing out of the lawful demands of subcontractors, laborers, workers, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this contract. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If the Contractor fails so to do, then the Owner may, after having served written notice on the said Contractor, either pay unpaid bills, of which the Owner has written notice, direct, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of this contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor or his Surety. In paying any unpaid bills of the Contractor, the Owner shall be deemed the agent of the Contractor, and any payment so made by the Owner shall be considered as a payment made under the contract by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

B. Payments by Contractor

The Contractor shall pay (a) for all transportation and utility services not later than the 20th day of the calendar month following that in which services are rendered, (b) for all materials, tools, and other expendable equipment to the extent of ninety percent (90%) of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools, and equipment are delivered at the site of the project, and the balance of the cost thereof, not later than the 30th day following the completion of that part of the work in or on which such materials, tools, and equipment are incorporated or used, and (c) to each of his subcontractors, not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his subcontractors to the extent of each subcontractor's interest therein.

C. Time for Completion and Liquidated Damages

It is hereby understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion as specified in the contract of the work to be done hereunder are ESSENTIAL CONDITIONS of this contract; and it is further mutually understood and agreed that the work embraced in this contract shall be commenced on a date to be specified in the "Notice to Proceed".

The Contractor agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the work described herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

If the said Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of this contract, to pay to the Owner the amount specified in the contract, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the contract for completing the work.

The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be retained from time to time by the Owner from current periodical estimates.

It is further agreed that time is of the essence of each and every portion of this contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this contract. Provided that the Contractor shall not be charged with liquidated damages or any excess cost when the Owner determines that the Contractor is without fault and the Contractor's reasons for the time extension are acceptable to the Owner; Provided further that the Contractor shall not to be charged with liquidated damages or any excess cost when the delay in completion of the work is due:

(a) To any preference, priority or allocation order duly issued by the Government.

(b) To unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and severe weather; and

(c) To any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsections (a) and (b) of this article:

Provided further that the Contractor shall, within ten (10) days from the beginning of such delay, unless the Owner shall grant a further period of time prior to the date of final settlement of the contract, notify the Owner, in writing, of the delay and notify the Contractor within a reasonable time of its decision in the matter.

D. Protection of Lives and Health

"The Contractor shall exercise proper precaution at all times for the protection of persons and property and shall be responsible for all damages to persons or property, either on or off the site, which occur as a result of his prosecution of the work. The safety provisions of applicable laws and building and construction codes, in addition to specific safety and health regulations described by Chapter XIII, Bureau of Labor Standards, Department of Labor, Part 1518, Safety and Health Regulations for Construction, as outlined in the Federal Register, Volume 36, No. 75, Saturday, April 17, 1971. Title 29 - LABOR, shall be observed and the Contractor shall take or cause to be taken, such additional safety and health measures as the Contracting Authority may determine to be reasonably necessary."

E. Subcontracts

The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5 (a)(1) through (10) and such other clauses as the (Department of Housing and Urban Development) may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses 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.

F. Interest of Member of or Delegate to Congress

No member of or Delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract or to any benefit that may arise there from, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

G. Other Prohibited Interests

No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part hereof. No officer, employee, architect, attorney, engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

H. Use and Occupancy Prior to Acceptance by Owner

The Contractor agrees to the use and occupancy of a portion or unit of the project before formal acceptance by the Owner, provided the Owner:

(a) Secures written consent of the Contractor except in the event, in the opinion of the Architect/Engineer, the Contractor is chargeable with unwarranted delay in final clean-up of punch list items or other contract requirements.

(b) Secures endorsement from the insurance carrier and consent of the surety permitting occupancy of the building or use of the project during the remaining period of construction, or,

(c) When the project consists of more than one building, and one of the buildings is occupied, secures permanent fire and extended coverage insurance, including a permit to complete construction. Consent of the surety must also be obtained.

I. Photographs of the Project

If required by the Owner, the Contractor shall furnish photographs of the project, in the quantities and as described in the Supplemental General Conditions.

J. Suspension of Work

Should the Owner be prevented or enjoined from proceeding with work either before or after the start of construction by reason of any litigation or other reason beyond the control of the Owner, the Contractor shall not be entitled to make or assert claim for damage by reason of said delay; but time for completion of the work will be extended to such reasonable time as the Owner may determine will compensate for time lost by such delay with such determination to be set forth in writing.

4. FEDERAL LABOR STANDARDS PROVISIONS

Applicability

The Project or Program to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such Federal assistance.

A. 1. (i) Minimum Wages

All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), 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 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less than 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 Part 5.5(a)(iv). 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 29 FR Part 5.5(a)(1)(ii) 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.

(ii)(a) Any class of laborers or mechanics 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. HUD shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee 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 HUD or its designee to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(c) In the event the contractor, the laborers or mechanics to be employed in the classification or their representative, and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(d) The wage rate (including the fringe benefits where appropriate) determined pursuant to subparagraphs (1)(b) or (c) of this paragraph, 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.

(iii) 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.

(iv) If the contractor does not make payments to a trustee or other third persons, 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. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

2. Withholding

HUD or its designee 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 and trainees, 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 or trainee, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, HUD or its designee may, after written notice to the contractor, sponsor, applicant, or owner, 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. HUD or its designee may, after written notice to the contractor, disburse such amounts withheld for and on account of the contractor or subcontractor to the respective employees to whom they are due. The Comptroller General shall make sure disbursements in the case of direct Davis-Bacon Act contracts.

3. (i) Payrolls and basic records.

Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). 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. (Approved by the Office of Management and Budget under OMB Control Numbers 1215-0140 and 1215-0017.)

(ii)(a) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR Part 5.5(a)(3)(i). This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. (Approved by the Office of Management and Budget under OMB Control Number 1215-0149).

(b) 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:

(1) That the payroll for the payroll period contains the information required to be maintained under 29 CFR Part 5.5(a)(3)(i) and that such information is correct and complete;

(2) That each laborer or mechanic (including each 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 29 CFR Part 3;

(3) 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.

(c) 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 A.3.(ii)(b) of this section.

(d) 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.

(iii) The contractor or subcontractor shall make the records required under paragraph A.3.(i) of this section available for inspection, copying, or transcription by authorized representative of HUD or its designee or the Department of Labor, and shall permit such representative 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, HUD or its designee may, after written notice to the contractor, sponsor, applicant, or owner, 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 Part 5.12.

4. (i) Apprentices.

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, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, 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 Bureau of Apprenticeship and Training 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 Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, 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.

(ii) Trainees.

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 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.

(iii) Equal employment opportunity.

The utilization of apprentices, trainees and journeyman under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

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 will insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as HUD or its designee may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses 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 Part 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 HUD or its designee, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

    (i) 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) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.
    (ii) 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) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.
    (iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001. Additionally, U.S. Criminal Code, Section 1010, Title 18, U.S.C., "Federal Housing Administration transactions", provides in part "Whoever, for the purpose of ...influencing in any way the action of such Administration ...makes, utters or publishes any statement, knowing the same to be false ...shall be fined not more than $5,000 or imprisoned not more than two years, or both."

11. Complaints, Proceedings, or Testimony by Employees.

    No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this Contract are applicable shall be discharged or in any other manner discriminated against by the Contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contract to his employer.

B. Contract Work Hours and Safety Standards Act

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 subparagraph (1) of this paragraph, the contractor and any subcontractor responsible therefore 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 subparagraph (1) of this paragraph, 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 subparagraph (1) of this paragraph.

3. Withholding for unpaid wages and liquidated damages.

   HUD or its designee 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 contract, 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 subparagraph (2) of this paragraph.

4. Subcontracts.

   The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph 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 subparagraphs (1) through (4) of this paragraph.

C. Health and Safety

1. No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

2. The contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 (formerly part 1518) and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (Public Law 91-54, 83 Stat. 96).

3. The Contractor shall include the provisions of this Article in every subcontract so that such provisions will be binding on each subcontractor. The Contractor shall take such action with respect to any subcontract as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

5. SPECIAL HAZARDS

The Contractor's and his Subcontractor's Public Liability and Property Damage Insurance shall provide adequate protection against the following special hazards:

6. CONTRACTOR'S AND SUBCONTRACTOR'S PUBLIC LIABILITY, VEHICLE LIABILITY, AND PROPERTY DAMAGE INSURANCE

As required under Article 5 of the General Conditions, the Contractor's Public Liability Insurance and Vehicle Liability Insurance shall be in an amount not less than $ 500,000 for injuries, including accidental death, to any one person, and subject to the same limit for each person, in an amount not less than $ 500,000 on account of one accident, and Contractor's Property Damage Insurance in an amount not less than $ 500,000 .

The Contractor shall either (1) require each of his subcontractors to procure and to maintain during the life of his subcontract, Subcontractor's Public Liability and Property Damage Insurance of this type and in the same amounts as specified in the preceding paragraph, or (2) insure the activities of his subcontractors in his own policy.

7. PHOTOGRAPHS OF PROJECT

As provided in Paragraph 3.I of the Supplemental General Conditions, the Contractor will furnish photographs in the number, type, and stage as enumerated below:

8. SCHEDULE OF OCCUPATIONAL CLASSIFICATIONS AND MINIMUM HOURLY WAGE RATES AS REQUIRED UNDER PARAGRAPH 4.B OF THE SUPPLEMENTAL GENERAL CONDITIONS

Given on Pages 30-38, _____ and _____.

9. BUILDER'S RISK INSURANCE

As provided in the General Conditions, Article 5.6, the Contractor will/~~will not~~** maintain Builder's Risk Insurance (fire and extended coverage) on a 100 percent completed value basis on the insurable portions of the project for the benefit of the Owner, the Contractor, and all Subcontractors, as their interests may appear.

_____

** Strike out one.

10. SPECIAL EQUAL OPPORTUNITY PROVISIONS

A. Activities and Contracts Not Subject to Executive Order 11246, as Amended

(Applicable to Federally assisted construction contracts and related subcontracts $10,000 and under.)

During the performance of this contract, the Contractor agrees as follows:

1. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants for employment are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: 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.

2. The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices to be provided by Contracting Officer setting forth the provisions of this nondiscrimination clause. The Contractor shall state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

3. Contractors shall incorporate foregoing requirements in all subcontracts.

B. Executive Order 11246 (contracts/subcontracts above $10,000)

1. Section 202 Equal Opportunity Clause

During the performance of this contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: 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. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

b. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration without regard to race, color, religion, sex, or national origin.

c. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding a notice to be provided by the Contract Compliance Officer advising the said labor union or workers' representatives of the Contractor's commitment under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

e. The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the Department of the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and others.

f. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

g. The Contractor will include the provisions of the sentence immediately preceding paragraph a. and the provisions of paragraphs a. through g. in every subcontract or purchase order unless exempted by rules, regulations, orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Department may direct as a means of enforcing such provisions, including sanctions for non-compliance. Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Department, the Contractor may request the United States to enter into such litigation to protect the interest of the United States.

2. Notice of Requirement for Affirmative Action to ensure Equal Employment Opportunity (Executive Order 11246). (Applicable to contracts/subcontracts exceeding $10,000.)

a. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

b. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation	Goals for female participation
Insert Goals 12%	Insert Goals 6.9%

NOTE: THESE GOALS MUST BE PROVIDED. Also, list State Geographic Area to be covered on following page.

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the Contractor performs construction work in a geographic area located outside of the covered area, it shall apply the goals established for such geographic area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its Federally involved and non-Federally involved construction.

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 41 CFR 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 throughout 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.

c. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs 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. 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.

d. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is _____ Cornersville, Tennessee_____.

3. Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

a. As used in these specifications:

(1) "Covered area" means the geographical area described in the solicitation from which this contract resulted;

(2) "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

(3) "Employer identification number" means the federal social security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941;

(4) "Minority" includes:

(a) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(b) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South America or other Spanish Culture or origin, regardless of race);

(c) 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);

(d) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

b. 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 and which is set forth in the solicitations from which this contract resulted.

c. 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 and timetables) 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.

d. The Contractor shall implement the specific affirmative action standards provided in paragraphs g.(1) through (16) of these specifications. The goals 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. Covered construction contractors performing contracts in geographical areas where they do not have a Federal or Federally-assisted construction contract shall apply the minority and female goals established for the geographic area where the contract is being performed. Goals are published periodically in the Federal Register in notice form and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

e. 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 specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

f. In order for the nonworking training hours of apprentices and 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.

g. 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:

(1) 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.

(2) 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 union have employment opportunities available, and maintain a record of the organization's responses.

(3) 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 therefore, along with whatever additional actions the Contractor may have taken.

(4) 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.

(5) 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 compiled under g.(2) above.

(6) 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's EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

(7) 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.

(8) 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.

(9) 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 of 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, screening procedures, and tests to be used in the selection process.

(10) 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 work force.

(11) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60-3.

(12) 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 appropriate training, etc., such opportunities.

(13) 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.

(14) 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.

(15) 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.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

h. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations g.(1) through (16). 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 g.(1) through (16) 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 shall not be a defense for the Contractor's non-compliance.

i. 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).

j. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

k. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

l. The Contractor shall carry out such sanctions and penalties for violation 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.

m. 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 g. 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.

n. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company's 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 where 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 location 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, contractor shall not be required to maintain separate records.

o. 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).

C. Certification of Nonsegregated Facilities (Over $10,000)

By the submission of this bid, the bidder, offeror, applicant or subcontractor certifies that he/she does not maintain or provide for his/her employees any segregated facility at any of his/her establishments, and that he/she does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. He/She certifies further that he/she will not maintain or provide for employees any segregated facilities at any of his/her establishments, and he/she will not permit employees to perform their services at any location under his/her control where segregated facilities are maintained. The bidder, offeror, applicant or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause of this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, ***transportation and housing facilities provided for employees which are segregated on the basis of race, color, religion, or are in fact segregated on the basis of race, color, religion, or otherwise. He/She further agrees that (except where he/she has obtained identical certifications from proposed subcontractors for specific time periods) he/she will obtain identical certification from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause; that he/she will retain such certifications in his/her files; and that he/she will forward the following notice to such proposed subcontractors (except where proposed subcontractors have submitted identical certifications for specific time periods).

D. Civil Rights Act of 1964

Under Title VI of the Civil Rights Act of 1964, no person shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.

E. Section 109 of the Housing and Community Development Act of 1974

No person in the United States shall on the grounds of race, color, national origin, or sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity funded in whole or in part with funds made available under this title.

F. "The Section 3 Clause"

1. The work to be performed under this contract is on a project assisted under a program providing direct Federal financial assistance from the Department of Housing and Urban Development and is subject to the requirements of section 3 of the Housing Urban Development Act of 1968, as amended, 12 U.S.C. 1701u. Section 3 requires that to the greatest extent feasible, opportunities for training and employment be given to lower income residents of the area of the Section 3 covered project, and contracts for work in connection with the project be awarded to business concerns which are located in, or owned in substantial part by persons residing in the area of the Section 3 covered project.

2. The parties to this contract will comply with the provisions of said Section 3 and the regulations issued pursuant thereto by the Secretary of Housing and Urban Development set forth in 24 Part CFR 135, and all applicable rules and orders of the Department issued thereunder prior to the execution of this contract. The parties to this contract certify and agree that they are under no contractual or other disability which would prevent them from complying with these requirements.

3. The contractor will send to each labor organization or representative of workers with which he has a collective bargaining agreement or other contract or understanding, if any, a notice advising the said labor organization or workers' representative of his commitments under this Section 3 clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment or training.

4. The contractor will include this Section 3 clause in every subcontract for work in connection with the project and will, at the direction of the applicant for or recipient of Federal Financial assistance, take appropriate action pursuant to the subcontract upon a finding that the subcontractor is in violation of regulations issued by the Secretary of Housing and Urban Development, 24 CFR Part 135. The contractor will not subcontract with any subcontractor where it has notice or knowledge that the latter has been found in violation of regulations under 24 CFR part 135 and will not let any subcontract unless the subcontractor has first provided it with a preliminary statement of ability to comply with the requirements of these regulations.

5. Compliance with the provisions of Section 3, the regulations set forth in 24 CFR Part 135, and all applicable rules and orders of the Department issued thereunder prior to the execution of the contract, shall be a condition of the Federal financial assistance provided to the project, binding upon the applicant or recipient, its contractors and subcontractors, its successors, and assigns to those sanctions specified by the grant or loan agreement or contract through which Federal assistance is provided, and to such sanctions as are specified by 24 CFR Part 135.

G. Age Discrimination Act of 1975

No person in the United States shall, on the basis of age, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under, any program or activity receiving Federal financial assistance.

H. Section 504 Handicapped

Non-Discrimination for Handicapped Workers

No otherwise qualified handicapped individual in the U.S., as defined in Section 7, Paragraph 6 of the Rehabilitation Act of 1973 shall, solely by reason of this handicap, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.

11. CERTIFICATION OF COMPLIANCE WITH AIR AND WATER ACTS

(Applicable to Federally assisted construction contracts and related subcontracts exceeding $100,000)

Compliance with Air and Water Acts

During the performance of this contract the contractor and all subcontractors shall comply with the requirements of the Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 15, as amended.

In addition to the foregoing requirements, all nonexempt contractors and subcontractors shall furnish to the Owner, the following:

1. A stipulation by the Contractor or subcontractors, that any facility to be utilized in the performance of any nonexempt contract or subcontract, is not listed on the List of Violating Facilities issued by the Environmental Protection Agency (EPA) pursuant to 40 CFR 15.20.

2. Agreement by the Contractor to comply with all the requirements of Section 114 of the Clean Air Act, as amended, (42 USC 1857c-8) and Section 308 of the Federal Water Pollution Control Act, as amended, (33 USC 1318) relating to inspection, monitoring, entry, reports and information, as well as all other requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued thereunder.

3. A stipulation that as a condition for the award of the contract, prompt notice will be given of any notification received from the Director, Office of Federal Activities, EPA, indicating that a facility utilized, or to be utilized for the contract, is under consideration to be listed on the EPA List of Violating Facilities.

4. Agreement by the Contractor that he will include, or cause to be included, the criteria and requirements in paragraph (1) through (4) of this section in every nonexempt subcontract and requiring that the Contractor will take such action as the Government may direct as a means of enforcing such provisions.

12. SPECIAL CONDITIONS PERTAINING TO HAZARDS, SAFETY STANDARDS AND ACCIDENT PREVENTION

A. Lead-Based Paint Hazards

(Applicable to contracts for construction or rehabilitation of residential structures.) The construction or rehabilitation of residential structures is subject to the HUD Lead-Based Paint regulations, 24 CFR Part 35. The Contractor and Subcontractors shall comply with the provisions for the elimination of lead-base paint hazards under sub-part B of said regulations. The Owner will be responsible for the inspections and certifications required under Section 35.14(f) thereof.

B. Use of Explosives (Modify as Required)

When the use of explosives is necessary for the prosecution of the work, the Contractor shall observe all local, state and Federal laws in purchasing and handling explosives. The Contractor shall take all necessary precaution to protect completed work, neighboring property, water lines, or other underground structures. Where there is danger to structures or property from blasting, the charges shall be reduced and the material shall be covered with suitable timber, steel or rope mats.

The Contractor shall notify all owners of public utility property of intention to use explosives at least eight hours before blasting is done, close to such property. Any supervision or direction of use of explosives by the engineer, does not in any way reduce the responsibility of the Contractor or his Surety for damages that may be caused by such use.

C. Danger Signals and Safety Devices (Modify as Required)

The Contractor shall make all necessary precautions to guard against damages to property and injury to persons. He shall put up and maintain in good condition, sufficient red or warning lights at night, suitable barricades and other devices necessary to protect the public. In case the Contractor fails or neglects to take such precautions, the Owner may have such lights and barricades installed and charge the cost of this work to the Contractor. Such action by the Owner does not relieve the Contractor of any liability incurred under these specifications or contract.

13. FLOOD DISASTER PROTECTION

This Contract is subject to the requirements of the Flood Disaster Protection Act of 1973 (P.L. 93-234). Nothing included as a part of this Contract is approved for acquisition or construction purposes as defined under Section 3(a) of said Act, for use in an area identified by the Secretary of HUD as having special flood hazards which is located in a community not then in compliance with the requirements for participation in the national flood insurance program pursuant to Section 201(d) of said Act; and the use of any assistance provided under this Contract for such acquisition or construction in such identified areas in communities then participating in the national flood insurance program shall be subject to the mandatory purchase of flood insurance requirements of Section 102(a) of said Act.

Any contract or agreement for the sale, lease, or other transfer of land acquired, cleared or improved with assistance provided under the Contract shall contain, if such land is located in an area identified by the Secretary as having special flood hazards and in which the sale of flood insurance has been made available under the National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq., provisions obligating the transferee and its successors or assigns to obtain and maintain, during the ownership of such land, such flood insurance as required with respect to financial assistance for acquisition or construction purposes under Section 102(a) of the Flood Disaster Protection Act of 1973.

14. ACCESS TO RECORDS/MAINTENANCE OF RECORDS

The Contractor shall maintain accounts and records, including personnel, property, and financial records, adequate to identify and account for all costs pertaining to the contract and such other records as may be deemed necessary by the locality to assure proper accounting for all funds. These records will be available for audit purposes to the locality or the State or any other authorized representative, and will be retained for three years after contract completion unless permission to destroy them is granted by the locality. Moreover, the locality, State, or any authorized representative shall have access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purpose of making audit, examination, excerpts, and transcriptions.

15. CONFLICT OF INTEREST OF OFFICERS OR EMPLOYEES OF THE LOCAL JURISDICTION, MEMBERS OF THE LOCAL GOVERNING BODY, OR OTHER PUBLIC OFFICIALS

No officer or employee of the local jurisdiction or its designees or agents, no member of the governing body, and no other public official of the locality who exercises any function or responsibility with respect to this contract, during his/her tenure or for one year thereafter, shall have any interest, direct or indirect, in any contract or subcontract, or the proceeds thereof, for work to be performed. Further, the contractor shall cause to be incorporated in all subcontracts the language set forth in this paragraph prohibiting conflict of interest.

16. DRUG-FREE WORKPLACE

Under the provisions of Tennessee Code Annotate § 50-9-113 enacted by the General Assembly effective 2001, a) employers with five (5) or more employees who contract with either the state or a local government to provide construction services are required to submit an affidavit stating that they have a drug free workplace program that complies with Title 50, Chapter 9, in effect at the time of submission of a bid at least to the extent required of governmental entities. The statute, imposes other requirements on the contractor, but the grantee's responsibility is specifically limited in section (b) of the state as follows:

(b) A written affidavit by the principal officer of a covered employer provided to a local government at the time such bid or contract is submitted stating that the employer is in compliance with this section shall absolve the local government of all further responsibility under this section and any liability arising from the employer's compliance or failure of compliance with the provisions of this section.

17. PROJECT SIGN

If a project sign is erected, it must include the following:

Governor *(Name)*
Department of Economic and Community Development
Commissioner *(Name)*
CDBG Grant *(Amount)*

SPECIFICATIONS

Description of Project

Location (Recipient)

List of Contracts

Contract No.

Name and Address of Consultant or, if Prepared by Recipient Staff, the Name of the Office to be Contacted for Information Pertaining to Project

TENNESSEE DEPARTMENT OF TRANSPORTATION

STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

Tennessee Department of Transportation, Authorization No. 401093, 5,000 copies, January 2021. This public document was promulgated at a cost of $5.83 per copy.

January 1, 2021

TENNESSEE DEPARTMENT OF TRANSPORTATION

The mission of the Tennessee Department of Transportation is to provide a safe and reliable transportation system that supports economic growth and quality of life.

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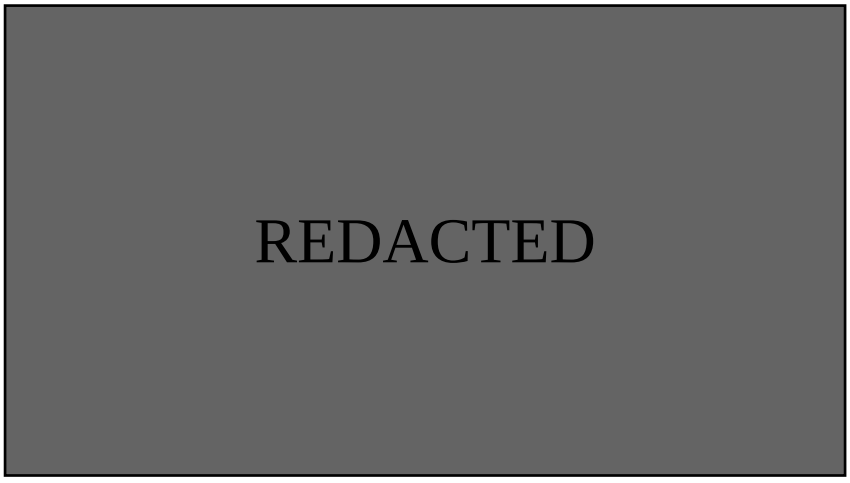

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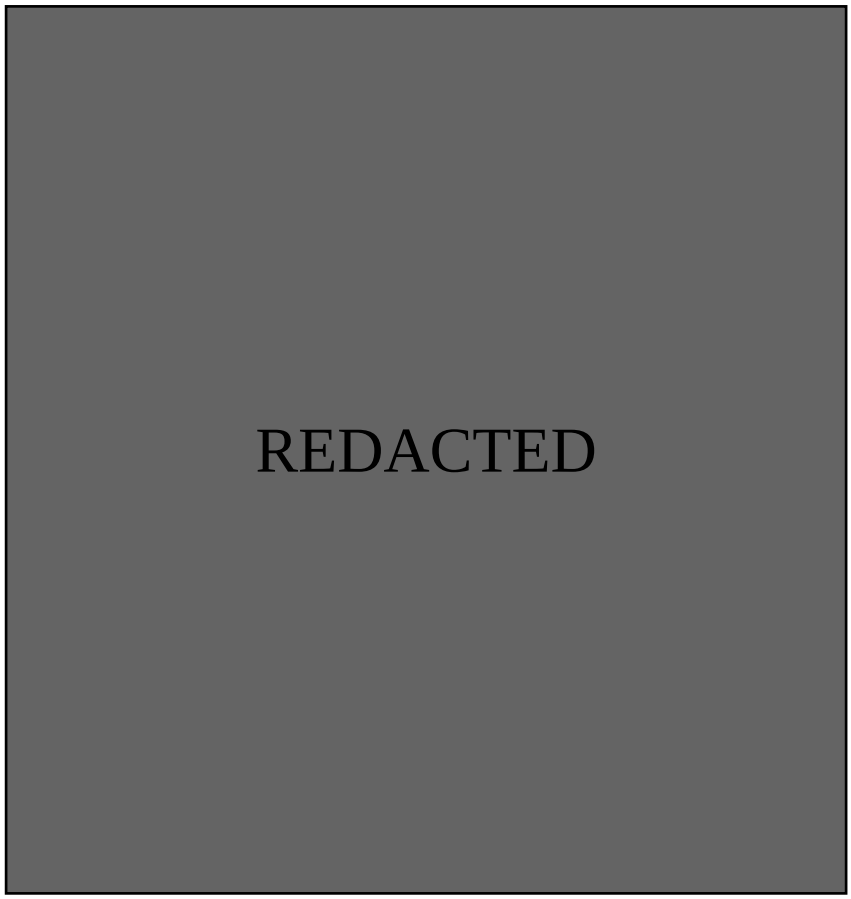

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PART 1 – GENERAL PROVISIONS

REDACTED

SECTION 101 – DEFINITIONS AND TERMS

101.01 General

These Standard Specifications for Road and Bridge Construction apply to the bidder, before the award of the Contract, and to the Contractor after award. The sentences that direct the Contractor to perform work are written in the active voice/imperative mood. These directions to the Contractor are written as commands. For example, a requirement to provide cold weather protection could be expressed as:

> **Passive Voice / Indicative Mood:** Cold weather protection for concrete shall be provided by the Contractor.
>
> **Active Voice / Indicative Mood:** The Contractor shall provide cold weather protection for concrete.
>
> **Active Voice / Imperative Mood:** Provide cold-weather protection for concrete.

As shown in the above examples, in the active voice/imperative mood, the subject "the bidder" or "the Contractor" is understood. In these Specifications, this implied subject is typically the Contractor, although in certain situations, the subject may also be a vendor, fabricator, or manufacturer engaged by the Contractor to supply material, products, or equipment for use on the Project.

Sentences defining the actions or responsibility of the Department or its representative are generally written in active voice/indicative mood. Sentences written in the active voice/indicative mood identify the party responsible for performing the action. For example, "The Engineer will determine the density of the compacted material."

The following words refer to actions of the Department or its representative: "directed," "required," "ordered," "approved," "rejected," "acceptable," and "satisfactory." These and words with similar meaning shall be understood to

convey the same intent as if followed by the words “by the Engineer” or “to the Engineer.”

The titles or headings of the Sections and Subsections in these Specifications are intended for convenience of reference and shall not be considered as having any bearing on the interpretation of the Specifications.

101.02 Abbreviations

These Specifications and other Contract documents use the following abbreviations:

ANLA	American Nursery Landscaping Association
AAR	Association of American Railroads
ACI	American Concrete Association
AASHTO	American Association of State Highway and Transportation Officials
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWWA	American Water Works Association
AWS	American Welding Society
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services Administration
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IMSA	International Municipal Signal Association
ITE	Institute of Traffic Engineers
ICEA	Insulated Cable Engineers Association
ISSA	International Slurry Surfacing Association
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NCHRP	National Cooperative Highway Research Program
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings

TCA	Tennessee Code Annotated
TDEC	Tennessee Department of Environment and Conservation
UL	Underwriters Laboratories, Inc.

101.03 Terms

Wherever, in these Specifications or elsewhere in the Contract, the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

Addendum. Written interpretation or modification of any of the Contract documents, which is delivered to prospective bidders prior to the opening of proposals.

Advertisement. The public announcement provided by the Notice to Contractors, as required by law, inviting proposals for the Work to be performed or materials to be furnished.

Amendment. A revision to the electronic bid file, which may include adjusting a quantity, or adding, deleting, or revising Contract item(s).

Award. The formal acceptance by the Department of a proposal.

Base Course. The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a surface course.

Bidder. A pre-qualified individual, partnership, firm, corporation, or joint venture acting directly or through a duly authorized representative to submit a proposal to perform the advertised Work.

Box Bridge. A box culvert type structure consisting of a single box or multiple boxes, with or without a bottom slab, having a length, measured along the centerline of the roadway, of more than 20 feet between the inside faces of the outside walls.

Bridge. A structure erected over a stream, watercourse, highway, railroad or opening, for carrying traffic, having a length, measured along the centerline of the roadway, of more than 20 feet between the faces of end supports.

Calendar Day. Every day shown on the calendar.

Change Directive. An action taken by the Department, when the Contractor has filed a claim, that allows the Department to compensate the Contractor for completed additional work as determined to be fair and reasonable by the Department and that does not require the consent or signature of the Contractor or Surety.

Change Order. A written agreement entered into by and between the Department and the Contractor, with the written assent of the Surety, covering modifications or alterations beyond the scope of the original Contract, and establishing any necessary new Contract items, any other basis of payment, and any time adjustments for the work affected by the changes. This Agreement becomes a part of the Contract when properly executed and approved.

Commissioner. The Commissioner of the Department of Transportation of the State of Tennessee.

Completion Date. The calendar date by which the Contract shall be completed when such date is shown in the proposal instead of a stipulation of a number of working days, or the date of final acceptance of the Work.

Construction Change. A completed document, approved by the Engineer, covering changes in the Plans, Specifications or quantities, and additional items and the basis of payment that have been established by a previously executed Change Order.

Contract. The written agreement between the Department and the Contractor setting forth the obligations of the parties thereunder, including but not limited to, performance of the Work, which includes the furnishing of labor, equipment, and materials, and the basis of payment.

The Contract includes the Instructions to Bidders; the proposal; all conditions and terms of the Contract form; Contract Payment and Performance Bond; Letter of Credit where applicable; Specifications, Supplemental Specifications, Special Provisions, and Addenda; Standard Drawings and Contract Plans; the Work Order; and Construction Changes and Change Orders that are required to complete the construction of the Project in an acceptable manner including authorized time extensions thereof; all of which constitute one instrument.

Contract Payment and Performance Bond. The approved form of security, executed by the Contractor and its Surety or Sureties, guaranteeing

complete execution of the Contract and all Change Orders, and the payment of all legal debts pertaining to the performance of the Work.

Contract Time. The number of working days or calendar days allowed for completion of the Contract or an item(s) of work, or the number of calendar days between the time of starting as determined by the Work Order, and the Completion Date including all authorized time extensions.

Contractor. The individual, firm, partnership, limited liability company, corporation, joint venture, or other business entity contracting with the Department for performance of the Work.

Controlling Activity of Work. Any portion of the Work, a change in which would cause an adverse impact to the critical path schedule.

Critical Path. The sequence and duration of activities of work that control the duration of the Project.

Critical Path Method (CPM). A process for defining the time-frame required and relationship (logic ties) between critical and non-critical activities associated with construction projects and their completion dates.

Department. The Department of Transportation of the State of Tennessee.

Detour. A temporary rerouting of road users onto an existing highway in order to avoid a temporary traffic control zone.

Disadvantaged Business Enterprise (DBE). A for-profit small business concern that is at least 51% owned by one or more individuals who are both socially and economically disadvantaged or, in the case of a corporation, in which at least 51% of the stock is owned by one or more such individuals, and whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it. Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, and Subcontinent Asian Americans, as defined in 49-CFR Section 26.5, women, and any additional groups whose members are designated as socially and economically disadvantaged by the U.S. Small Business Administration are rebuttably presumed to be socially and economically disadvantaged. Other individuals may also qualify as socially and economically disadvantaged on a case-by-case basis.

Engineer. The Chief Engineer of the Department of Transportation or a duly authorized assistant or representative.

Equipment. All machinery, apparatus, and tools necessary for the proper construction and acceptable completion of the Project, plus the necessary repair parts, tools, and supplies for upkeep and maintenance.

Extra Work. An item of work not provided for in the Contract as awarded but found essential to the satisfactory completion of the Contract within its intended scope.

Force Account. A method of payment for Extra Work when a Change Order is not arrived at between the Engineer and the Contractor.

Highway, Road, and Street. Each of these words is a general term denoting a public way for the purpose of vehicular travel including the entire area within the right-of-way.

Holidays. Holidays recognized by the State of Tennessee occur as follows:

New Year's Day	January 1
Martin Luther King Day	Third Monday in January
Presidents' Day	Third Monday in February
Good Friday	Friday before Easter
Memorial Day	Last Monday in May
Independence Day	July 4
Labor Day	First Monday in September
Columbus Day	Second Monday in October
Veterans Day	November 11
Thanksgiving Day	Fourth Thursday in November
Christmas Day	December 25

All days appointed by the Governor of this State, or by the President of the United States, as days of fasting or thanksgiving.

Plan notes precluding restrictions to traffic on holiday weekends, unless specifically noted otherwise, do not apply to weekends associated with Martin Luther King Day, Presidents' Day, Columbus Day, and Veterans Day.

Inspector. The authorized representative of the Engineer assigned to make detailed inspections of materials and Contract performance.

Instructions to Bidders. Instructions included in the document entitled "Instructions to Bidders," which give information to the bidder with regard to preparing the Proposal Guaranty and the Letter of Credit where applicable. It also covers submission or delivery of the Proposal to the Department.

Item (Contract Item, Pay Item, or Bid Item). A specifically described unit of work for which a price is provided in the Contract.

Laboratory. The official testing laboratories of the Department or such other laboratories as may be designated or approved by the Engineer, acting only within the scope of the duties assigned to them individually.

Letter of Credit. A contractual promise to honor drafts presented for funds upon compliance with the terms and conditions specified. The Department shall have the authority to approve the issuer and prescribe said terms and conditions.

Major and Minor Items. Major Items will be determined as follows:

1. Any original Contract Item having a value of 15% or more of the original Contract amount, based on the original estimated quantity, shall be a Major Item.

2. The accumulation of the least number of individual items that total at least 40% of the original Contract amount also shall be Major Items. The items shall be totaled sequentially starting with the largest item (based on original prices and quantities).

Any items that do not meet 1 or 2 above are Minor Items.

Materials. Any substance specified to be furnished or proposed for use in the construction of the Project and its appurtenances.

Notice to Contractors. A notice to Contractors and other interested parties of proposed construction to be bid giving the date the bids are to be received and the location and general description of the Work to be performed.

Pavement Structures. The combination of base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Plans. The approved plans, profiles, cross-sections, standard roadway and structure drawings, working drawings and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the construction to be performed under the Contract.

Prequalification. The procedure established and administered by the Department by virtue of which prospective bidders are required to establish their responsibility and qualifications in advance of submission of Proposals.

Project. The specific improvement, together with all appurtenances, to be constructed under the Contract.

Proposal. The offer of a bidder, on the prescribed form, to perform the Work at the prices quoted.

Proposal Form. The approved form on which the Department requires that Proposals be prepared and submitted for the performance of the Work.

Proposal Guaranty. The security furnished with a Proposal to guarantee that the bidder will enter into a Contract if the bidder's Proposal is accepted and the Contract is awarded to it.

Qualified Products List (QPL). A listing of products that have been tested or analyzed by the Department and have been approved for use on the Department's road construction projects.

Right-of-Way. A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a highway and its appurtenant structures.

Roadbed. The graded portion of a highway prepared as a foundation for the pavement structure and shoulders.

Roadside. A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Development. Those items necessary to the complete highway that provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; and such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

Roadway. The portion of a highway within limits of construction.

Shoulder. The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles for emergency use, and for lateral support of base and surface courses.

Special Provisions. Provisions inserted into a contract revising the Standard or Supplemental Specifications, and covering conditions unique to the individual project.

Specialty Item. Work items identified in the contract that are not bid but are 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.

Specifications. A general term applied to all directions, provisions, and requirements pertaining to the performance of the Work.

Standard Specifications. The *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction* and its revisions effective on the Contract execution date.

State. The State of Tennessee.

Subcontractor. Any individual, firm, partnership, limited liability company, corporation, joint venture, or other business entity to whom the Contractor or any Subcontractor, regardless of tier, sublets any part of the Work under the Contract.

Subgrade. The top surface of a roadbed upon which the pavement structure and shoulders are constructed.

Substructure. That part of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

Superintendent. The Contractor's authorized representative in responsible charge of the Work.

Superstructure. The entire structure except the substructure.

Supplemental Specifications. Approved additions and revisions to the Standard Specifications.

Surety. A company authorized to guarantee a bidder's proposal and a contractor's performance and payment obligations under a contract, which is authorized to do business in the State of Tennessee and is listed on the United States Department of the Treasury Financial Management Service list of approved bonding companies.

Work. The furnishing of all labor, materials, equipment, and incidentals necessary for the satisfactory completion of the Project, including the carrying out of all duties and obligations imposed by the Contract.

Working Day. A calendar day, exclusive of Saturdays, Sundays, and Holidays, on which weather or other conditions not under the control of the Contractor will allow construction operations to proceed for at least 5 hours of the day with the normal working force engaged in performing the Work, which are normal to progress at the time, as determined by the Engineer.

Working Drawings. Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data that the Contractor is required to submit to the Engineer for approval.

Work Order. Written notice to the Contractor to proceed with the Work under the Contract, including, when applicable, the date of beginning of Contract Time.

PART 2 – EARTHWORK

SECTION 201 – CLEARING AND GRUBBING

DESCRIPTION

201.01 Description

This work consists of clearing, grubbing, removing, and disposing of all vegetation and debris within the designated limits, except such objects that are to remain or are to be removed according to other items of work. This work also includes preserving from injury or defacement all vegetation and objects designated to remain.

201.02 Reserved

CONSTRUCTION REQUIREMENTS

201.03 Clearing and Grubbing

A. General

The Engineer, or Contractor when required, will establish right-of-way and construction lines. The Engineer will designate all trees, shrubs, plants, and other objects to remain.

Avoid clearing and grubbing operations in areas designated to remain undisturbed in the Project's Stormwater Pollution Prevention Plan and applicable environmental permits.

Perform clearing and grubbing in advance of excavation and embankment operations.

B. Preparation

Before beginning construction activities, clearly mark the limits of disturbance (clearing limits) with stakes or other acceptable visible markers. Also mark all environmentally sensitive areas, such as streams, wetlands, buffers, and ARAP boundaries, included in the Project limits with markers that are readily visible to project personnel, including equipment operators.

C. Clearing and Grubbing Activities

1. **Within the Right-of-Way.** Clear all dead trees, stumps, brush, projecting roots, hedge, weeds, pole stubs, logs, and other objectionable material from the right-of-way necessary for construction, as directed by the Engineer.

   Clear all hedges, weeds, pole stubs, logs, and other objectionable material, that are located inside the right-of-way but outside the construction lines, flush to the ground surface.

2. **Within 5 Feet of the Construction Lines.** Completely grub all trees, stumps, roots, pole stubs, brush, hedge, and other protruding obstructions within the area bounded by lines 5 feet outside the construction lines. The Contractor may leave in place sound, undisturbed stumps and roots that will be a minimum of 5 feet below subgrade or slope of embankment under the following conditions:

   a. Undercutting or other corrective measures, or topsoil stripping, is not stipulated in the Plans or directed by the Engineer; and

   b. Stumps do not extend more than 6 inches above the ground surface.

3. **More than 5 Feet Outside the Construction Lines.** Do not disturb, and protect from damage and injury, living trees that have not been marked for removal by the Engineer and that are located more than 5 feet outside the construction lines of the road. Treat cut or scarred surfaces of trees or shrubs with a paint prepared especially for tree surgery.

Cut off trees marked for removal by the Engineer, to within 6 inches of the ground surface. Trim all stumps to within 6 inches of the ground surface.

4. **Swampy Areas.** When embankments are to be constructed in swampy areas, and undercutting or other corrective measures are not shown on the Plans or directed by the Engineer, the Contractor may, with the Engineer's approval, cut off undisturbed trees and stumps at not more than 6 inches above the ground surface or low water level and leave the stump and root mass in place.

5. **Borrow Pit Areas.** 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.

6. **Drainage Areas and Structures.** Clear slopes of cuts, embankments, ditches, channels, waterways, and all structures, both old and new, of all brush, hedges, weeds, heavy vegetation, and other objectionable material. Maintain such areas in a neat and satisfactory condition until the Project is accepted.

   Clear areas that are within the limits of drainage structures of all objectionable material to within 3 inches of the ground surface. Such areas shall extend the full length of the structures, as measured along the centerline of the highway, and to the right-of-way lines along lines parallel to the centerline of the inlet and outlet channel or drainage of the structure. These areas shall also include the entire area of all easements obtained for drainage purposes.

7. **Removing Branches.** Remove, as directed by the Engineer, low hanging, unsound, or unsightly branches on trees or shrubs designated to remain. Trim tree branches that extend over the roadbed to provide a clear height of 20 feet above the roadbed surface. Perform trimming operations using skilled workmen and good tree surgery practices.

D. Backfilling

Within the areas where embankments are to be constructed, backfill all depressions resulting from grubbing operations with suitable excavation material, and compact as specified in **205** to the natural ground elevation before starting embankment construction.

Backfill, with suitable material, all depressions in excavation areas that lie below the finished subgrade elevation due to grubbing operations, and compact to the finished subgrade elevation as specified in **205** during the excavation operations.

Complete backfilling a satisfactory distance ahead of embankment construction operations.

201.04 Disposal of Debris

Properly dispose of wood debris that is chipped onsite so that does not become part of embankment.

If burning perishable material, follow applicable laws and ordinances. Ensure burning operations proceed under the constant care of competent watchmen, at times and in a manner that will not harm the surrounding vegetation, adjacent property, or anything designated to remain within the right-of-way.

If the construction is through land subject to scour, the Engineer may direct the Contractor to dispose of stumps, logs, brush, and similar material in the scoured ditches within the right-of-way, and to cover the material so deposited with suitable excavation or borrow material. If the Contractor obtains permission to dispose of such material in scoured ditches on private property that is within view of the roadway, the Contractor shall thoroughly cover the material so deposited with suitable material at no cost to the Department.

All merchantable timber in the clearing area that has not been removed from the right-of-way before the start of construction shall become the property of the Contractor unless otherwise specified.

COMPENSATION

201.05 Method of Measurement

If the Contract contains an item for Clearing and Grubbing on a lump sum basis, the Department will not measure the area cleared and grubbed.

In cases where changes in the Contract documents affect the right-of-way area or when additional Clearing and Grubbing is required in conjunction with Road and Drainage Excavation (Additional Material) under **203**, the Department will make a proportionate adjustment for the increased or decreased area; however, if the bid schedule includes the item for Adjusted Clearing and Grubbing, then the Department will measure and pay for these area adjustments by the acre.

Unless otherwise shown on the Plans, no separate measurement or payment will be made for the items of work defined under Clearing and Grubbing.

For Contractor-supplied borrow pits, the Contractor shall include clearing and grubbing costs in the unit price bid for Borrow Excavation under **203**. For Department-obtained designated borrow pit areas, the Department will measure and pay for clearing and grubbing by the acre, provided the item for Clearing and Grubbing (Borrow Pits) is in the Contract. If the item for Clearing and Grubbing (Borrow Pits) is not in the Contract, the Contractor shall include the costs of clearing and grubbing such designated borrow pit areas in the unit price bid for Borrow Excavation.

If the Contract does not contain an item for Clearing and Grubbing, the Department will consider all Clearing and Grubbing required within the construction limits as incidental to other items of work.

201.06 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Clearing and Grubbing	Lump Sum
Clearing and Grubbing (Borrow Pits)	Acre
Adjusted Clearing and Grubbing	Acre

Such payment is full compensation for providing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 202 – REMOVAL OF STRUCTURES AND OBSTRUCTIONS

DESCRIPTION

202.01 Description

This work consists of removing, entirely or partially, and disposing of all buildings, fences, structures, old pavements, abandoned pipelines, and other obstructions not designated or permitted to remain, except for obstructions to be removed and disposed of under other contract items. The work also includes backfilling the resulting trenches, holes, and pits, and salvaging designated materials.

If the Contract does not include pay items for Removal of Structures and Obstructions, include such work in the prices bid for other items of construction.

202.02 Reserved

CONSTRUCTION REQUIREMENTS

202.03 General

Raze, remove, and dispose of all buildings and foundations, structures, fences, and other obstructions as shown on the Plans. Do not remove utilities and obstructions for which other provisions have been made.

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.

The Department reserves the right to dispose of buildings on any tract before they are torn down or removed by the Contractor. If structures designated for removal by the Contractor contain friable asbestos, conduct demolition activities according to TDEC policy and regulations, including providing prior notification to TDEC of all pending demolitions. The Department will remove friable asbestos from other structures to be demolished either prior to, or concurrently with, the Work. The Department's removal of friable asbestos may or may not include complete demolition of the structure. Remove structures, or portions of a structure, remaining after the Department's removal of asbestos under the appropriate item or in accordance with **202.01**, as applicable.

Buildings and other structures that the Plans show as being removed or disposed of by other agencies will not be held as a charge or responsibility of the Contractor, except that the Contractor waives any and all claims for interference, delay, or damage due to their removal or non-removal.

Remove foundations of buildings and other structures to a depth of not less than 1 foot below natural ground, except that within construction limits, remove to a depth of not less than 2 feet below subgrade elevation. Break up basement floors to prevent water retention. Fill basements or cavities left by structure removal to the level of the surrounding ground or to subgrade elevation within the prism of construction. Compact the material placed in these cavities as specified in **205**.

202.04 Removal of Bridges, Culverts, and Other Drainage Structures

Do not remove structures in use by traffic until after making arrangements to accommodate traffic.

Remove all bridges, culverts, and drainage structures from streams according to the terms and conditions specified in the applicable environmental permits, including the TN Construction General Permit. Use highly visible markers to clearly mark permit boundaries and disturbed area limits.

Unless otherwise specified or directed, remove portions of bridge substructures that are located outside a stream to 1 foot below the adjacent ground level or natural stream bottom, or the lowest scour elevation shown on the Plans. For those portions that are located in a stream or wetland, adhere to the permit form of the applicable State and Federal agencies approving the location and plans and authorizing the construction of the bridge. Remove, as necessary, those portions of existing structures that lie entirely or partially within the limits of a new structure to accommodate the construction of the proposed structure.

Without causing unnecessary damage, dismantle bridges designated for salvage, and store such material as specified in **202.03**.

Remove bridge decks according to the following:

1. Where bridge decks are to be entirely removed, but the girders are to remain in service:

    a. The Contractor may apply transverse saw cuts to help remove the concrete deck, but the depth of the cut may not exceed:

        (1) 3 inches for decks supported by steel beams or girders;

        (2) 3 inches for decks supported by prestressed concrete beams; and

        (3) 1 inch for decks of cast-in-place hollow box or t-beam bridges.

    b. Use pneumatically or electrically operated chipping hammers, not exceeding 60 pounds in weight, to remove the remainder of the slab depth under the cuts.

c. Longitudinal saw cuts may be full depth, but no closer than the following:

(1) For decks supported by steel beams or girders, within 1 inch of the widest top flanges;

(2) For decks supported by prestressed beams, within 1 inch of the top flange; and

(3) For decks of hollow boxes or t-beam bridges, within 1 inch of the web, unless otherwise shown on the Plans.

2. To remove slab overhangs, the Contractor may use concrete saws to remove the top 1 inch of the slab and pneumatically or electrically operated chipping hammers, not exceeding 60 pounds in weight, to remove the remainder of the concrete. Do not damage transverse slab reinforcing bars.

3. When removing bridge decks as part of a complete bridge demolition, the Contractor may use concrete saws to remove the deck, but the depth of the cuts may not exceed the following:

a. For decks supported by steel beams or girders, the plan depth of slab minus 1 inch.

b. For decks of hollow box or t-beam bridges, if not otherwise shown on the Plans, the Contractor shall submit a plan to the Engineer for approval.

Do not use hoe rams, pneumatic shears, pavement breakers, or other heavy equipment to remove slabs where girders or adjacent slab portions are to remain.

Complete blasting or other operations necessary to remove an existing structure or obstruction without damaging new construction. Complete such operations prior to placing the new work, or take adequate precautions to prevent such damage.

202.05 Removal of Pipe

Remove, and store when necessary, pipe designated for salvage so that no loss or damage occurs. Replace, at no cost to the Department, sections damaged by negligence or by the use of improper methods.

202.06 Removal of Pavement, Sidewalks, and Curbs Constructed of Portland Cement Concrete

As directed, dispose of pavement, base course, sidewalks, curbs, gutters, and similar features constructed of Portland cement concrete designated for removal. If the Plans do not to identify the existence of concrete pavement under asphaltic pavement, do not interpret this as meaning that no concrete is present. Remove and dispose of concrete pavement, parking strip, and base, all with or without bituminous overlay, concrete curb and gutter, sidewalk, driveways, and similar features as follows or as directed:

1. If the items are no more than 2 feet below subgrade elevation, remove and dispose of the items according to **202**.

2. If the items are more than 2 feet below subgrade elevation, break them into sections no greater than 2 feet in maximum dimension and leave in place, unless doing so will interfere with succeeding items of construction. Include the cost of this work in the unit price bid for other items of construction.

3. If the items are above subgrade elevation, include their removal and disposal with the work performed under **203.**

4. When specified, remove and stockpile ballast, gravel, bituminous pavement, or other pavement materials in accordance with **202.03**; otherwise, dispose of such materials as directed.

202.07 Removal of Underground Storage Tanks

A Petroleum Underground Storage Tank refers to any one or combination of tanks including underground piping, which is used or has been used to contain petroleum substances and the volume of which is 10% or more beneath the surface of the ground.

The Department will remove and dispose of Petroleum Underground Storage Tanks or Tank Systems through its Environmental Consultant. This work will include removal and disposal of piping, pumps, and other tank fixtures,

the investigation and testing of the tank(s) for leakage, and backfilling the resulting holes or trenches as shown on the Plans or as approved by the Engineer. The Department's Environmental Consultant will perform this work according to the Tennessee Petroleum Underground Storage Tank Act, TDEC policies and regulations, the United States Environmental Protection Agency, and local ordinances or statutes governing removal of Underground Storage Tanks.

If the Contract includes an item for Removal and Disposal of Underground Tanks, before work begins, submit an application for closure of each Petroleum Underground Storage Tank or Tank System to the TDEC, Division of Underground Storage Tanks. In addition, the Contractor shall:

1. Provide the Engineer with copies of the application for closure, the TDEC's approval of that application, laboratory test reports, closure notification form, and all pertinent correspondence.

2. Engage a laboratory approved by the TDEC to perform all required sampling and testing for leakage and contamination before and after removal of the tank(s). Upon receipt of written approval from the TDEC, remove the tank(s) according to TDEC regulations. If soil testing either before or after tank removal reveals soil contamination, remove and dispose of the contaminated soil according to TDEC regulations.

3. After removal, take ownership of the tank(s) and tank fixtures unless otherwise shown on the Plans. Ownership of the tank(s) shall not relieve the Contractor of the responsibility of labeling, transporting, and disposing of the tank(s) according to TDEC regulations.

4. After removing the tank(s) and contaminated soil, backfill the hole or trench as necessary with material specified on the Plans or approved by the Engineer.

202.08 Water Well Abandonment

Locate and seal abandoned water wells, and remove and dispose of pumps, pipe, and other related items not provided for elsewhere in the Contract. Perform all work according to applicable TDEC regulations.

Seal abandoned wells as follows:

A. Wells with a Diameter of 1 Foot or Less

Retain a licensed driller or pump installer to remove all pumps and related plumbing. Clear the bore hole of all other obstructions. A licensed well driller shall clean the bore hole by drilling, blowing, or bailing as applicable. To disinfect the well, add laundry bleach to the water in the well to equal 1 quart of bleach for each 100 gallons of water. Obtain the number of gallons of water in the well as follows:

$$V = [D_{well} - D_{swl}] \times 0.0408 (Dia^2)$$

Where:

V	=	volume of water in the well in gallons
D_{well}	=	total depth of the well in feet
D_{swl}	=	depth to static water level in feet
Dia	=	diameter of the well in inches

After disinfecting the well, the licensed well driller shall fill the well using flowable fill. Use bentonite or other approved colloidal reagent as an admixture in an amount equal to 1.5% by volume of the cement.

The flowable fill material shall extend from the bottom of the well to within 5 feet of the final surface where the well is in a roadway cut, or to within 5 feet of the existing ground surface where the well is located under roadway embankment or where the well is outside of the construction limits. Pipe the flowable fill directly to the point of application by a tremie or dump bailer to avoid segregation or dilution. Cut off the well casing flush with the top of the flowable fill material.

B. Wells with Diameter Greater than 1 Foot

Remove all pumps and related plumbing, and clear the well of all other obstructions as described in **202.08.A**. Disinfect the water in the well by adding 1 quart of bleach for each 100 gallons of water. Compute the amount of bleach to be used as described in **202.08.A**.

Fill the bottom 5 feet of the well or a depth equal to the depth of the water, whichever is greater, with flowable fill as specified in **202.08.A**. Fill the remainder of the well with compacted soil. Remove projecting well casings or walls or cut off 5 feet below the existing or proposed ground surface, as applicable.

If flowable fill loss is excessive due to crevices in the borehole wall, use Mineral Aggregate, Type A Base, Grading D, meeting **903.05**, to seal the crevices. After sealing the crevices, resume filling with flowable fill.

Immediately after sealing the wells, provide an affidavit to the Tennessee Water Supply Division stating the name of the licensed contractor(s) who performed the cleaning and sealing of the wells, the project number, location of the wells, type and sequence of material used, volume of material used, and date completed.

COMPENSATION

202.09 Method of Measurement

If the Contract specifies that Removal of Structures and Obstructions is on a lump sum basis, the work will include all structures and obstructions encountered within the right-of-way, except for structures and obstructions specified for removal on a unit basis.

If the Contract specifies removal of specific items on a unit basis, the Department will measure the quantity of each item by the unit stipulated in the Contract.

202.10 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Removal of Structures and Obstructions	Lump Sum, or Each
Removal of Pipe (Size, Sta)	Linear Feet
Removal of Rigid Pavements, Sidewalks, etc.	Square Yard
Removal of Undergrounds Tanks (Tract No._____)	Lump Sum
Removal of Buildings (Tract No._____)	Lump Sum
Water Well Abandonment	Lump Sum

Payment for Removal of Underground Tanks (Tract No._____) includes locating, drilling, testing, removing, and disposing of Underground Storage Tanks, piping, pumps, and other tank fixtures, any portion of which is on the designated tract, and hauling, placing, and compacting backfill where required.

If soil testing reveals contamination, the Department will pay for the removal and disposal of contaminated soil under the item for Road and Drainage Excavation (Unclassified) in accordance with **203**, provided the volume is 500 cubic yards or less. However, the Department may consider the removal, disposal, and replacement of contaminated soil in excess of 500 cubic yards as Extra Work under **104.02.D** and will then pay for such work in accordance with **109.04**.

Payment for Water Well Abandonment includes all labor, equipment, materials, including flowable fill, and incidentals necessary to complete the work.

Payment for removing specific obstruction items, including Removal of Pipe and Removal of Rigid Pavements, Sidewalks, etc., includes the removal of such items; excavation and subsequent backfill incidental to their removal; salvage of materials removed, their custody, preservation, and storage within the right-of-way; and disposal.

The Department will only make payment when payment for all or any part thereof is provided for in a pay item.

SECTION 203 – EXCAVATION AND UNDERCUTTING

DESCRIPTION

203.01 Description

This work consists of excavating and grading the roadway (including the removal of slides), borrow pits, waterways, and ditches (including structure inlet and outlet ditches, channels, waterways, and similar features, even if they extend beyond the highway limits); excavating for intersections, approaches, and benches under the side-hill embankments; excavating unsuitable material from roadbed and beneath embankment areas; excavating selected material found in the roadway that is required for specific use in the construction; the construction and removal of detours authorized by the Engineer or otherwise shown on the Plans; trimming and shaping of all slopes; and disposing of all excavated material.

The work also includes all embankment construction as specified in **205**, shoulder and ditch construction as specified in **208**, and if the Contract includes construction of pavement or other surfacing, Subgrade Construction and Preparation as specified in **207**.

203.02 Classification

The Department will classify excavation as follows:

A. Road and Drainage Excavation (Unclassified)

The Department will consider all excavation performed under this item, including Portland cement concrete located above subgrade elevation, other than Borrow Excavation, Channel Excavation, and Undercutting, as unclassified excavation regardless of the nature of the material excavated.

B. Borrow Excavation

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

The Contractor may use excavated materials, other than Borrow Excavation (Unclassified), on the Project as specified in **104.09** provided it meets the specifications of the designated borrow material. However, if the flattening of certain cut slopes on projects graded under previous contracts is desirable and approved in writing by the Engineer, the Contractor may use this material for borrow if the material is satisfactory and in accordance with plans approved by the Engineer, and if the requirements of **203.04.E** regarding borrow areas are met.

Do not obtain borrow material from wetland areas, unless otherwise shown on the Plans and approved by applicable environmental permits.

The Department will classify borrow as:

1. **Borrow Excavation (Solid Rock)**, which consists of removing and placing non-degradable rock that cannot be economically excavated by the proper use of a power shovel or without the use of explosives.

2. **Borrow Excavation (Unclassified)**, which consists of removing and placing all approved material included under the classification of Borrow Excavation (Solid Rock) and all other approved material.

3. **Borrow Excavation (Graded Solid Rock)**, which consists of removing and placing sound, non-degradable rock having the following characteristics:

    a. Maximum particle size of 3 feet in any direction.

b. Particle size distribution in which at least 50% of the rock is uniformly distributed between 1 foot and 3 feet in diameter, and no more than 10% is less than 2 inches in diameter.

c. Roughly equi-dimensional in shape.

d. No thin, slabby material.

Process the material until it meets the required gradation and quality requirements of **903.25**. Obtain the Engineer's approval before using the material.

4. **Borrow Excavation (Select Material)**, which is used for special construction purposes and meets the requirements set forth in the Contract or shown on the Plans.

Borrow material other than solid rock, graded solid rock, or select materials shall be AASHTO M 145, classification A-6 or better if reasonably available. If classification A-6 is not reasonably available, the borrow shall be no worse than the predominant soil type in the roadway excavation based on AASHTO classification.

Do not use material obtained from an approved borrow source off the right-of-way to produce processed aggregate as described in **903**. Borrow Excavation (Graded Solid Rock) may be obtained from an approved borrow source. Do not use material excavated from an offsite borrow source in base or other paving courses above the elevation of the subgrade.

Unless otherwise designated in the Contract, arrange for obtaining borrow material according to the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

C. Channel Excavation (Unclassified)

This item consists of removing and disposing of all material excavated in widening, deepening, and straightening existing channels or constructing new ones, which have a bottom width of more than 14 feet as shown on the Plans. Perform similar excavation activities for channels with a bottom width of 14 feet or less, as shown on the Plans, under the Road and Drainage Excavation (Unclassified) item. The

Department will measure Channel Excavation (Unclassified) within the limits of box bridges or box culverts according to **204.12.A.2.b**. Construct channel excavation that includes an existing stream or a proposed stream relocation in accordance with the applicable environmental permits.

D. Undercutting

This item consists of removing and disposing of unsatisfactory materials below grade in cut sections and from areas upon which embankments are to be placed, and may also include excavating material below the foundation elevation for pipe, box culverts, and box bridges as provided for in **204.12**. Undercutting does not include the stripping, stockpiling, and placing of topsoil, as specified in **203.06**, nor does it include step-benching in the preparation of embankment areas on hillsides, as provided for under **205.03**.

203.03 Reserved

CONSTRUCTION REQUIREMENTS

203.04 General

Perform the required Clearing and Grubbing, Removal of Structures and Obstructions, and placement of Erosion Control Devices as specified in **201**, **202**, and **209**, respectively, before starting excavation, grading, and embankment operations.

Address both natural and created steep slope areas as required in the TN Construction General Permit. Maintain and stabilize steep slopes according to the TN Construction General Permit and all applicable environmental permits.

Remove excavation materials so that the slopes may be neatly trimmed to the lines given. The Engineer may change the slopes shown on the original cross-sections, depress raised medians or islands, raise depressed medians or islands, or daylight cuts to increase or decrease the quantity of Road and Drainage Excavation (Unclassified) if the material can be excavated without blasting and these changes are set in the slope stakes before excavation of the affected slopes, medians, or islands begins.

Use all suitable materials removed from the excavation areas to construct embankments, intersecting road approaches, and in such other places as directed by the Engineer. Construct embankment as specified in **205**.

Remove all loose rock on cut slopes immediately.

Do not waste, deposit or dispose of excavated material outside the construction lines without the Engineer's approval. Ensure that all excavation material wasted, deposited, or disposed of outside the construction lines is in accordance with the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

Temporarily discontinue excavating operations upon encountering remains of prehistoric archeological sites or artifacts of historical or archaeological significance. The Engineer will contact archaeological authorities to determine the disposition thereof.

Scarify, obliterate, and apply topsoil and seed to all existing roads within the right-of-way, and not in the graded area, which are to be abandoned. Obliteration of old roadways shall include all grading operations necessary to incorporate the old roadway into the new roadway and surroundings to provide a natural terrain appearance from the new roadway.

A. Additional Material

If more material is required to complete the embankments after all cuts have been brought to grade and all Road and Drainage Excavation (Unclassified) has been removed from within the balance, obtain additional materials from within the right-of-way by flattening, widening, or daylighting cut slopes, or by depressing raised medians or islands at locations designated and as directed by the Engineer, provided:

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.

B. Rock Cuts

Construct roadbed through rock cuts to the grading line shown on the Plans, with an allowable working tolerance of plus 1 inch to minus 3 inches. Bring portions of the roadway that are less than 3 inches below grade up to grade with spalls or other suitable granular material that is available from the excavation within the balance. If such excavation is not available, the Engineer may direct the Contractor to use approved base material for capping.

If the roadbed is excavated in excess of 3 inches below the grading line shown on the Plans, provide and place, at no additional cost to the Department, sufficient amounts of spalls or base material to bring the roadbed to a line 3 inches below the grading line.

Where the Plans require placement of sod on rock cuts, remove the rock to 1 foot below the grading line and backfill to grade with earthen material before placing the sod.

Where boulder formations occur, scarify the roadbed in the excavation area and remove all boulders to a depth of 12 inches below grade. Backfill and compact resulting cavities with suitable material.

C. Presplitting and Blasting

Presplit all rock cuts at the outside limits of the cut areas. Presplitting shall consist of forming a plane of split rock, for the entire depth of the cut or to a predetermined bench level, prior to any primary blasting.

To accomplish presplitting, drill holes of appropriate size to the desired depth along the outside limits of the cut area, load such holes with appropriate charges of explosives, stem with minus 3/8-inch clean stone

chips to the collar of each hole, and simultaneously detonate the charges. The initial horizontal spacing of holes and vertical spacing of charges and blasting cord for simultaneous detonation shall be as recommended by a reliable powder company. Adjust horizontal hole spacing and vertical spacing of charges as necessary to obtain a relatively smooth shear plane. Do not use sand, gravel, clay, or dirt for stemming. In drilling holes for presplitting, ensure that the drills are plumbed for vertical slopes or set on the required slope when other than vertical slopes are specified, and that all holes are drilled in the same plane. Presplitting will not be required on slopes flatter than 1:1. Presplit rock cuts under bridge sites as specified in this Subsection, but comply with the hole spacing specified in **204.08.A**.

After presplitting is done, drill primary blast holes at least 3 feet from the presplit face. Provide blasting records to the Engineer upon request. Do not perform blasting within 300 feet of any structure or concrete until at least 72 hours after concrete placement. Replace and/or repair all damage associated with blasting operations at no cost to the Department.

D. Unsuitable Soil

The Engineer will designate as unsuitable those soils that cannot be properly compacted in embankments. Dispose of all unsuitable soil as directed and at no additional cost to the Department.

If the location of unsuitable soil is shown on the Plans, remove and replace as shown.

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 30 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 independently 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.

203.05 Undercutting

The Department will designate areas to be undercut on the Plans if appropriate information is available. However, the Engineer may increase, decrease, or shift such designated areas as conditions require during construction.

Backfill undercut areas with suitable material from within the grading balance, or in the first 1,000 feet of the adjacent balances if obtainable. If road and drainage excavation is not available, use borrow excavation as backfill.

Conduct operations so that the Engineer can take the necessary cross-sectional measurements.

Compact backfill materials as specified in **205**.

If disposing of undercutting material off the right-of-way, adhere to the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*, and obtain advance approval for the disposal site from the Engineer, Environmental Coordinator, and the Environmental Division.

203.06 Stripping, Stockpiling, and Placing Topsoil

The Engineer will designate areas for stripping and stockpiling existing topsoil between slope stake points in both cut and fill areas. Strip the quantity of material necessary to cover all areas to be seeded with 2 to 3 inches of topsoil. If the quantity of topsoil available in such areas is insufficient, obtain additional topsoil from an approved borrow area according to the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

The Engineer will designate areas to be deleted from stripping operations because of rock or other unsuitable material.

Before performing stripping operations, notify the Engineer. Stockpile the stripped topsoil in the areas designated by the Engineer. Neatly dress each stockpile, when completed, to facilitate measurement.

Immediately before the Contractor prepares an area for seeding, the Engineer will take cross-section measurements of the topsoil stockpiles. Until the construction sequence for seeding has been established and is ready to proceed, the Engineer will not cross-section stockpiles, and the Contractor shall not spread topsoil.

Place a 2 to 3-inch layer of topsoil on all areas requiring seeding or sod, except for cut slopes steeper than 2:1. On cut slopes steeper than 2:1 that require seeding or sod, spread topsoil to a depth of 1 to 2 inches, as directed by the Engineer. Cover rock slopes and other rock areas that require seeding with 9 inches of suitable material and 2 to 3 inches of topsoil. After placing the stockpiled topsoil, neatly dress the former stockpile areas and allow the Engineer to take final cross-sections.

203.07 Disposing of Excess or Unsuitable Material

Use excess excavation material to raise, widen, or flatten the slopes of embankments; to fade embankments into cuts; or to place in such other locations and for such purposes as the Engineer may direct.

The Engineer will provide specific instructions regarding the disposal of surplus material. Place and compact excess or unsuitable material within the right-of-way limits as specified in **205.04**. Foundation preparation for and drainage through these waste areas shall be equivalent to that provided for the adjacent roadway embankment.

If no suitable place can be found to dispose of excess or unsuitable material within the right-of-way, the Engineer may direct the Contractor to provide a suitable offsite disposal area at no additional cost to the Department in accordance with the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

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

203.08 Shaping and Dressing

Trim and shape the slopes of all excavated areas, ditches, waterways, channels, borrow pits, and embankments to be in reasonably close conformity with the cross-sections shown on the Plans or as directed by the Engineer.

Scale all loose fragments, projecting points, and debris from rock cuts, and leave in a neat, safe, and workmanlike condition.

Dispose of excess material created by trimming slopes, resloping, and shaping as specified in **203.07**.

Perform Final Dressing as specified in **206**.

COMPENSATION

203.09 Method of Measurement

Where excavation of different classifications overlap, the following order of measurement and computation for payment applies:

1. Road and Drainage Excavation (Unclassified) or Channel Excavation (Unclassified) shall supersede Structure Excavation and Foundation Preparation. Road and Drainage Excavation (Unclassified) shall supersede Channel Excavation (Unclassified).

2. Excavation, the cost of which is included in lump sum items or the unit price bid for other items of construction, shall supersede all other classifications.

Excavation of embankment will not be measured for payment unless the Engineer approved the excavation in writing.

Where it is impracticable to measure material by the cross-section method due to the erratic location of isolated deposits, the Department may use methods involving three-dimensional measurements.

The Department will measure water used in the work by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

A. Road and Drainage Excavation

1. The Department will measure Road and Drainage Excavation by the number of cubic yards of material, acceptably excavated, measured in its original position by cross-sectioning the area excavated. The Engineer may determine cross-sections from conventional manual surveys, aerial surveys, Digital Terrain Modeling, or a combination of these methods.

2. The Department will measure excavation required to bench side-hill slopes of embankment construction as follows:

    a. Excavation in solid rock will be paid for as Road and Drainage Excavation (Unclassified) whether the excavation material is bladed and dozed or picked up and hauled.

    b. For excavation in other than solid rock:

        (1) The Department will measure excavated material that is picked up and hauled as Road and Drainage Excavation (Unclassified).

(2) The Department will not directly measure excavation material moved by blading or dozing and will consider such work as incidental to other items.

3. When the Plans specify or the Engineer directs that rock embankment material be obtained from the roadway excavation, all costs of constructing the rock embankment material, including, but not limited to, excavating, reserving, hauling and placing, will be measured and paid for under the item for Road and Drainage Excavation (Unclassified) and no additional compensation will be made for this work.

4. Authorized excavation of rock, shale, or unsuitable material below grade consists of that excavation necessary to provide the designed thickness of backfill. If the plane of the designated bottom of excavation falls within a layer or stratum of rock, the below-grade excavation to the bottom of the layer, not exceeding 3 inches below grade, will be considered as authorized and will be measured for payment. If the Engineer directs the Contractor to use approved base material to bring portions of the roadway that are less than 3 inches below grade up to grade, the Department will measure and pay for the furnishing and placing of such base material in tons under the applicable item in **303.15**. If base material is not a bid item in the Contract, the Contractor shall provide the material under the provisions of **104.02.D**.

   If the roadway is excavated in excess of 3 inches below the grading line shown on Plans, the Contractor shall furnish and place, at no cost to the Department, sufficient amount of spalls or approved base course material, or other suitable approved granular material, to bring the roadway to a line 3 inches below the grading line.

B. Road and Drainage Excavation (Additional Material)

1. If the Engineer adjusts the slopes shown on the original cross-sections, depresses raised medians or islands, or flattens, widens, or daylights cuts, the Department will measure the additional material thus obtained in cubic yards under Road and Drainage Excavation (Additional Material).

2. If additional material is paid for under the item for Road and Drainage Excavation (Additional Material) and additional clearing and grubbing is required, the Department will measure and pay for

the additional clearing and grubbing by the acre, provided the item for Adjusted Clearing and Grubbing is in the Contract, or as negotiated. No additional payment will be made for extra handling of stockpiled topsoil made necessary by the use of the item for Road and Drainage Excavation (Additional Material).

C. Borrow Excavation

The Department will measure and pay for Borrow Excavation by the cubic yard or ton in accordance with **109**.

D. Presplitting

If the Contract contains an item for Presplitting, the Department will measure presplitting of rock cuts by the number of square yards of rock face determined by multiplying the difference in elevation in yards between the bottom and top of face at each station and intermediate stations (where break sections are needed to accurately show the work) by the length of face in yards taken from cross-sections. If the Contract does not have an item for Presplitting, the required presplitting shall be included in the price bid for Road and Drainage Excavation or Channel Excavation (Unclassified).

E. Undercutting

1. The Department will measure unsuitable materials excavated and removed to obtain proper compaction in cut sections, in foundations for fill sections, and for pipe and box culverts in accordance with **204.12**. The removal and disposal of this unsuitable material will be classified as Undercutting, unless otherwise specified.

2. The Department will not measure suitable material temporarily removed and replaced to facilitate compaction of the material for the full depth shown on the Plans.

3. The Department will measure Undercutting by the cubic yard based on cross-sectional measurement or the most feasible method.

F. Topsoil

1. Except for topsoil obtained from a source outside the right-of-way, the Department will measure and pay for stripping and stockpiling

of topsoil as Road and Drainage Excavation (Unclassified) by the cubic yards of material in its original position.

2. The Department will measure the Placing and Spreading of stockpiled topsoil on slopes and elsewhere within the right-of-way by the cubic yards of material in the stockpile as determined using the cross-section method.

3. Furnishing and Spreading Topsoil obtained from an approved borrow source located outside the right-of-way will be measured by the cubic yards of material removed as determined by cross-sectioning the area before and after removal.

203.10 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Road and Drainage Excavation (Unclassified)	Cubic Yard
Road and Drainage Excavation (Additional Material)	Cubic Yard
Channel Excavation (Unclassified)	Cubic Yard
Borrow Excavation (_____)	Cubic Yard or Ton
Presplitting of Rock Excavation	Square Yard
Undercutting	Cubic Yard
Placing and Spreading Topsoil	Cubic Yard
Furnishing and Spreading Topsoil	Cubic Yard
Water	M.G.

Such payment is full compensation for providing all materials, including hauling excavation and borrow, and providing all equipment, labor, and incidentals to complete the work as specified.

The Department will pay for Road and Drainage Excavation (Additional Material) at a rate per cubic yard equal to 1.5 times the contract unit price for Road and Drainage Excavation (Unclassified).

The Department will pay for excavation required to correct slides, regardless of its location relative to the theoretical slope line, or excavation required to prevent potential slides including blasting, and the dressing, reshaping or flattening of the affected slopes as directed by the Engineer, under the item for Road and Drainage Excavation (Additional Material). If it becomes

necessary to flatten a slope to correct a slide or prevent a potential slide after the cut has been started but not completed, payment under Road and Drainage Excavation (Additional Material) will be limited to material removed between the original staked slope line and the newly established slope line above the elevation to which the cut has been made. The Department will pay for all other material at the contract unit price of Road and Drainage Excavation (Unclassified). Seeding, sod and other items required to repair the slide area will be paid for at the contract unit price bid for the respective items.

The Department will pay for Undercutting at the contract unit price per cubic yard. If unsuitable material not described in the Plans is encountered and no contract unit price has been established for Undercutting, the Department will pay for this work at a rate per cubic yard equal to 1.5 times the contract unit price for Road and Drainage Excavation (Unclassified) due to the nature of the unforeseen, slower production work. However, if the unsuitable material is known and described in the Plans and has been accounted for in grading quantities (either Undercutting or Road and Drainage), it will be paid at the contract bid price.

If the Plans require placement of sod on rock cuts, the Department will pay for rock removal, earthen backfill, and sod placement under Road and Drainage Excavation (Unclassified) and Sodding (New Sod).

The Department will pay for furnishing and placing topsoil and seeding waste areas inside the right-of-way at the contract unit prices for the respective items. The Department will not directly pay for furnishing and placing topsoil and seeding waste and borrow areas located outside the right-of-way.

The Department will pay for the removal of concrete pavement, base, parking strip, and sidewalk, curb and gutter, and similar features under the classifications specified in **202.06** and **203.02.A**.

The Department will pay for roadway obliteration as Road and Drainage Excavation (Unclassified). The Department will pay for the application of topsoil and seed to obliterated roadways under the items for Topsoil and Seeding.

SECTION 204 – STRUCTURE EXCAVATION FOUNDATION PREPARATION, AND BACKFILL

DESCRIPTION

204.01 Description

This work consists of excavation, foundation preparation, and backfill for the installation or construction of bridges, culverts, underdrains, and other structures not otherwise provided for in the Specifications.

This work also includes constructing and subsequently removing all bracing, shoring, cribbing, and cofferdams, all pumping and bailing, backfilling, and disposing of excess or unsuitable material.

204.02 Classification

The Department will classify and pay for Structure Excavation and Foundation Preparation under the following designations:

A. Culvert Excavation (Unclassified)

Structure Excavation and Foundation Preparation performed within the limits specified in **204.08** and **204.10**, for all box bridges, pipe culverts, sewers, conduits, all other culverts, all minor structures of any type and description, will not be measured and paid for directly but the cost will be incidental to other items, unless otherwise shown on the Plans.

B. Dry Excavation (Bridges)

Structure Excavation and Foundation Preparation performed above the datum line (established by elevation and definitively shown on the Plans) and within the limits specified in **204.08.A** and **204.10.A** and not classified as Rock Excavation (Bridges), as indicated or directed, will be classified and paid for as Dry Excavation (Bridges).

C. Wet Excavation (Bridges)

Structure Excavation and Foundation Preparation performed below the datum line (established by elevation and definitively shown on the Plans) and within the limits specified in **204.08.A** and **204.10.A** and not classified as Rock Excavation (Bridges), as indicated or directed, will be classified and paid for as Wet Excavation (Bridges).

D. Rock Excavation (Bridges)

Structure Excavation and Foundation Preparation performed either above or below the datum line (established by elevation and definitively shown on the Plans) and within the limits specified in **204.08.A** and **204.10.A** and consisting of material which cannot be economically excavated without the use of explosives, also any boulder, slab, or fragment of rock having a volume of not less than 1/2 cubic yards, all Portland cement concrete, all masonry (dry mortar), as indicated or directed, will be classified and paid for as Rock Excavation (Bridges).

Cemented gravel, cemented chert, soft shale, or soft slate, even though requiring the use of explosives for economical excavation, will not be classified as rock.

E. Bridge Excavation (Unclassified)

Bridge Excavation (Unclassified) shall be structure excavation and foundation preparation performed either above or below the datum line

(established by elevation and definitively shown on the Plans) as stipulated in **204.08.A** and **204.10.A** regardless of the nature of the material excavated.

F. Rock Drilling (Bridges)

Rock Drilling includes the drilling or sinking of test holes through or in rock to verify the condition of the foundation.

MATERIALS

204.03 Foundation Fill Material

Material for foundation fill shall consist of suitably graded sand, gravel, slag or stone, as approved by the Engineer.

204.04 Bedding Material

A. Support for Pipe Culverts

For Class A bedding, use Portland Cement Concrete, Class A meeting **604**.

For Class B bedding, use sand or a natural sandy soil, all of which passes a 3/8-inch sieve and not more than 10% passes a No. 200 sieve, or a Type A or Type B Aggregate, Grading C, D, or E meeting **903.05**.

B. Areas Requiring Free Drainage Material

In rock cuts or other areas designated by the Engineer that require a free drainage bedding or backfill material, provide crushed stone, crushed slag, or washed gravel meeting **903.17**.

204.05 Reserved

204.06 Backfill Material

A. General

Material for backfill shall be fine compatible soil selected from structure excavation if approved by the Engineer as being suitable. Obtain

additional material needed from roadway or borrow excavation as specified in **203.**

Granular Backfill Material for Structures shall be Type A aggregate, Grading D meeting **903.05**.

B. Flowable Fill

If shown on the Plans, place as backfill material a controlled low strength material (CLSM) (flowable fill) at the locations shown on the Plans or as directed by the Engineer.

Materials used in the placement of CLSM shall meet the following requirements:

Portland Cement, Type I **901.01**
Fine Aggregate **903.01**
Water **921.01**
Chemical Admixtures and Additives **921.06**
Air Entraining Admixtures **921.06.A.2**
Fly Ash, Class C or Class F **921.15**
Ground granulated blast furnace slag (GGBFS) **921.16**

Submit for approval a proposed mix design for CLSM as specified in **604.03**.

As defined herein, there are three types of CLSM: general use flowable fill, excavatable flowable fill, and early strength flowable fill.

As part of acceptance testing, the Department will determine the consistency of CLSM in accordance with the procedure described below. This method applies to each of the types of CLSM.

a. Place an inverted slump cone on a smooth, level surface.

b. Fill the inverted slump cone with a representative sample of the flowable fill without rodding in one lift.

c. Remove the slump cone by lifting it straight up, thus allowing the sample to diffuse on the smooth, level surface.

d. The flowable fill should diffuse into a circular shape having an approximate diameter of not less than 15 inches.

Each consistency test will represent up to 100 cubic yards of flowable fill at each installation.

The Engineer may adjust the Specification Limits identified below to obtain the consistency required for satisfactory flow.

1. **General Use Flowable Fill.** When not otherwise shown on the Plans, or specified in the Contract, provide general use flowable fill proportioned to meet the consistency of a 15-inch minimum spread.

2. **Excavatable Flowable Fill (EFF).** If shown on the Plans, design, proportion, and deliver to the Project an EFF that meets the performance requirements specified in Table 204.06-1.

Table 204.06-1: Specification Limits for EFF

Property	Specification Limit
Air content (ASTM D6023)	Maximum 30% (1)
Consistency	15 inches minimum as tested per **204.06.B**
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.

The Contractor may adjust the mixture design with the Engineer's approval to obtain the required properties.

3. **Early Strength Flowable Fill (ESFF).** If shown on the Plans, design, proportion, and deliver to the Project ESFF that meets the performance requirements specified in Table 204.06-2.

Table 204.06-2: Specification Limits for ESFF

Property	Specification Limit
Air content (ASTM D6023)	Maximum 30% (1)
Consistency	15 inches minimum as tested per **204.06.B**
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.

Include in the proportions of ESFF sufficient amounts of cementitious materials, high range water reducers, accelerators, and other chemical admixtures so the ESFF can be loaded/backfilled as specified.

The Contractor may adjust the mixture design with the Engineer's approval to obtain the required properties.

4. Provide an approved Concrete Daily Report, and furnish the resources, information, and tools that will meet the requirements of **501.03.B**. To produce the desired consistency, the Contractor may use chemical admixtures, air entraining admixtures, or both, at no additional cost to the Department.

204.07 Reserved

CONSTRUCTION REQUIREMENTS

204.08 Excavation

A. Bridges, Box Culverts, and Other Major Structures

Before the start of excavation, the Engineer, or Contractor when required, will set stakes locating and outlining the structure and cross-section for excavation computations.

Before starting excavation, clearly mark the limits of disturbed area and undisturbed area using highly visible markers that are readily visible to project personnel including equipment operators.

Excavate to the lines and elevations shown on the Plans or as directed by the Engineer. The Engineer will allow working variations outside the neat lines; however, the Department will only measure that excavation specified in **204.12** for payment.

Do not deposit or dispose of any excavated materials outside the construction lines unless directed and approved by the Engineer according to the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

If solid rock is encountered in roadway cut sections and channel sections under bridges, perform presplitting operations as specified in **203.04.C**. Hole spacing along bridge abutment sites shall not exceed 12 inches. If overshooting of rock beyond the cut sections shown on the bridge plans requires modification of bridge abutments or span lengths, make such modifications at no additional cost to the Department.

Excavate inclined surfaces of rock used as foundation either level or in steps. When necessary to obtain good bond, as determined by the Engineer, roughen the surface of rock foundation or install suitable anchors. Over-excavations that require re-design, increased bridge length, increased quantities, supplemental retaining walls or other earth retaining structures, shall be at no additional cost to the Department.

Remove existing concrete foundations, boulders, or ledge streaks of rock projecting into the bottom of the excavation to a depth of 6 inches below foundation elevation. Backfill and compact the resulting cavity with approved material.

Only excavate below the specified bridge foundation elevations as directed by the Engineer. Replace, at no cost to the Department, all materials moved without such authority by constructing a sub-footing of the same materials as the footing of the structure unit and 6 inches wider on every side.

B. Pipe Culverts

Excavate for pipe culverts as specified in **204.08.A** and as follows:

1. The width of the pipe trench shall be as shown on the Plans to allow satisfactory joining of the pipe, thorough tamping of the bedding material under and around the pipe, and placement of flowable fill.

2. Remove rock, hardpan, or other unyielding material encountered in the pipe trench to below the foundation grade for a depth of 6 inches, or as directed by the Engineer.

C. Use of Excavated Materials

Use suitable excavated material as backfill or embankment. When disposing of excess or unsuitable material, do not obstruct the stream or otherwise impair the efficiency or appearance of the structure. Deposit excavated material so as not to damage a partly finished structure.

Carefully handle, deposit, and protect excavated materials that will be incorporated in the structure.

In streams, dispose of material according to the laws of the U.S. Government, the requirements in the TN Construction General Permit, and all other applicable environmental permits.

204.09 Protection of Excavation

Protect excavation areas and ensure that the excavation remains intact.

If OSHA regulations require shoring, submit to the Engineer, prior to starting work, computations and drawings, prepared by and stamped by a Professional Engineer licensed in the State of Tennessee, showing the basis for the design.

If using cofferdams or cribs for foundation construction, ensure that they are carried to sufficient depths below the bottom of the footings, are substantially braced in all directions, and are as watertight as necessary for proper performance of the work.

When dewatering work areas, comply with the requirements of the TN Construction General Permit, and do not violate water quality standards. Unless otherwise shown on the Plans, construct cofferdams so that the interior dimensions provide sufficient clearance for the construction and inspection of forms, and to allow for pumping of leakage outside of the footing area. If cofferdams or cribs tilt or move out of position during the process of sinking, right, reset, or enlarge them to provide the necessary clearance at no additional cost to the Department.

Construct cofferdams or cribs to protect the foundation and the construction therein against damage from a rise in the stream.

With the Engineer's written permission, obtained before the start of cofferdam or crib construction, the Contractor may extend timber, or bracing of a cofferdam or crib, into or through the substructure. Do not brace the cofferdams for structure widening off of the existing structure.

Before starting any work, submit drawings to the Engineer, prepared and stamped by a Professional Engineer licensed in the State of Tennessee, showing details of the proposed cofferdam or crib construction. The type and clearance of cofferdams, or cribs, insofar as they affect the finished structure or part thereof, will be subject to the Engineer's approval, but the design and successful construction of cofferdams or cribs is the Contractor's responsibility. Do not begin work in a stream without receipt of the applicable permits from State and Federal agencies. Ensure that cofferdam construction is in accordance with all permit requirements.

Unless otherwise directed, remove cofferdams or cribs, with all falsework, sheeting, bracing, and related appurtenances, after completing the sub-structure therein, unless otherwise directed. Complete the removal without disturbing or marring the completed work.

If the foundation excavation becomes disturbed or distorted, clean out and restore it to satisfactory condition at no additional cost to the Department.

204.10 Foundation Preparation

A. Bridges, Box Culverts, and Other Major Structures

Prepare foundations for bridges, box culverts, and other major structures according to the following:

1. After completing the foundation preparation to the specified elevation, notify the Engineer and await the Engineer's inspection and approval before resuming construction therein.

2. When directed by the Engineer, unless piles are indicated, test each foundation in the presence of the Engineer by sinking three to six test holes to a depth of between 6 and 10 feet.

If these test holes reveal unsatisfactory foundation conditions, continue the excavation lower, as directed by the Engineer, and conduct new tests until a satisfactory foundation is obtained.

3. If rock is encountered in the excavation for the foundation, remove loose fragments and debris and notify the Engineer. Drill test holes in the rock as shown on the Plans or as directed by the Engineer to determine the lines of demarcation, the classification, and the stability of the rock. Continue the excavation to the elevation designated by the Engineer. If required by the Engineer, drill test holes and continue excavation until a foundation approved by the Engineer is secured.

   Strip and clean rock used as foundation of all overlying materials. Remove all loose, disintegrated, or light slabby portions of the rock.

   In rock foundations, if the rock is shattered below the foundation elevation, remove the shattered material and rebuild the resulting space with the same type of construction as the proposed overlying construction, at no additional cost to the Department.

4. If the Plans require driven piles, or if after the foundation excavation has been completed it becomes necessary to reinforce the foundation by driving piles, remove any resulting bulges of the foundation material, at no additional cost to the Department, to the elevation indicated or directed, and bring the foundation to an even surface over its entire area.

5. Remove unsatisfactory material in the foundation and replace with satisfactory material designated by the Engineer. Place the satisfactory material in layers not exceeding 6 inches in loose depth and compact to 100% of maximum density up to the foundation elevation.

6. If pumping from the interior of a foundation enclosure, prevent the possibility of concrete material being carried away. Use a suitable sump located outside the concrete forms to perform any pumping required during the placing of concrete, or for a period of at least 24 hours thereafter. When dewatering work areas, comply with the requirements of the TN Construction General Permit, and do not cause a water quality violation.

7. If conditions make it impracticable to dewater the foundation before placing the footing, the Engineer may allow the Contractor to construct a concrete foundation seal of the dimensions and thickness necessary to resist possible uplift.

    a. Before pouring the seal, clean the foundation of all objectionable material using sand pumps, spud bars, or other suitable means.

    b. Construct the seals as specified in **604.18**.

    c. Allow the seal to set sufficiently to withstand the hydrostatic pressure before starting pumping for dewatering operations.

    d. Dewater the foundation and thoroughly clean the seal of all laitance and ensure that it is generally prepared for further construction.

B. Pipe Culverts

Bedding and trench installation shall conform to the requirements in the Standard Drawings, Specifications, or the Plans. Pipe Culvert shall be placed into an excavated trench. When existing embankment areas are not available to excavate for a trench, follow guidance in Standard Drawings for induced trench method. Bedding for plastic pipe shall be Class B, Type A or B Aggregate, Grading D or E meeting **903.05**.

If placing bell and spigot pipe, dig recesses in the bedding material of sufficient width and depth to ensure that the bell will not rest on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than 2 inches. If the class of bedding is not shown, cut a shallow trench in natural ground or compacted embankment to a depth of not less than 10% of the outside vertical pipe diameter, and shape to fit the lower pipe exterior for the specified embedment. If placing bell and spigot pipe culvert, dig recesses in the earth foundation of sufficient width and depth to ensure that the bell will not rest on the bottom of the recess. The width of the recess shall not exceed the width of the bell by more than 2 inches.

204.11 Backfilling

Place all backfill, other than flowable fill, which will become a part of the roadway prisms or their foundations, in layers, and compact to the density as

specified in **205.04**, Standard Drawings, or the Plans. Place flowable fill, if called for on the Plans, as specified in **204.06.B**.

A. Bridges, Box Culverts, and Other Major Structures

Backfill all excavated areas not occupied by structures with acceptable earth material to the normal ground surface, unless otherwise directed. Place backfill in layers, not more than 6 inches in loose depth for mechanical tamps and 10 inches in loose depth for tamping rollers, on both sides of the structure or around the structure unit, maintaining the layers at equal elevation and thoroughly compacting each layer by tamping with suitable rapid-striking power-driven mechanical tampers or sheepsfoot rollers before placing the succeeding layer.

Place Granular Backfill Material for Structures (Type A, Grading D) meeting **204.06**, so that the compacted depth does not exceed 6 inches per layer. Compact every 6-inch layer to 100% density.

If any part of the structure is to function as a retainer for backfill, such as abutments, retaining walls, wing walls, arches, side walls of box culverts, or minor structures, step the boundary slopes as necessary to prevent wedge action during backfilling.

Do not place backfill against a structure or any section or unit thereof, until the following conditions have been met:

1. Forms have been removed and concrete surfaces have been finished as specified in **604.21** and **604.22**, respectively;

2. Representative specimens of the structural concrete, cured by the same methods and in the same manner as the concrete in the structure, attain a compressive strength of 3,000 psi; and

3. The concrete has been in place a minimum of 7 days, not counting the days of 24 hours each in which the temperature falls below 40 °F, or 21 calendar days, whichever occurs first.

When backfilling behind abutments held at the top by a superstructure, and behind the sidewalls of culverts, bring up backfill simultaneously behind abutments or sidewalls.

Promptly backfill box culverts and bridge ends after the strength requirements have been met, but no longer than 30 days following

strength attainment, and before placing a bridge deck, or as directed by the Engineer.

B. Pipe Culverts

After the bedding has been prepared and the pipe culvert installed; place backfill and embankment uniformly as shown in the Standard Drawings, Specifications, or Plans. Compact material with mechanical tampers to the required density. Above the top of a backfilled trench, place embankment as specified in the applicable section of **205**, except for those requirements related to the induced trench method. Backfill for plastic pipe culvert shall be Class B, Type A or B Aggregate, Grading D or E meeting **903.05**. Use vibratory plate type compactors to achieve required density. Do not use hydrohammer compactors over the top of the pipe culvert. Engineer shall approve compaction equipment.

C. Backfill Material (Flowable Fill)

Place Excavatable Flowable Fill at the locations shown on the Plans or as directed by the Engineer. Cover or otherwise protect the flowable fill while in the plastic state. Do not place embankment or base materials on the flowable fill prior to final set or hardening as determined by the Engineer.

Before placing flowable fill, install pipe and bedding as shown on the Plans and Standard Drawings. Securely brace or anchor all sections of pipe both horizontally and vertically, as required, to prevent movement of the pipe during placement of the flowable fill. Join pipe sections to prevent the influx of flowable fill around the joints. Replace, at no cost to the Department, all pipe or sections of pipe that cannot withstand placement of flowable fill. Make provisions to form up, or provide earthen berms, to prevent the flowable fill from escaping at the ends of the trench and around headwalls.

COMPENSATION

204.12 Method of Measurement

The normal ground surface, as used in this Section, is defined as the bottom of channel excavations when channel excavation is indicated in the contract documents, the template section of the roadway in cuts, or the natural ground surface, whichever is at the lower elevation. When structure excavation is

required in new embankment, the normal ground surface shall be the planes of the new embankment at the elevation specified or directed for construction in advance of performing the required structure excavation, but in no case shall the normal ground surface be above the planes of the new embankment.

A. Structure Excavation

1. The Department will measure structure excavation by the cubic yards of material in its original position only.

2. The Department will measure excavation necessary to construct box bridges, box culverts, retaining walls or minor structures, including pipe culverts and sewers, as follows:

    a. Unless otherwise shown on the Plans, no allowance will be made for excavation, except that undercutting for these structures made at the direction of the Engineer to remove unsuitable foundation material will be classified and paid under the item for Undercutting, in accordance with **203.10**.

    b. If the Plans provide for direct payment of excavation, the excavation, including undercutting made at the direction of the Engineer to remove unsuitable foundation material, will be classified and paid for as Culvert Excavation (Unclassified) with the following exception:

        Excavation within the limits of box bridges, box culverts with a bottom width between the inner faces of the outside walls greater than 14 feet, that is performed above the flow line of the structure, and with a bottom width equal to the distance between the inner faces of the outside walls on a 1:1 slope to the normal ground surface, will be measured and paid for under the item for Channel Excavation (Unclassified).

3. If the Plans provide for direct payment of excavation, the Department will measure the actual volume of material excavated, provided it does not extend beyond the following limits of excavation:

    a. For box bridges, box culverts, retaining walls or minor structures, including pipe culverts and sewers, the volume of Culvert Excavation (Unclassified) measured will extend horizontally to the vertical planes located 18 inches outside the

neat lines of the section of the structure at foundation elevation, as indicated or directed, and vertically between the normal ground surface and the foundation elevation, as approved. For box bridges and box culverts without bottom slabs, the foundation elevation is considered to be the bottom of footings and the flow line elevation between footings. No allowance will be made for overlapping areas.

b. Where internal forming is required, as for cut off walls and similar features, the quantity measured will extend horizontally 12 inches outside the neat lines of the completed work and vertically from the foundation elevation to the bottom of the completed excavation.

c. For pipe culverts, the volume of Culvert Excavation (Unclassified) measured will extend vertically between the normal ground surface and the bottom of the excavation for the pipe, as approved, and horizontally to not beyond two vertical planes separated by a horizontal distance equal to the outside diameter of the pipe plus 3 feet.

d. Where rock removal is necessary to prepare a satisfactory bed for pipe culverts, the quantity removed will be measured to a depth of 6 inches below the bed of the pipe, as approved. No allowance will be made for the material used in backfilling, except bedding material when specified.

e. The volume of Dry Excavation (Bridges), Wet Excavation (Bridges), Rock Excavation (Bridges), and Bridge Excavation (Unclassified) measured will extend vertically between the normal ground surface and the bottom of the excavation as approved, and horizontally to the vertical planes located 18 inches outside of the neat lines of the section of the structure at foundation elevation. Where a concrete seal is used, the limits of excavation will not extend beyond the neat lines of the concrete seal, as specified or as directed by the Engineer.

f. For excavation necessary to form struts, diaphragms, beams, and similar features, the volume measured will extend vertically between the normal ground surface and a horizontal plane located 12 inches below the members, and horizontally to the vertical planes located 18 inches beyond the limits of the members.

4. No increase or decrease in payment will be allowed for changes in amount of excavation due to the shifting of location of structures from that shown on the Plans or for the addition of structures to those shown on the Plans when the Plans do not indicate that direct payment will be made for this excavation. Further, if this area of excavation, namely 18 inches horizontally outside of the neat line of the structure at foundation elevation, overlaps an area in which the excavation is computed on a separate unit price, the excavation in the overlapping area will not be allowed.

5. The Department will measure extra excavation below foundation elevation, as shown on the Plans or as directed by the Engineer, if due to causes not attributable to the Contractor's actions.

   In computing extra depth excavation, the working limits established herein will be adhered to.

6. No allowance will be made for shaping necessary to accommodate the bells of the pipe.

7. The Department will measure Rock Drilling performed as specified in **204.10.A** by the linear foot.

B. Protection of Excavation

1. If items for cofferdams or cribs for individual piers or bents are provided by the Plans, the Department will measure this work in individual lump sum items for the pier or bent designated.

2. If a bid item for sheet piles is provided on the Plans, the Department will measure and pay as specified. If payment for the sheet piles is by the square foot, the Department will measure based on the as-designed sheet pile length to retain and counteract lateral earth forces, plus 1 foot.

C. Bedding and Backfill

1. If payment for bedding is provided on the Plans, the Department will determine the volumes of Class A and Class B bedding based on the theoretical quantity, in cubic yards per foot of pipe, as shown on the Standard Drawings or Plans.

2. The Department will measure Backfill Material (Flowable Fill) based on the theoretical quantity in cubic yards, as shown on the Standard Drawings. Measurement will be made along the centerline of the pipe for the width of trench shown on the Plans.

3. Material used to replace approved undercutting for box bridges, box culverts, retaining walls or minor structures, including pipe culverts and sewers, will be paid under the item for Foundation Fill Material, and the measurement will be the same quantity as the approved undercutting it replaces.

The Department will not measure for payment:

1. Materials moved from their original position before being measured by the Engineer;

2. Slides, cave-ins, and excavation extending outside of the workable limits;

3. Removal of foundation material that has bulged due to driving piles;

4. Excavation above the normal ground surface, unless otherwise shown on the Plans;

5. Water and its removal; and

6. Construction and/or removal of cofferdams, cribs, sheet piles, or other protective measures provided to safeguard an excavation, unless otherwise shown on the Plans.

204.13 Basis of Payment

If provided for on the Plans, the Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Culvert Excavation (Unclassified)	Cubic Yard
Dry Excavation (Bridges)	Cubic Yard
Wet Excavation (Bridges)	Cubic Yard
Rock Excavation (Bridges)	Cubic Yard
Bridge Excavation (Unclassified)	Cubic Yard

Extra Depth Structure Excavation and Foundation Preparation	Cubic Yard
Rock Drilling (Bridges)	Linear Foot
Bedding Material (Pipe) Class A	Cubic Yard
Bedding Material (Pipe) Class B	Cubic Yard
Cofferdam	Lump Sum
Foundation Preparation	Lump Sum
Backfill Material (Flowable Fill)	Cubic Yard

Such payment is full compensation for providing all materials, equipment, labor, and incidentals to complete the work as specified, including performing embankment construction, sloping, shaping, dressing, disposal of excess or unsuitable material, and final cleanup.

The Department will pay for Structure Excavation and Foundation Preparation of the various classes based on the volume computed in accordance with **204.12**.

A. Extra Depth Structure Excavation and Foundation Preparation

The Department will pay for Extra Depth Structure Excavation and Foundation Preparation, classified as Culvert Excavation (Unclassified), made necessary by the Engineer establishing the foundation below the elevation shown on the Plans, at the contract unit price per cubic yard for Culvert Excavation (Unclassified).

Extra Depth Structure Excavation and Foundation Preparation for bridges made necessary by the Engineer requiring excavation below the foundation elevation shown on the Plans, will be paid for at the contract price per cubic yard for Dry Excavation (Bridges), Wet Excavation (Bridges), Rock Excavation (Bridges), as classified for the actual quantity in cubic yards, excavated from the designated zone, this zone being between the elevation shown on the Plans and the final approved elevation, as directed by the Engineer, plus the additional percentages for each zone corresponding to the depths lowered below Plan elevation as specified in Table 204.13-1.

Table 204.13-1: Designated Zone for Extra Depth Structure Excavation

Sub-Item Designation	Zone No.	Depth Lowered below Plan Elevation		
		More than (ft)	Additional Not Over (ft)	Percent
None	0	0	4	0
a	1	4	8	50
b	2	8		80

Using Table 204.13-1, the Department will compute the volumes of material for payment under any sub-item based on the depths applicable to each zone between the foundation elevation as shown on the Plans and the final foundation elevation as approved by the Engineer. For example: If the foundation were lowered 7-1/2 feet below the foundation elevation shown on the Plans, the Department will compute the volume for the sub-item for a depth of 3-1/2 feet and multiplied by the contract unit price for the class of material excavated plus 50%. The volume of material down to a level 4 feet below the foundation elevation shown on the Plans will be paid for at the contract unit price for the class of material excavated.

B. Cofferdams or Cribs

If items for cofferdams or cribs have been provided for and installed for a designated pier or bent, the lump sum item is full compensation for the furnishing and installation of all material, maintenance, removal, and satisfactory cleanup of the area, and for all tools, equipment, labor, and incidentals necessary to complete the work. Concrete seal shall also be included, except when otherwise shown on the Plans, in which case, measurement and payment for concrete foundation seal will be as provided for under **604.30** and **604.31**.

C. Foundation Preparation

1. Unless otherwise shown on the Plans, no direct payment will be made for Foundation Preparation and Backfill.

2. If Foundation Preparation is a separate pay item, the lump sum price is full compensation for the preparation of foundations for all substructures. The cost for cofferdams, shoring, pumping, or seal concrete required to establish the approved footing shall be

incidental to the lump sum bid for Foundation Preparation, except payment will be made at 40% of the price bid for the footing concrete when approved by the Engineer:

a. For leveling placed within the neat lines of the bottom of the footing, where permitted, and

b. For additional seal concrete required by changes directed by the Engineer. Payment will be made only for the additional seal concrete placed within vertical planes located 18 inches horizontally outside of the neat lines of the bottom of the footing. No payment of seal concrete will be made for any depth the seal is embedded in sound material below the elevation of the bottom of the pier footing as shown on the Plans to allow placement of an adequate seal.

3. The Department will not allow a percentage increase for extra depth excavation required for the foundation preparation.

4. Unless otherwise provided, the Department will not pay for the sinking of test holes to test foundations.

D. Backfill Material (Flowable Fill)

Payment for Excavatable Flowable Fill as backfill material for pipe will be included in the unit price paid for pipe unless otherwise shown on the Plans.

E. Backfill and Bedding Material

Payment for granular backfill and concrete or aggregate bedding material will be included in the unit price paid for pipe unless otherwise shown on the Plans.

The Department will not pay for: material moved before it has been measured by the Engineer; material specified to be moved under **203**; slides or cave-ins occurring outside of the working limits specified in **204.08** and **204.10**; material excavated outside of said working limits; material excavated, even though within the said working limits, below foundation elevation, as indicated or directed, and made necessary on account of the construction methods of the Contractor, or its failure to provide sufficient or proper protection; presplitting of rock; material excavated below foundation when shooting; bulged material caused by driving piles in a foundation; water and

its removal; and in general, material moved which would have been unnecessary to move to complete the structure in accordance with the Plans, these Specifications, or the directions of the Engineer.

SECTION 205 – EMBANKMENTS

DESCRIPTION

205.01 Description

This work consists of constructing roadway embankments, including preparing the area upon which they are to be placed; constructing dikes within or outside the right-of-way; placing and compacting approved material within roadway areas where unsuitable material has been removed; and placing and compacting embankment material in holes, pits, and other depressions within the roadway area.

MATERIALS

205.02 Materials

For embankment and backfill, only use approved materials, consisting of Road and Drainage Excavation, Channel Excavation, and Borrow Excavation material as specified in **203**, or excess material as specified in **204**.

CONSTRUCTION REQUIREMENTS

205.03 Preparation of Embankment Areas

Before beginning embankment construction in any area, complete Clearing and Grubbing, Removal of Structures and Obstructions, and installation of preliminary erosion control measures according to the approved SWPPP as specified in **201**, **202**, and **209** respectively.

Address both natural and created steep slope areas as required in the TN Construction General Permit. Maintain and stabilize steep slopes according to the TN Construction General Permit and all applicable environmental permits.

Remove snow, ice, and mud before placing embankment materials on the ground. Do not place embankment materials on top of ground surfaces and existing embankment layers that are frozen.

Fill all depressions or holes below the natural ground surface, whether caused by grubbing or otherwise, with suitable material and compact to the ground surface before starting embankment construction.

Unless otherwise shown on the Plans or specified in the Special Provisions, if constructing embankment of less than 3 feet below subgrade:

1. Remove all sod and vegetative matter from the surface.

2. Remove unsuitable material and replace with suitable material.

3. Break up the cleared surface by plowing, scarifying, or stripping to a minimum depth of 6 inches, and then re-compact this area.

4. If a compacted road surface containing granular materials lies within 3 feet of the subgrade, scarify the old road surface to a depth of at least 6 inches, and then re-compact the scarified material.

Remove and dispose of concrete pavement, parking strip, and base, all with or without bituminous overlay, concrete curb and gutter, sidewalk, driveways, and similar features as specified in **202.06** or as otherwise directed by the Engineer.

When placing embankment material on or against existing slopes that are steeper than 4:1, cut benches into the existing slope while bringing up the new embankment material in layers. Cut each bench of sufficient width to accommodate the operation of placing and compacting equipment. Begin each successive cut at the intersection of the original ground and the vertical side of the previous cut. Re-compact the cut material along with the new embankment material at no additional cost to the Department.

Before placing embankment material on a structure or any unit of a structure, ensure that the surrounding backfill has been completed and thoroughly compacted to ground surface.

205.04 Formation of Embankments

Do not incorporate or bury any perishable materials, such as brush, hedge, roots, stumps, and parts of trees, in the embankments. Do not place rock, broken concrete, or other solid objects in embankments areas where piling will be installed.

Construct embankments to provide adequate surface drainage at all times. If roadway embankment materials consist predominantly of soil, place the material in horizontal layers not to exceed 10 inches in loose thickness, and compact each layer to a density not less than 95% of maximum density. Unless otherwise specified, compact the top 6 inches of the roadbed in both cut and fill sections to 100% of maximum density as specified in **207.04**. The Department inspector conducting the density tests shall be a certified Nuclear Gauge Technician.

The Engineer will determine maximum density and optimum moisture according to AASHTO T 99. For material with less than 5% retained on a No. 4 sieve, method A with 4-inch mold will be used. For material with more than 5% retained on a No. 4 sieve but less than 50% retained on a 3/4-inch sieve, Method D with corrections according to AASHTO T 224 will be used.

Use the correction on soils containing less than 50% plus 3/4-inch material.

Determine the density of the soil in place according to an approved AASHTO method. Compact each embankment layer to the required density, and obtain the Engineer's approval before placing material for the next succeeding layer. Keep placing and compacting areas separate.

When constructing embankment across low swampy ground that will not support earth moving equipment, construct the lower part of the fill in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. Construct the embankment full width unless otherwise shown on the Plans or approved by the Engineer. The Engineer will waive the density requirement for such a lift, but the moisture content of the material used shall not exceed the optimum moisture range for 95% density for that material. Comply with the maximum thickness and minimum density requirements for all succeeding layers of the embankment.

When a minimum of 95% of maximum density is required, ensure that the moisture content of the material being compacted meets both of the following conditions:

1. The moisture content shall be within the range of values at which 95% of the maximum density can be obtained as indicated by the moisture-density relationship curve; and

2. The moisture content shall not exceed the optimum moisture content to the extent that the material pumps under loads applied by the construction equipment.

Even if the required density is achieved and the moisture content is in range, if pumping occurs, remove the affected sections.

When 100% of maximum density is required, the moisture content of the material being compacted shall meet condition (2) above and shall not vary from the optimum moisture content by more than plus or minus 3%.

Aerate the material, or distribute and incorporate water uniformly into the material, as necessary, to control the moisture content within the applicable limits.

If the excavated material consists predominantly of rock, the following shall apply:

A. Definition of Material

If deemed necessary by the Engineer, the Contractor shall conduct test or tests with a 60,000-pound static tamping foot roller (costs to be included in other items) to determine whether the material is degradable or non-degradable. Consider material that readily breaks down under three passes of the 60,000-pound static tamping foot roller as degradable.

B. Non-Degradable Rock

If sound, non-degradable rock is encountered in the unclassified excavation, the Engineer may require the Contractor to provide a mechanical means for separating the sound rock from degradable rock and other soils. The Engineer may allow the use of sound, non-degradable rock in the backfilling of benches, lower and outside portions of embankments, rock buttresses, or other areas.

If the material for embankments consists of sound, non-degradable rock of a size that makes placing the material in 10-inch layers impracticable, place the material in layers no thicker than 3 feet. Do not use rock fragments greater than 2 feet in maximum dimension. With the

Engineer's approval, the Contractor may place occasional individual rocks and boulders not exceeding 4 feet in height in the exterior portions of the embankment next to the slope face. Place such rocks to prevent nesting and fill the adjacent voids with fine fragments to form a dense and compact mass.

Do not dump rock material into its final position. Place rock by blading or dozing in a manner that will minimize voids, pockets, and bridging. Ensure that each layer is leveled the full width of the embankment. Rolling is not required if the rock embankment consists of sound, non-degradable material placed in greater than 10-inch layers.

C. Degradable Rock

Compact degradable rock for use in embankment with an approved vibratory tamping-foot roller in conjunction with a static tamping-foot roller. The minimum weight for the static tamping-foot roller shall be 60,000 pounds. The minimum compaction effort, as rated by the manufacturer, for the vibratory tamping-foot roller shall be 55,000 pounds. Submit roller specifications to the Engineer for approval before use.

Place degradable rock in 10-inch maximum loose lifts and provide a minimum of three passes with the static roller and two passes with the vibratory roller. The Engineer may direct additional passes with either or both rollers until satisfactory breakdown and compaction is accomplished. Do not place degradable rock in the top 5 feet of an embankment unless approved by the Engineer.

If embankment composed of degradable rock does not contain sufficient moisture to compact properly, the Engineer will require the Contractor to apply water in sufficient quantities to achieve the approximate optimum moisture for the particular material involved. Uniformly mix the added water with the material for the entire depth of the lift by blading, discing, or other approved methods.

D. Combination of Degradable and Non-Degradable Rock

Do not blend or combine degradable rock and non-degradable rock in a common lift without the Engineer's written approval.

If approved, place embankment material consisting of a mixture of degradable rock and non-degradable rock, or rock and soil, in layers not

exceeding 10 inches in thickness unless otherwise directed by the Engineer. If the combined material is predominantly sound, non-degradable rock with fragments thicker than 10 inches, the Engineer may increase the layer thickness to be consistent with the size of the material, not to exceed 3 feet. Place the mixture by blading or dozing in a manner that will minimize voids, pockets, and bridging. Compact the mixture with suitable compaction equipment as defined in **205.04.A**, and apply water to facilitate compaction as directed by the Engineer. Uniformly mix the added water with the material for the entire depth of the lift by blading, discing, or other approved methods.

E. Density Requirements

Density requirements will not apply to portions of embankments constructed of materials that cannot be tested by approved methods.

When the Plans require Solid Rock Fill, the material shall meet the quality requirements in **903.25**. Do not use plastic soil or shale material. Place Solid Rock Fill as shown on the Plans or as directed by the Engineer.

Construct the roadway through rock fills to the grading line shown on the Plans with an allowable working tolerance of plus 1 to minus 3 inches. Bring up to grade those portions of the roadway that are then below grade with spalls or other suitable granular material that is available from the excavation within the balance. If no such excavation is available, the Engineer may direct the Contractor to use approved base material for bringing the fill to grade, not to exceed the specified 3-inch limit.

If embankment material is to be placed on both sides of a concrete wall or box type structure, bring the material up equally on both sides of the structure.

At the location of abutments, bents, and similar features, construct embankment to the finished grade before starting excavation on the respective section of the substructure, unless otherwise shown on the Plans. If embankment material is to be placed on only one side of abutments, wing walls, piers, and similar features, do not begin construction until the superstructure is in place. Perform compaction operations without causing wedge action or placing excessive pressure against the structure.

205.05 Stability of Embankments and Cut Slopes

Assume responsibility for the stability of all embankments and cut slopes until final acceptance. In accordance with **105.16** and as determined by the

Engineer, replace or rework all portions that have become displaced or damaged at no additional cost to the Department.

205.06 Disposal of Excess or Unsuitable Material

Dispose of excess or unsuitable material as specified in **203.07**.

COMPENSATION

205.07 Method of Measurement

The Department will not measure embankment. The Contractor shall construct embankments under the items described in **203** and **204** that apply to the materials used to construct the embankments.

The Department will measure excavation to bench side-hill slopes for embankment construction in accordance with **203.09.A.2**.

205.08 Basis of Payment

The Department will not directly pay for embankments. The contract unit prices for the materials with which embankments are acceptably constructed is full compensation for all embankment construction, including materials, equipment, labor, and incidentals to complete the work as specified.

If the Contractor encounters pumping of soil despite having achieved the required density and moisture content, the Department will pay for the removal of these sections as Undercutting by the cubic yard in cut sections only. No such payment will be made in fill sections.

If the excavated material consists predominantly of rock, the Department will pay for water required and provided by the Contractor to facilitate compaction at the unit price per M.G. (1,000 gallons) for Water, which price is full compensation for furnishing and applying the water, mixing, labor, and equipment. The Department will consider all other costs associated with the constructing embankment of material consisting predominantly of rock, including providing suitable compaction equipment and separating sound rock from degradable rock and soils, as included in the unit price for Road and Drainage Excavation (Unclassified).

If the Engineer directs the Contractor to use approved base material to bring portions of the roadway that are less than 3 inches below grade up to grade,

the Department will measure and pay for the furnishing and placing of such base material in tons under the applicable item in **303.15**. If base material is not a bid item in the Contract, the Contractor shall provide the material under the provisions of **104.02.D**.

If, despite proper construction and protection, damage to the embankments or cut slopes occurs due to unusual natural causes such as cloudbursts, floods, slides or subsidence, the Department will pay for the material used to make the necessary repairs at the contract unit price for the material classification designated by the Engineer to be used for this purpose. The Department will pay for removal of slides in accordance with **203.10**.

SECTION 206 – FINAL DRESSING

DESCRIPTION

206.01 Description

This work consists of dressing all slopes and areas, including borrow pits and embankments, and generally preparing the Project for final inspection and acceptance. The costs of this work are incidental to other items of construction.

206.02 Reserved

CONSTRUCTION REQUIREMENTS

206.03 Method and Scope of Work

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.

Clean the right-of-way of all weeds, briars, and brushes unless otherwise shown on the Plans. Clear and clean all structures, both old and new, of all brush, drifts, heavy vegetation, sediment, rubbish, obstructions, and other objectionable material.

Perform final dressing before sodding and seeding operations if the Contract includes these construction items.

Run tracked machines used in dressing slopes up and down slopes as opposed to longitudinally.

SECTION 207 – SUBGRADE CONSTRUCTION AND PREPARATION

DESCRIPTION

207.01 Description

This work consists of constructing and preparing part of or all the roadbed to a condition suitable for supporting the immediate construction of a base or pavement.

207.02 Reserved

CONSTRUCTION REQUIREMENTS

207.03 Preparing Subgrade

Perform Excavation and Undercutting as specified in **203**.

Where the roadbed is below grade, haul, spread, and compact, as specified in **205**, suitable material in sufficient quantity to bring the roadbed to grade.

Where the roadbed has been seeded for erosion protection or has established vegetative growth, clip the roadbed to remove vegetation and other deleterious material before placing the base or subbase material. Correct depressions resulting from the removal of deleterious material by hauling, spreading, and compacting suitable material as specified in **205**.

Where subbases are to be constructed on the subgrade, extend the limits of subgrade preparation across the entire section that will receive the subbase course, including the shoulders.

Where forms are required to construct base or pavement, prepare the subgrade 12 inches wider, on each side, than the neat width of the base or pavement.

207.04 Compacting Subgrade

On subgrades that require reworking, remove all vegetation within the limits of subgrade preparation, and dispose of this material as directed by the Engineer before beginning reworking and re-compacting operations.

The density of the finished subgrade shall not be less than 100% of the maximum density. The optimum moisture, maximum density, and density of the soil in place will be determined in accordance with **205.04**. If field tests show failure to meet the density requirement, loosen the subgrade by discing, harrowing, or other approved methods to a depth of not less than 6 inches, then reshape and re-compact the subgrade material as specified in **205.04**. Moisten or aerate the subgrade material as necessary during mixing and compacting to provide optimum moisture content as specified in **205.04**.

Rework, or remove and replace, all soft, yielding material that will not compact readily, and compact the replacement material as specified in **205**.

207.05 Drainage and Protection

Grade the subgrade to provide for ready drainage of water from the subgrade. Maintain ditches and drains to provide proper drainage during the construction.

Take all precautions necessary to protect the subgrade from damage. Limit hauling over the finished subgrade to that which is essential for construction purposes.

Correct ruts or rough places that develop in a completed subgrade and re-compact as necessary.

207.06 Checking Subgrade

Check the lines, cross-sections, and grades of the subgrade as completed to ensure they are in reasonably close conformity with those shown on the Plans for the bottom of subbase, base, or pavement, or with those established by the direction of the Engineer.

Construct the subgrade to the grading line shown on the Plans, with an allowable working tolerance of plus or minus 1 inch.

Recheck the subgrade as specified in the respective sections governing construction of the particular type of base and pavement.

207.07 Disposal of Excess or Unsuitable Material

Dispose of excess or unsuitable material as specified in **203.07**.

COMPENSATION

207.08 Method of Measurement

The Department will measure items of construction as follows:

1. Subgrade Construction and Preparation will be measured by the station (100 feet) along the median centerline of the Project for divided sections, and along the centerline of the pavement for 2-lane and other undivided sections, excluding bridges.

2. The volume of excess or additional material moved, or of unsuitable material removed, will be measured in cubic yards by the cross-section method, or if that method is unfeasible, by some other method, with the volume computed for payment in accordance with **109**.

    a. If grading has been performed under a previous Contract, the Department will measure the number of cubic yards of unsuitable material below subgrade elevation, acceptably removed and disposed of, in both cut and fill sections under the item for Road and Drainage Excavation (Unclassified) in accordance with **203.09.A**.

b. If grading is included in the Contract, the Department will measure the number of cubic yards of unsuitable material below subgrade elevation in cut sections, acceptably removed and disposed of, under the item for Undercutting in accordance with **203.09.E**. In the subgrade of embankment sections, the Department will not measure the removal and disposal of excess or unsuitable material for payment.

3. Water required for compaction by the M.G. (1,000 gallons) will be measured using calibrated tanks or distributors, or accurate water meters.

207.09 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Subgrade Construction and Preparation	Station

Payment for Subgrade Construction and Preparation per 100-foot station is full compensation for shaping and compacting the roadbed, all ramps, service roads, approaches, roadside rest areas, and similar features, as shown on the Plans. If the material to be placed or removed does not exceed a depth of 3 inches, this payment also includes the moving or furnishing of all additional material required, or the disposal of excess material. If a depth of 3 inches is exceeded, the Department will pay for the total quantity of material removed or placed at the appropriate contract unit price per cubic yard for Borrow Excavation (Unclassified) or Road and Drainage Excavation (Unclassified), as provided in **203**.

If the Contract includes the construction of the combined grading, drainage, and pavement structure, the Department will consider the construction and preparation of the subgrade as incidental to the construction and preparation of the road, and the material moved will be classified and included in the computation of pay items provided in **203**.

If the Contract provides for the construction of a subbase, base, or pavement on a road that has been graded under a previous contract, and the item for Subgrade Construction and Preparation is included in the Contract, the Department will pay for this item at the contract unit price per 100-foot station. Payment for material moved will be subject to the stipulations set forth above.

Unless otherwise shown on the Plans, the Department will consider clipping of a roadbed that has been seeded as incidental to other items of construction.

The Department will pay for Water applied as directed by the Engineer at the contract unit price per M.G. (1,000 gallons), as provided in **203**.

SECTION 208 – SHOULDERS AND DITCHES

DESCRIPTION

208.01 Description

This work consists of constructing shoulders and ditches adjacent to both sides of the base or pavement to obtain proper drainage.

MATERIALS

208.02 Materials

The Contractor may obtain material for constructing shoulders as approved by the Engineer. Provide additional material, if required, from approved sources.

EQUIPMENT

208.03 Equipment

The Contractor may perform compaction operations using any type roller that will produce the required results.

CONSTRUCTION REQUIREMENTS

208.04 General

While constructing shoulders, protect the surface and edges of pavement. Do not start shoulder work until the pavement has developed effective resistance to damage.

Complete shoulder construction by blading, moistening as may be necessary, and thoroughly compacting. After completion, maintain the shoulders with respect to lines, grades, and cross-sections until final acceptance of the Project.

208.05 Final Cleanup

Perform Final Dressing as specified in **206**.

Dispose of excess or unsuitable material as specified in **203.07**.

Perform final cleanup as specified in **104.10**.

COMPENSATION

208.06 Method of Measurement

The Department will measure:

1. Shoulder and ditch construction by the mile along each respective shoulder and/or ditch constructed or reworked;

2. Material required in excess of that obtained by cleaning outside ditches by taking cross-sections of the approved borrow pit or pits before and after removal of the material; and

3. Water by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

208.07 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Shoulders and Ditches	Linear Mile

The Department will pay for material required in excess of that obtained by cleaning outside ditches at the contract unit price per cubic yard for Borrow Excavation (Unclassified).

The Department will pay for water applied as directed by the Engineer at the contract unit price per M.G. (1,000 gallons).

SECTION 209 – PROJECT EROSION PREVENTION AND SEDIMENT CONTROL

DESCRIPTION

209.01 Description

This work consists of implementing temporary and permanent best management practices (BMPs) to prevent erosion and control sediment through the use of structural and non-structural controls.

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.

Comply with all provisions of the SWPPP, noting that additional EPSC measures beyond those shown in the SWPPP may be needed to maintain compliance with permits.

209.02 Classification

The Department will classify structural and non-structural BMPs according to the manual for *Management of Storm Water Discharges Associated with Construction Activities*.

BMPs are structural and non-structural controls required for the Project. Implement BMPs according to the more restrictive of the TN Construction General Permit, the manual for *Management of Storm Water Discharges*

Associated with Construction Activities, the project SWPPP, and Roadway Standard Drawings.

209.03 Reserved

CONSTRUCTION REQUIREMENTS

209.04 Project Review

At the preconstruction conference, discuss with the Engineer the potential problems with implementing EPSC measures due to construction activities, as well as the actions to be taken to prevent such problems. If the Contractor's operations and construction staging differ significantly from the Project SWPPP, propose modifications to the SWPPP, as specified in **209.05**, that do not conflict with the requirements of the TN Construction General Permit, the conditions of any ARAP for the Project, and other environmental permits. Comply with all provisions of the SWPPP during the term of the Contract.

If a waste or borrow area is needed, prepare a Waste and Borrow Plan according to the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

209.05 Preconstruction Conference

The Department will hold a preconstruction conference for every project. For sites that have environmental permits, the Department will also hold an environmental preconstruction conference. These conferences may be held jointly or separately, as determined by the Engineer.

At the preconstruction conference, submit for approval a phasing plan that identifies:

1. All areas within the right-of-way designated for clearing and grubbing, grading, bridges and other structures at water courses, paving, and incidental construction activities; and

2. Areas outside the right-of-way that will be disturbed by the construction such as waste and borrow areas (which must have an approved Waste and Borrow Plan and be properly permitted), haul roads, utilities, and staging areas, and utility work in general.

If the phasing plan requires additional EPSC measures, or modifications to the existing SWPPP, submit these modifications to the Engineer for discussion during the preconstruction conference. The modifications shall incorporate and supplement, as applicable, the basic control devices shown on the Plans to provide acceptable temporary and permanent EPSC measures during all stages of construction as well as to comply with all applicable environmental permit conditions. The modifications shall also include controls for managing and stabilizing natural and created steep slope areas as defined in the TN Construction General Permit. Do not begin work until the Engineer has accepted the erosion prevention and sediment control plan, including the phasing of temporary and permanent erosion control measures. Rejection of all or part of the plan is not a basis for an extension of contract time.

Discuss with the Engineer how utilities will be managed on the Project, specifically whether or not the utilities are within the construction contract. Coordinate a start date for utilities with the Engineer if utility work will begin before the Project start date. Unless approved in advance by the Engineer, utilities that are within the construction contract cannot begin construction on the Project until the Engineer has approved the work.

Update the EPSC plan as work progresses to show changes due to revisions in work schedules or sequence of construction, or when directed by the Engineer. Install additional measures in the field as needed to manage erosion and sediment and to prevent pollutants from discharging into waters of the State or off the Project.

The environmental preconstruction conference will include a review of the Project's environmental permits and all additional environmental commitments required for the Project. This meeting will address the required marking of clearing limits and the marking of sensitive environmental areas in accordance with applicable environmental permits. Discuss potential problems with implementing the requirements of any environmental permits due to construction activities, as well as actions to be taken to prevent conflicts between environmental permits and construction activities.

209.06 Construction Requirements

Mark the disturbed area limits and environmental boundaries in the field before starting construction in each section or portion of the Project. Before or simultaneously with clearing and grubbing operations, install EPSC devices according to the approved SWPPP. Such work may involve the construction of temporary berms, dams, silt fences, sediment basins, lined

channels, permanent cut-off ditches, slope drains, or other control devices as necessary to prevent and control erosion.

Do not pump water from cofferdams or other dewatering activities directly into streams. Pump such water into sediment basins, traps, or filter bags, or otherwise adequately treat before discharging. Do not start grading operations until the EPSC devices are in place to the satisfaction of the Engineer. If adequate controls are in place, the Contractor may clear and grub areas to be graded according to the TN Construction General Permit before starting grading operations. Protect stockpiled topsoil or fill material to prevent sediment runoff from contaminating surrounding areas or entering nearby streams. To reduce sediment in runoff, promptly install EPSC structures during all construction phases and maintain these measures until the areas they are serving have been permanently stabilized.

Identify both natural and created steep slope areas as defined in the TN Construction General Permit. Ensure the SWPPP is updated to reflect all steep slope areas. Manage and stabilize steep slopes according to the TN Construction General Permit and other applicable environmental permits.

Stage construction operations so that graded or otherwise disturbed erodible surfaces remain protected as the Work progresses. Once started, complete grading of roadway cuts or embankments as a continuous, viable operation to subgrade elevation, unless otherwise approved in writing by the Engineer. As grading operations progress, perform final dressing, place topsoil, and protect exposed erodible cut or embankment slopes with permanent seeding, sodding, matting, or other acceptable EPSC measures in vertical increments not exceeding 25 feet. Do not allow any portion of these slopes to remain unprotected longer than allowed by the TN Construction General Permit unless the Engineer determines that weather conditions or other special circumstances prevent prompt placement of permanent control measures. Implement temporary erosion control measures as directed by the Engineer.

Perform seeding, sodding, matting, or other acceptable EPSC operations within 48 hours of the occurrence of either of the following:

1. Each 25-foot vertical increment is graded, or
2. Upon suspension or completion of grading operations in a specific area.

The above requirements for progressive erosion prevention and sediment control also apply to graded areas off the right-of-way, such as waste areas, borrow areas, and haul roads. Develop a Borrow and Waste Plan for all waste

or borrow areas selected according to the Statewide Storm Water Management Plan and the manual *Procedures for Providing Offsite Waste and Borrow on TDOT Construction Projects*.

Incorporate all permanent EPSC practices into the Project as soon as practicable and in accordance with the TN Construction General Permit. To the extent practicable, coordinate temporary and permanent erosion prevention and sediment control work. Use temporary EPSC features to control erosive conditions before permanent control features can be installed or to temporarily control erosion that develops during construction, but which is not associated with permanent control features on the Project. Perform temporary stabilization of disturbed areas according to the TN Construction General Permit.

Where construction activities cross or border areas of depression (i.e., sinkholes without openings or open throats), install and maintain EPSC measures as shown on the Plans and as required by the TN Construction General Permit and all other applicable environmental permits. If construction activities encounter an open throated sinkhole (Class V Injection Well), immediately notify the Engineer and implement the applicable measures as described in the approved SWPPP. Prevent silt or other potential pollutants from entering the sinkhole opening.

Remove temporary EPSC measures when no longer needed or permanent control measures are installed. Any materials removed shall become the property of the Contractor.

Inspect EPSC measures on a regular basis. Remove accumulated sediment and maintain the structural components of the EPSC measures as necessary to ensure that they continue to function properly. Repair EPSC measures damaged by the Contractor's sediment removal operations at no additional cost to the Department. Upon complete removal of sediment traps, special ditches, and similar structures, restore the area upon which they were constructed by placing topsoil, seed, and mulch, or otherwise stabilizing.

If temporary EPSC measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled, and are ordered by the Engineer, perform such work at no additional cost to the Department.

If there is a conflict between these requirements, the TN Construction General Permit, and the laws, rules, or regulations of other Federal, State, or local agencies, adhere to the more restrictive laws, rules, or regulations.

209.07 Construction of Structures

Structural controls include, but are not limited to, bonded fiber matrix, riprap, inlet protection, check dams, silt fence, and sediment basins. Install and maintain structural measures according to the manual for Management of Storm Water Discharges Associated with Construction Activities, TN Construction General Permit, and the Roadway Standard Drawings.

A. Sediment Filter Bags

The Contractor may use sediment bags on slope drains, pipe culverts, and box bridges, or for pumping sediment from sediment traps and sediment basins. Perform such work as shown on Plans or as directed by the Engineer.

Provide filter bags consisting of a non-woven geotextile bag resistant to rot, mildew, puncture, and tearing, and that has a minimum seam breaking strength of 200 pounds. The seams shall demonstrate less elongation and deformation than the geotextile fabric. The Division of Materials and Tests will certify the fabric for the Temporary Sediment Filter Bags and place them on the Department's Qualified Products List.

Ensure that each bag has a permanently attached label from the manufacturer designating the bag's maximum allowable flow rate in gallons per minute. Do not allow the flow into the filter bag to exceed the designated flow rate. Connect the filter bag to the pump hose as recommended by the manufacturer. Upon Project completion, remove the sediment filter bag and permanently stabilize the disturbed areas at the dewatering structure location. Dispose of the bag and the sediment contained in the bag as directed by the Engineer.

B. Sandbag Berms and Temporary Plugs

The Contractor may use sandbag berms and temporary plugs for velocity control, runoff management, sediment control, and separating streamflow from work areas. Do not use sandbag measures for filtration, in high concentrated flow areas where the bags may be displaced by flow, and in areas where equipment and/or traffic may damage the bags. Place sandbags so that their ends tightly abut and overlap to direct flow away from bag joints.

Sandbags for the sandbag berms and channel plugs shall be made of durable, weather resistant geotextile, having tight enough pores to retain

the bag filler material. Use of burlap is not acceptable for sandbags used in sandbag berms and temporary plugs. Typical bags measure approximately 24 inches x 12 inches x 6 inches. Use clean, non-cohesive sand as fill material for the sandbags.

Where sandbags are used to construct sandbag berms or temporary plugs across a ditch or channel, install the sandbags along a level contour. Turn the sandbags at the ends of the measure upstream.

The Contractor may install sandbag berms in both unpaved and paved ditches and channels. Construct the sandbag berm to be wider than the high water mark of the ditch or channel to prevent undercutting. The center of the sandbag berm shall be lower than either of the edges. For multiple sandbag berms installed in ditches, the maximum spacing between the berms should be such that the toe of the upstream sandbag berm is at the same elevation as the top of the downstream sandbag berm.

To temporarily separate stream flow from work areas, construct sandbag temporary plugs as necessary. Construct temporary plugs to prevent leaks between bags.

Remove and replace torn or damaged sandbags to prevent the bag filler material from becoming a stormwater pollutant. Remove any sediment accumulations at sandbags when the sediment accumulation has reached half the original height of the sandbags. If the ends of sandbag structures are breached, place new bags in the breach, and extend the ends of the berm to a higher elevation. If needed, repair the bank damage. If sandbags are undermined, do not repair the sandbags in place as additional undermining may occur. Move the sandbags downstream of the damaged location.

Upon Project completion, remove all sandbags and permanently stabilize disturbed areas underlying the sandbags with measures such as permanent seed and mulch.

C. Flocculants

Furnish and apply flocculant materials to control erosion on disturbed areas and for use with sediment control devices to reduce turbidity from stormwater runoff.

1. **Equipment.** If using a liquid application system, it may be necessary to pump a surfactant through the delivery system before

injecting liquid flocculant and afterwards to prevent clogging of pipes and valves.

After applying flocculant materials, clean all application equipment according to the flocculant manufacturer's recommendations to prevent the formation of dried residue that may impede future equipment performance.

Apply dry flocculant materials with a hand-held fertilizer spreader or a tractor-mounted spreader. If approved by the flocculant manufacturer, the Contractor may mix certain dry flocculants with dry silica sand to aid in spreading.

2. **Limitations.** Do not apply cationic PAM blends.

   Do not apply flocculants directly to streams, wetlands, or other natural water resources; to sediment ponds; or to slopes that produce runoff directly into a stream, wetland, or other natural water resource. Apply flocculants so that all flocculant-applied runoff flows into a sediment trap, sediment pond, or series of multiple sediment-control BMPs prior to discharge from the site. Always use flocculants for both erosion and sediment control in conjunction with approved stormwater BMPs, as shown on the Standard Drawings.

   Perform dry flocculant applications in dry weather conditions with light winds. Do not apply anionic PAM during rainfall or onto saturated soils.

   Do not apply flocculants over snow-covered surfaces or over surfaces of pure sand or gravel with no fines.

   Apply flocculants at least 60 feet from any stream, wetland, or other natural water resource located on or adjacent to the construction site.

   Do not apply emulsion forms of coagulant/flocculants directly to stormwater runoff or to streams, wetlands, or other water resources due to surfactant toxicity. Emulsions may only be used to prepare liquid flocculants specifically used for erosion control applications, such as soil binders and tackifiers.

3. **Preparation of Treatment Areas.** Before using flocculants, obtain and test site-specific soil samples to identify the optimum flocculant

blends to use for effectiveness. Obtain soil samples from each soil horizon to be accessed during excavation.

4. **Application Requirements.** Use flocculants in conjunction with other BMPs (with the bulk of structural sediment-control BMPs, including sediment ponds, positioned down slope of the flocculant-application areas) to increase flocculant performance. Direct stormwater runoff from flocculant-treated soils to pass through a series of sediment control BMPs prior to discharge to surface waters, with flow passing through a minimum of three enhanced rock check dams and a silt trap. It is preferable that runoff from flocculant-treated areas be directed into a sediment pond.

   Store flocculant materials in cove red areas. Many flocculants demonstrate a decrease in effectiveness after exposure to sunlight and air. Anionic PAM loses its effectiveness within three months after exposure to sunlight and air. Anionic PAM as well as certain other flocculant materials, when combined with water, become very slippery and can produce a safety hazard. Take care to prevent spills of flocculants, in liquid, emulsion, or powder form, onto paved surfaces.

   Application of flocculants will be most effective when applied as follows:

   1. During rough grading operations;

   2. On stockpiles and borrow areas;

   3. Temporary haul roads before placement of crushed rock surface;

   4. Compacted soil road base;

   5. After final grading and before paving and/or final seeding;

   6. Along the interior surface area of ditches;

   7. Sites where work has been temporarily suspended (e.g., winter shutdown), and

   8. Areas that will be mulched.

The use of a visible tracer or colorant to visibly track flocculant application is recommended.

For liquid applications of flocculants, use source water for mixing with a low turbidity (20 NTUs or less).

For turbidity reduction within sediment ponds, apply flocculants to conveyance ditches above the pond that discharge into the pond.

For dewatering and suspended solids removal of turbid pooled water within pipe tranches, silt traps, or other areas, flocculants may be introduced, in either liquid or solid forms, into the turbid water during pumping/evacuation of the pooled water, with the discharge either pumped through a filter bag or jute-lined treatment ditch prior to ultimate discharge. Strictly adhere to the application rates as given in this specification for turbidity reduction for anionic PAM, and as given by the manufacturers' requirements for other types of flocculants, during dewatering.

a. **Anionic Polyacrylamide.** Before using any flocculant, submit the flocculant manufacturer's written application, storage, and mixing requirements and specifications to the Engineer.

   Store, handle, mix, and apply anionic PAM in strict accordance with the flocculant manufacturer's recommendations and in strict compliance with OSHA Material Safety Data Sheet requirements and all applicable Federal, State, and local regulations. Use proper personal protective equipment when handling the flocculant per industry, manufacturer, State, and Federal regulations.

   Do not exceed the specified maximum application rates for anionic PAM. Applying additional PAM beyond the rates specified will not improve the effectiveness of PAM but could present toxicity issues to receiving streams down gradient of the PAM application zone.

   (1) For Erosion Control Applications on Sloped Areas

      a) For hydroseeding applications, add anionic PAM as the last component to the hydroseeding mixture. When mixing, never add water to anionic PAM. Add PAM at a slow rate to water. Mixing of anionic PAM

for hydroseeding shall include agitation of the PAM/water mixture. Apply using a method that will ensure uniform flocculant coverage over the target application area.

b) Never use anionic PAM as the sole erosion control method for slopes; accompany slope applications of PAM with mulching.

c) For PAM tackifiers, dissolve dry PAM with a known quantity of clean water in a container for several hours (preferably overnight). Apply PAM using a hydro-mulch machine at a rate ranging from 0.5 pounds to 1.0 pound (maximum) per 1,000 gallons of water per acre of application area.

d) For soil binder applications, dissolve pre-measured dry PAM with a known quantity of clean water in a container for several hours (preferably overnight.) Apply PAM at a rate ranging from 2/3 pounds to 1 pound (maximum) per 1,000 gallons of water per acre of bare soil.

e) Mix emulsion batches according to the recommendations of the flocculant manufacturer to determine the proper product type and application rate to meet site-specific requirements. Apply using a method that will ensure uniform coverage over the target application area.

f) When using an emulsion form of anionic PAM to slopes, apply no greater than 1.5 gallons emulsion per acre per event. Solution mixtures shall be 1.5 gallons (maximum) anionic PAM emulsion per 3,000 gallons of water. Do not use water volumes that are less than 3,000 gallons of water due to increased viscosity issues.

g) Spray the anionic PAM/water mixture uniformly across the dry soil slope until completely wetted.

h) For dry anionic PAM applications for erosion control, apply anionic PAM as a powder at the following rates:

- For slopes less than 25%, apply at a maximum rate of 10 pounds per acre
- For slopes greater than or equal to 25%, apply at a maximum rate of 20 pounds per acre

i) Reapply liquid anionic PAM for erosion control on actively worked areas after a 48-hour period.

j) Do not apply liquid anionic PAM to the same slope area more than once in a 48-hour period and no more than seven times in a 30-day period.

k) For inactive slope areas where anionic PAM has been applied, reapply once every two months.

l) Anionic PAM applications (dry or liquid) shall not exceed 200 pounds per acre per year.

(2) For Turbidity Reduction within Ditches

a) If possible, apply flocculant as erosion control in the watershed above the treatment ditches in conjunction with the application of flocculants within treatment ditches for turbidity control.

b) Line the surface area of stormwater ditches, as well as the surface area of ditch check dams, with jute mesh.

c) Apply dry powder anionic PAM over the jute mesh at a rate of 0.25 pounds to 0.5 pounds per 1,000 square feet of ditch surface area.

d) Reapply dry powder anionic PAM to jute mesh in ditches every three to five storm events. Dry anionic PAM application shall not exceed 4.6 pounds per 1,000 square feet per year.

e) Ensure anionic PAM bricks/logs are of appropriate size, shape, and number to deliver the appropriate dosage to the water within the conveyance. Obtain brick/log dissolution rates and dosages from the flocculant manufacturer.

f) Locate anionic PAM bricks/logs in a shaded, preferably moist, installation zone during application.

g) Place anionic PAM bricks/logs near the main flow area of the ditch, at an appropriate distance above sediment ponds or traps to maximize mixing and flocculation. Refer to the manufacturer's guidance for flocculant mixing time and block/log spacing configurations.

h) Install one anionic PAM brick/log for every 65 to 70 gallons per minute of flow to be treated, unless otherwise specified by the flocculant manufacturer.

i) Unless otherwise specified by the flocculant manufacturer, anionic PAM bricks/logs are estimated to treat, on average, 475,000 to 550,000 total gallons of flow volume.

j) Install stakes, mesh bags, cages, and other mechanisms to anchor bricks/logs in place to provide stability during flows and to maximize exposure of the brick/log surface area to flows.

k) Replace anionic PAM bricks/logs at least every 3 to 4 months or earlier if bricks/logs have excessive sediment/debris deposition on the outer brick/log surface area or excessive degradation of brick/log mass.

b. **Miscellaneous Coagulants/Flocculants.** Miscellaneous flocculant materials shall include all other flocculants that are not polyacylamide blends and that have been pre-approved for use on Department projects through the Materials and Testing Division.

Before using any flocculant, submit the manufacturer's written application, storage, and mixing requirements and specifications to the Engineer.

Store, handle, mix, and apply flocculants in strict accordance with the flocculant manufacturer's recommendations and in strict compliance with OSHA Material Safety Data Sheet

requirements and all applicable Federal, State, and local regulations. Use proper personal protective equipment when handling the flocculant per industry, manufacturer, State, and Federal regulations.

Do not exceed the manufacturer's specified application rates for flocculants.

For erosion and sediment control applications for sloped areas and ditches:

1. Strictly follow the manufacturer's requirements for application mixtures and rates.

2. With hydroseeding applications, mix flocculants according to the manufacturer's written recommendations.

3. Do not use flocculants as the sole erosion control method for slopes; accompany slope applications of flocculants with mulching. Use flocculant for turbidity reduction in ditches in conjunction with other structural sediment-control BMPs.

4. Re-application frequency and rates shall strictly follow the manufacturer's written recommendations, as provided to the Department and the Contractor.

5. Store flocculants according to the manufacturer's written requirements, as provided to the Department and the Contractor.

5. **Documentation and Maintenance.** Flocculants will enhance the deposition of soil solids in downstream ditches, pipes, and ponds. Inspect these hydraulic structures regularly, and routinely remove solids from these structures to ensure optimization of performance.

   Provide suitable means for storing and protecting flocculants against moisture and sunlight.

   Department field personnel will maintain records of all flocculant applications including the following information:

a) Date, time, and specific location of application;

b) Rates of application;

c) Method of application;

d) Weather conditions, and

e) Type of flocculant applied including manufacturer name and product name.

6. **Final Cleanup.** Clean liquid or dry flocculant spills according to the manufacturer's requirements. Thoroughly rinse flocculant mixing and application equipment with water to prevent residue formation. The Contractor may apply rinse residues to exposed slopes for erosion control. Keep the amount of unused flocculant mixtures to a minimum. Dispose of excess flocculant material in compliance with Federal, State, and local environmental regulations. Do not dispose of excess material within stormwater conveyances, sewers, or streams.

Where temporary erosion prevention and sediment control or pollution prevention work is acceptably performed and failure of all or any part of the system occurs but is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls and falls within the specifications for a work item that has a contract price, the Department will pay for units of work at the proper contract prices except as noted below. Should the temporary EPSC work not be comparable to the project work under the applicable contract items, the Department will direct the Contractor to perform the work on a force account basis, or by agreed unit prices as specified in **109.04**.

Except as noted below, the Department may pay the Contractor to replace temporary EPSC measures installed according to the Plans or as approved by the Engineer provided such devices are no longer effective due to deterioration or functional incapacity that is not attributable to improper installation, lack of reasonable maintenance, or failure of the Contractor to pursue timely installation of permanent control devices according to the Plans and Specifications or as directed by the Engineer.

Unless provided for on the Plans, the Department will not directly pay for temporary and permanent EPSC measures in disturbed areas outside the right-of-way, such as borrow areas, waste areas, and haul roads, unless the

borrow areas or waste areas are provided for by the Department, and except for permanent Seeding (with Mulch) on borrow areas and waste areas within the limitations specified in **203.04.E** and **203.07**, respectively. Where the Plans show separate quantities for erosion prevention and sediment control or pollution prevention items to be used outside the right-of-way in connection with waste areas, borrow areas or other project related construction, the Department will pay for the items used and accepted up to the plan quantities; but the cost of any overruns in these items, or the cost of any additional items required for erosion prevention and sediment control or pollution prevention off the right-of-way, shall be borne by the Contractor unless prior written approval is received from the Engineer.

If the Contractor fails to control project related erosion or the discharge of pollutants, either on or off the right-of-way, the Engineer may withhold payment of future progress estimates until the Contractor has satisfactorily performed the necessary corrective measures. If deemed necessary, the Engineer may employ outside assistance or use Department forces to provide the needed protective measures, and will charge all incurred direct costs plus project engineering costs to the Contractor by appropriate deductions from the Contractor's monthly progress estimate.

COMPENSATION

209.08 Method of Measurement

The Department will measure EPSC measures according to the appropriate Standard Drawing or as specified below.

The Department will measure:

1. Temporary seeding and mulching operations in accordance with the appropriate provisions of **801.09**.

2. Seeding (without Mulch) and Crown vetch mixture (without Mulch) per unit.

3. Accepted quantities of Road and Drainage Excavation by the cubic yard.

4. Sediment removal and disposal for maintaining erosion prevention and sediment control measures by the cubic yard.

5. Sandbags by the square foot area of berm face.

6. Flocculants used for turbidity reduction by the actual weight in pounds of flocculant materials applied, or, for brick or log forms of flocculant material, by the unit, per each.

7. Flocculants used as either a soil binder or tackifier for erosion control applications by the acre.

209.09 Basis of Payment

The Department will not make separate payment for Non-Structural BMPs.

The Department will pay for accepted quantities of EPSC measures based on the item numbers and measurement and payment information provided on the Standard Drawings.

Unless otherwise stated on the corresponding Standard Drawings, payment for EPSC measures is full compensation for all materials and labor necessary to construct, maintain, and remove the measures.

For catch basin filter assemblies, structure maintenance including cleaning to prevent clogging is included in the contract unit price for the structure. The Department will not directly pay for sediment removal and disposal for maintaining these assemblies.

The Department will pay for Seeding (with Mulch), Seeding (without Mulch), Temporary Seeding (with Mulch) Crown vetch mixture (without Mulch), and Mulch items in accordance with **801.10**.

The Department will pay for accepted quantities of Road and Drainage Excavation at the contract unit price per cubic yard.

Unless otherwise specified, the Department will pay for sediment removal and disposal for maintaining EPSC measures at the contract unit price per cubic yard.

The Department will pay for rock used for inlet and outlet control on EPSC measures at the contract unit price per ton.

The Department will pay for pipe used to construct EPSC measures in accordance with **607.13**.

The Department will pay for concrete used to construct spillways or other sediment control structures in accordance with **703**.

The Department will pay for water used to prepare the seed bed and for maintenance at the contract unit price per M.G. (1,000 gallons) of water.

The Department will pay for sandbags at the contract unit price per bag.

The Department will pay for accepted quantities of flocculants at the contract unit price. Such payment is full compensation for all equipment, materials, labor, and incidentals necessary to apply the flocculant materials.

The Department will pay for sediment filter bags at the contract unit price for the size bag used. Such payment includes installation and replacement as needed, along with all materials, equipment, tools, labor, and incidentals to complete the work. The Department will pay for removal and disposal of material from bag by the cubic yard at the contract unit price for sediment removal.

PART 3 – BASE AND SUBGRADE TREATMENTS

SECTION 302 – SUBGRADE TREATMENT (LIME)

DESCRIPTION

302.01 Description

This work consists of treating in-place subgrade material with lime, and includes preparing the existing subgrade, distributing the specified percentage of lime, initial mixing, mellowing, final mixing, compacting, finishing, and curing.

302.02 Reserved

MATERIALS

302.03 Materials

A. Lime

Provide either hydrated lime or quicklime meeting **921.04**.

B. Water

Only use water that meets the requirements of **921.01**.

C. Soil

Use in-place subgrade material, removing unsuitable soil and replace it with suitable material.

Before the work is started, sample the in-place material and perform laboratory testing to determine the percentage of lime required and the appropriate optimum moisture content of the lime-soil mixture according to AASHTO T 99, Method C. Submit the design to the Department for approval.

D. Bituminous Material

For use as a curing agent, provide bituminous material as specified in:

PG64-22, 70-22, 76-22, and 82-22 ..... **904.01**
Emulsified Asphalt,
Types allowed for Tack Coat in **403**..... **904.03**

Provide emulsified asphalt, of a type allowed for Tack Coat in **403**, meeting the test requirements specified in Table 904.03-1.

The Contractor may select the type of bituminous material to use for curing.

EQUIPMENT

302.04 Equipment

A. Distributing Equipment

Provide equipment to distribute the lime uniformly, at the required rate and without excessive loss.

B. Mixers

Provide an acceptable mixer capable of attaining final mixing specified in **302.10**.

C. Compaction Equipment

Provide compaction equipment of the size and weight required to obtain the specified density and quality of finished surface.

CONSTRUCTION REQUIREMENTS

302.05 Limitations

Handle and store lime in completely enclosed, moisture resistant containers until immediately before use. Store bagged lime in weatherproof buildings with adequate protection from ground dampness.

Do not stabilize areas that will not be covered with the succeeding stage of sub-base or base construction during the same construction season.

Do not apply lime:

1. to frozen subgrade material;
2. if the air temperature in the shade is less than 40 °F;
3. during periods of high winds; and
4. to areas that cannot be mixed and sealed as specified in **302.09** on the same day as application.

Do not leave lime exposed to the open air for a period of 6 hours or more.

Do not allow traffic or equipment on the spread lime other than that required for spreading, watering, or mixing.

302.06 Preparing the Existing Subgrade

Grade and shape the existing roadway in reasonably close conformity with the lines, grades, and cross-sections shown on the Plans or as directed by the Engineer.

Remove all grass turfs and other deleterious substances from the subgrade and prepare the subgrade as specified in **207.03**.

Correct wet or unstable underlying foundation material, if encountered, as directed by the Engineer.

302.07 Extra Depth Stabilization

If directed by the Engineer, perform extra depth lime stabilization as follows:

1. Blade the overlying material to the sides, and incorporate the lime slurry or, in dry applications, the hydrated lime and any necessary water, into the underlying material at the rate and to the depth specified.

2. Thoroughly mix and compact the lime-soil mixture to obtain the required stability.

3. Moisten the compacted surface, and cover with the previously windrowed subgrade material.

4. Compact the overlying subgrade material, which will serve as the curing medium.

Curing and mellowing periods will not be required for the lime-stabilized underlying material unless otherwise directed by the Engineer.

302.08 Applying Lime

After preparing the subgrade as specified in **302.06**, apply lime using the dry or slurry application method for either hydrated lime or quicklime. Use the slurry application method unless otherwise shown on the Plans.

A. Dry Application

Spread hydrated lime at the required rate, using an approved spreader that will uniformly distribute the material without excessive loss, or by bag distribution.

B. Slurry Preparation and Application

Mix lime with water in approved agitating equipment, and apply to the roadway as a thin water suspension or slurry through approved distributing equipment. The distributing equipment shall be equipped to continuously agitate the mixture from the mixing site until applied on the roadbed. Proportion the mixture so that the dry solids content is at least 30% by weight.

In preparing, transporting, distributing, and mixing slurry with the soil, do not cause injury, damage, discomfort, or inconvenience to individuals or private property.

302.09 Initial Mixing and Mellowing

In dry applications, immediately after applying the hydrated lime, scarify the course, if necessary, and mix to the required depth, width, and cross-sections.

In slurry applications, before applying the lime slurry, scarify or partially pulverize with approved mixing equipment the full width of the course to be treated, as directed by the Engineer, to the depth required for stabilization. Perform successive passes over a measured section until the specified percentage of lime has been distributed. After each successive pass, incorporate the slurry into the soil with approved mixing equipment.

Incorporate lime into the soil to the depth needed to provide a finished course of lime-treated material conforming to the specified thickness and surface requirements.

Continue mixing, and applying water as necessary, until a homogeneous mixture of soil, lime, and water is obtained. During this initial mixing operation, add the quantity of water needed for the moisture content of the mixture to reach 5% above its optimum moisture content, plus or minus 3%, unless otherwise directed by the Engineer.

If applying the lime as a slurry, ensure that the water added with the slurry does not cause the moisture content of the lime-soil mixture to exceed the above tolerance.

After completing mixing operations, reshape the treated course to the approximate lines, grades, and cross-sections, and seal with a pneumatic-tire roller, and other approved equipment as necessary, and allow the treated course to mellow for 2 to 7 days as directed by the Engineer. During the mellowing period, maintain the entire surface of the treated course in a moist condition.

302.10 Final Mixing

After the required mellowing period, reshape and grade the initially mixed material to the required lines, grades, and cross-sections.

Thoroughly mix the previously mixed material with approved mixers while adding water as necessary.

Continue mixing until 100% of the material, except for gravel and stone, will pass a 1-inch sieve, and 60% by dry weight will pass the No. 4 sieve.

The quantity of water added shall be such that at the end of the final mixing and during compaction and finishing operations the percentage of moisture in the mixture and the unpulverized soil lumps will not vary more than plus or minus 3% from the specified optimum moisture of the lime-soil mixture.

302.11 Compaction and Finishing

Immediately after completing the final mixing, blade the material to uniform thickness and shape, and start compaction operations. Use sheepsfoot rollers to compact the material in a continuous operation until the entire depth of the lime-soil mixture is uniformly compacted to the required density. The Contractor may remove the sheepsfoot rollers when a surface mulch not exceeding 1 inch remains. Lightly scarify the resulting surface and shape to the required lines, grades, and cross-sections within the tolerances specified in **302.13**. Perform final rolling with the roller specified by the Engineer.

The completed lime stabilized subgrade shall be smooth, dense, well bonded, unyielding, and free of cracks or loose material.

Compact the lime-soil mixture in layers as shown on the Plans. The Department will determine the maximum density and optimum moisture content of the lime-soil mixture according to AASHTO T 99. The sample used to determine the maximum density and optimum moisture content will be representative field samples of the lime-soil mixture that have undergone the same treatment as the lime treated subgrade being tested.

For density testing purposes, the Department will divide the completed subgrade treatment into lots of approximately 10,000 square yards, and will perform five density tests on each lot. The average dry density of each lot shall not be less than 95% of maximum density, and no individual test shall be less than 92% of maximum density.

Immediately scarify, moisten (if required), rework, and compact to the required density all areas that do not meet density requirements at no additional cost to the Department.

302.12 Curing

After finishing the lime-treated subgrade as specified in **302.11**, seal the surface by applying one of the bituminous materials specified in **302.03.D** using a pressure distributor at the rate of 0.10 to 0.25 gallons per square yard, as directed by the Engineer or as shown on the Plans. Heat or otherwise prepare the bituminous material to ensure uniform distribution and apply as soon as possible.

302.13 Tolerances and Reconstruction

The Department will determine the thickness of the completed lime-treated subgrade by measuring test holes at random locations as specified in Departmental procedures. The measured thickness at the locations shall not deviate from that shown on the Plans by more than plus 1-1/2 inches or minus 1 inch.

Immediately reconstruct areas of lime-treated subgrade that do not meet thickness requirements. For areas having a thickness greater than that allowed, add sufficient lime to correct the deficiency in lime content. Perform reconstruction, including adding lime, to correct the thickness deviation at no cost to the Department.

As directed by the Engineer, repair areas of lime-treated subgrade that become unstable or that lose the required density or surface finish. Use additional lime and water if and as directed.

Limit hauling over the treated subgrade to the minimum amount necessary to construct the overlying base or sub-base.

When at least one course of base or sub-base has been constructed upon the treated subgrade, the Contractor may resume hauling, provided the layer or layers of base or sub-base are constructed and maintained as specified in **303.10** and **303.11**.

COMPENSATION

302.14 Method of Measurement

A. Lime

The Department will measure Lime by the ton. Quantities and percentages of lime shown on the Plans are based on preliminary soil investigations and dry laboratory sample tests using hydrated lime. The Engineer will establish the actual application rate from dry density tests conducted just before the start of stabilization work. For quicklime, the Department will determine the accepted quantity by converting the quicklime to an equivalent quantity of hydrated lime as follows:

$$EHL = 1.32\ QL\left[1 - \frac{I}{100}\right]$$

Where:

EHL = Equivalent amount of hydrated lime in tons
QL = Tons of quicklime accepted
I = Percent of impurities in the quicklime

The Department will deduct for quantities of lime that have been wasted or not actually used in the work.

If sacked lime is used, the Department will use the net weight as packed by the manufacturer for measurement.

B. Processing of Subgrade Treatment (Lime)

The Department will determine the area processed by the square yards of treated subgrade, as computed using the length measured at the surface of the treated subgrade and the width shown on the Plans or designated by the Engineer.

C. Extra Depth Stabilization

1. **Direction Application Method.** The Department will classify processing performed using the Direct Application Method, as specified in **302.07**, as Subgrade Treatment, and will measure this work for payment as follows:

a. If the thickness of the layers processed is equal to or greater than the Plan thickness for normal stabilization, the Department will measure processing by the square yards of each extra depth layer processed.

b. If the thickness of the layers processed is less than the Plan thickness for normal stabilization, the Department will measure the area in square yards of each extra depth layer processed and will adjust this area to determine the quantity for payment by multiplying the number of square yards processed by the thickness of the layer and dividing by the Plan thickness for normal stabilization. To determine the area of extra depth layers, the Department will measure the length and width used in accordance with **302.14.B**.

2. Drill-Lime Method. The Department will measure drilling necessary to complete Extra Depth Stabilization by the total quantity in linear feet of all holes drilled, from either the finished subgrade or from the top of base to the bottom of the drilled holes.

D. Water

The Department will measure water by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters. The quantity measured for payment will be the amount necessary for subgrade preparation, initial mixing, mellowing, final mixing, compacting, finishing, and curing. The Department will not measure water used to prepare or apply slurry.

E. Bituminous Material

The Department will measure in tons the quantity of bituminous material used and accepted.

F. Preparation of Existing Subgrade

The Department will classify and measure the materials moved, furnished, or disposed of to prepare the subgrade in accordance with **302.06** as provided for under **207**.

302.15 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Hydrated Lime	Ton
Bituminous Material	Ton
Soil-Lime Processing	Square Yard
Drilling for Subgrade Treatment	Linear Feet
Water	M.G.

Such payment is full compensation for providing all materials, equipment, labor, and incidentals to complete the work as specified.

The Department will pay for moving, furnishing, or disposing of material under **207** if the Contract is for any of the following:

1. Combined grading, drainage and paving project,

2. Construction of a base and/or pavement on a road that has been graded under a previous Contract, or

3. Base and/or paving project that includes sections of grading.

For Extra Depth Stabilization, the Department will not pay for any shifting of the overlying material; however, the Department will pay for the lime and water used and for the mixing of the underlying material with the lime and water.

If repairs to the lime-treated surface are made necessary by a cause beyond the Contractor's control, the Department will pay for the construction items involved at the contract unit prices.

SECTION 303 – MINERAL AGGREGATE BASE

DESCRIPTION

303.01 Description

This work consists of furnishing and placing one or more courses of aggregates, and additives if required, on a prepared subgrade.

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

MATERIALS

303.02 Aggregate

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**.

The Engineer will accept aggregate for gradation as follows:

1. When the stationary plant method for mixing is used, the Engineer will accept aggregate immediately after or prior to mixing, based on periodic samples taken from the pugmill output or from the belt feeding the pugmill.

2. When two or more materials are blended on the road using mechanical mixers, the Engineer will accept aggregate after mixing and before compaction, based on samples taken from each layer of base material

3. For aggregate that does not require blending, the Engineer will accept aggregate at the aggregate production plant, based on samples taken from stockpiles of plant production immediately before delivery to the road.

303.03 Calcium Chloride

Provide calcium chloride meeting **921.02** for Type 1, Type 2 or calcium chloride liquor.

303.04 Reserved

303.05 Emulsified Asphalt

Use emulsified asphalt of a type allowed for Prime Coat in **401**, meeting the test requirements specified in **904.03**.

EQUIPMENT

303.06 Equipment

Provide a stationary mixing plant, mechanical road mixer, or motor grader, whichever is applicable to the type of work to be performed, as specified in **303.08**.

A. Stationary Mixing Plant

Provide an approved twin-shaft pugmill capable of producing a constant, uniform mixture. Equip the mixing plant with the following:

1. suitable truck-loading hopper with a gate that will prevent segregation of the material when dumped into the truck;

2. A spray bar, capable of ensuring an even wetting of the aggregate, mounted at the entrance of or above the pugmill;

3. A meter, valve, or other approved type of regulating device to control the flow of water through the spray bar to maintain a uniform moisture content in the mixture;

4. A separate, quick, and automatically operating on-and-off device to shut the water off instantly when the pugmill stops; and

5. Adjustable mechanical feeders for each size material capable of regulating a constant, uniform flow of material.

B. Mechanical Mixer (for Road Mixing)

Provide a pugmill or rotary type mechanical mixer capable of producing a uniform blend of all materials to the full depth of the course being placed. The mixer may be either self-propelled or trailer-drawn.

C. Compaction Equipment

Provide one or more rollers of a type and sufficient weight to obtain the required density and seal the surface of the base course.

CONSTRUCTION REQUIREMENTS

303.07 General

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

Prepare the subgrade as specified in **207** or **302**, whichever is applicable.

Obtain the Engineer's approval of the subgrade before spreading any mineral aggregate. Subgrade that has been previously checked and approved, but subsequently subjected to freezing conditions or prolonged wet weather, shall be rechecked for approval.

Do not spread mineral aggregate on a subgrade that is frozen or contains frost.

Do not haul over any material that has been placed until it has been spread, mixed, shaped and compacted to the required density.

303.08 Mixing

A. Mixing Methods

Unless otherwise specified, mix the base course material, including an additive if shown on the Plans, by one or more of the following three methods:

1. **Stationary Plant Method.** Mix the base course material and water in an approved stationary mixing plant as specified in **303.06.A**. Add sufficient water during the mixing operation to provide a moisture content satisfactory for compacting. If combining materials to meet the grading requirements, blend the materials, as specified in **903.05**, before mixing. Ensure that all material fed into the plant travels the full length of the pugmill.

2. **Road Mix Method (Mechanical Mixer).** After placing the material for each layer of base course through an aggregate spreader or windrow-sizing device, mix the material using approved mechanical mixing machines as specified in **303.06.B**.

   During mixing, add sufficient water to provide a moisture content satisfactory for compacting.

3. **Road Mix Method (Motor Grader).** After depositing and uniformly spreading material for each layer of base course, sprinkle it with just enough water to moisten all particles, but without causing segregation of sizes or softening of the subgrade. Immediately after applying water, thoroughly mix the material by windrowing and spreading with motor graders until the mixture is uniform throughout.

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.

B. Use of Calcium Chloride

If using calcium chloride, incorporate it in either the solid or liquid form, at the approximate rate of 6 pounds per ton of aggregate, noting that:

- 6 pounds is equivalent to 1.29 gallons 60 °F 32% solution
- 6 pounds is equivalent to 1.02 gallons 60 °F 38% solution

For stationary plant mixing, proportion chloride material, in solid form, through a hopper equipped with an approved vibratory feeder and an adjustable opening capable of accurately controlling the flow of material. Proportion calcium chloride liquor using an approved calibrated meter that has a registering capacity capable of indicating the total amount of liquid used during any single day's operation.

For road mixing, add the chloride material to the aggregate at the point in the mixing operation and in the manner directed by the Engineer.

303.09 Spreading

Spread material as follows according to the mix method used:

A. Stationary Plant Mixing

After mixing, transport material to the site for each layer of base while it contains the proper moisture content. Spread the material to the required thickness and cross-section using an approved mechanical spreader.

B. Road Mixing (Mechanical Mixer)

Before mixing, spread material with an approved mechanical spreader that can be adjusted to spread materials in the proper proportions.

C. Road Mixing (Motor Grader)

After thoroughly mixing the aggregate and water, spread the base material while at optimum moisture content in layers of specified thickness and cross-section using approved motor graders.

If the required compacted depth of the base course exceeds 6 inches, construct the base in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

In some cases, the Plans may show the base as extending for the full width of the roadbed. In other cases, the edges of the base may be shown as coinciding with the inside edges of the shoulders. In the latter case, place shoulder material to a minimum width of 3 feet before spreading each layer of base material in order to confine the base material and to allow for proper compaction.

The Contractor may spread and mix any base material used for constructing detours, for maintenance of traffic, for backfilling rock cuts, and for capping rock fills as specified in **303.09.B**.

303.10 Shaping and Compaction

A. Final Shaping

Immediately after spreading, shape the base material to the required degree of uniformity and smoothness. Except where using mechanical aggregate spreading equipment to place the base material, use a motor grader to shape each layer before compacting. If the mechanical spreading equipment fails to shape the base material properly, use a motor grader or other approved means to perform final shaping.

B. Compaction

Compact the base material to the required density before any appreciable evaporation of surface moisture occurs. Continuously compact each layer until the minimum density requirement, as specified in **303.10.C.2**, is achieved. The Contractor may use any type of compacting equipment provided the required density is attained.

If the density requirement does not apply, as provided for in **303.10.C.3**, gradually compact the base material, progressing from the edges of the base to the center, parallel with the centerline of the road. Continue compacting until the base layer has been compacted to its full width as directed by the Engineer. Where lifts of shoulder materials are placed to confine the base material, overlap the initial pass of the compacting equipment with the shoulder to a width of not less than 12 inches.

Construct the surface of each layer so that the aggregates become firmly keyed and a uniform texture is produced. Maintain the surface in this condition until it is covered by the following stage of construction or until final acceptance of the project. Correct irregularities by loosening the material at those places and adding or removing material as required.

Use approved distributors to apply water uniformly over the base materials during compaction in sufficient quantity to allow for proper compaction without causing softening of the underlying subgrade due to excessive water use.

C. Compaction Acceptance

1. Lot Sizes and Testing. For density testing purposes, the Department will divide each completed layer into lots of approximately 10,000 square yards, and will average the results of five density tests performed on each lot. Smaller lots may be considered as directed or approved by the Engineer.

2. Density Requirements

a. Type A Base. The average density of each lot of Type A 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.

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 plus or minus 3% of the optimum moisture content as determined by Departmental analysis. Mixing of the material with water shall be completed per **303.08**.

If the specified density is not obtained for either type of base, rework or replace the material to comply with the density requirement.

3. Exclusions. Unless otherwise specified, the density requirements specified in **303.10.C.2** will not apply to:

a. Type A or Type B base construction on projects that do not include the construction of a surface upon the base, or to

b. Projects having a specified total base thickness of less than 4 inches.

When the specified density requirements do not apply, the Engineer will consider the desired degree of compaction to have been reached when the surface is tightly bound and shows no undue rutting or displacement under operation of the roller or other equipment. Obtain the Engineer's approval of the compaction of each layer before placing material for the next successive layer. Keep placing and compacting areas separate.

303.11 Maintenance

Maintain the completed base in a smooth and uniform condition until it is covered by the following stage of construction or the Project has been completed and accepted. Comply with the requirements of **104.05** regarding maintenance and protection.

303.12 Thickness Requirements

Construct the base to the grade and compacted thickness shown on the Plans, with an allowable working tolerance of plus or minus 1/2 inch. The thickness will be measured at such frequency as established by the Department using test holes or other approved methods.

303.13 Surface Requirements

The surface of the finished base shall be in reasonably close conformity to the lines, grades, and cross-sections shown on the Plans or established by the Engineer and shall have a satisfactorily smooth riding quality.

COMPENSATION

303.14 Method of Measurement

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

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

B. Water

The Department will deduct the weight of total moisture, as determined by dry weights, of the base material at the time of weighing in excess of 3% of optimum moisture content.

The Department will not measure or pay for water when mixing is performed in a stationary plant,

When road mixing is performed, the Department will measure water added to the material at the direction of the Engineer by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

C. Calcium Chloride

The Department will measure calcium chloride by the ton. The Department will weigh calcium chloride received in liquid form as specified in **109**, and will convert the weight of liquid calcium chloride to tons as follows:

1. 32% Solution

$$\text{Tons Calcium Chloride} = \frac{\text{(Total tons of 32\% solution)} \times 0.32}{0.94}$$

2. 38% Solution

$$\text{Tons Calcium Chloride} = \frac{\text{(Total tons of 38\% solution)} \times 0.38}{0.94}$$

The Department will consider calcium chloride liquor used in a solution of 32% or more, but less than 38%, as a 32% solution. The Department will consider a solution of 38% or greater as a 38% solution.

303.15 Basis of Payment

A. The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Mineral Aggregate, Type ____ Base	Ton
Calcium Chloride	Ton
Water	MG

The Department will pay for the work required to prepare the subgrade in accordance with **303.07** as provided for in the applicable Section or Subsection under which the work is performed.

B. Adjustments

Specific Gravity. In cases where the Bulk SSD specific gravity of the mineral aggregate exceeds 2.85, the Department will adjust the tonnage of mineral aggregate for payment by multiplying the tonnage of mineral aggregate used by a specific gravity of 2.85 and dividing by the higher specific gravity.

SECTION 304 – SOIL-CEMENT BASE

DESCRIPTION

304.01 Description

This work consists of mixing in-place or select soil with Portland cement, and moistening and compacting the soil-cement mixture in one or more courses.

MATERIALS

304.02 Materials

Provide materials as specified in:

Portland Cement, Type I **901.01**
Portland-Pozzolan Cement, Type IP **901.01**

Bituminous Curing Seal, Emulsified Asphalt,
Types allowed for Tack Coat in **403**..... **904.03**
Select Material for Soil-Cement Base..... **921.05**

Provide water as specified in **921.01**.

Provide emulsified asphalt, of a type allowed for Tack Coat in **403**, meeting the test requirements specified in Table 904.03-1.

The Contractor may select the kind of bituminous material to use for curing.

Submit a sample of the cement and the select material to be used to the Materials and Tests Laboratory for approval at least 15 days before use.

EQUIPMENT

304.03 Equipment

Provide a mechanical cement spreader that will distribute the cement uniformly at the required rate without excessive loss.

Provide mechanical mixers meeting **309.03.B**; or a stationary mixing plant meeting **309.03.A**.

CONSTRUCTION REQUIREMENTS

304.04 Limitations

Only process the amount of soil-cement that will be covered with the succeeding stage of base or pavement construction during the same construction season. Only apply cement to subgrade or select material that is unfrozen and when the air temperature in the shade is at least 40 °F and rising.

Limit application of cement to an area that will allow for continuous operations and for the completion of all but the final surface finish within three hours from the time the cement is applied. Do not leave any uncompacted soil-cement mixture undisturbed for more than 30 minutes.

If the uncompacted soil-cement mixture is wetted by rain so that the average moisture content exceeds the specified tolerance, reconstruct the entire section as specified in **304.13**.

304.05 Preparing the Existing Subgrade

If in-place soil is to be used, grade and shape the area to be treated as required to construct the soil-cement base in reasonably close conformity with the lines, grades, thickness, and cross-sections shown on the Plans. Place any additional soil needed as directed and blend with the in-place material. Remove unsuitable soil or material and replace with acceptable soil. When removing and replacing unsuitable soil, and placing additional soil, comply with the pertinent provisions of **203**.

Where only select material is to be used, prepare the subgrade as specified in **205**, **207**, or **302**, whichever is applicable.

Slightly dampen the subgrade just before spreading the select material or soil-cement mixture upon it.

304.06 Pulverizing

If required, before applying cement, scarify the soil and pulverize for sufficient depth and width to achieve the cross-section shown on the Plans. Pulverize the soil-cement mixture so that, at the completion of mixing, at least 80% of the dry material passes the No. 4 sieve and 100% of the combined material passes the 1-inch sieve, exclusive of gravel or stone retained on these sieves. Remove material retained on a 3-inch sieve and other unsuitable material.

304.07 Cement Application, Mixing, and Spreading

Use an approved mechanical spreader to spread select material on the subgrade before mixing to the required thickness, width, and cross-section. The Engineer will establish the percentage of cement to be used based on tests of the in-place soil or select material.

Apply the specified quantity of Portland cement uniformly over the spread select material or in-place soil. Do not apply cement if the moisture content of the soil exceeds 3% the optimum moisture content specified by the Engineer for the soil-cement mixture. Before starting mixing, replace spread cement that has been lost due to the Contractor's negligence at no additional cost to the Department.

Use a mechanical mixer to perform road mixing. At least one pass of the mixer may be required before adding water. When required, add water uniformly by distributors or other approved methods to bring the mixture to

the required moisture content. Continue mixing until the pulverization requirements of **304.06** are met and a homogeneous mixture of soil, cement, and water is obtained.

If using stationary plants or mixers, ensure they are equipped with feeding and metering devices that will introduce the cement, soil, and water into the mixer in the quantities specified. All material fed into the plant shall travel the full length of the pugmill. Continue mixing until a uniform and intimate mixture of cement, soil, and water has been obtained. Transport the mixture from the plant to the road in numbered trucks equipped with tight metal rear-end dump beds. Provide a sufficient number of trucks to ensure satisfactory progress of construction operations.

Spread the material using approved mechanical spreaders within one hour after being discharged from the mixer and in ample time to secure compaction during daylight hours. If the moisture content of the uncompacted mixture exceeds the specified tolerance, reconstruct the material as specified in **304.13**. When mixing, handling, and placing the base material, take care to prevent segregation.

When using select material, place shoulder material for a width of at least 3 feet before spreading the base material in order to confine the base material and allow satisfactory compaction along the edges of the base.

304.08 Compaction

At the start of compaction, the percentage of moisture in the mixture and in the pulverized soil lumps, based on oven-dry weights, shall not vary more than plus or minus 2% from the specified optimum moisture content, and shall be less than the quantity that will cause the soil-cement mixture to become unstable during compaction and finishing. The Contractor may use any type of compaction equipment that will produce the required results. Extend compaction efforts over the edges of the base material into the shoulders.

During final rolling, reshape the surface of the base course and lightly scarify to loosen any imprints left by the compacting or reshaping equipment.

The Department will divide the soil-cement base into lots of approximately 10,000 square yards for density testing purposes, and will perform five density tests on each lot. The average dry density of each lot shall be not less than 95% of maximum density as determined according to AASHTO T 134, and no individual test shall be less than 92% of the maximum density.

Rework material not meeting the required density at no additional cost to the Department, unless conditions exist as described in **304.13**. At the beginning of a project or at any time thereafter the Engineer may evaluate the rolling procedures.

Complete compaction and final shaping operations within three hours from the time the cement is mixed with the soil or select material.

304.09 Finishing

After compaction, shape the surface of the soil-cement to the required lines, grades, and cross-sections. Sprinkle the surface until it is damp, but not wet, and clip with a motor grader as directed by the Engineer. Dispose of the material removed by clipping. Following clipping, seal the surface with a roller.

304.10 Construction Joints

At the beginning of each day's construction, form a straight transverse construction joint by cutting back into the previously completed work to form a true vertical face free of loose or shattered material.

304.11 Thickness and Surface Tolerances

The Department will determine the thickness of the base by measuring test holes dug at random locations. The measured thickness shall not deviate from that shown on the Plans by more than plus 1-1/2 inches or minus 1 inch. Reconstruct or replace work found not to be within this tolerance as specified in **304.13**.

The finished base shall meet the surface requirements specified in **407.18**, and when tested as specified in that Subsection, the deviation of the surface from the testing edge of the straight edge shall not exceed 1/2 inch.

304.12 Curing

After the soil-cement has been finished, protect it against drying for 7 days by applying one of the bituminous materials specified in **304.02**. Apply the curing material at the rate shown on the Plans as soon as possible after completing the base construction, but in no case later than 24 hours after completing finishing operations. Maintain the finished soil-cement in a continuously moist condition until the curing material is placed.

If construction equipment or other traffic must use the bituminous-covered surface before the bituminous material has dried sufficiently to prevent pickup, first apply sufficient granular cover, consisting of clean sand passing a 3/8-inch sieve or other approved material.

During the 7-day protection period, maintain the curing material to ensure that all the soil-cement remains effectively covered.

Protect finished portions of soil-cement that are traveled on by equipment used in constructing an adjoining section to prevent equipment from marring or damaging completed work.

Sufficiently protect soil-cement from freezing for 7 days after its construction.

304.13 Reconstruction and Replacement

If reconstruction becomes necessary, repeat all construction procedures and adhere to the time limitations specified in **304**; however, the Engineer will determine the amount of cement to be used in the reconstructed soil-cement base.

Replace faulty work for the full depth of treatment. Correct low areas by replacing the material for the full depth of treatment rather than by adding a thin layer of soil-cement to the completed work.

304.14 Traffic

The Contractor may open completed portions of soil-cement to local traffic after the 7-day curing period, provided the soil-cement has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic. However, provide ingress and egress for property owners and public crossroads as necessary before the 7-day curing period.

304.15 Maintenance

Maintain the soil-cement in good condition until all work has been completed and accepted. Immediately repair defects that may occur at no additional cost to the Department.

COMPENSATION

304.16 Method of Measurement

The Department will measure:

1. Processing by the square yards of completed base, as determined using the actual length measured along the centerline of the roadbed and the width shown on the Plans or designated by the Engineer.

2. Material moved to prepare the existing subgrade, in accordance with **304.05**.

3. Portland Cement incorporated in the work by the ton in accordance with **109**.

4. Bituminous Material used for curing seal by the ton in accordance with **109**.

5. Water used in mixing and finishing operations by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate meters.

6. Select Material for Soil-Cement Base, added to that already on the road, by the cross-section method in approved borrow pits.

The Department will not measure or pay for water added to emulsified asphalt used for curing.

304.17 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Processing (Soil-Cement Base)	Square Yard
Portland Cement (Soil-Cement Base)	Ton
Bituminous Material	Ton
Water	MG
Select Material (Soil-Cement Base)	Cubic Yard

The Department will not pay for reconstructive work, including additional cement and processing, required due to the Contractor's negligence.

The Department may use net certified weights as a basis of measurement for cover material aggregate, subject to correction for aggregate that is lost, wasted, or otherwise not incorporated in the Work.

SECTION 306 – PORTLAND CEMENT CONCRETE BASE

DESCRIPTION

306.01 Description

This work consists of constructing a single course of Portland Cement Concrete Base, with or without reinforcement, as specified, on a prepared surface.

MATERIALS

306.02 Materials

Provide materials as specified in:

Portland Cement, Type I **901.01**
Fine Aggregate **903.01**
Coarse Aggregate **903.03**
Concrete Reinforcement **907**
Curing Materials **913**
Water **921.01**
Air Entraining Admixtures **921.06.A.2**
Chemical Admixtures and Additives **921.06**

EQUIPMENT

306.03 Equipment

Provide equipment as specified in **501.04**.

CONSTRUCTION REQUIREMENTS

306.04 Proportioning

Proportion materials for concrete base as specified in **501.03.A**.

306.05 General

Prepare the subgrade as specified in **205**, **207**, or **302**, whichever is applicable. Perform sub-base or subgrade treatment, when specified, according to the applicable Sections of Part 3 of these Specifications.

To construct cement concrete base, apply the applicable methods and procedures specified in **501.07**, **501.10, 501.12** through **501.15**, **501.16.A** through **501.16.F**, **501.17** through **501.24,** and **604.11 through 604.13**.

306.06 Surface Finish and Tolerances

Slightly roughen the surface of the concrete base by brooming. Meet the surface tolerances specified in **501.17**.

306.07 Integral Curb

Construct edging (integral curb), when shown on the Plans or required by the Engineer, of the same concrete mixture as is used in the base. Construct edging to the width and height shown on the typical cross-section by securely fastening auxiliary forms to the regular side forms of the base. Except as otherwise directed by the Engineer, construct edging immediately after the final floating of the base and before the concrete in the base upon which the edging is to be constructed has taken its initial set. Roughen the surface of the base before placing edging material upon it. At the end of the day's work, the Contractor may temporarily omit the curb from a section of the base sufficient in length to provide for backing-up of the paving train the following day, provided the base upon which the curb is to be placed is roughened sufficiently to bond the curb to the base. Remove all laitance from this section for the full width of the curbs by wire brushes or other satisfactory

means. Ensure that the concrete placed in the edging is well consolidated to avoid honeycombing. The top of the edging shall be smooth and uniform and given a wood float finish. Shape the inside and outside edges with edging tools as shown on the Plans. For final finishing of the edging, wipe the surface with a soft brush having a width not less than the width of the edging.

306.08 Tolerance in Base Thickness

For base thickness, meet the tolerance specified for pavement thickness in **501.24**.

COMPENSATION

306.09 Method of Measurement

The Department will measure Portland Cement Concrete Base (Plain) and Portland Cement Concrete Base (Reinforced) of the various thicknesses specified by the square yard in accordance with **109**.

If during construction the Engineer orders the cement increased or decreased from that approved for the job mix by more than 8 pounds per cubic yard, the Department will calculate the quantity of increased or decreased cement in accordance with **501.25**. These calculations will provide the basis for payment to the Contractor for additional cement, or for reimbursement to the Department for reduction in cement, as applicable.

306.10 Basis of Payment

A. General

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Portland Cement Concrete Base (Plain) ___"	Square Yard
Portland Cement Concrete Base (Reinforced) ___"	Square Yard

Such payment is full compensation for furnishing and placing all materials, including edging when specified, and for providing reinforcing, dowels, and joint materials.

The Department will pay for additional cement required if the cement is increased by more than 8 pounds per cubic yard at the purchase price, F.O.B. the unloading point, as verified by invoices, and will provide no additional compensation for further handling.

If the cement is decreased by more than 8 pounds per cubic yard, the Department will be reimbursed from any monies due the Contractor an amount equal to the purchase price of the cement, F.O.B. the unloading point, and no other charges will be included. The Department will not pay for any changes in the proportions of the aggregates.

The Department will not make additional payment for concrete slab placed in excess of Plan thickness.

The Department will not pay for any concrete base removed by order of the Engineer for deficiency in thickness or for otherwise not meeting Specification requirements.

The Department will pay for work required to prepare the subgrade or sub-base in accordance with **306.05**.

B. Thickness Adjustments

Where the average thickness of base is deficient in thickness by more than 1/4 inch, but not more than 1 inch, the Department will pay an adjusted price as specified in the Table 306.10-1.

Table 306.10-1: Concrete Base Deficiency

Deficiency in Thickness as Determined by Cores (inches)	Proportion of Concrete Price Allowed
¼	100%
> ¼ through ½	75%
> ½ through ¾	60%
> ¾ through 1	50%

Where the thickness of base is deficient by more than 1 inch and, in the Engineer's judgment, the area of such deficiency should not be removed and replaced, the Department will not make payment for the area retained.

SECTION 307 – BITUMINOUS PLANT MIX BASE (HOT MIX)

DESCRIPTION

307.01 Description

This work consists of constructing one or more base course layers of aggregate and asphalt, prepared in a hot bituminous mixing plant and spread and compacted on a prepared subgrade, granular sub-base, or base.

MATERIALS

307.02 Materials

Provide materials as specified in:

Aggregate for Mixture,
Grading A, ACRL, AS, B, BM, BM2, C, CS, or CW..... **903.06**
Asphalt Cement, Grade PG 64-22, 70-22, 76-22, 82-22..... **904.01**
Bituminous Additives **921.06.B**

The specific grading of aggregate to be used will be specified in the Contract or shown on the Plans. The Engineer will accept mineral aggregate, bituminous material, and the plant mix in accordance with **407.02**.

307.03 Composition of Mixtures

A. General

The bituminous base and/or leveling course shall be composed of aggregate and bituminous materials. The hot plant mixes shall comply with the applicable requirements of **407.03**.

Combine the specified mineral aggregate and asphalt cement in proportions that will meet the design composition limits specified in Table 307.03-1.

Table 307.03-1: Mixture Composition

Mixtures	Proportions of Total Mixture, Percent by Weight	
	Combined Mineral Aggregate, %	Asphalt Cement, % [1]
Grading AS and ACRL	96.3 - 97.7	2.3 - 3.7
Grading A	95.8 - 96.7	3.3 - 4.2
Grading B, BM, and BM2	93.8 - 95.8	4.2 - 6.2
Grading C and CW	93.8 - 95.8	4.2 - 6.2
Grading CS	92.3 - 94.7	5.3 - 7.7

[1] If the effective combined specific gravity of the aggregate exceeds 2.80, the Engineer may adjust the proportions specified.

In addition, combine the materials with the required amount of bitumen to meet the design properties specified in Table 307.03-2, except that on low volume roads (ADT 1,000 or below), the minimum stability shall be 1,500 pound-feet and the VMA and dust-asphalt ratio will be waived for 307-B, 307-BM, 307-BM2 and 307-C mixes.

Table 307.03-2: Mixture Design Properties

Mix [1]	Stability (minimum) lbf [2]	Design Void Content % [2]	Production Void Content, % [2]	VMA (minimum) % [2]	Dust-Asphalt Ratio [3]
307-B	2,000	4.0±0.2	3-5.5	11.5	0.6-1.5
307-BM	2,000	4.0±0.2	3-5.5	13.5	0.6-1.5
307-BM2	2,000	4.0±0.2	3-5.5	13.5	0.6-1.5
307-C	2,000	4.0±0.2	3-5.5	13.0	0.6-1.5
307-CS	2,000	3.0±0.5	1-5	---	---
307-CW	1,500	4.0±0.2	3-5	13.0	0.6-1.5

[1] To identify critical mixes and make appropriate adjustments, the mix design shall meet these design properties for the bitumen content range of Optimum Asphalt Cement ±0.25%.

[2] Tested according to AASHTO T 245 with 75 blows with the hammer on each end of the test specimen, using a Marshall Mechanical Compactor.

[3] The dust-asphalt ratio is the percent of the total aggregate sample that passes the No. 200 sieve, as determined by AASHTO T 11, divided by the percent asphalt in the total mix.

If the materials proposed for use do not meet the design criteria specified in Table 307.03-2, find other suitable sources of materials. If the material at the asphalt plant will not combine within the tolerances of the Job Mix Formula (JMF), provide a new design.

B. Recycled Asphalt Pavement and Recycled Asphalt Shingles

1. **Recycled Asphalt Pavement (RAP).** The Contractor may use asphaltic concrete removed from a Department project or other State Highway Agency project by an approved method and stored in a Department approved stockpile. RAP combined with the appropriate aggregate, asphalt cement, and anti-strip additive when required shall produce a mixture that meets **903.06** and **307**. The Contractor may incorporate RAP in the mixes specified in 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	10	10	-
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.

All mixes shall contain at least 65% virgin asphalt.

The Contractor shall obtain a representative sample from the recycled material stockpile and shall establish a gradation and asphalt cement content. The Contractor shall determine the gradation and asphalt content of the recycled material at the beginning of a project and every 2,000 tons thereafter. The stockpile asphalt cement content for all recycled material shall not vary by more than 0.8%. The stockpile gradation tolerance for all recycled material on each sieve is specified in Table 307.03-4.

Table 307.03-4: Stockpile Gradation Tolerance

Sieve Size	Tolerance
3/8 inch and larger	± 10%
No. 4	± 8%
No. 8	± 6%
No. 30	± 5%
No. 200	± 4%

The Engineer will accept the mixture for aggregate gradation and asphalt content in accordance with **407.20.B**.

Provide a special mix design with asphalt content in the range of 5 to 7% where 307-C Mix is used as a surface on the shoulder.

Perform sampling and testing of the planings as well as new materials for bid purposes, and for the submission of the Job Mix Formula (JMF) as specified in **407.03**. Submit all additives to the Engineer for approval at the same time other materials are submitted for design verification.

After mixing, verify the moisture content of the total mix is no more than 0.1% as determined by oven drying. Provisions for lowering the temperature because of boiling or foaming shall not apply.

2. **Recycled Asphalt Shingles (RAS).** RAS may be included to a maximum of 3% of the total weight of mixture. The percentage of RAS used will be considered part of the maximum allowable RAP percentage. The ratio of added new asphalt binder to total asphalt binder shall be 65% or greater for all 307 mixes. Either the mix producer or the RAS supplier shall obtain a representative sample from the recycled material stockpile and establish a gradation and asphalt cement content as required. Determine shingle asphalt binder content according to AASHTO T 164 Method A, with a minimum sample size of 500 grams. Determine the gradation and asphalt content of the recycled material at the beginning of the Project and every 2,000 tons of recycled material used thereafter. The stockpile asphalt cement content for all recycled material shall not vary by more than 0.8%. All RAS material shall be processed

to a minimum 100% passing the 3/8 inch sieve and a minimum 90% passing the No. 4 sieve.

To conduct the gradation testing, air dry a 500 to 700-gram sample of processed shingle material, dry sieve over the 3/8-inch and No. 4 sieves, and weigh. For mix design purposes, the Contractor may use the aggregate gradation specified in Table 307.03-5 as a standard gradation instead of determining the shingle gradation according to AASHTO T 30.

Table 307.03-5: Standard Gradation (for Mix Design Purposes)

Sieve Size	Total Percent Passing
3/8 inch	100
No. 4	97
No. 8	95
No. 16	80
No. 30	60
No. 50	50
No. 100	40
No. 200	30

An aggregate bulk specific gravity (G_{sb}) of 2.650 may be used instead of determining the shingle aggregate G_{sb} according to AASHTO T 84. In addition, the effective binder available for mixing with additional aggregates shall be considered as 75% of the total binder content as determined by AASHTO T 164 and shall be the value listed as the RAS binder content on the JMF.

Scrap asphalt shingle shall not contain extraneous waste materials. Extraneous materials including, but not limited to, asbestos, metals, glass, rubber, nails, soil, brick, tars, paper, wood, and plastics, shall not exceed 0.5% by weight as determined on material retained on the No. 4 sieve. To conduct deleterious material testing, take a representative 500 to 700-gram sample of processed shingle material, place over the No. 4 sieve, and pick and weigh all extraneous waste material retained on the No. 4 sieve. Base the percent of extraneous material on the total sample weight.

RAS shall contain less than the maximum percentage of asbestos fibers based on testing procedures established by the Department, or State or Federal environmental regulatory agencies. Analyze a minimum of one sample of processed asphalt roofing material for every 500 tons of material processed for the presence of asbestos.

Before a JMF for a particular design is approved, submit the following, along with the materials and information specified in **407.03**:

a. Certification by the processor of the shingle scrap describing the shingle scrap content and source.

b. A 1000-gram sample of the processed RAS material for inspection (new designs only).

Stockpile RAS separate from other salvage material. Do not blend RAS material in a stockpile with other salvage material. Do not blend Manufacture Waste Scrap Shingles (MWSS) and Tear-Off Scrap Shingles (TOSS). In addition, do not blend virgin sand material with the processed shingles, to minimize agglomeration of the shingle material.

All RAS supplied to a Department project shall come from a certified shingle processor/supplier approved by the Division of Materials and Tests.

C. Anti-Strip Additive

Check asphaltic concrete mixtures (Grading A, AS, ACRL, B, BM, BM2, C, CS, and CW) for stripping by the following methods:

1. The Ten Minute Boil test for dosage rate and the Root-Tunnecliff procedure (ASTM D4867) for moisture susceptibility.

   Do not use the Root-Tunnecliff procedure (ASTM D4867) with the following mixtures: Grading A, AS, ACRL, and B.

2. For mixtures not requiring design, the Ten Minute Boil test for dosage rate and moisture susceptibility.

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

EQUIPMENT

307.04 Equipment

Provide equipment as specified in **407.04** through **407.08**.

If using recycled mix, modify the asphalt plant as approved by the Engineer to accommodate the addition of asphalt planings. If using a batch plant to produce recycled mix, heat the aggregate to a temperature that will transfer sufficient heat to the cold planings to produce a mix of uniform temperature within the specified range.

CONSTRUCTION REQUIREMENTS

307.05 General

Conform to the construction requirements specified in **407.09** and **407.11** through **407.17**.

307.06 Preparing the Subgrade, Sub-base, or Surface

The Plans will indicate whether the plant-mixed base is to be constructed on a treated or untreated subgrade or sub-base, on a granular base, or on an existing surface. Ensure that the surface upon which the plant mix base is to be constructed meets **205**, **207**, **302**, **303**, **304**, or **309**, whichever is applicable. If shown on the Plans, condition the surface as specified in **407.10**. Condition existing mineral aggregate base as specified in **310**. Construct prime coat or tack coat as specified in **402** or **403**, respectively.

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

Only place bituminous plant-mix base mixture on a surface that is dry and free of loose particles and other undesirable materials.

307.07 Thickness and Surface Requirement

Control thickness during the spreading operation by frequently measuring the freshly spread mixture to establish a relationship between the uncompacted mixture and the completed course. Thickness or spread rate in pounds per square yards shall be within reasonably close conformity with that shown on the Plans. Each course shall have a thickness after compaction of not more than 4 inches, unless otherwise approved by the Engineer.

The surface of the base shall meet the requirements specified in **407.18**, and when tested in accordance with **407.18**, the deviation of the surfaces from the testing edge of the straightedge shall not exceed the amounts specified in Table 307.07-1.

Table 307.07-1: Maximum Surface Deviation

Mixture	Maximum Deviation (inches)
Grading A, ACRL, and AS	1/2
Grading B, BM, BM2, C, CS, and CW	3/8

COMPENSATION

307.08 Method of Measurement

The Department will measure Mineral Aggregate, including Mineral Filler when required, and Asphalt Cement for Bituminous Plant Mix Base and other related items in accordance with **407.19**.

307.09 Basis of Payment

The Department will pay for accepted quantities at the contract prices in accordance with **407.20**.

For bidding purposes, use the asphalt cement content specified in Table 307.09-1 for the designated mix.

Table 307.09-1: Asphalt Cement Content

Mix Type	Asphalt Content
307 A	4.0%
307 AS	3.5%
307 ACRL	3.5%
307 B	4.3%
307 BM	5.0%
307 BM2	5.0%
307 C	5.0%
307 CW	6.0%
307 CS	6.5%

If the Engineer sets an asphalt content other than that specified in Table 307.09-1, the Department will calculate a price adjustment, based on the asphalt content set by the Engineer and the Monthly Bituminous Index for the specific grade asphalt on the mix design, in accordance with **407.20**.

SECTION 309 – AGGREGATE-CEMENT BASE COURSE

DESCRIPTION

309.01 Description

This work consists of constructing a base of mineral aggregate and Portland cement on a prepared surface.

MATERIALS

309.02 Materials

Provide materials as specified in:

Water **302.03.B**
Portland Cement, Type I **901.01**
Portland-Pozzolan Cement, Type IP **901.01**
Crushed Stone or Sla
g, Grading D **903.05**
Aggregate, Crushed or Uncrushed Gravel or Chert **903.15**

Recycled Concrete Aggregate..... **903.05.C**
Bituminous Material for Curing, Emulsified Asphalt,
Types allowed for Tack Coat in **403**..... **904.03**

Provide emulsified asphalt, of a type allowed for Tack Coat in **403**, meeting the test requirements specified in Table 904.03-1.

Submit a sample of the cement and aggregate to be used to the Materials and Tests Laboratory for approval at least 15 days before use.

EQUIPMENT

309.03 Equipment

Provide a stationary mixing plant or mechanical road mixer(s).

A. Stationary Mixing Plant

Provide an approved twin-shaft pugmill as specified in **303.06.A**.

The cement feeder shall include a surge tank between the cement supply and the pugmill. The feeder system shall be so designed that the aggregate feeder will not operate unless the cement feeder operates. During production of aggregate cement base, do not use the plant for other operations. The plant shall be capable of weighing each component and adjusting for moisture in the aggregates. Plants shall be calibrated annually and in the presence of the Engineer if requested.

B. Mechanical Mixer (for Road Mixing)

Provide pugmill or rotary type mechanical mixers capable of producing a uniform blend of all materials to the full depth of the course being placed. At least one mixer shall be capable of adding a regulated amount of water under pressure and uniformly mixing it with the aggregate and cement. The mixers may be either self-propelled or trailer type.

CONSTRUCTION REQUIREMENTS

309.04 Limitations

Only process the amount of aggregate-cement base that will be covered with the succeeding stage of base or pavement construction during the same construction season. Do not process aggregate-cement base unless the ambient air temperature is at least 40 °F in the shade and rising. Only add cement to aggregate that is free of frost, whether the aggregate is stockpiled for plant mixing or spread for roadway mixing.

For roadway mixing, limit application of cement to an area that will allow for continuous operations and for the completion of all but the final surface finish within 3 hours from the time cement is applied.

When using a stationary mixing plant, spread the material, using approved mechanical spreaders, within 1 hour after being discharged from the mixer. Complete all operations except final surface finishing within 3 hours after the material is discharged from the mixer.

Continue processing the uncompacted aggregate-cement mixture with no delay of more than 30 minutes. If the uncompacted aggregate-cement mixture is wetted by rain so that the average moisture content exceeds the specified tolerance, reconstruct the section as specified in **304.13**.

309.05 Preparing the Existing Subgrade

Before beginning other construction operations, prepare the subgrade as specified in **205**, **207**, or **302**, whichever is applicable.

309.06 Cement Application, Mixing, and Spreading

The quantity of cement to be added to the aggregate shall range between 3% and 5%, by weight, of the dry material. The Engineer will establish the exact percentage of cement within the above range based on test results, provided by the Contractor, of the aggregate selected for use on the project.

A. Roadway Mixing

Spread the aggregate on the subgrade to the required thickness, width, and cross-section using an approved mechanical spreader. Uniformly apply the specified quantity of Portland cement over the spread

aggregate using an approved mechanical cement spreader. Do not apply cement if the moisture content of the aggregate exceeds by more than 4% the optimum moisture content specified by the Engineer for the aggregate-cement mixture. Replace spread cement that has been lost due to the Contractor's negligence at no additional cost to the Department.

Perform road mixing using mechanical mixer(s). At least one pass of the mixer may be required before adding water. When required, add water through the mixer or by other approved methods to bring the mixture to the required moisture content. Continue mixing until a uniform mixture is obtained.

B. Stationary Mixing Plant

If using a stationary plant, continue mixing until a uniform and intimate mixture of cement, aggregate, and water has been obtained. All material fed into the plant shall travel the full length of the pugmill. Periodically check the quantity of cement expended by emptying the cement storage bin. Transport the mixture from the plant to the road in numbered trucks equipped with tight, metal, rear-end dump beds. Provide a sufficient number of trucks to ensure satisfactory progress of the construction operations. Use an approved mechanical spreader to spread the material. In mixing, handling, and placing the base material, take care to prevent segregation.

Place shoulder material for a width of at least 3 feet before spreading the base material in order to confine the base material and allow satisfactory compaction along the edges of the base.

309.07 Compaction

The Contractor may use any type of compacting equipment that will produce the required result. At the start of compaction, the percentage of moisture in the mixture based on oven dry weight shall not vary more than 3% above or 1% below the specified optimum moisture. Extend rolling over the edges of the base material onto the shoulders.

The Department will divide the completed base into lots of approximately 10,000 square yards for density testing purposes, and will perform five density tests on each lot. The average dry density of each lot shall be not less than 95% of maximum density as determined according to AASHTO T 134, and no individual test shall be less than 92% of maximum density. Rework or replace material not meeting the specified density at no additional cost to

the Department. At the beginning of a project or at any time it is deemed advisable, smaller lots may be considered to evaluate rolling procedures or for other reasons as approved or directed by the Engineer.

309.08 Finishing

Perform finishing operations in the same manner as specified for soil-cement base construction in **304.09**.

309.09 Construction Joints

At the beginning of each day's construction, form a straight transverse construction joint by cutting back into the completed work to form a true vertical face.

Build aggregate-cement base for large, wide areas in a series of parallel lanes of convenient length and width meeting the approval of the Engineer. Form straight longitudinal joints at the edge of each day's construction by cutting back into the completed work to form a true vertical face free of loose or shattered material.

309.10 Thickness and Surface Tolerances

The Department will determine the thickness of the base by measuring test holes dug at random locations. The measured thickness shall not deviate from that shown on the Plans by more than plus 1-1/2 inches or minus ½ inch. Reconstruct or replace work found not to be within this tolerance as specified in **304.13**.

The surface of the completed base shall be in reasonably close conformity to the lines, grades, and cross-section shown on the Plans or established by the Engineer and shall have a satisfactorily smooth riding quality.

309.11 Curing

Perform curing of the finished base in the same manner as specified for soil-cement base construction in **304.12**.

309.12 Traffic and Maintenance

The Contractor may open portions of completed base to traffic as specified in **304.14**.

Maintain the completed base as specified in **304.15**.

COMPENSATION

309.13 Method of Measurement

The Department will measure:

1. Mineral Aggregate for Aggregate-Cement Base Course by the ton in accordance with **109**.

2. Earth moved to prepare the existing subgrade, in accordance with **309.05**, as provided for under the appropriate provisions of **203** and **207**.

3. Portland Cement incorporated in the work by the ton in accordance with **109**.

4. Bituminous Material used for curing seal by the ton in accordance with **109**.

5. Water used in mixing and finishing operations by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate meters.

The Department will deduct the weight of total moisture, as determined by dry weights, of the base material at the time of weighing in excess of 3% of optimum moisture content.

The Department will not measure or pay for water added to emulsified asphalt used for curing.

309.14 Basis of Payment

A. General

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Mineral Aggregate	Ton
Portland Cement	Ton

Bituminous Material	Ton
Water	MG

When mixing is performed in a stationary plant, the Department will not pay for water. When road mixing is performed, the Department will pay for water added to the material during mixing at the direction of the Engineer.

B. Adjustments

Specific Gravity. In cases where the Bulk SSD specific gravity of the mineral aggregate exceeds 2.85, the Department will adjust the tonnage of mineral aggregate for payment by multiplying the tonnage of mineral aggregate used by a specific gravity of 2.85 and dividing by the higher specific gravity.

SECTION 310 – CONDITIONING MINERAL AGGREGATE BASE

DESCRIPTION

310.01 Description

This work consists of reshaping and compacting an existing mineral aggregate base or surface.

MATERIALS

310.02 Materials

Provide materials as specified in:

Aggregate for Conditioning Base **903.05**
Calcium Chloride, Type 1, Type 2 or
Calcium Chloride Liquor **921.02**

EQUIPMENT

310.03 Equipment

Provide motor graders and water distributors in the number necessary for satisfactory prosecution and completion of the work, as well as one or more rollers of a type and sufficient weight to obtain the required density and to seal the surface of the base course.

CONSTRUCTION REQUIREMENTS

310.04 Conditioning

Condition the existing base by applying water, blading, and compacting as directed by the Engineer. Scarify sections of existing base that are pot-holed to the full depth of the potholes. Scarify and shape warped and distorted sections as directed by the Engineer. Moisten the material as necessary, and mix, shape, and roll until the base is uniformly and thoroughly compacted. Continue applying water, blading, and rolling until a smooth, dense, well-bonded surface is obtained that meets the Engineer's approval.

The Department will divide the completed base into lots of approximately 10,000 square yards for density testing purposes, and will perform five density tests in each lot. The average dry density shall be not less than 100% of maximum density as determined according to AASHTO T 99 Method D, and no individual test shall be less than 97% of maximum density. Smaller lots may be considered when approved or directed by the Engineer.

Distribute calcium chloride, when specified, at the approximate rate of 1 pound per square yard and incorporate it in the base material during blading and rolling operations as directed by the Engineer.

If additional material is to be added to the existing base, lightly scarify the existing base, add the material, and condition the base as specified above.

310.05 Surface Requirements

The surface of the conditioned base shall be in reasonably close conformity with the lines, grades, and cross-sections shown on the Plans or as directed by the Engineer and shall provide a satisfactory riding surface.

COMPENSATION

310.06 Method of Measurement

The Department will measure:

1. Conditioning Mineral Aggregate Base by the linear mile, based on a horizontal measurement made along the median centerline of the Project for divided sections and along the centerline of the pavement for two-lane sections, excluding bridges.

2. Calcium Chloride by the ton in accordance with **303.14.D**.

3. Water by M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

If the Contract requires the construction of a mineral aggregate base and a surface course, the Department will not directly measure or pay for conditioning of the base but will consider this work to be incidental to the unit price bid for the base material.

If the Contract requires the addition of base material to sections or the entire length of a previously constructed base, the Department will not directly measure or pay for conditioning of the base on the sections where base material is added. Sections where base material is not added will be measured for payment by the linear mile.

If the Contract requires a surface to be constructed on a previously constructed base and no additional material is added to the base, the Department will measure and pay for conditioning of the base by the linear mile.

310.07 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Conditioning Mineral Aggregate Base	Linear Mile
Calcium Chloride	Ton
Water	MG

Payment for Conditioning Mineral Aggregate Base is full compensation for conditioning all base on interchanges, approaches, service roads, ramps, frontage roads, roadside rest areas, and all other base within the limits of the Project that requires conditioning to receive a succeeding stage of construction under the Contract.

SECTION 312 – AGGREGATE-LIME-FLY ASH STABILIZED BASE COURSE

DESCRIPTION

312.01 Description

This work consists of constructing a base of mineral aggregate, hydrated lime, and fly ash.

MATERIALS

312.02 Materials

Provide materials as specified in:

Crushed Limestone Aggregate Type A, Grading C **903.05**
Bituminous Material for Curing Emulsified Asphalt,
Types allowed for Tack Coat in **403** **904.03**

Water **921.01**
Lime..... **921.04**

Provide emulsified asphalt, of a type allowed for Tack Coat in **403**, meeting the test requirements specified in Table 904.03-1.

Fly Ash shall meet the requirements of **921.15**.

312.03 Proportioning

Proportion the lime, fly ash, and aggregate to meet the limits specified in Table 312.03-1.

Table 312.03-1: Proportioning of Lime, Fly Ash, and Aggregate Mix

Material	Range of Percent by Weight of Total Dry Mix
Lime	3.5
Fly Ash	11.0
Aggregate	85.5

The mixture shall be within plus or minus 2% of the optimum moisture of the mixture, as determined according to AASHTO T 99, Method C (with replacement).

Design the mixture so that when compacted into cylinders, cured and tested according to ASTM C593, the cylinders will have a minimum average compressive strength of 950 psi and no individual test is lower than 800 psi.

At least 45 days before producing the stabilized mixture, submit the following for the Engineer's approval:

1. Mix design,
2. Statement naming the source and percentage of each component, and
3. Report showing the results of the applicable tests meeting the above requirements.

For material testing and verification of the mix design, submit component materials in the quantities specified in Table 312.03-2.

Table 312.03-2: Material Quantities for Mix Verification Testing

Material	Quantity (pounds)
Hydrated Lime	25
Fly Ash	50
Aggregate	200

The Engineer may choose to verify the mix design on an annual basis provided the properties and proportions of the materials do not change appreciably. Adhere to the approved proportions of material during the progress of the work. Do not change the source or character of any material without the Engineer's approval, which will be based on verification of the new mix design.

EQUIPMENT

312.04 Equipment

A. Mixing Plant

Provide a stationary or portable batch or continuous mix type mixing plant that is equipped to allow the Engineer to verify the component percentages at any time.

1. **Stationary or Portable Batch Type Plants.** Equip mixing plants with batching devices and scales to proportion the individual components by weight. Ensure that such devices have the accuracy needed to maintain the material percentages, based on total dry weight, within the tolerances specified in Table 312.04-1.

Table 312.04-1: Tolerances for Mix Components (based on dry weight)

Material	Tolerance
Hydrated Lime	± 0.25%
Fly Ash	± 0.75%
Water	± 2.0%

Equip stationary or portable batch type plants with scales as specified in **501.04.A.3**. Use separate scales and hoppers for weighing the aggregate and the lime and the fly ash; however, the fly ash may be weighed cumulatively in the weigh hopper with the lime, provided the lime is added first.

2. Continuous Type Mixing Plants. Equip continuous type mixing plants with:

1. Metering devices and scales for proportioning the lime and fly ash by weight to meet the tolerances specified in Table 312.04-1;

2. An out-of-range alarm system that will sound an audible alarm when the lime or fly ash is not within the established tolerances;

3. A meter or other approved regulating device to control the flow of water into the plant in a manner that positively maintains a uniform moisture content in the mixture; and

4. A separate, quick, and automatically operating on-off device to shut the water off instantly when the mixer stops.

Maintain an approved method of checking and calibrating the weighing system in an easily accessible location on the plant.

B. Rollers

Provide either pneumatic tire or vibratory type rollers as specified in **407.07**.

C. Spreader

Provide either a self-propelled or tractor-drawn spreader that can maintain a uniform rate of travel while spreading and of laying a lift of uniform consistency and thickness with proper grade control.

D. Haul Trucks

Transport the mixture from the central plant in clean trucks equipped with tight metal rear-end dump beds having a cover of canvas, or other suitable material, securely fastened on all sides of the truck bed, and of such size as to maintain the moisture content and prevent the loss of fines.

CONSTRUCTION REQUIREMENTS

312.05 Limitations

The Contractor may perform stabilization from March 1 through September 30, and may continue this operation from October 1 through November 30 provided that Type I Portland cement is substituted for the lime on a pound for pound basis. Do not perform stabilization when the aggregate or the surface on which the base course is to be placed is wet or frozen, when it is raining, sleeting, or snowing, or when the temperature is 40 °F or less. Do not begin processing operations for this material unless the air temperature in the shade is at least 40 °F and rising. Cover the aggregate-lime-fly ash stabilized base course with the succeeding stage of base or pavement construction before December 15.

312.06 Subgrade Preparation

Prepare the subgrade as specified in **205**, **207**, or **302**, whichever is applicable.

312.07 Mixing

Mix the aggregate with the proper amount of lime, fly ash, and water in an approved mixer. Continue mixing until a thorough and uniform mixture is obtained. Handle the aggregate in a manner that will prevent contamination and segregation. Ensure that the plant will discharge the mixture without undue segregation.

312.08 Spreading

After mixing, transport the material to the site while it contains the proper moisture content, and spread the material to the required thickness and cross-section using an approved spreader. If the required compacted depth of the base exceeds 8 inches, construct the base in two or more approximately equal layers. The maximum compacted thickness of any one layer shall not exceed 8 inches.

312.09 Compaction

The Contractor may use any type of compacting equipment that will produce the required result. At the start of compaction, the percentage of moisture in the mixture based on oven dry weight shall not vary more than 3% above or 1% below the specified optimum moisture. Extend rolling over the edges of the base material onto the shoulders.

The Department will divide the completed base into lots of approximately 10,000 square yards for density testing purposes, and will perform five density tests on each lot. The average dry density of each lot shall be not less than 100% of the maximum density as determined according to AASHTO T 99, Method C (with replacement), and no individual test shall be less than 97% of the maximum density. If the specified density is not obtained, rework or replace the material to comply with the density requirement at no additional cost to the Department.

The Engineer may employ a control strip and random sampling to evaluate and adjust the Contractor's compaction procedure.

Provide a sufficient number of compaction and finishing units to ensure that the initial compaction of the processed section of the stabilized base course is completed within 4 hours from the time the water is added at the mixer. The final finishing and compaction shall be within 8 hours from the time of mixing. The Engineer may extend this time if the material has not reached an initial set. If, for any reason, construction operations are delayed or suspended and the Engineer requires the removal and disposal of loose or uncompacted material, the Contractor shall perform this work at no additional cost to the Department. No aggregate-lime-fly ash base course may be salvaged.

312.10 Finishing

Perform finishing operations as specified in **304.09**.

312.11 Construction Joints

Construct joints as specified in **309.09**.

312.12 Thickness and Surface Requirements

Meet the thickness and surface requirements specified in **309.10**.

312.13 Curing

After finishing the aggregate-lime-fly ash base, seal the surface with one of the bituminous materials specified in **312.02**, applied by a pressure distributor at the rate of 0.10 to 0.25 gallons per square yard or as directed by the Engineer. Heat or otherwise prepare the bituminous material to ensure uniform distribution. Apply the material no later than 24 hours after completing finishing operations unless the Engineer determines that application should be delayed. Keep the finished base continuously moist until the bituminous curing seal has been applied. Maintain the curing material during a 7-day protection period so that all the aggregate-lime-fly ash base course will be covered effectively during this period. Until the mixture has cured for 7 days, only allow on the base the pneumatic-tired equipment required for applying the curing seal. However, provide ingress and egress for property owners before the 7-day curing period.

312.14 Traffic and Maintenance

The Contractor may open portions of completed base to traffic as specified in **304.14**.

Maintain the completed base as specified in **304.15**.

COMPENSATION

312.15 Method of Measurement

The Department will measure bituminous material for curing seal and the mineral aggregate, lime, and fly ash mixture by the ton in accordance with **109**.

The Department will deduct the weight of total moisture in the aggregate, as determined by dry weights, of the base material at the time of weighing in excess of 3% of optimum moisture. The Department will not measure and

pay for mixing water; however, it will measure and pay for water added on the road at the direction of the Engineer by the M.G. (1,000 gallons) in accordance with **109**.

312.16 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Mineral Aggregate	Ton
Lime	Ton
Fly Ash	Ton
Bituminous Material	Ton
Water	MG

If fly ash is substituted with cement it will not result in additional cost to the Department.

SECTION 313 – TREATED PERMEABLE BASE

DESCRIPTION

313.01 Description

This work consists of constructing treated permeable base, composed of either a mixture of aggregate, Portland cement, and water, or a mixture of aggregate with asphalt binder, on a prepared sub-base. The Contractor may use either cement treated or asphalt treated permeable base.

MATERIALS

313.02 Materials

Provide materials as specified in:

Portland Cement, Type I	**901.01**
Aggregate for Portland Cement Treated Mixture	**903.03**
Aggregate for Bituminous Treated Mixture	**903.06**
Asphalt Cement, Grade PG 64-22, 70-22, 76-22, 82-22	**904.01**
Liquid Membrane – Forming Compounds	**913.05**
Water	**921.01**

313.03 Composition of Mixtures

A. Portland Cement Treated Permeable Base

In accordance with **604**, submit a concrete mix design, meeting the requirements specified in Table 313.03-1, to the Engineer for approval.

Table 313.03-1: Mix Design Properties

Property	Value
Water-Cement Ratio	0.43 (approximately)
Portland Cement Content	$\geq$ 282 lbs/yd^3
Compressive Strength at 7 days (AASHTO T 22)	$\geq$ 500 psi

B. Bituminous Treated Permeable Base

Asphalt treated permeable base shall be Bituminous Plant Mix Base (Hot Mix) as specified in **307** and **407**. Use liquid asphalt at the rate of 3% by weight of the total mixture. Asphalt content shall be such that all aggregate is visibly coated. Submit a mix design to the Engineer for approval as specified in **407.03**. Recycled Asphalt Pavement (RAP) meeting the requirements of **307.03.B** may be incorporated into asphalt treated permeable base up to 10% by weight of the aggregate. 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**.

EQUIPMENT

313.04 Equipment

To construct Portland cement treated base, provide equipment meeting **501.04.A** and **501.04.B**.

To construct bituminous treated base, provide equipment meeting **407.04** through **407.08**.

The spreading equipment shall meet either **501.04.D.11** or **407.06**.

CONSTRUCTION REQUIREMENTS

313.05 Construction Requirements

Construct cement treated permeable base and asphalt treated permeable base as specified in **309** and **307** respectively, unless otherwise specified below.

A. Cement Treated Permeable Base

1. **Consolidation and Finishing.** Immediately after placing the cement treated permeable base, compact the mixture using a steel wheel roller weighing not less than 6 tons. Continue rolling until maximum densification is achieved; immediately cease rolling if aggregate breakage occurs. Do not use vibratory rollers. Instead of using a steel wheel roller, the Contractor may place the cement treated permeable base with a high-density screed with dual tamping bars.

2. **Curing.** Immediately after spreading and compacting operations, cover the entire surface and exposed edges of the cement treated permeable base with transparent or white polyethylene sheeting as specified in **501.18**, or a white pigmented wax base curing compound meeting AASHTO M 148.

   Use polyethylene sheeting having a thickness of at least 4 mils and hold the sheeting in place for a minimum of 7 days using a method approved by the Engineer. Before placing the sheeting, thoroughly wet the surface of the cement treated permeable base.

   Place wax-based curing compound at a rate of 0.04 to 0.05 gallons per square yard.

B. Asphalt or Cement Treated Permeable Base

From the time of placement until placement of the following pavement layer, protect the treated permeable base from severe weather conditions, particularly freezing rain, snow, and icing, and from contamination by dust, dirt, mud, or other fine-grained material. Remove and replace, at no additional cost to the Department, all portion(s) of the treated

permeable base that become contaminated to the extent that drainage is reduced or inhibited.

Do not allow traffic on the treated permeable base, except for equipment required to place the following layer of pavement, provided that it enters and exits as near as possible to the paving operation. Repair damage to the treated permeable base caused by the Contractor's equipment at no additional cost to the Department.

313.06 Limitations

If using asphalt treated permeable base, adhere to the limitations specified in **407.09**. Do not place any treated permeable base that cannot be covered by the next course of pavement within the same construction season.

313.07 Surface Requirements

The Department will test the finished surface of the treated permeable base with a 12-foot straightedge in both transverse and longitudinal directions. The finished surface shall be uniform and shall not vary by more than ½ inch from the lower edge of the straightedge. If the tested surface varies by more than ½ inch, adjust the surface to a new grade, as established by the Engineer, as follows:

1. Fill the low areas with Portland cement concrete during the concrete paving operation, or

2. Apply emulsified asphalt, RS-2, at a rate not to exceed 0.2 gallons per square yard, as determined by the Engineer, over the specified low areas, and fill the low areas with No. 8 mineral aggregate. Seat the size No. 8 mineral aggregate with a pneumatic tire roller.

313.08 Tolerance in Pavement Thickness

Place treated permeable base to the thickness designated on the Plans. Before beginning any further work, take core samples from the treated permeable base, at locations established by the Engineer, in accordance with **501.24** for verification of base thickness. Take core samples at locations determined and witnessed by a Department representative, and document on the appropriate form.

The Department will adjust the contract unit price in accordance with **501.26** if the base thickness is determined by the Engineer to be deficient.

COMPENSATION

313.09 Method of Measurement

The Department will measure treated permeable base by the square yards complete in place for the width and thickness specified.

313.10 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Treated Permeable Base	Square Yard

The Department will adjust payment in accordance with **501.26.B** for all base found to be deficient in thickness by more than ¼ inch. The Department will not make additional payment over the contract unit price for base that has an average thickness in excess of that shown on the Plans.

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

If the Department orders any increase or decrease in the cement content of the Cement Treated Base from the approved mix design, the measurement and payment for this change will be computed in accordance with **501.25** and **501.26**.

The Department will consider the cost of taking cores for verification of pavement thickness to be included in the contract unit price of treated permeable base.

The Department will not allow additional compensation for leveling of the treated permeable base except on ramps that contain 4,500 square yards or less of Portland cement concrete pavement. The Department will measure and pay for additional concrete used on these ramps in accordance with **501.25** and **501.26**.

PART 7 – INCIDENTAL CONSTRUCTION AND SERVICES

SECTION 701 – CEMENT CONCRETE SIDEWALKS, DRIVEWAYS AND MEDIAN PAVEMENT

DESCRIPTION

701.01 Description

This work consists of constructing, on a prepared subgrade, Portland cement concrete Sidewalks, Driveways, and Median Pavement, excluding those Sidewalks, Driveways, and Median Pavement that are integrally part of structures.

MATERIALS

701.02 Materials

Provide materials as specified in:

Preformed Joint Filler **905.01**
Cement Concrete Curing Materials **913**
Drain Pipe, Standard Strength **914.04**

To construct sidewalks, driveways, and median pavement, use Class A concrete meeting the requirements of **604**.

EQUIPMENT

701.03 Equipment

A. Forms

Use forms of wood, metal, or other suitable material. Extend forms for the full depth of the concrete. Only use forms that are true to line, free from warp, and of sufficient strength to resist the pressure of the concrete without springing. On all radial sections, use curved forms of proper radius and that are of a design acceptable to the Engineer. Brace and stake forms to ensure that they will remain in both horizontal and vertical alignment until their removal.

B. Mixing and Finishing Equipment

Use mixers that meet **501.04.B**.

Furnish satisfactory floats, templates, straightedges, edgers, spades, and tamps. Compact the subgrade using tamping or rolling equipment that will produce the desired results.

Instead of using forms, the Contractor may use a slip form paver that will produce the required results.

CONSTRUCTION REQUIREMENTS

701.04 Preliminary Work

Perform Clearing and Grubbing, Removal of Structures and Obstructions, Excavation and Undercutting, and Embankment Construction as specified in **201**, **202**, **203**, and **205**, respectively.

701.05 Subgrade Preparation

Prepare subgrade for sidewalks, driveways, and median pavement to the required depth and to a width that will allow for the installation and bracing of the forms. Shape and compact the subgrade to a firm, even surface in

reasonably close conformity with the grade and cross-section shown on the Plans. Remove all soft and yielding material, replace it with acceptable material, and compact it as directed by the Engineer.

701.06 Expansion Joints

Unless otherwise shown on the Plans or directed by the Engineer, place premolded expansion joint filler, 1 inch in thickness, at the locations and in line with expansion joints in the adjoining pavement, gutter, or curb. Cut all premolded expansion joint filler to the full width or length of the proposed construction and extend it to within 1 inch of the top or finished surface. Place all longitudinal expansion joints as shown on the Plans or as directed by the Engineer. Ensure that all expansion joints are true, even, and present a satisfactory appearance.

Form construction joints around all appurtenances, such as manholes and utility poles, that extend into and through the sidewalk or median area. Install 1-inch thick premolded expansion joint filler in these joints. Install expansion joint filler, of the thickness shown on the Plans, between concrete sidewalks and any fixed structure, such as a building or bridge. Install 1-inch thick expansion joint filler between concrete curb and median pavement and, unless otherwise specified, between concrete curb and sidewalk. This expansion joint material shall extend for the full depth of the walk or median pavement.

701.07 Limitations on Mixing

Comply with **604.12**.

701.08 Mixing and Placing Concrete

Mix concrete as specified in **604.14**.

Place concrete as specified in **501.12**, except that mechanical spreaders will not be required. Immediately before placing the concrete, thoroughly wet the subgrade, and give the forms a coating of light oil. Thoroughly clean and oil the forms before each use.

701.09 Finishing

Strike-off the concrete with a transverse template resting upon the side forms. After striking-off the concrete to the required cross-section, finish it with

floats and straightedges until the required surface requirements have been obtained.

When the concrete surface is free from water and just before the concrete obtains its initial set, finish and lightly sweep the surface with a broom to produce a sandy texture. The longitudinal surface variations shall not exceed ¼ inch under a 12-foot straightedge, or 1/8 inch on a 5-foot transverse section. Ensure that the finished concrete surface will drain completely at all times.

Carefully finish the edges of the sidewalks, driveways, and median pavement, and round with an edging tool having a ½-inch radius.

Divide the surface of sidewalks into blocks using a grooving tool. Space the grooves approximately 5 feet apart to produce rectangular blocks unless otherwise directed by the Engineer. Cut the grooves to a depth of not less than 1 inch. Shape the edges of the grooves with an edging tool having a ¼-inch radius.

Place grooves in median pavement to be in line with corresponding joints in adjoining construction or as directed by the Engineer.

Unless otherwise shown on the Plans, place marks or grooves at right angles to the centerline of driveways and approximately 8 inches apart. Using a suitable marking tool, make these markings to be between 1/8 and ¼ inch in depth. A grooving tool, of 6 to 8 inches in width, with multiple grooves for grooving alternate strips 8 inches apart, may be used for this purpose. Remove irregularities caused by the edges of the marking tool using a wetted brush or wooden float. Round all marking edges.

Do not place grooves in the surface of sidewalks or driveways reinforced for beam action where the full thickness of concrete is required for strength.

Round the edges of the concrete at expansion joints with an edging tool having a ¼-inch radius. Remove all marks caused by edging. Clean the top and ends of expansion joint material of all concrete and trim the expansion joint material to be slightly below the surface of the concrete.

701.10 Protection and Curing

Forms may be removed as soon as their removal will not damage the concrete. Do not exert pressure upon the concrete when removing forms.

Perform curing and provide cold weather protection as specified in **501.18**.

Do not allow pedestrians on concrete sidewalks, driveways, or medians until 12 hours after finishing the concrete. Do not allow vehicles or loads on any sidewalk, driveway, or median until the Engineer has determined that the concrete has attained sufficient strength for such loads.

Construct and place barricades and protection devices as necessary to keep pedestrians and other traffic off the sidewalk, driveway, or median.

Repair all sidewalks, driveways, or paved medians damaged prior to final acceptance of the Project, at no cost to the Department, by removing concrete within groove limits and replacing it with concrete of the same type and finish as used in the original construction.

701.11 Backfilling

Immediately after removing the side forms, fill the spaces along the edges of the sidewalk or driveway with suitable material, placed in layers not exceeding 4 inches in loose thickness, and compact this material until firm and stable.

701.12 Final Cleanup

Perform final cleanup as specified in **104.10**.

COMPENSATION

701.13 Method of Measurement

The Department will measure Concrete Sidewalks and Concrete Driveways by the square foot, complete in place, based on surface area measurements. Where standard widths are constructed, the measurements shall not exceed the standard widths shown on the Plans without the Engineer's written approval. The Department will measure Concrete Sidewalks of each thickness, and Concrete Driveways, separately.

The Department will measure Concrete Median Pavement by the volume in cubic yards, complete in place, as obtained from the specified thickness shown on the Plans and surface measurements for width and length.

The Department will measure Concrete Curb Ramps and Concrete Curb Ramps (Retrofit) by the area in square feet, complete in place, as obtained from surface measurements. Where standard widths are constructed, the measurements shall not exceed the standard widths shown on the Plans, unless approved in writing by the Engineer.

Unless otherwise shown on the Plans, the Department will consider subgrade preparation, backfill, expansion joint materials, and drain pipe to be incidental to the work.

701.14 Basis of Payment

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

Item	*Pay Unit*
Concrete Sidewalk (__ “)	Square Feet
Concrete Driveway (__ “)	Square Feet
Concrete Median Pavement	Cubic Yard
Concrete Curb Ramp	Square Feet
Concrete Curb Ramp (Retrofit)	Square Feet

Such payment is full compensation for all subgrade preparation, backfill, and all other incidentals necessary to complete the work.

SECTION 702 – CEMENT CONCRETE CURB, GUTTER, AND COMBINED CURB AND GUTTER

DESCRIPTION

702.01 Description

This work consists of constructing Curb, Gutter, or Combined Curb and Gutter of Portland cement concrete.

MATERIALS

702.02 Materials

Provide materials that meet the applicable requirements of **604** and **913**, and as specified in:

Preformed Joint Filler **905.01**
Drain Pipe, Standard Strength **914.04**

To construct curb, gutter, and combined curb and gutter, use Class A concrete meeting the requirements of **604**, with the following exception: when placing

concrete with a curb extruding machine, the slump shall range from 0 to 3 inches.

The Contractor may adjust water and percentages of fine and coarse aggregate within the limits specified (fine aggregate may range from 40 to 65%) to allow satisfactory placement.

The Department will make compressive strength test specimens in accordance with AASHTO T 23.

EQUIPMENT

702.03 Equipment

A. Forms

Except for the templates between 10-foot sections, use either wood or metal forms that meet **701.03.A**. For the templates, use 1/8-inch thick metal, of the same width as that of the curb, gutter, or combination curb and gutter, and that is not less than ¼ inch more in depth than the respective depth of the type curb and gutter being constructed. The templates shall have lugs or other devices to hold them in position during concrete placement and shall be of a design that will allow their removal without damaging the concrete. For gutters, use a strike-off template, of the form and shape of the gutter, to shape the top surface of the gutter.

B. Compaction Equipment

Compact the subgrade using tamping or rolling equipment that will produce the desired results.

C. Mixing and Finishing Equipment

Use mixers that meet **604.04**. With the Engineer's approval, the Contractor may use a curb machine that will place the concrete in a satisfactory manner. Provide finishing equipment, including satisfactory floats, edgers, spades, and tamps.

CONSTRUCTION REQUIREMENTS

702.04 Preliminary Work

Perform Clearing and Grubbing, Removal of Structures and Obstructions, Excavation and Undercutting, and Embankment Construction as specified in **201**, **202**, **203**, and **205**, respectively.

702.05 Subgrade Preparation

Perform subgrade preparation for curb, gutter, and combined curb and gutter to the required depth, and to a width that will allow the installation and bracing of the forms. Shape and compact the subgrade to a firm, even surface, in reasonably close conformity with the grade and section shown on the Plans. Remove all soft and yielding material, replace it with acceptable material, and compact as directed by the Engineer.

702.06 Expansion Joints

Form expansion joints at the intervals and locations shown on the Plans, using 1-inch thick preformed joint filler, unless otherwise specified. Place expansion joints in line with corresponding expansion joints in adjoining pavement or other construction. Cut joint filler to the full cross-section of the curb, gutter, or curb and gutter.

702.07 Limitations on Mixing

Comply with **604.12**.

702.08 Mixing, Placing, and Finishing Concrete

Mix concrete as specified in **604.13**.

Immediately before placing the concrete, thoroughly wet the subgrade, and apply a coating of light oil to the forms. Thoroughly clean and oil the forms before each use.

Place concrete as specified in **501.12**, except that the mechanical spreader will not be required.

Place the concrete immediately after mixing. Spade and vibrate the edges, sides, or faces to thoroughly consolidate the concrete and bring the mortar to

the surface. After vibrating, use a wooden float to give the surface a smooth and even finish.

Construct concrete curb, gutter, or combined curb and gutter, to be reasonably true to line, grade, and cross-section, and, unless otherwise shown on the Plans, in sections having uniform lengths of 10 feet. The length of these sections may be reduced to no less than 6 feet where necessary for closures. Carefully set the templates before placing the concrete and keep them in place until the concrete has set sufficiently to hold its shape. Remove templates while the forms are still in place. Remove the forms on the face of all curbs as soon as the concrete will hold its shape, and then use a wooden float on the surface to provide a smooth and even finish. No plastering is permitted. Unless otherwise specified, round the top edges of the curb and the edge of the gutter to a radius of ¾ inch. Finish the edges on each side of templates and expansion joint material with an edging tool having a radius of not over ¼ inch, and then remove all lines or marks with a wet brush. Finish the back of curbs not less than 3 inches below the top of backfill against the curb. Leave all exposed surfaces, against which some rigid type of construction is to be made, smooth and uniform to allow free movement of the curb, gutter, or combined curb and gutter.

Remove all tool marks with a wetted brush or wooden float and ensure that the finished surface presents a uniform and pleasing appearance.

If the Engineer allows use of curb machines, perform finishing as specified above, except that instead of constructing the curbs in sections, contraction joints may be sawed a minimum depth of ¼ the thickness of the section, at intervals of 6 to 10 feet.

Place weep holes or drainage openings through curbs as shown on the Plans or as directed by the Engineer. Place coarse aggregate behind each opening as needed.

702.09 Protection and Curing

Immediately after finishing the concrete, provide protection and perform curing as specified in **501.18**.

Protect the curb, gutter, and combined curb and gutter until final acceptance. Repair concrete that is damaged before final acceptance by removing and reconstructing each 10-foot section that has been damaged at no cost to the Department.

702.10 Backfilling

Immediately after the concrete has set sufficiently and the forms have been removed, fill the space behind the curb or combined curb and gutter with suitable material, placed in layers not exceeding 4 inches in loose thickness, and compact until firm and stable.

702.11 Final Cleanup

Perform final cleanup as specified in **104.10**.

COMPENSATION

702.12 Method of Measurement

The Department will measure Concrete Curb, Concrete Gutter, and Concrete Combined Curb and Gutter for payment by the cubic yard, complete in place. The volume, per linear foot of length, will be obtained from the dimensions shown on the Plans. Linear measurements will be surface measurements taken along the center of gravity of the section.

Unless otherwise shown on the Plans, the Department will consider subgrade preparation, backfill, expansion joint materials, and drain pipe to be incidental to the work.

The Department will not measure or make payment under this Section for curb integral with concrete pavement or concrete base unless otherwise shown on the Plans or specified in the Contract.

702.13 Basis of Payment

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

Item	*Pay Unit*
Concrete Curb	Cubic Yard
Concrete Gutter	Cubic Yard
Concrete Combined Curb and Gutter	Cubic Yard

Such payment is full compensation for all subgrade preparation, backfill, and all other incidentals necessary to complete the work.

SECTION 703 – CEMENT CONCRETE DITCH PAVING

DESCRIPTION

703.01 Description

This work consists of constructing paved ditches of Portland cement concrete on a prepared subgrade.

MATERIALS

703.02 Materials

Provide materials that meet the applicable requirements of **604**.

For Portland cement concrete ditch paving, use Class A concrete meeting the requirements of **604**.

EQUIPMENT

703.03 Equipment

A. Forms

Use forms of either wood or metal that meet **701.03.A**. To shape the top surface of the paved ditch, use a strikeoff template having the same form and shape as the ditch section.

B. Compaction Equipment

Compact the subgrade using tamping or rolling equipment that will produce the required compaction and shape.

C. Mixing and Finishing Equipment

Use mixers that meet **604.04**. Mechanical ditch paving machines may be used when approved by the Engineer.

Provide finishing equipment, including satisfactory floats, edgers, spades, and tamps.

CONSTRUCTION REQUIREMENTS

703.04 Preliminary Work

Perform Clearing and Grubbing, Removal of Structures and Obstructions, Excavation and Undercutting, and Embankment Construction as specified in **201**, **202**, **203**, and **205**, respectively.

703.05 Subgrade Preparation

Prepare subgrade for ditch paving to the required depth and to a width that will allow the installation and bracing of forms. Shape and compact the subgrade to a firm, even surface, in reasonably close conformity with the grade and section shown on the Plans or as directed by the Engineer. Remove all soft and yielding material, replace it with acceptable material, and compact as directed by the Engineer.

703.06 Joints

Form joints at the intervals and locations shown on the Plans. Cut joint filler for expansion joints to the full depth of the ditch pavement.

703.07 Limitations on Mixing

Comply with **604.12**.

703.08 Mixing, Placing, and Finishing Concrete

Mix concrete as specified in **604.13**.

Before placing concrete, prepare the subgrade and forms as specified in **701.05**.

Place the concrete immediately after mixing. After spading the edges and allowing the concrete to thoroughly consolidate, use a wooden float to give the surface a smooth and even finish.

Round the edges of the paved ditch to a radius of ½ inch, and finish edges along expansion and contraction joints with an edging tool having a radius of not over ¼ inch. Remove all edging tool marks with a float and brush.

703.09 Protection and Curing

Immediately after finishing the concrete, cure it as specified in **501.18**.

Protect the ditch paving until final acceptance of the Project. Remove concrete that is damaged prior to acceptance by removing and reconstructing the damaged sections at no cost to the Department.

703.10 Backfilling

Immediately after the concrete has set sufficiently and the forms have been removed, fill the spaces on each side of the ditch paving with suitable material and compact thoroughly; or, if sod is specified, lay it in accordance with **803**.

703.11 Final Cleanup

Perform final cleanup as specified in **104.10**.

COMPENSATION

703.12 Method of Measurement

The Department will measure Portland Cement Concrete Ditch Paving for payment by the cubic yard, complete in place. The volume per linear foot of length will be obtained from the dimensions shown on the Plans. Linear measurements will be surface measurements taken along the centerline of the paved ditch.

Unless otherwise shown on the Plans, the Department will consider subgrade preparation, backfill, and expansion joint materials to be incidental to the work.

703.13 Basis of Payment

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

Item	*Pay Unit*
Portland Cement Concrete Ditch Paving	Cubic Yard

Such payment is full compensation for all subgrade preparation, backfill, and all other incidentals necessary to complete the work.

SECTION 705 – GUARDRAIL

DESCRIPTION

705.01 Description

This work consists of furnishing and erecting guardrail, and constructing anchor blocks and approach ends, of the specified kind and dimensions.

Guardrail includes appurtenant materials and work required to make connections with other guardrail or structures, as may be required to complete the Work shown on the Plans.

MATERIALS

705.02 Materials

Provide materials as specified in:

Metal Beam Guardrail **909.05**
Guardrail Posts **909.07**
Guardrail Hardware **909.08**

Use Class A Portland cement concrete. Mix, place, finish, and cure concrete as specified in **604**.

For all guardrail safety end treatment systems, provide certification from the supplier that the device meets the requirements of and is listed on the Department's QPL or Standard Drawings. In addition, submit detailed shop drawings for the QPL or Standard Drawing approved devices to the Engineer, and utilize a copy onsite during installation.

705.03 Reserved

CONSTRUCTION REQUIREMENTS

705.04 Preliminary Work

Perform Clearing and Grubbing, Removal of Structures and Obstructions, Excavation and Undercutting, and Embankment Construction as specified in **201**, **202**, **203**, and **205**, respectively.

705.05 Posts

Provide posts of the shape, size, and dimensions shown on the Plans and/or the approved Shop Drawings. Set posts reasonably true to the lines and grades shown on the Plans or established by the Engineer.

705.06 Installation of Posts

Before beginning any excavation or driving any guardrail post, determine the location of all underground electrical, drainage, and utility lines in the vicinity, and conduct work so as to avoid damaging these facilities. Dig or drill holes to the depth shown on the Plans and/or the approved Shop Drawings and to a size that will allow proper setting of the posts and sufficient room for backfilling and tamping. Alternatively, the Contractor may drive posts using approved methods and equipment, provided the posts are erected in the proper position and are free of distortion, burring, or other damage.

If solid rock is encountered while drilling post holes:

1. Within 18 inches of the ground surface, drill an oversized or elongated hole 24 inches into the rock. Set the post at the roadside edge of the hole, and backfill the hole with the cutting spoils.

a. If using wooden posts, either drill a single oversized hole 23 inches in diameter, or three overlapping holes 10 inches in diameter, to a length of 23 inches.

b. For steel posts, drill a single oversized hole, 20 inches in diameter, or three overlapping holes 8 inches in diameter, to a length of 20 inches.

2. Below 18 inches of the ground surface, drill holes 12 inches into the rock or to the depth shown on the Plans. The holes shall be 8 inches in diameter for steel posts, and 12 inches in diameter for wood posts.

3. When installing end terminals using tubes, install posts 1 and 2 to full depth or a minimum of 36 inches into the solid rock. Backfill the holes around the steel tube with the cutting spoils.

4. See approved shop drawings for additional information concerning post depth and hole size.

To validate proper installation of posts, for each guardrail contractor/installer doing work for the Department, the Regional Operations and Materials and Tests offices may select any post for verification. If the posts are found to be in accordance with the Plans and Specifications, the Contractor may re-install the posts if they were not damaged during the pulling process. If the post length is found to be deficient, the Department will require the contractor/installer to remove the entire run of guardrail or end terminal and replace it properly at no cost to the Department.

Backfill holes with selected earth or other suitable materials in layers not to exceed 4 inches in thickness. Thoroughly tamp each layer. After backfilling and tamping is complete, hold the posts or anchors securely in place.

For metal divider guardrail on bridges, bolt posts to the structure as shown on the Plans. Set the anchor bolts to the proper location and elevation, with templates, and carefully check after the median is placed and before the concrete has set.

Set anchor bolts for metal divider guardrail, to be placed on a previously constructed bridge, by drilling holes in the proper locations and anchoring the bolts as shown on the Plans.

Repair damaged coating on galvanized steel posts as specified in **713.04.B**, or replace the posts, at the Engineer's direction, at no cost to the Department.

705.07 Erection

Set guardrail anchors, and make and place attachments as shown on the Plans and/or approved Shop Drawings, or as directed by the Engineer. Guardrail installed on new alignments is to be complete in place before the mainline roadway is opened to traffic unless otherwise directed by the Engineer. On roadways open to traffic, install each section of guardrail complete in place including end sections in a continuous operation.

Draw up tightly all bolts or clips used for fastening the guardrail or fittings to the posts. End bolts shall have sufficient length to extend at least ¼ inch through and beyond the full nut, except where such extension might interfere with or endanger traffic, in which case, cut off the bolt flush with the nut.

Erect, draw, and adjust all railings so that the longitudinal tension will be uniform throughout the entire length of the rail.

Shop curve Metal Deep Beam Single Guardrail and Protective Guardrail at Bridge Ends that are installed on a curve with a radius of 150 feet or less.

705.08 Final Cleanup

Perform final cleanup as specified in **104.10**.

COMPENSATION

705.09 Method of Measurement

The Department will measure Guardrail of the various classes and dimensions in accordance with the Plans.

The Department will measure Terminal Anchors of the various types for payment by the unit within the limits shown on the Plans.

The Department will not measure projections or anchors beyond the end post for payment, except as noted.

The Department will consider excavation and backfilling, and the furnishing and placing of anchor bolts and devices for guardrail posts on bridges, to be incidental to the work.

705.10 Basis of Payment

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

Item	*Pay Unit*
Guardrail (Class)	Linear Feet
Guardrail End Terminal (Type)	Each
Single Guardrail (Type)	Linear Feet
Guardrail at _____	Linear Feet

The Department will make no payment for a section of guardrail, including end terminals, until it is complete in place. Payment is full compensation for all posts, blocks, rail elements, terminal sections, fittings, hardware, labor and equipment, and all incidentals necessary to complete the work.

When no contract unit price has been established for Shop Curved Metal Deep Beam Single Guardrail, payment will be made at a rate equal to 1.5 times the contract unit price for Metal Deep Beam Single Guardrail with corresponding post spacing. When no unit price has been established for Shop Curved Protective Guardrail at Bridge Ends, payment will be made at a rate equal to 1.25 times the contract unit price of Guardrail at Bridge Ends.

No additional payment will be made for shop curving the guardrail in the Guardrail End Terminal units.

When no contract unit price has been established for drilling or boring in solid rock for posts while placing Single Guardrail or End Terminal Posts, the Department will pay for each hole at a rate equal to 2.0 times the contract unit price for Single Guardrail. When no pay item for Single Guardrail exists in the Contract, payment will be made at a rate of 2.0 times the current yearly State average.

While drilling or boring into solid rock for posts placed in conjunction with Guardrail at Bridge Ends, Parapets, Piers, Concrete Endposts, and other similar edifice, payment will be made at a rate equal to 1.25 times the contract unit price per applicable end device.

No additional payment will be made for drilling or boring for the placement of posts, unless posts are driven to refusal in solid rock.

SECTION 706 – GUARDRAIL ADJUSTED, REMOVED AND RESET

DESCRIPTION

706.01 Description

Guardrail Adjusted or Removed and Reset consists of dismantling, removing, salvaging, resetting, or adjusting existing guardrail, as shown on the Plans or as directed by the Engineer. The work includes the furnishing of all necessary hardware, anchors, and other appurtenances required to replace those that are not suitable for reuse.

Posts Furnished and Guardrail Furnished consists of furnishing and setting guardrail and posts to replace rail and posts that are unsuitable for resetting, as shown on the Plans or as directed by the Engineer. Guardrail removed and reset shall comply with the Department's Standard Drawings and/or approved Shop Drawings, as applicable for the type of installation.

MATERIALS

706.02 Materials

Provide materials as specified in:

Guardrail Posts **909.07**

Remove, dismantle, reshape, repair, and reset all materials that can be reused.

For the reset rail, use salvaged material for posts, rails, cables, wire, metal sheets or plates, and similar features, but furnish whatever additional bolts, clips, and other appurtenances of the kind and quality used in the original guardrail as may be required to complete the guardrail.

Posts, rail and hardware furnished and set shall be of the size and type used in the original guardrail, or as shown on the Plans, and/or approved Shop Drawings, and shall meet the requirements of **909.05**, **909.07**, and **909.08**.

706.03 Reserved

CONSTRUCTION REQUIREMENTS

706.04 Preliminary Work

Perform Clearing and Grubbing, Removal of Structures and Obstructions, Excavation and Undercutting, and Embankment Construction as specified in **201**, **202**, **203**, and **205**, respectively.

706.05 Dismantling or Removing Guardrail

Carefully dismantle and detach railings, anchors, fittings, and all other material suitable for reuse from the posts, and neatly store and protect from damage.

Do not remove any sections of existing guardrail until the Engineer concurs the removal is necessary and the appropriate warning devices are installed. Promptly install the proposed guardrail, including any anchor system, to minimize traffic exposure to hazards.

Excavate or pull all posts so as not to damage the posts for further use.

Inventory, clean, and store all salvaged material until it is reset.

Replace, at no cost to the Department and with material of the same type and kind, all material damaged or lost on account of carelessness, negligence, or failure to properly protect the material and perform the work.

Remove broken posts or stubs and dispose of as directed by the Engineer.

706.06 Installation of Posts

Install posts as specified in **705.06**.

The Engineer will designate which posts are to be reused.

706.07 Erection

Thoroughly clean all posts and guardrail to be reset.

Space posts as originally spaced, unless otherwise shown on the Plans. Set posts vertically, and to the depth shown on the Plans or as established by the Engineer.

For all other details of erection, comply with **705.07**.

706.08 Guardrail Adjustment

Perform guardrail adjustment or realignment as shown on the Plans and in accordance with these Specifications and the following definitions:

A. Realigned Guardrail: Sections of guardrail that may be realigned without removal or disassembly and are not out of line horizontally plus or minus 6 inches or vertically plus or minus 2 inches.

B. Adjusted Guardrail: Guardrail that may be repositioned by the vertical adjustment of the block.

C. **Resetting Guardrail:** Entire sections of guardrail that require removal as directed by the Engineer.

706.09 Final Cleanup

Perform final cleanup as specified in **104.10**.

COMPENSATION

706.10 Method of Measurement

The Department will measure for payment:

1. Guardrail Removed, Guardrail Reset, and Guardrail Adjustment by the linear foot along the centerline of the guardrail, and from center of end post to center of end post.

2. Guardrail Furnished by the linear foot along the centerline of the rail before installations.

3. Posts Furnished by the individual unit.

4. End terminals in accordance with **705.09** and **705.10**.

The Department will not measure projections or end terminals beyond the end post, or any excavation or backfilling performed in connection with this construction.

706.11 Basis of Payment

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

Item	*Pay Unit*
Guardrail Removed	Linear Feet
Guardrail Reset	Linear Feet
Guardrail Removed and Reset	Linear Feet
Guardrail Adjustment	Linear Feet
Posts Furnished	Each
Guardrail Furnished	Linear Feet

Payment for Guardrail Adjustment, Guardrail Removed, and Guardrail Reset is full compensation for all additional bolts, clips, and other incidentals required to complete the work.

SECTION 707 – FENCES

DESCRIPTION

707.01 Description

This work consists of constructing fences, gates, and water crossings.

MATERIALS

707.02 Materials

Provide materials of the kind, size, and type shown on the Plans, including all necessary posts, fittings, and appurtenances.

Provide materials as specified in:

Portland Cement Concrete, Class A **604**
Stock Fence **909.01**
Chain-Link Fence **909.02**
Fence Gates **909.03**
Water Gates and Water Crossings **909.04**

The Engineer will reject galvanized material that is damaged. With the Engineer's approval, the Contractor may repair damaged galvanized material as specified in **713.04.B**.

707.03 Reserved

CONSTRUCTION REQUIREMENTS

707.04 Preliminary Work

Before beginning construction or placing of fences, perform all necessary Clearing and Grubbing and Removal of Structures and Obstructions as specified in **201** and **202**, respectively. Clearing for fence construction shall not extend beyond the right-of-way line. Do not disturb living trees and shrubs 1 foot or more on each side of the fence line unless otherwise directed by the Engineer. Locate the fence 1 foot inside the right-of-way unless otherwise shown on the Plans. Remove rock, which protrudes above the ground surface and is in the line of the fence, to the ground surface.

Turn fences in at drainage structures, cattle passes, and bridges where directed by the Engineer so as to abut wingwalls and abutments.

Provide two weeks notice to affected property owners before cutting existing fences. Install access control fences before cutting existing fences in areas used by domestic livestock or other areas as directed by the Engineer.

707.05 Setting Posts and Backfilling

Set line posts for stock fence at intervals not to exceed 10 feet. Erect braced line posts at intervals of 330 feet between end or corner posts, and, when necessary due to terrain features, install additional braced line posts at locations designated by the Engineer. Measure the interval between posts parallel to the bottom of the fabric of the proposed fence and in line of fence from center to center of post.

Set posts for chain-link fence at intervals not to exceed 10 feet. Measure the intervals between posts as specified above for stock fence.

Install posts, shown on the Plans to be set in concrete, in dug or drilled holes of the size and to the depth shown on the Plans or directed by the Engineer. For embedment of posts and for anchors, use Class A concrete meeting the requirements of **604**. Construct the concrete embedment and anchors with a crown at the top to shed water.

If ground conditions allow, the Contractor may drive posts that do not require embedment to the required depth using approved methods, or otherwise shall

install such posts in holes dug or drilled to the specified depth and to a size that will allow sufficient room for proper backfilling.

If solid rock is encountered, install posts by drilling the rock to the required depth and grouting the post therein with Portland cement grout composed of one part cement to three parts sand.

Backfill post holes for posts not requiring concrete embedment with selected earth or other approved material. Place backfill material in layers not exceeding 6 inches, and thoroughly tamp each layer. When backfilling and tamping is completed, secure the posts and anchors in the proper position.

Do not apply pull to posts set in concrete until the concrete has cured a minimum of 72 hours.

707.06 Erecting Fence

At certain locations along the right-of-way, the Engineer will direct the Contractor to construct chain-link fence or stock fence prior to the removal of existing fences.

When fences are constructed 1 foot inside the right-of-way, landowners may join these fences by setting posts adjacent to them.

A. Stock Fences

Place fabric by securing or fastening one end and applying sufficient tension to remove approximately one-half of the tension curve in the wire before making permanent attachment elsewhere. Fasten the fabric and barbed wire to the posts as shown on the Plans. Tightly draw up all bolts and clips or ties used to fasten wire or fittings to the posts. Use bolts of sufficient length to extend at least ¼ inch through and beyond the full nut; however, where such extension might constitute a safety hazard, cut the bolt off flush with the nut.

B. Chain-Link Fence

Place the fabric by securing one end and applying sufficient tension to remove all slack before making attachment elsewhere. Fasten the fabric to the posts at intervals not exceeding 14 inches. When specified, connect the top rail with expansion sleeves to form a continuous rail, and fasten the fabric to the rail at intervals not exceeding 2 feet. When using aluminum-alloy fabric, attach a tension wire to the bottom of the fabric

by means of a hog-ring type fastener at a maximum of 2-foot intervals, and secure the wire at the terminal posts with brace bands.

Pull barbed wire taut before permanently attaching to a post or extension arm.

When chain-link or stock fences cross short depressions or ditches, construct water crossings or water gates of the type, at the locations, and in accordance with the Plans or as directed by the Engineer.

Construct and install fence gates as shown on the Plans or as directed by the Engineer.

707.07 Final Finishing and Cleanup

The Engineer will inspect fences after they have been placed in final position. Dispose of all excess or unsuitable material as directed by the Engineer.

Perform final cleanup as specified in **104.10**.

COMPENSATION

707.08 Method of Measurement

The Department will measure:

1. Fences by the linear foot along the bottom of the fabric and from end to end of the fence, complete in place, deducting the width of openings.

2. Gates by the unit, per each, complete in place, for the kinds and dimensions as shown on the Plans.

3. Water Crossings, complete in place, by the length in linear feet, as determined in accordance with the details shown on the Plans.

4. Water Gates, complete in place, by the area in square feet, as determined in accordance with the details shown on the Plans.

5. End, braced line, and corner post assemblies as determined in accordance with the details shown on the Plans and the following:

a. Chain Link Fence: The Department will measure each assembly consisting of one post and one or more horizontal rails and one or more truss rods, as detailed on the Plans by the unit.

b. Stock Fences: The Department will measure each assembly consisting of one post, diagonal or horizontal braces and tie wires as detailed on the Plans, by the unit.

The Department will consider excavation, backfilling, and concrete for anchors and post embedment to be incidental to the work.

The Department will not measure projections or anchors beyond the end posts for payment.

707.09 Basis of Payment

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

Item	*Pay Unit*
Fence (Description)	Linear Feet
Gate (Description)	Each
End, Braced Line, and Corner Post Assemblies (Description)	Each
Water Crossings	Linear Feet
Water Gates	Square Feet

Such payment is full compensation for all excavation, backfill, and all other incidentals necessary to complete the work.

SECTION 708 – MONUMENTS AND MARKERS

DESCRIPTION

708.01 Description

This work consists of furnishing and erecting monuments or markers composed of Portland cement concrete or other materials approved by the Engineer. Monuments and Markers shall be of the kind, size, dimensions, shapes, and markings as shown on the Plans.

MATERIALS

708.02 Materials

Furnish monuments and markers manufactured of Class A concrete, composed of materials including reinforcement meeting **604.02**.

Provide concrete right-of-way markers that have a smooth finish and are fabricated as shown on the Plans.

Stone for monuments and markers shall meet **921.07**.

Metal materials shall conform to the requirements shown on the Plans or specified in the Special Provisions.

Provide paint, if required, that meets **910** for the kind and type of paint called for on the Plans.

EQUIPMENT

708.03 Equipment

Provide hoisting equipment, rollers, skids, protecting mats, and other equipment necessary to handle monuments or markers without damage.

CONSTRUCTION REQUIREMENTS

708.04 Foundation Preparation

A. Monuments

Unless otherwise shown on the Plans, excavate for monuments to not less than 6 inches larger on all sides than the base of the monument, and to a depth of not less than 6 inches below the grade of the base of the monument, unless solid rock is encountered. Remove all soft or yielding material in the foundation to such depth as directed by the Engineer, and refill and tamp in 6-inch layers with material satisfactory to the Engineer.

If solid rock is encountered, excavate to below the grade of the base, remove soft or flaky material, and bring to a true even grade.

Ensure that the foundations for all monuments are of such character as will hold the monument in place and in its intended position. Obtain the Engineer's approval of the foundation.

B. Markers

Prepare the excavation for markers by digging holes to the depth shown on the Plans or as directed by the Engineer, and of such size as will allow satisfactory backfilling and tamping. If rock is encountered above the grade of the base of the marker, the Contractor may cut off the marker, provided it is set 1 foot in solid rock and the area around the marker is filled with Class A concrete or mortar meeting **905.02**. Place the backfill in 6-inch layers. Thoroughly tamp each layer, and when the backfilling is completed, ensure that the marker is substantial and unyielding.

708.05 Manufacture and Erection of Monuments and Markers

Concrete monuments and markers may be precast or cast-in-place. The concrete shall meet the requirements of **604.03** for Class A concrete.

Manufacture monuments and markers in accordance with the applicable provisions of **604**.

Cut stone monuments and markers from stone conforming to **921.07** and to be of the size and shape and to contain such other details as shown on the Plans or as directed by the Engineer.

Place markers in the prepared excavation, and hold firmly in place, true to line and grade, until backfilled. Place backfill in 6-inch layers, and thoroughly tamp each layer.

Install or erect stone or precast monuments on the prepared foundation, set accurately at the proper elevation, and in a manner that will ensure they will remain firmly in place. Set the monuments on blocks or shims to line and grade. Fill the excavation below the bottom of the monument with Class A concrete. Work the concrete in, under, and around the base of the monument until all voids are filled. After the concrete has set, backfill the remainder of the excavation to the natural ground line with suitable material.

Perform painting, if called for on the Plans, as specified in **603**.

708.06 Final Finishing and Cleanup

The Engineer will inspect monuments or markers after they have been placed in their final position. Remove all defects and scars.

Neatly shape the surface of the ground immediately around each installation to the established grade. Dispose of all excess material as directed by the Engineer.

Perform final cleanup as specified in **104.10**.

COMPENSATION

708.07 Method of Measurement

The Department will measure Monuments and Markers for payment by the number of individual units furnished, placed, and accepted, complete in place.

The Department will consider excavation and foundation preparation, and the backfill material and concrete used in preparing foundations or backfilling the excavation, to be incidental to the work.

708.08 Basis of Payment

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

Item	*Pay Unit*
Monuments (Description)	Each
Markers (Description)	Each

Such payment is full compensation for all labor, materials, equipment, and all other incidentals necessary to complete the work.

SECTION 709 – RIPRAP AND SLOPE PAVEMENT

DESCRIPTION

709.01 Description

Riprap consists of furnishing and setting or placing rubble stones, crushed stone, sacked sand-cement, machined riprap, and embedded riprap.

Slope Pavement consists of constructing a reinforced concrete mat on prepared slopes.

MATERIALS

709.02 Materials

To construct riprap and slope pavement, provide materials that meet the following:

A. Rubble-Stone Riprap

For Rubble-Stone Riprap, provide stone or broken Class A or paving concrete meeting the requirements of **921.07**. Ensure that at least 80% of the stone have a minimum dimension of 10 inches. The remainder

shall be 2 to 4 inches and shall be approximately rectangular or trapezoidal in shape. Broken Class A or paving concrete shall be free of steel and wire fabric reinforcement.

For Rubble-Stone Riprap (Grouted), provide sand meeting **903.01** or **903.02** and cement meeting **901.01**.

B. Sacked Sand-Cement Riprap

For Sacked Sand-Cement Riprap, provide manufactured or natural sand meeting the quality requirements of **903.01** or **903.02** and cement meeting **901.01**.

Use sacks of either cotton or jute, standard grade of cloth, that will hold the sand-cement mixture without leakage during handling and tamping. Sacks shall be strong and sized to hold approximately 1 cubic foot.

C. Reinforced Concrete Slope Pavement

Construct reinforced concrete slope pavement of Class A concrete meeting **604.03** and steel reinforcement meeting **907.01** or **907.03**, whichever is specified.

Preformed expansion joint filler shall meet **905.01**.

D. Curing Materials

Provide materials meeting **913**.

E. Machined Riprap

For Machined Riprap, provide clean shot rock that is essentially free of sand, dust, and organic materials, and that is of the size designated for the class specified. The stone shall be uniformly distributed throughout the size range. Construct the stone layer to the thickness designated for the specified class, as defined in **709.03**, unless otherwise noted on the Plans.

Provide washed or clean rock, at no additional cost to the Department, for sensitive areas of the Project, as shown on the Plans, described in permits, or designated by the Engineer. Obtain the Engineer's approval

of washed or clean rock before placing in environmentally sensitive areas.

When using rock or stone as riprap, ensure that the material meets the quality requirements in **903.25**. Obtain the Engineer's approval of the material before using.

709.03 Classification

Riprap is classified according to the following designations:

1. Rubble-Stone Riprap (Grouted)

2. Sacked Sand-Cement Riprap

3. Machined Riprap

    a. Machined Riprap (Class A-1) shall vary in size from 2 inches to 1.25 feet with no more than 20% by weight being less than 4 inches. The thickness of the stone layer shall be 1.5 foot with a tolerance of 3 inches.

    b. Machined Riprap (Class A-2) shall be identical to Class A-1 except that the Contractor may substitute hand placed rubble stone riprap placed 1 foot thick in accordance with **709.11** for 1.5 feet of machined riprap.

    c. Machined Riprap (Class A-3) shall vary in size from 2 to 6 inches with no more than 20% by weight being less than 4 inches. The thickness of the 4-inch stone layer shall be as shown on the Plans.

    d. Machined Riprap (Class B) shall vary in size 3 inches to 2.25 feet with no more than 20% by weight being less than 6 inches. The thickness of the layer shall be 2.5 feet with a tolerance of 4 inches.

    e. Machined Riprap (Class C) shall vary in size from 5 inches to 3 feet with no more than 20% by weight being less than 9 inches. The thickness of the layer shall be 3.5 feet with a tolerance of 6 inches.

EQUIPMENT

709.04 Equipment

Provide wooden or metal tamps of sufficient weight and number to properly compact the slopes on which the riprap or slope pavement is to be placed.

When using sacked sand-cement, furnish wooden hand tamps, having a tamping face not greater than 1 square foot, and of sufficient weight and number to properly tamp the riprap.

Provide a mechanical mixer to mix concrete, cement grout, or sand-cement.

Provide all necessary small tools or implements to perform the work.

CONSTRUCTION REQUIREMENTS

709.05 Foundation Preparation

Immediately before constructing riprap or slope pavement, trim the slopes or ground surface within reasonably close conformity to the lines and grades shown on the Plans or as directed by the Engineer, and thoroughly compact the slopes or ground surface using hand or mechanical tamps.

On slopes, place the bottom of the riprap at least 2 feet below the natural ground surface, unless otherwise directed by the Engineer.

709.06 Rubble-Stone Riprap (Grouted)

A. Placing Stone

Construct Rubble-Stone Riprap (Grouted) by hand on the prepared foundation. Place the stones as close together as is practicable to minimize voids.

When constructing rubble-stone riprap in layers, tie the layers together using large stones protruding from one layer into the other.

Construct rubble-stone riprap to a standard depth of 12 inches, unless otherwise shown on the Plans or directed by the Engineer, but in no case to less than 10 inches in depth. Ensure that, for each 25 square feet of surface, Rubble-Stone Riprap has an average depth of not less than the

depth shown on the Plans or as directed by the Engineer, or the standard depth required in these Specifications.

Place each stone with the larger dimension parallel to the surface upon which it is set, except as set forth above to provide keys between layers. Place the length as directed by the Engineer, and set each main stone against the adjoining stones to provide close contact. Place stone so as to equally distribute the large stones to the extent possible.

After a workable area of the riprap has been set, shape the stones by knapping to a uniform surface. Thoroughly chink the voids and fill with the smaller stones and spalls. Continue this work as construction progresses.

B. Grouting

After chinking and filling, fill the voids between the stones with grout. Take care to prevent earth or sand from filling the spaces between the stones before the grout is poured.

To fill the voids, use grout composed of one part Portland cement and four parts sand, measured by volume, and mixed thoroughly with sufficient water to make a grout of a consistency that will flow into and completely fill the voids.

Mix this grout either in a one-bag mixer or larger for not less than 1-1/2 minutes.

Immediately before pouring the grout, sprinkle the stones with water. Pour the grout carefully into the voids between the stones, beginning at the lower portions of the riprap and progressing upward. Ensure that the entire bottom line of voids is filled with grout before pouring the line of voids next above. To pour the grout, use vessels of adequate size and shape. Broadcasting, slopping, or spilling of grout from the vessels on the surface of the riprap will not be permitted. Progress of pouring shall be sufficiently slow to prevent the grout from oozing from the voids and flowing over the surface. During the pouring operations and continuing until the grout has reached its initial set, use fiber brooms to maintain a uniform distribution. Continue the grouting operations until all the voids have been completely filled and the grout has set even with the surface of the riprap.

C. Curing

As soon as any section of the grouted riprap has hardened sufficiently, sprinkle it with water until the riprap has been covered with burlap, cotton, or jute mates, earth, or liquid membrane-forming compound. Maintain the mats or earth by soaking with water for a period of not less than 72 hours. The water used for wetting and curing the grouted riprap shall be free from salt or alkali.

709.07 Sacked Sand-Cement Riprap

Construct Sacked Sand-Cement Riprap by placing sacks, filled approximately ¾ full of a mixture of sand and cement, on the prepared foundation.

Mix the sand and cement dry, with a mechanical mixer, in the proportion of 94 pounds of cement to 5 cubic feet of dry sand, until the mixture is uniform in color. After the mixing has been completed, pour the sand-cement mixture into sacks, of approximately 1-cubic foot capacity, until they are approximately ¾ filled. Securely fasten the sacks with hog rings, by sewing, or by using other suitable methods that prevent leakage of the mixture from the bags.

Bed the sacks of sand-cement, by hand, on the prepared grade with all the fastened ends on the grade and with the joints broken. The completed riprap shall have a minimum thickness of 10 inches, measured perpendicular to the slope. The surface shall not vary more than 3 inches above or below the desired theoretical plane.

Ram and pack the sacks against each other and tamp on the surface to form close contact and to ensure a uniform surface. Immediately after placing and tamping the sacks of sand-cement, thoroughly soak them by sprinkling with water. Do not apply water under high pressure.

Before soaking with water, remove and replace sacks of sand-cement that were ripped or broken during placing.

709.08 Reinforced Concrete Slope Pavement

Construct Reinforced Concrete Slope Pavement as shown on the Plans and in accordance with the applicable requirements of **604**, except that the concrete shall be of such consistency that it will not flow on the slope and that will allow finishing to the thickness shown on the Plans.

Score or saw the slope pavement for a depth of 1 inch on 6-foot centers, both ways, or as directed by the Engineer. Use a ½-inch preformed expansion joint filler wherever the slope pavement abuts a portion of the bridge sub-structure.

Remove forms, which may be of wood or metal, after the concrete has set. Cure the concrete as specified in **501.18.**

709.09 Machined Riprap

Take care in preparing the riprap subgrade to ensure that no reduction in the design waterway occurs. Do not place any riprap until the final subgrade elevation has been verified by the Engineer. When directed by the Engineer, roll the riprap down with metal tracked equipment to provide a more dense stone mass with final contours in reasonable conformance to the Plans. Do not begin to place the super-structure until the Engineer has accepted the final elevation of the riprap.

Upon completion of the work, visually inspect to ensure that approximately 50% of the surface area consists of stones no smaller than half of the maximum size specified.

Dump and place the material using appropriate power equipment in a manner that will produce a uniform surface appearance. Hand work may be required to correct irregularities.

When preparing the site, adhere to the provisions for erosion control specified in **209** and for channel excavation specified in **203.02.C**.

When required by the Plans or permits, or as directed by the Engineer, properly tamp into the subsurface, or otherwise blend into the substrate, embedded riprap in streams, conveyances, diversions, or other sensitive areas. Ensure that water will flow over the embedded riprap and that flow is not lost below or within the rock. If clean rock is required by the Plans or permit, or as directed by the Engineer, provide rock that meets the provisions of **709.02** for clean rock.

709.10 Final Cleanup

Perform final cleanup as specified in **104.10**.

COMPENSATION

709.11 Method of Measurement

The Department will measure Rubble-Stone Riprap (Grouted), Concrete Block Riprap, and Reinforced Concrete Slope Pavement by the volume in cubic yard, complete in place, as obtained from the thickness shown on the Plans and surface measurements. Unless otherwise specified, the Department will not measure or pay for reinforcement in slope pavement but will consider the costs thereof as included in the price bid for slope pavement.

The Department will measure Machined Riprap by the ton or the cubic yard for the respective items in accordance with **109**, complete in place. However, where Machined Riprap (Class A-2) is specified and the Contractor selects the hand placed rubble stone riprap option, the Department will increase actual tonnage measured and accepted by 50% for payment purposes.

No measurement for payment will be made for excavation or for preparing the foundation for riprap, and filter blanket where specified.

709.12 Basis of Payment

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

Item	*Pay Unit*
Rubble-Stone Riprap	Cubic Yard or Ton
Rubble-Stone Riprap (Grouted)	Cubic Yard
Concrete Block Riprap	Cubic Yard
Reinforced Concrete Slope Pavement	Cubic Yard
Machined Riprap (Class __)	Cubic Yard or Ton

SECTION 710 – UNDERDRAINS

DESCRIPTION

710.01 Description

This work consists of constructing underdrains composed of stone, gravel, slag, sand, or any one of these materials and perforated pipe, semi-circular drain pipe (with connections), or filter cloth, on prepared foundations at the locations shown on the Plans or as directed by the Engineer. The work shall include all necessary excavation and backfill, together with such work and materials as may be necessary to make connections with other drainage structures, as shown on the Plans.

MATERIALS

710.02 Materials

Provide materials as specified in:

Aggregate for Underdrains **903.17**
Joint Mortar **905.02**
Pipe (Size shown on the Plans) **914.03**, **914.07**, **915.02, 915.03**
Polyvinyl Chloride (PVC) Underdrain Pipe **914.09**
Geotextile **921.12**

710.03 Kinds and Sizes of Underdrains

Construct underdrains of the kinds specified. Unless otherwise specified, circular pipe for underdrains shall have a diameter of 4 inches. Semi-circular pipe for underdrains shall have a diameter of 4-5/8 inches. In the case of pipe, consider the size to mean the nominal inside diameter.

710.04 Reserved

CONSTRUCTION REQUIREMENTS

710.05 Aggregate Underdrains

Excavate trenches to receive the aggregate at the locations and to the dimensions shown on the Plans or as directed by the Engineer. Make the trench deep enough to intercept the water-bearing strata and provide it with a smooth and uniform finish.

Place aggregate meeting the requirements of **903.17** in the trench in 6-inch layers to the depth shown on the Plans. Tamp each layer with an approved tamp.

Do not construct any underdrains that will not be paved over during the same construction season.

710.06 Aggregate Underdrains (with Pipe)

Excavate the trench to receive the pipe at the locations shown on the Plans or as directed by the Engineer. If the Plans do not show dimensions, construct the width of the trench to be not less than the outside diameter of the pipe plus 12 inches. Make the trench deep enough to intercept the water-bearing strata and to allow installation of the pipe and cover material. Unless otherwise shown on the Plans, spread a 2-inch layer of aggregate on the bottom of the trench, compact it, and bring to a uniform grade.

Ensure that the pipe is firmly embedded in the layer of aggregate. Lay perforated pipe with the flow sector and perforations at the bottom.

If an underdrain is extended through a dry fill or other section where perforated pipe is undesirable, construct the underdrain with the pipe specified, and join sections by forming mortar joints or approved manufactured joints, or by using connecting bands.

After the pipe has been laid and approved, carefully backfill around the pipe with the specified aggregate in a manner that will not displace the pipe. Place the aggregate around and over the pipe in 6-inch layers. Thoroughly tamp each layer with a vibratory compactor.

Make lateral and other connections where shown on the Plans or as directed by the Engineer.

710.07 Filter Cloth and Aggregate Underdrain (with and without Pipe)

A. Trench Excavation

Excavate trenches at the locations and to the depth and width shown on the Plans. Prepare the sides and bottom of the trenches to a relatively smooth condition, free of sharp objects, obstructions, depressions, and debris that might damage the filter cloth during installation.

Dispose of material removed from the trench outside of the right-of-way at locations obtained by the Contractor unless the Engineer authorizes its disposal within designated locations.

B. Filter Cloth

Place geotextile meeting **921.12** with the long dimension parallel to the centerline of the channel, laying it loosely without wrinkles or creases. When more than one width of filter cloth is necessary, overlap the joints a minimum of 12 inches. Insert securing pins with washers through both strips of overlapped material and into the material beneath, until the washer bears against the cloth and secures it firmly to the base material. Insert these securing pins through the overlapped cloth at not greater than 2-foot intervals along a line through the midpoint of the overlap.

Protect the cloth at all times during construction to prevent contamination by surface runoff. Remove contaminated cloth and replace with uncontaminated cloth at no cost to the Department. Replace cloth damaged during installation at no cost to the Department. Drop stone for overlaying on the cloth from a height no greater than 3 feet. Place the cloth so that the downstream edges overlap the upstream edges.

Install the filter cloth so that all splice joints are provided with a minimum overlap of 3 feet. Overlap the closure at the top of the trench as shown on the Plans, and secure with mechanical ties. Where outlet pipe passes through the fabric, use a separate piece of fabric of sufficient

size to be wrapped around the pipe and flared against the side of the filled drain fabric.

Anchor field splices of filter cloth with securing pins as directed to maintain the required overlap. Take care when placing the aggregate filler and installing the pipe (when specified) to prevent damage to the filter cloth. To repair a torn, punctured, or otherwise damaged section, cut a piece of filter cloth large enough to cover the damaged area and overlap all around the damaged area a minimum of 12 inches.

C. Aggregate Underdrain

Place the aggregate in 6-inch layers, and compact each layer using a vibratory compactor to the satisfaction of the Engineer before making the filter cloth closure at the top of the trench. Protect the exposed end of the outfall pipe by an endwall matching the existing slope.

Bevel the end of the outfall pipe to fit the slope of the endwall. Should the outlet end of the pipe or the endwall fall within the limits of ditch paving, remove to neat lines that portion of the ditch paving within the endwall limits necessary to provide a connection with the new endwall, and make the endwall blend with the ditch paving.

710.08 Final Cleanup

Dispose of all excess or unsuitable material as directed by the Engineer. Perform final cleanup as specified in **104.10**.

COMPENSATION

710.09 Method of Measurement

The Department will measure for payment:

1. Aggregate Underdrains by the linear foot along the centerline of the underdrains, and from end to end of the underdrains, complete in place.

2. Filter Cloth Underdrains and Filter Cloth Underdrains (With Pipe) by the linear foot along the centerline of each type of Underdrain (with or without pipe) installed.

3. Lateral Underdrain by the linear foot, as measured along the center of the outfall pipe from the center of the Filter Cloth Underdrain to the centroid of the beveled outfall end.

4. Lateral Endwalls by the unit, per each, for the type and size as indicated on the Plans.

5. 6-inch Perforated Pipe with Vertical Drain System by the linear foot along the centerline of the underdrains, and from end to end of the underdrains, complete in place.

710.10 Basis of Payment

The Department will pay for accepted quantities of underdrains of the various kinds and sizes installed, complete in place, at the contract prices as follows:

Item	*Pay Unit*
Aggregate Underdrains (With Pipe)	Linear Feet
Filter Cloth Underdrain	Linear Feet
Filter Cloth Underdrain (With Pipe)	Linear Feet
Lateral Underdrain	Linear Feet
Lateral Endwall	Each
Perforated Pipe with Vertical Drain System	Linear Feet

Such payment is full compensation for all excavation, backfill, connections, specials, and all other incidentals necessary to complete the work.

Payment for Filter Cloth Underdrain is full compensation for furnishing and installing the 4-inch perforated underdrain pipe and pipe elbow when an underdrain outlet is required.

Payment for Lateral Underdrain is full compensation for excavating the trench, furnishing and installing the outlet pipe and all materials, backfilling and compacting the trench, disposing of excess materials, returning the shoulder and slope to the previously existing normal condition, and for providing all tools, equipment, labor, and incidentals necessary to complete this item of work.

Payment for Lateral Endwalls is full compensation for excavation, concrete, backfill, compaction, disposal of excess material, and for all tools, equipment, labor, and incidentals necessary to complete this item of work.

Payment for 6-inch Perforated Pipe with Vertical Drain System is full compensation for the pipe and pipe elbows, the installation of the materials including the polyethylene sheeting, and for all tools, equipment, labor, and incidentals necessary to complete this item of work.

In cases where the Bulk SSD specific gravity of the mineral aggregate exceeds 2.85, the Department will adjust the tonnage of mineral aggregate for payment by multiplying the tonnage of mineral aggregate used by a specific gravity of 2.85 and dividing by the higher specific gravity.

SECTION 711 – CONCRETE MEDIAN BARRIER

DESCRIPTION

711.01 Description

This work consists of constructing cement concrete median barriers on a prepared subgrade.

MATERIALS

711.02 Materials

Provide materials as specified in:

Portland Cement	**901.01**
Fine Aggregate for Concrete	**903.01**
Coarse Aggregate for Class A Concrete:	
Size No. 467, 57 or 67	**903.03**
Joint Filler, Preformed Type	**905.01**
Steel Bar Reinforcement	**907.01**
Welded Steel Wire Fabric	**907.03**
Cement Concrete Curing Materials	**913.05**
Water	**921.01**
Air-Entraining Admixtures	**921.06**

For Portland cement concrete median barriers, use Class A concrete, meeting **604**.

EQUIPMENT

711.03 Equipment

Provide the applicable equipment specified in **604.04**.

CONSTRUCTION REQUIREMENTS

711.04 General

Construct concrete median barriers as shown on the Plans by fixed-form, slip-form, or precast methods.

Perform all necessary excavation and backfilling for the barriers, and satisfactorily dispose of all excess excavated material. Thoroughly compact the material adjacent to the median barrier base as directed by the Engineer.

Place slip-formed concrete with an approved slip-form placing machine designed to vibrate, consolidate, and finish the concrete in one pass of the machine so that a minimum of hand finishing will be necessary to provide a dense, homogeneous unit. Hold the sliding forms rigidly together to prevent spreading of forms and ensure after passing there is no noticeable slumping of concrete. Hold the concrete at a uniform consistency.

Where the median is concrete, form transverse contraction joints in the base and barrier to match the adjacent concrete median. Where the median is asphalt, construct transverse contraction joints in the base and barrier at a uniform spacing of 15 to 20-foot intervals. Construct joints in the barrier directly over the joints in the base. Construct transverse contraction joints as shown on the Plans. Where concrete median barrier is installed on concrete pavement, the joints in the barrier and pavement shall coincide.

Construct expansion joints in accordance with Plan details. Form expansion joints about all bridge piers, drainage inlets, concrete gutters, and other features projecting through, into, or against the barrier curb and base. Chamfer joints as specified in **604**.

711.05 Finishing

Concrete median barriers shall present a smooth, uniform appearance in their final position, conforming to the horizontal and vertical lines shown on the Plans or as directed by the Engineer. Ensure the top surface and the top

6 inches of the barrier, when checked with a 12-foot straight-edge, do not vary more than 1/8 inch from the testing edge of the straight-edge when placed parallel to the centerline. Correct deviations in excess of this requirement.

Do not begin corrective work on extruded median barriers until the barrier surfaces have set sufficiently to withstand further damage that could be caused by making corrections. Give the exposed surface of the median barrier a Class II finish or applied texture finish as specified in **604.21**. However, should the median barrier abut a similar barrier on a bridge, give the roadway barrier the same finish as that required on the bridge median barrier.

711.06 Curing

Perform curing as specified in **604.23**.

COMPENSATION

711.07 Method of Measurement

The Department will determine quantities of concrete median barrier, of the type specified, by measuring the length in linear feet, parallel to the centerline of the barrier, and including the joints but excluding all other openings in the barrier.

711.08 Basis of Payment

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

Item	*Pay Unit*
Concrete Median Barrier (Description)	Linear Feet

Unless otherwise provided, such payment is full compensation for all required excavation, backfill, disposal of excess excavated material, reinforcement, joint materials, drilling and grouting, and all other incidentals necessary for the complete construction of concrete median barriers.

SECTION 712 – TEMPORARY TRAFFIC CONTROL

DESCRIPTION

712.01 Description

This work consists of furnishing, erecting, and maintaining all construction warning signs, barricades, flexible drum channelizing units, temporary pavement markings, and other traffic control devices in accordance with the provisions of the current edition of the MUTCD, including all addenda, or as shown on the Plans or as directed by the Engineer for the purpose of safely directing traffic through construction zones. This work shall include installing additional devices as necessary in construction work zones.

MATERIALS

712.02 Materials

Provide traffic control and marking devices in accordance with the current edition of the MUTCD, except as herein modified.

Provide materials as specified in:

Signs:
- Aluminum **916.02**
- Reflective Sheeting **916.06**
- Paint **916.09**

Cold Rolled Carbon Steel -16 gauge ..... ASTM A1008
Non-metallic Drums and Barricades..... QPL
Reflective Sheeting..... **916.06**

A. Sign Sheeting Material

Sign sheeting material for all temporary construction signing shall be Type B or better, Fluorescent Orange color meeting the requirements of AASHTO M 268 and **916.06**. For all interstate projects, provide new fluorescent orange sign sheeting material; for all other construction projects, provide new or previously used sign sheeting that is in good condition.

B. Temporary Pavement Marking Material

Unless otherwise specified, the material for pavement marking line shall be either temporary pavement marking tape, or reflectorized paint with raised reflective pavement markers placed as shown on the Plans.

Where Removable Pavement Markings are specified, provide materials listed on the Department's QPL. Before use, the manufacturer shall certify to the Department that the removable tape is identical to that listed on the Department's QPL. Failure of the removable tape to perform satisfactorily with regard to installation or removability is cause for rejection of the material.

C. Cones

Cones shall be a minimum of 28 inches high and weighted at the base.

D. Portable Barrier Rail

Portable barrier rail shall meet the requirements of and be listed on the Department's QPL or Standard Drawings.

Provide certification from the supplier that the proposed portable barrier meets the requirements of and is listed on the Department's QPL or Standard Drawings. Submit all certification documents to the Engineer before delivery to the Project. Do not use different shapes, lengths, or connections of rail in the same continuous run.

E. Portable Impact Attenuators

Portable impact attenuators shall be in accordance with the Plans and Specifications, meet the requirements for the appropriate test level, and meet the requirements of and be listed on the Department's QPL or Standard Drawings.

F. Sign Supports

Stationary sign supports shall be steel posts meeting **916**. Do not use wood for stationary or portable sign supports. Provide portable sign supports that meet the requirements of and are listed on the Department's QPL or Standard Drawings. In splicing supports, use 5/16-inch diameter galvanized ASTM A449 (SAE J429 Grade 5) or galvanized ASTM F3125 Grade A325 bolts.

G. Vertical Panels

The substrate material for vertical panels shall be aluminum, meeting the requirements of **916.02**, or a high density copolymer polyethylene. The high density copolymer polyethylene shall be flexible and shatterproof for temperatures to -50 °F (ASTM D746). The reflective sheeting shall be AASHTO M 268 Type B or better, meeting the requirements for Fluorescent Orange material as specified in **916.06**. Attach the vertical panel (aluminum or copolymer) to a steel "U" post (weight 2.0 pounds per foot) meeting the requirements of **916.03**.

H. Flexible Drums, Flashing Arrow Boards, and Changeable Message Signs

Select Flexible Drums, Flashing Arrow Boards, and Changeable Message Signs that meet the requirements of and are listed on the Department's QPL or Standard Drawings.

Traffic control devices defined by the FHWA as Work Zone Category 1 and Category 2 devices weighing less than 100 pounds. Select all Category 1 and Category 2 devices that meet the requirements of and are listed on the Department's QPL or Standard Drawings. Alternatively, the Contractor may submit a notarized letter, along with documentation from the FHWA Office of Safety, certifying that Category 1 devices and Category 2 devices weighing less than 100 pounds meet the requirements of the Department's QPL and Standard Drawings.

Submit all certification documents to the Engineer before delivering these traffic control devices to the Project.

712.03 Reserved

CONSTRUCTION REQUIREMENTS

712.04 General

At the pre-construction conference, designate a responsible person who will be assigned to the Project to supervise traffic control.

Erect signs in a workmanlike manner such that all supports are plumb, sign panels are generally perpendicular to the travelway, and legends are horizontal so that they effectively convey the intended message. Do not display advanced warning signs more than 48 hours before physical construction begins. The Contractor may erect signs up to one week before needed, if the sign face is fully covered in a manner approved by the Engineer. Ensure that the sign sheeting is free of any damage that would reduce the reflectivity. Do not use overlay plates on signs. Mount signs on stationary or portable supports dependent on the type work being performed. Drive sign supports a minimum of 3.5 feet into soil or 1 foot into solid rock. Where soil and solid rock are both encountered, the depth of the sign support in the ground shall be:

$$d_1 + 3.5d_2 = 42$$

where

d_1 = depth in inches of support in soil
d_2 = depth in inches of support in solid rock

The Contractor may splice stationary U-Post sign supports that are 3 lbs/ft or less, provided the splice is a minimum of 18 inches. In addition, drive the stubs for the splice as required above and so as not to extend above 18 inches from ground level. A splice is only allowable with U-Posts and shall not be permitted for any other post types (square tube, round post, I-beam, etc.). Fasten the splice with four bolts, two placed at each end of the splice. In general, work being performed at spot locations and of short duration will necessitate the use of portable supports properly weighted for stability.

During periods of non-use, remove warning signs and other devices from the work area, and cover or otherwise position them so they do not convey their

message to the traveling public and do not present a safety hazard to drivers. If covered, maintain the covering material in a neat and workmanlike manner during its use. The method of covering the sign face shall not deface or damage the sheeting of the sign.

Use flashing or steady burning lights to light barricades and other devices that require lighting, as shown on the Plan details or as directed by the Engineer. Procure and bear the expense of a continuous power source.

A. Flaggers

Provide flaggers with proper attire and paddle when necessary to safely handle traffic through the construction zone. Ensure that flaggers are trained and certified in flagging operations by one of the following training programs:

1. American Traffic Safety Services Association (ATSSA)
2. National Safety Council (NSC)
3. Tennessee Transportation Assistance Program (TTAP)
4. ABET Accredited University Programs

The Department will accept flagger training programs developed and conducted by construction industry associations, consultant organizations, and contractors if they have an established, written program that meets all MUTCD requirements and Department Policy.

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.

B. THP Troopers and Uniformed Law Enforcement Officers

When requested by the Engineer or the Contractor and approved by the Regional Safety Coordinator or Regional Operations Office, a Tennessee Highway Patrol (THP) Trooper may be provided to enforce motor

vehicle laws and otherwise assist in securing the public safety. Submit requests for the THP at least 48 hours in advance of the requested time of service. If the THP is scheduled to work and the work is canceled, or the schedule is changed, notify the THP and the Engineer at least 2 hours before the scheduled start of work.

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.

All Uniformed Law Enforcement Officers working on Department projects shall have training from a Peace Officer Standards and Training (POST) certified police training academy in the State of Tennessee and an additional 4 hours of FHWA approved work zone training. Submit records of this training to the Engineer.

C. Flashing Arrow Board

Install Flashing Arrow Board(s), meeting all requirements of the MUTCD, at the locations shown on the Plans or as directed by the Engineer. Ensure that the Flashing Arrow Board(s) will perform as specified herein. Correct or immediately replace all Flashing Arrow Boards that exhibit any type of malfunction, including improper dimming.

The Flashing Arrow Board shall be capable of displaying the following configurations:

1. Right Arrow – ten lamps flashing in unison forming an arrow
2. Left Arrow – ten lamps flashing in unison forming an arrow
3. Double Arrow – five lamps in each arrow head and three lamps in a common shaft all flashing in unison
4. Four Point Caution – four outermost corner lamps flashing in unison

Use the Flashing Arrow Board(s) in the single arrow mode for lane closure only, and situate and align them so that the flashing arrow is

clearly visible and legible. The single arrow mode display shall have ten lamps flashing in unison. Do not use the sequential arrow configuration, chevron arrow configuration, and horizontal bar configuration. The flash rate shall not be less than 25 flashes per minute or more than 40 flashes per minute. Minimum lamp "on-time" shall be 50% of the cycle.

Mount the Flashing Arrow Board(s) so as to provide a minimum of 7 feet between the bottom of the panel and the roadway.

D. Signs

Portable signs may be used when the duration of the work is less than 3 days or as allowed by other conditions in the proposal. Ensure that all portable signs and sign mounting devices used in work meet the requirements of and are listed on the Department's QPL or Standard Drawings. When not being used, remove portable signs from the clear zone. Do not turn signs sideways or backwards while the signs are in the clear zone. Mount portable interim signs a minimum of 1 foot above the level of the edge of traveled way and at the height recommended by the manufacturer's crashworthy testing requirements.

All regulatory sign blanks shall be rigid.

Make every effort to eliminate the use of interim signs as soon as the Work allows for the installation of permanent signs.

Maintain existing street name signs at street intersections.

Cover all signs or portions of a sign(s) that are not applicable to the Traffic Control Plan so as not to be visible to traffic, or remove such sign(s) from the roadway when not in use.

Do not remove existing signs and supports without the Engineer's prior approval. Store and protect all existing signs and supports that are to be removed if this material will be required later in the Work.

Furnish, install, reuse, and maintain interim guide, warning, or regulatory signs required to direct traffic in accordance with the MUTCD. Mount the bottom of all interim signs at least 7 feet above the level of the pavement edge when the signs are used for long-term stationary operations as defined in the MUTCD.

Maintain existing guide and exit directional signs on the Project until conditions require a change in location or legend content. When change is required, the signs shall be in accordance with the Traffic Control Plan. When an existing guide and exit directional sign is in conflict with work to be performed, remove the conflicting sign and reset it in a new, non-conflicting location that has been approved by the Engineer.

When it is not possible to use existing signs, either in place or relocated, furnish, erect, maintain, modify, relocate, and remove new interim guide and exit directional signs as shown on the Plans or as directed by the Engineer.

Complete the installation of new permanent guide and exit directional signs, and the permanent modification or resetting of existing guide and exit directional signs, when included in the Contract, as soon as practicable to minimize the use of interim guide and exit directional signs.

E. Worker Visibility and Safety

Ensure that all workers within the Project's right-of-way, who are exposed to either vehicular traffic or to construction equipment in the work area, wear high-visibility safety apparel. Consider high-visibility apparel to be personal protective clothing that meets performance Class 2 or Class 3 of the ANSI/ISEA 107 publication. Provide Class 3 apparel for night work.

F. Portable Barrier Rail

Place all portable barrier rail as far away from the travel lanes as possible while serving the intended purpose. Move or remove all portable barrier as directed by the Engineer. The Department will make no additional payment for removing barrier that is no longer required.

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 a lane closure shall have certifications that meet the requirements in Table 712.04-1 to close lanes on TDOT facilities and shall be onsite during each lane closure performed.

Table 712.04-1: Lane Closure Certification Requirements

Type of Facility	Requirement
Two Lane	Flagging Operations Certification (Shall comply with **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.

H. Night Work Lighting

When the Contract requires night work, supply sufficient lighting and equipment as specified herein.

1. **Lighting Plan.** Submit the following information regarding the lighting plan to the Engineer:

   a. Descriptions and sketches of the layout of lighting devices including spacing, luminary height, lateral placement, and anticipated illuminance provided.

   b. Photometric and physical specifications of all lighting equipment.

   c. Detailed description of all lighting to be used on construction equipment.

   d. Methods to be employed to reduce glare.

   e. Contractor's frequency and procedure for checking illumination levels.

2. **Protective Equipment and Lighting.** In addition to their standard protective equipment, equip construction personnel and equipment as follows:

a. Traffic Control Persons, all equipment operators, and all other workers shall:

   (1) Wear high-visibility apparel that meets performance Class 2 or Class 3 of the ANSI/ISEA 107 publication. Class 3 apparel shall be required for night work.

   (2) Have a minimum of 12 square inches of reflective material added to their hard hats that is visible from all sides.

b. Also equip Traffic Control Persons with:

   (1) A flashlight complete with semi-transparent red cone, and

   (2) Radios or cell phones so that they may communicate with each other.

c. All workers shall receive specific training on night work operations.

d. All vehicles in the work area must operate rotating or flashing incandescent amber lights visible in 360 degrees around the vehicle.

e. All work vehicles including trucks must have red and white reflective tape applied to all sides such that it defines the outline of the vehicle.

Provide the equipment specified in Table 712.04-2 with non-glare balloon style lights or equivalent. The lights will be required on each piece of equipment in operation.

Table 712.04-2: Night Work Lighting Requirements

Equipment Type	Illuminance Requirement
Paver, Milling Machine, Material Transfer Devices	One 4000-watt assembly or two 2000-watt assemblies
Grader, Roller, Rumble Strip Machine, Shoulder Machine	One 400-watt assembly
Paint truck	One 400-watt assembly or a non-glare 300-watt floodlight assembly
Guardrail driver, stationary operation	One 4000-watt assembly or two 2000-watt assemblies or equipment light plant
Trail Vehicle	One 4000-watt assembly or two 2000-watt assemblies

A trail vehicle will be required to follow the last piece of equipment in a mobile operation (i.e. finish roller, pavement marking, etc.) depicting the beginning of the working area. In addition, ensure that portable lighting of at least 400 watts is available for the density testing inspector. The Engineer will determine the illuminance requirement for other vehicles not listed in Table 712.04-2. The Contractor may substitute a 400-watt metal halide lamp or equal approved by the Engineer for a 2000 or 400-watt balloon light assembly.

Locate and direct all luminaries in such a way to minimize glare to both motorists and work vehicles. If glare is noted from any travel path, adjust the lighting to reduce the glare to a level acceptable to the Engineer.

Replace non-functioning lamps immediately. Check the luminary aiming daily. Regularly clean the luminaries.

I. Specification Compliance

The Engineer will notify the Contractor of failure to comply with this Specification or the Plans. The safe passage of pedestrians and traffic through and around the temporary traffic control zone, while minimizing confusion and disruption to traffic flow, shall have priority over all other Contractor activities. Continued failure of the Contractor to comply with the requirements of the Traffic Control Standard Specification or Special

Provisions will result in non-refundable deductions of monies from the Contract for non-performance of Work as long as the deficiency remains.

Failure of the Contractor to comply with this Specification or take immediate correction actions required within 48 hours of written notice shall be reason for the Engineer to suspend all other work on the Project, except erosion prevention and sediment control and traffic control, to apply non-refundable deductions of monies from the Contract at a rate of $2,500 per calendar day per notice, and to withhold payment of monies due to the Contractor for any work on the Project until traffic control deficiencies are corrected. These other actions shall be in addition to the deductions for non-performance of traffic control.

712.05 Pavement Marking Removal

Remove conflicting pavement markings, in a manner acceptable to the Engineer, to prevent confusion to vehicle operators.

Remove final surface pavement markings by sand blasting, water blasting, or acceptable grinding methods that will cause the least possible damage to the pavement.

Remove intermediate surface pavement markings by sand blasting or water blasting, or other approved methods that will cause the least possible damage to the pavement. The following methods are acceptable for removing intermediate surface pavement markings: sand blasting using air or water, high pressure water, steam or superheated water, or mechanical devices such as grinders, sanders, scrapers, scarifiers, and wire brushes.

At no cost to the Department, repair damage to the pavement or surface resulting from pavement marking removal using methods and materials acceptable to the Engineer. The removal shall not result in what appears to be a line that conflicts with the current markings.

Accomplish traffic shifts on the final surface using interim traffic marking tape unless otherwise shown on the Plans.

Do not remove an existing pavement marking by painting over with black paint or asphalt.

When the method of removal causes sand or other material to accumulate on the pavement, remove the residue as the work progresses.

712.06 Temporary Centerline and Lane Marking

Unless otherwise specified, install temporary pavement marking as follows:

1. Provide 4-inch wide pavement marking line as shown on the Plans for projects that will have traffic maintained overnight. For temporary pavement line markings on intermediate layers of pavement, use reflective tape, reflectorized paint, and raised pavement markers, or a combination thereof as shown on the Plans or as required by the Engineer, and install to permanent standards before dark hours. Short, unmarked sections will not be allowed. The Department will measure and pay for these markings as Painted Pavement Marking (Line) in accordance with **716.08** and **716.09**. Preserve established no-passing zones, if any, on the existing pavement; if no-passing zones have not previously been established, establish them before beginning the work. Mark two-lane, two-way highways with 10-foot long center lines applied on 40-foot centers and appropriate no-passing barrier lines.

2. Where required on the completed permanent surface, for 10-foot lane lines, no-passing barrier line, and edge line, use reflectorized paint applied as specified in **716**.

3. Maintain pavement markings at no additional cost to the Department until they are covered by the subsequent paving course or the Project is accepted.

4. It will not be necessary to remove pavement markings except for markings that convey conflicting or incorrect information to the traveling public.

712.07 Maintenance

Assume full responsibility for the continuous and expeditious maintenance of all signs, barricades, temporary impact attenuators, and all other traffic control devices to meet the "acceptable" category as described in *Quality Guidelines for Temporary Traffic Control Devices and Features* published by ATSSA. Such maintenance will be considered a part of the original installation cost. Failure to maintain all traffic control devices so as to provide continuous safety to the public will be cause for suspension of construction operations until proper traffic control is re-established.

712.08 Adjustment to Plans

Maintain traffic through the Project in accordance with the traffic control plan and the MUTCD. To request a change to the traffic control plan, submit a plan revision request in writing to the Engineer for approval, with the requested change marked in red on the traffic control plans sheets. The Engineer may adjust the traffic control plan as deemed necessary to ensure the safety of the workmen and traveling public.

COMPENSATION

712.09 Method of Measurement

The Department will measure the following for payment:

1. Signs, including Vertical Panels, erected on suitable supports by the actual area in square feet installed, with no deductions made for corner radii.

2. Flexible Drums for channelizing traffic by the unit, per each, as determined by counting the maximum number of drums on a jobsite and in use at any one time. This shall be designated by making a notation such as "On October 29, 2013, there were 242 Flexible Drums in use. Pay quantity is 242 Each." This will not apply to phase construction projects. On phase construction projects, each phase is treated as a separate project to arrive at a final pay quantity. The highest number used on Phase I, plus the highest number used on subsequent phases, will constitute the final pay quantity.

3. Barricades by the linear foot for the type designated.

4. Delineators and Temporary Flexible Tubular Delineators by the unit, per each.

5. Warning Lights and Flashing Arrow Boards by the unit, per each for the type designated. Payment will be based on the maximum number in place at one time.

6. Portable Barrier Rail by the linear foot. Separate measurement will be made for the initial installation of portable barrier rail at each site that the rail is used on the Project as shown on the Plans or approved by the Engineer. No separate measurement will be made for

removing and resetting portable barrier rail on new alignment at the same site to provide for changes in traffic control required by the different phases of construction. The following conditions apply to measurements of portable barrier rail:

a. The sites on one directional roadway of a divided highway will be considered independently of the sites on the other directional roadway.

b. Each bridge for which portable barrier rail is shown on the Plans or approved by the Engineer will be a separate site.

c. Additional relocations of barrier rail due to safety of work zone or traffic, as established in the traffic control plans or as directed by the Engineer laterally up to 10 feet, will be paid at 10% of the interconnected portable barrier bid amount unless a separate item is in the proposal.

7. Portable Impact Attenuators based on the initial installation of each portable impact attenuator. No additional payment will be made for removal, moving, and reinstalling impact attenuators at other locations on the Project as directed by the Engineer. Payment will be based on the maximum number of portable impact attenuators in place at one time.

8. Temporary pavement marking line as described for Painted Pavement Marking Line in **716.07** regardless of whether the lines are painted, taped markings, or raised pavement markers, or a combination of the above as shown on the Plans or as required by the Engineer, except that Removable Pavement Marking (Line) will be measured by the linear foot of installed line.

Unless otherwise specified, the Department will not separately measure or pay for traffic cones, removal of pavement marking, and flaggers, as these items will be considered incidental to the lump sum item Traffic Control.

The Department will pay for THPs, but the Contractor is responsible for notifying the THP and the Engineer when work has been canceled within 2 hours of the scheduled start of work. If the THP is not notified of work cancellation and the THP elects to monitor/patrol the project for a maximum of 2 hours, the Department will deduct from the monies owed the Contractor an amount equaling the THP pay rate for 2 hours of work.

The Department will pay for Uniformed Law Enforcement Officers provided by the Contractor at the per hour invoice price of the officer's work plus 5%, not to exceed $60 per hour for the total hours present on the Project. No compensation will be made for drive time.

712.10 Basis of Payment

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

Item	*Pay Unit*
Traffic Control	Lump Sum
Portable Barrier Rail	Linear Feet
Portable Impact Attenuator	Each
Signs	Square Feet
Vertical Panels	Square Feet
Flexible Drums	Each
Temporary Barricades (Type)	Linear Feet
Removable Pavement Marking (Description)	Linear Feet

The lump sum payment for Traffic Control is full compensation for providing Temporary Workzone Lighting and all equipment, labor, and materials, and for furnishing flaggers and traffic cones, and for removing conflicting and incorrect pavement markings, as required, until Project completion.

Payment for Portable Barrier Rail is full compensation for all materials, installation, maintenance, and all incidentals necessary to complete the work.

Payment for Portable Energy Absorbing Terminals will be made at the contract price per Portable Energy Absorbing terminal, complete in place, with total payment based on the maximum number of portable energy absorbing terminals in place at one time as specified in **712.09**.

Payment for Signs and Vertical Panels is full compensation for providing sign panels with proper sheeting and legend, erecting on proper supports, furnishing all mounting hardware, covering when not in use, relocating, handling, and maintaining until Project completion.

Payment for Barricades is full compensation for materials, equipment, relocating, handling, maintaining, and all incidentals of the work.

Unless otherwise designated, all signs, barricades, and other traffic control devices covered by this section shall become the property of the Contractor

at the completion of the Project. The salvage value for these items shall be reflected in the contract unit price bid.

The Department will pay for 10-foot lane line/center line and solid barrier line as Painted Pavement Marking (Line) in accordance with **716.08**.

Payment for Removable Pavement Marking Line, 8-inch Barrier Line, Channelization Striping or Stop Line, is full compensation for the installation, maintenance, and removal of the marking line when it is no longer required.

Payment for Uniformed Police Officers is full compensation for providing the Officer, official law enforcement vehicle, all necessary equipment, and administrative costs associated therewith.

SECTION 713 – HIGHWAY SIGNING

DESCRIPTION

713.01 Description

This work consists of constructing foundations and supports, fabricating, furnishing, assembling, and erecting traffic signs on the supports, including delineators when specified, for a section of highway, its interchanges, frontage roads, and roads or streets affording immediate access to the highway.

Construct and erect highway signs and devices in accordance with these Specifications and the MUTCD, latest edition.

The Plans will show the extent and general arrangement of the signs. Refer to the Plans for general guidance. If departures from the Plans and Specifications are deemed necessary by the Contractor, submit the reasons for and details of such departures to the Engineer for approval. Do not make any departure without the Engineer's prior written approval. For departures from the Plans, submit for the Engineer's approval eight copies of drawings showing the complete design of the proposed departure and all other information necessary to complete the sign assembly.

MATERIALS

713.02 Materials

Provide materials as specified in:

Portland Cement Concrete, Class A **604**

Highway Signing Material..... **916**

713.03 Reserved

CONSTRUCTION REQUIREMENTS

713.04 Construction Methods and Requirements

Before beginning any excavation or driving any sign posts, determine the location of all underground electrical, drainage, and utility lines in the vicinity, and perform work so as to avoid damaging these facilities.

All signs are numbered or otherwise identified. Locate signs as shown on the Plans. Obtain the Engineer's approval for all changes in locations before erection.

Locate delineators as shown on the Plans and in accordance with the MUTCD**.**

Place the top of all sign footings level with the ground line. Remove the existing footings of signs to be eliminated to 6 inches below ground line.

The Engineer, or Contractor when required, will stake the location of all sign supports and delineators and mark the location of each sign with the number of the sign. After the sign locations have been staked, but before ordering any material for the supports, allow for a field inspection and approval by the Engineer. Construct the signs at the approved locations.

Ensure steel meets all specifications in **602.04**.

A. Flexible Delineator Posts

Drive the flexible delineator posts or anchors into the ground with equipment that does not damage the posts, anchors, or the reflective sheeting. Drill or form pilot holes where necessary to obtain the embedment shown on the Plans.

B. Post Supports for Ground Mounted Signs

Furnish and erect post supports consisting of one or more posts of the type shown on the Plans.

Drive all posts into the ground, or bolt to a stub in the concrete foundation. Plumb, align, and orient posts as shown on the Plans. To drive posts, use a method that will not damage or deface the top of the post.

For sign posts that are to be bolted to or stubbed in a concrete foundation, excavate as nearly to neat lines as possible and generally pour all parts of the sign post foundation against the soil or rock face. Use forming below ground level in sandy soils or when directed by the Engineer. Forming will be required for all concrete work above the finished ground level and the top 12 inches of all concrete work. Provide necessary braces to keep anchor bolts and stubs in proper position. For foundations, use Class A concrete, meeting the requirements of **604.03**. Perform forming and concrete work as specified in **604**. Remove and dispose of all surplus excavated material.

Repair all cracked, chipped, or scratched galvanized steel members by "touching-up" with an approved zinc powder, wire, stick, or spray manufactured especially for this purpose. The zinc powder, wire, or stick shall become completely liquid at a temperature no greater than 475 °F. Thoroughly clean the area to be regalvanized, including removing slag on welds, and repair according to the recommendations of the manufacturer of the material being used.

C. Foundations for Sign Supports

Furnish all materials and labor, and perform all necessary construction to complete the foundations upon which the sign supports will be erected.

1. **Excavation and Backfill.** Excavate and backfill as specified in **204**.

2. **Disposing of Surplus or Unsuitable Material.** Dispose of surplus or unsuitable material as specified in **203.07**.

3. **Forms.** Construct forms as specified in **604.05**.

4. **Steel Reinforcement.** Provide steel reinforcement as specified in **604.08**.

5. **Electrical Conduit.** Install electrical conduit, when specified, in the foundations as shown on the Plans.

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.

7. **Placing Concrete.** Place concrete as specified in **604.16**.

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 **730.11**.

9. **Surface Finish.** Perform finishing as specified in **604.21**.

10. **Curing.** Cure concrete as specified in **604.23**.

D. Column Supports for Cantilever Structures

Fabricate and erect supports and horizontal arms constructed of galvanized steel. The supports shall consist of one or more vertical poles, one or more horizontal arms, and all necessary fastenings for assembling the units and anchoring the supports to a foundation.

Use leveling nuts to plumb supports. Erect cantilever supports so that the arms are horizontal.

Assemble all high strength bolt connections as specified in **602.17**.

Perform all welding as specified in **602.19**.

The Engineer will reject supports on which galvanizing has been damaged in transportation, handling, and erection. With the Engineer's approval, the Contractor may replace such damaged supports in the field as specified in **713.04.B**. The repaired area shall be similar in appearance and in coating thickness to the original coating. The Engineer will reject supports that are not coated satisfactorily.

E. Supports for Overhead Sign Structures

Fabricate and erect truss sign supports constructed of aluminum or galvanized steel.

Erect the structures with the specified camber and so as to prevent excessive stresses, damage, or defacement.

Provide brackets for mounting signs (including future signs) of the type to be supported by the structure. They shall be adjustable to allow mounting of the sign faces at any angle between a truly vertical position and 3 degrees from vertical. Obtain this angle by tilting the top of the sign toward traffic. All brackets shall be of a length equal to the heights of the signs being supported.

Before erecting aluminum end supports, protect the bottom of each base plate with an approved material that will adequately prevent any harmful reaction between the plate and the concrete.

Use leveling nuts to plumb the end supports. Do not fill the space between the base plate and the foundation with grout.

Tighten all nuts on aluminum trusses, except those used on the flanges, only until they are snug. This includes the nuts on the anchor bolts. Use a thread lubricant with each aluminum nut.

Tighten all nuts on galvanized steel trusses, with the exception of high strength bolt connections, only to a snug condition. Assemble all high strength bolt connections as specified in **602.17**.

Repair galvanizing on steel trusses as specified in **713.04.B**.

Field welding will not be permitted.

F. Signs

Furnish, fabricate, and erect signs on their supports.

When alternates are allowed, all legends, borders, and accessories for an entire project shall conform to the requirements of one and only one of the alternates.

Mechanically apply the reflective sheeting to the properly prepared aluminum with the equipment and in the manner prescribed by the sheeting manufacturer.

All completed signs shall be free from defects in materials and workmanship and shall effectively present the specified message under conditions of both day and night viewing. Reflectorized sign surfaces shall exhibit uniform color and brightness over the entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or in the incident beam of an automobile headlamp.

The reflectorized legend optical performance shall uniformly reflect incident light from motor vehicle headlamps back to the eyes of the operator at entrance angles up to 30 degrees without gaps or irregularities.

Position signs on, and fasten them to, the support as shown on the Plans or as directed by the Engineer. All signs, once erected, shall be clean and free of substances that would hide or otherwise obscure any portion of the sign face. Attach flat sheet signs to the posts with tamper resistant fasteners.

After the sheeting is thoroughly attached to the sign face, attach demountable letters, digits, borders, shields, and alphabet accessories flush against sign faces, with corrosive resistant fasteners as recommended by the manufacturer. Use a sufficient number of fasteners to securely fasten demountable legends and borders to sign panels.

Provide demountable borders of the width shown on the Plans. Place demountable borders as shown on the Plans. Spacing of all legends shall meet the FHWA Standard Alphabets for Highway Signs. Any improper size or spacing of legends and borders shall be cause for rejection of the entire sign.

713.05 Final Cleanup

Before final inspection, clean exposed sign and support surfaces, and level and repair the site as directed by the Engineer to ensure the effectiveness and neat appearance of the work. Perform final cleanup as specified in **104.10**.

COMPENSATION

713.06 Method of Measurement

The Department will measure:

1. Class A Concrete and Steel Bar Reinforcement for embedment of sign supports, and for foundations for sign supports and overhead sign structures, in accordance with **604.30**.

2. Mile Marker and Steel Posts by the unit, per each, complete in place.

3. Flexible delineator posts with reflective sheeting, anchors, and all material necessary for erection of this item payment by the unit, per each, in place.

4. Aluminum or Steel Hollow Square Posts for sign supports, Aluminum or Steel I-Beams and WF-Beams for sign supports, Structural Steel Hollow Square Posts (Break-Away) for sign supports, and Structural Steel I-Beams and WF-Beams (Break Away) for sign supports by the pound based on the nominal weight per foot listed on the sign schedule, for the various sizes and weights used, complete in place.

5. Aluminum or Steel Overhead Sign Structures and Steel Cantilever Sign Structures by the unit, per each, complete in place, including the footings and all incidentals necessary to construct these items.

6. "U" Section Steel Posts by the pound, based on the nominal weight per foot listed on the sign schedule, for the various sizes and weights used, complete in place.

7. Flat Sheet Signs by the square foot for each thickness, complete in place.

8. Extruded Aluminum Panel Signs for payment by the square foot complete in place, except that the measurement will be made only for the actual dimensions of the extruded panels. No payment will be allowed for any space between panels.

The Department will consider conduit, excavation, and backfilling to be incidental to the associated items.

713.07 Basis of Payment

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

Item	*Pay Unit*
Class A Concrete (Foundation for Sign Supports)	Cubic Yard
Steel Bar Reinforcement (Foundation for Sign Supports)	Pound
Mile Marker & Steel Post	Each
Flexible Delineator (Description)	Each
(Description) Sign Supports	Pound
Steel Overhead Sign Structure (Span ___)	Each
Steel Cantilever Sign Structure (Sign No.)	Each
"U" Section Steel Posts	Pound
Flat Sheet Aluminum Sign (___" thick)	Square Feet
Extruded Aluminum Panel Sign	Square Feet

Such payment is full compensation for furnishing all materials, equipment, tools, labor, and incidentals necessary to complete the work.

SECTION 714 – ROADWAY AND STRUCTURE LIGHTING

DESCRIPTION

714.01 Description

This work consists of furnishing and installing roadway and structure lighting systems complete or to the extent shown on the Plans.

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 local entity (city or county engineer) and the Traffic Operations 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 Division. Include a letter requesting deviations or alternate materials in the submittal for Traffic Operations 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 all lighting system materials listed in the submittal are 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**.

(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 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 ¼ 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 ¼-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 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, 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 II 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.** Excavate 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.

A. 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 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.

B. 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.

7. 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:

    a. Negligible light output from more than 10 percent of the LED packages.

    b. Condensed moisture inside the optical assembly.

    c. 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 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:

A. 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.

B. 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.

C. 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.

D. Performance Tests

Prior to acceptance and after all faults have been corrected, 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.

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 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.

SECTION 715 – ASPHALTIC CONCRETE CURB (HOT MIX)

DESCRIPTION

715.01 Description

This work consists of constructing an asphaltic concrete curb composed of a mixture of coarse aggregate, fine aggregate, mineral filler (if specified or required), and asphalt cement, on a prepared foundation.

MATERIALS

715.02 Materials

Provide materials meeting **411.02**, except that commercially available stabilizing material may be added with the Engineer's approval.

715.03 Composition of Mixture

The composition of the mixture shall conform to the requirements of **411.03** with the following additions and revisions:

A. Proportioning

Combine the mineral aggregate and asphalt cement as specified in Table 715.03-1.

Table 715.03-1: Proportioning

Combined Mineral Aggregate	Asphalt Cement
90-94%	6-10%

B. Mineral Aggregate

Use mineral aggregate of Grading E, except that other gradings that have a history of satisfactory performance may be used when approved by the Engineer.

C. Job Mix Formula

Use a job mix formula that will provide sufficient workability during placing and that will ensure a finished curb of adequate stability and the desired surface texture.

EQUIPMENT

715.04 Equipment

Use mixing and hauling equipment that meet **407.04** and **407.05**.

To place the curb, use an approved self-propelled automatic curb machine capable of producing a smooth, well-compacted finished curb. Equip the machine with a hopper sufficient in capacity to ensure a continuous operation, and a power driven screw or other device that forces the mixture through a tube and then through a die or mold attached to the tube. Ensure that the mold will produce the desired cross-section of the curb. The machine shall be so constructed that the thrust against the asphaltic mixture will eliminate objectionable surface voids as the mixture passes through the mold.

CONSTRUCTION REQUIREMENTS

715.05 Limitations

Comply with **407.09**.

715.06 Preparing the Curb Foundation

When the curb is to be placed on a granular base, remove all soft or otherwise unsuitable material and replace with suitable material. Thoroughly compact the finished base, and shape to the required line, grade, and cross-section, and prime in accordance with the applicable provisions of **402**.

When the curb is to be placed on an existing pavement, thoroughly clean the area receiving the curb of all dirt and other objectionable matter. Apply a tack coat to this area in accordance with the applicable provisions of **403.**

715.07 Preparing the Mixture

Prepare the asphaltic concrete curb mixture as specified in **407.11**, **407.12**, and **407.13**.

715.08 Hauling and Placing Mixture

Use hauling equipment of an approved type, and schedule hauls so that the temperature of mixture when deposited is not more than 25 °F lower than when it left the mixing plant.

Place the curb in position on the tacked or primed surface using an approved automatic curb machine that shapes and compacts the mixture to the designated cross-section. No side forms will be required for machine placed curb, but where the curb is laid on an existing pavement that does not have a smooth grade, the Engineer may require use of a 2 x 2 inch angle iron or other approved apparatus as a track so that the finished curb will have a smooth and true line and grade.

Where the curb is to abut an existing structure-wall or is placed at the extreme edge of pavement, use a machine that is capable of placing the curb within 1 inch of the structure-wall or pavement edge. Only use hand methods adjacent to structures that preclude machine placing.

On grades greater than 3%, place the curb with the machine traveling uphill. If, in the Engineer's opinion, the curb is not being adequately compacted, take corrective action. Corrective measures may include adjusting the mix, loading the machine with additional weight, retarding forward movement of the machine by braking, or other measures that will ensure adequate compaction.

Carefully construct required joints so as to ensure a continuous bond between the old and the new sections of the curb.

715.09 Curing and Protection

Protect the newly laid curb from traffic by barricades or other suitable methods until the asphaltic mixture has cooled to air temperature.

Remove and replace curb or sections of curb that are displaced, destroyed, or otherwise damaged before final acceptance.

715.10 Method of Measurement

The Department will measure Asphalt Concrete Curb for payment by the linear foot, complete in place.

715.11 Basis of Payment

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

Item	*Pay Unit*
Asphaltic Concrete Curb (__ inches)	Linear Feet

SECTION 716 – PAVEMENT MARKINGS

DESCRIPTION

716.01 Description

This work consists of furnishing and supplying pavement markings in accordance with these Specifications and the latest revision of the MUTCD, including establishing and locating non-passing zones as well as providing the layout of paint striping, preformed plastic pavement markings, raised reflective pavement markers, snowplowable reflective pavement markers, and thermoplastic pavement markings.

MATERIALS

716.02 Materials

Provide materials as specified in:

Paint	**910**
Thermoplastic Pavement Markings	**919.01**
Spray Thermoplastic Pavement Marking	**919.02**
Preformed Plastic Pavement Marking	**919.03**
Raised Reflective Pavement Markers	**919.04**
Snowplowable Reflective Pavement Markers	**919.05**

Plastic pavement markings may be either preformed or thermoplastic unless otherwise specified.

CONSTRUCTION REQUIREMENTS

716.03 Thermoplastic Pavement Marking

Furnish and apply thermoplastic pavement marking material meeting **919.01** by the screed extrusion or ribbon dispenser methods, or spray thermoplastic pavement marking material meeting **919.02**.

As an alternate, the Contractor may apply preformed thermoplastic marking material for stop bars, crosswalks, legends, or directional arrows. The preformed thermoplastic material shall have a minimum thickness of 0.090 inches and be fused to the pavement by the heat of a torch.

A. Equipment

Provide special kettle(s) for melting and heating the thermoplastic material. Equip the kettle(s) with automatic thermostatic control devices so that heating can be done by controlled heat transfer rather than by direct flame, to provide positive temperature control and prevent over-heating of the material.

Provide equipment that will continuously mix and agitate the material. Conveying parts of the equipment shall prevent accumulation and clogging. All parts of the equipment that come in contact with the material shall be easily accessible for cleaning and maintenance. All mixing and conveying parts of the equipment, including the shaping die (or spray nozzle in the case of spray thermoplastic marking material), shall maintain the material at the plastic temperature with heat transfer oil or electrical element controlled heat. Direct fire heat transfer will not be allowed.

The equipment shall ensure continuous uniformity in the dimensions of the stripe. The applicator equipment shall be mobile and maneuverable to the extent the straight line can be followed and normal curves can be made in a true arc. The applicator equipment shall provide a method of applying "skip" lines. Calibrate the equipment, and check it periodically by marking over a metal plate. The equipment shall provide for varying widths to produce varying widths of traffic markings.

1. **Extruded or Ribbon-Dispensed Thermoplastic Marking.** Apply the material to the pavement by either the screed extrusion method or the ribbon dispenser method.

The screed extrusion device shall have one side of the shaping die open with the other three sides contained by, or part of, suitable equipment for heating and controlling the flow of material. Do not use pans, aprons, or similar appliances that the die overruns.

Ribbon dispensers shall be heated, suspended above the road surface, and shall apply the material to the width and thickness specified.

Apply glass spheres to the surface of the completed stripe by an automatic bead dispenser attached to the striping machine in such a manner that the beads are dispensed almost instantaneously upon the installed line. The glass sphere dispenser shall be capable of applying glass spheres to the surface of the completed stripe by a double drop application for initial traffic striping and marking. Attach the bead dispenser for the first bead drop to the striping machine so that the beads are dispensed closely behind with the thermoplastic material. Attach the second bead dispenser to the striping machine so that the beads are dispensed immediately after the first bead drop application. Equip glass sphere dispensers with an automatic cut-off control that is synchronized with the cut-off of the thermoplastic material and applies the glass spheres so that the spheres appear uniform on the entire traffic stripes and markings surface with 50 to 60% embedment.

The applicator equipment to be used on roadway installations may consist of either hand equipment or truck mounted units depending on the type of marking required.

The hand equipment shall have sufficient capacity to hold 150 pounds of molten material and shall be sufficiently maneuverable to install crosswalks, lane, edge, and center lines, arrows, and legends. The truck mounted unit for lane, edge, and center lines shall consist of a mobile self-contained unit carrying its own material capable of operating at a minimum speed of 5 miles per hour continuously during an 8-hour period while installing striping.

Hand equipment used for stop bars, crosswalks, legends, directional arrows and other specialty markings shall use the same thermoplastic formulation as described above with the exception of placing the marking at a minimum thickness of 0.090 inches and a

single drop of AASHTO M 247, Type 1 bead at the rate of 8 to 10 pounds per 100 square feet of stripe.

2. **Spray Thermoplastic Marking.** For lane, edge, and center lines, use truck-mounted applicator equipment consisting of a mobile self-contained unit carrying its own material capable of operating at a minimum speed of 5 miles per hour continuously during an 8-hour period while installing striping.

   Each application machine must be equipped with an automatic counting mechanism capable of recording the number of linear feet of material applied to the roadway surface with an accuracy of 0.50%, to be checked by the Engineer.

   Apply glass spheres to the surface of the completed stripe by an automatic bead dispenser attached to the striping machine in such a manner that the beads are dispensed almost instantaneously upon the installed line. The glass sphere dispenser cut-off shall be synchronized with automatic cut-off of the thermoplastic material.

B. Application

1. **Contractor's Responsibility for Notification.** Notify the Engineer before placing the thermoplastic materials. Furnish the Engineer with the manufacturer's name and batch numbers of the thermoplastic materials and glass spheres to be used. Ensure that the approved batch numbers appear on the thermoplastic materials and glass spheres packages.

2. **Application.** Before beginning application, ensure that the pavement temperature is a minimum of 50 °F and rising. Suspend application if the pavement temperature falls below 50 °F. Thoroughly clean all surfaces to be marked of all dust, dirt, grease, oil, and all other foreign matter before applying the striping.

   The pavement marking material, when formed into traffic stripes, shall be readily renewable by placing an overlay of new material directly over old markings of the same material. Such new material shall bond itself to the old markings in a manner that will ensure no splitting or separation will take place.

   Offset longitudinal lines at least 2 inches from longitudinal joints of Portland cement concrete pavements.

a. **Extruded or Ribbon-Dispensed Thermoplastic Marking.** To ensure optimum adhesion of thermoplastic applied on all Portland cement concrete pavements, apply a binder-sealer material as recommended by the thermoplastic manufacturer. To ensure optimum adhesion, install the thermoplastic material in a melted state at a temperature of 400 to 450 °F.

Unless otherwise shown on the Plans, maintain a minimum average film thickness of 0.100 inch for lane and edge lines on all markings. Compute this thickness on the basis of the amount of material used each day. The film thickness shall be uniform in appearance throughout its application. Apply the glass sphere top coating with a pressure type spray gun designed specifically for this purpose, and that will embed the spheres into the line surface to at least one-half their diameter.

Place Drop on Glass Beads of AASHTO M 247 Type 1 and Type 4 on the thermoplastic stripe at a rate of 8 to 10 pounds per 100 square feet of stripe.

Place the AASHTO M 247 Type 4 glass beads immediately after the first bead drop application of AASHTO M 247 Type 1 beads.

Regardless of the application methods and procedures, or pavement types, replace all pavement markings that fail to comply with these Specifications, or fail to adhere to the pavement for one year after installation, at no cost to the Department.

b. **Spray Thermoplastic Marking.** Before applying the pavement-marking material, remove all dirt, glaze, grease, and all other material that would reduce the adhesion of the paint to the pavement. Open-graded roadways, such as double-bituminous surface treatment (DBST), require sweeping (brooming) to ensure cleanliness.

Remove all existing material that might cause premature failure of the new material.

To ensure optimum adhesion of spray thermoplastic applied to Portland cement concrete surfaces, apply a binder-sealer material as recommended by the thermoplastic manufacturer.

The binder-sealer material shall form, when applied with conventional mobile paint spraying equipment, a continuous film over the pavement surface that will dry rapidly and adhere to the pavement surface. The binder-sealer shall be that product currently in use and recommended by the thermoplastic material manufacturer. Include all costs, including materials, associated with application of the binder-sealer, in the unit bid price for the spray thermoplastic pavement markings.

Install the pavement-marking material in a molten state, by the spray method, at a minimum temperature of 350 °F and a maximum temperature of 425 °F. Scorching or discoloration of material is cause for rejection by the Engineer. Use equipment constructed so that all mixing and conveying parts, up to and including the spray gun, maintain the material in the molten state.

Do not apply the pavement-marking materials when air and pavement surface temperatures are below 40 °F or when the surface of the pavement contains evidence of moisture.

When the plans specify 60-mil markings, apply the pavement-marking material at a thickness of not less than 0.060 inch for all roads except open-graded roadways such as DBST. For such surfaces, apply material at a thickness of not less than 0.065 inch. In no case shall the applied thickness exceed 0.075 inch.

Place the pavement-markings with adequate drop-on glass spheres in accordance with the above requirements, uniformly applied to ensure adequate nighttime reflectivity. Use a compatible combination of marking material and spheres to preclude the surface spheres from sinking deeply into the marking, or from being prematurely lost from the surface of the marking.

The producers of the thermoplastic compound and glass spheres shall furnish to the Department three copies of certified tests reports showing results of all tests specified therein and shall further certify that the materials meet all requirements.

The Department will randomly sample molten thermoplastic material for verification testing in accordance with AASHTO T 250.

3. **Temporary Marking.** When thermoplastic is used on the final surface, the Contractor may use reflectorized paint installed to permanent standards at the end of each day's work and then install the permanent marking after the paving operation is completed. Short, unmarked sections are not allowed. The Department will not directly measure and pay for temporary markings for the final surface, and will consider the costs thereof to be incidental to the item for permanent markings.

4. **Protection of Newly Applied Traffic Stripes and Markings.** Do not allow traffic onto or allow vehicles to cross newly applied pavement markings until they are sufficiently dry. Remove and replace portions of the pavement markings damaged by passing traffic or from any other cause, at no additional cost to the Department.

716.04 Raised Reflective Pavement Markers

To bond markers to the pavement, use an epoxy listed on the Department's QPL and that is approved by the marker manufacturer or a hot bituminous adhesive conforming to the requirements specified below. Do not use markers manufactured with a self-adhesive backing. Space markers as shown on the Plans. Do not install markers over joints in rigid pavements.

Furnish pavement markers of a type listed on the Department's QPL. Install the markers when the pavement is dry and the pavement temperature is no less than 50 °F.

Clean the portion of the highway surface, to which the marker is to be bonded by the adhesive, of all dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint, and all other material that would adversely affect the bond of the adhesive. Perform cleaning by blast cleaning on Portland cement concrete and old bituminous pavements. Blast clean new bituminous pavement where, in the Engineer's judgment, the surface contains an abnormal amount of asphalt or the surface is contaminated with dirt, grease, paint, oil, or other material that would adversely affect the bond of the adhesive.

Melt and heat the bituminous adhesive in either thermostatically controlled double boiler type units using heat transfer oil or thermostatically controlled electric heating pots. Do not use direct flame melting units. Use a melter/applicator unit that is suited for both melting and pumping application through heated applicator hoses.

Heat the adhesive to between 375 and 425 °F, and apply it directly to the pavement surface from the melter/applicator by either pumping or pouring. Maintain the application temperature between 375 and 425 °F, as lower temperatures may result in decreased adhesion while higher temperatures may damage the adhesive.

Apply the adhesive in a puddle approximately 2/3 to ¾ the diameter of the marker. Apply markers to the adhesive immediately (within 10 seconds) to ensure bonding. Place the marker in position by applying downward pressure until the marker is firmly seated with the required adhesive thickness and squeeze out. Remove excessive adhesive squeeze out from the pavement, and immediately remove adhesive on the exposed surfaces of the markers. Remove adhesive from exposed faces of pavement markers according to manufacturer's recommendations.

Install reflective markers so that the reflective face of the marker is perpendicular to a line parallel to the roadway centerline. Protect the markers against impact until the adhesive has hardened to the degree designated by the Engineer.

The Contractor may reheat and reuse adhesive, provided the manufacturer's recommendations regarding the pot life at application temperatures are not exceeded.

Clean out equipment and tanks using petroleum solvents such as diesel fuel or similar materials. Turn off all heating equipment before beginning cleaning operations. Remove all solvent from the equipment tanks and lines before the next use of the melter.

716.05 Snowplowable Reflective Pavement Marker

Contour the pavement at each snowplowable marker location to match the bottom of the marker casting. Install markers according to the manufacturer's recommendations. For asphalt surfaces, only use the dry saw method to apply snowplowable reflective pavement markers. When using the dry saw method, provide a vacuum system to contain the dust. For other surfaces, regardless of the saw method used, ensure that the saw cut is clean, dry, and

free of all dust or residue before applying the adhesive. Accompany each shipment of adhesive with a written statement from the adhesive manufacturer certifying that the material furnished conforms to the recommendations of the marker manufacturer and stating the minimum temperature at which the adhesive can be satisfactorily mixed and applied.

716.06 Preformed Plastic Pavement Markings

Apply preformed plastic pavement markings on clean, dry surfaces free of dirt and foreign matter. Only apply markings when the pavement temperature is at least 60 °F. Should the plastic require activators for the adhesive or various special coatings for different pavement surfaces, include the cost of the activator or special coatings in the unit price of plastic.

Furnish with each package of reflectorized pavement marking materials complete instructions and specifications for applying pavement marking materials to pavement surface. Install the reflectorized pavement marking materials according to the vendor's specifications. Any adhesion used in the installation shall be as specified by the manufacturer. Use an adhesion-promoting primer when recommended by the pavement marking manufacturer.

Establish guides to mark the lateral location of pavement markings as shown on the Plans or as directed by the Engineer. The Engineer will verify the location of the guides. Place markings in proper alignment with the guides. The deviation rate in alignment shall not exceed 1 inch per 200 feet of roadway. The maximum deviation shall not exceed 2 inches, and there shall be no abrupt deviations.

Remove and replace, at no cost to the Department, markings placed that are not in the alignment or sequence as shown on the Plans or as specified herein. Remove such markings as specified in **712.05**. Guides placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway in the opinion of the Engineer.

When specified in the Contract, place markings for newly paved asphalt concrete surfaces immediately after final rolling of the mat. Use a rubber tired roller cart with a minimum weight of 200 pounds or a truck operated at no more than 3 miles per hour to ensure proper adhesion when the markings are in place. Do not use steel wheel rollers for this purpose.

716.07 Paint

A. Application of Painted Pavement Markings

Apply paint with a spray-type machine capable of satisfactorily applying the paint under pressure through a nozzle that sprays directly upon the pavement at a rate not to exceed 880 feet per minute. Equip the machine with:

1. Air blast device for cleaning the pavement ahead of the painting operation;

2. Guide pointer to keep the machine on an accurate line;

3. Device to agitate the paint;

4. Device to maintain a uniform flow and application of the paint;

5. Automatic device to provide a broken or skip line of the length required;

6. At least two spray guns capable of being operated either individually or together;

7. Automatic counting mechanism capable of recording the number of linear feet of material applied to the roadway surface with an accuracy of 0.50%, to be checked by the Engineer; and

8. Accurate meters that register quantities for both white and yellow applied paint to the nearest gallon.

When using waterborne paint, ensure the equipment can heat the material from ambient air temperature to 123 °F. Equip the machine with a bead or sphere dispenser that can be regulated to dispense the spheres automatically at the uniform rate required. The equipment shall be designed and operated so as to allow traffic to safely pass on the roadbed.

Do not apply paint unless the ambient air temperature is at least 45 °F. However, if the Engineer directs that paint be applied when air temperatures are below 45 °F, heat the paint according to the manufacturer's recommendations.

For the following operations, the Engineer will not require large automatic spray application machinery meeting the preceding requirements, provided the Contractor selects pavement marking equipment capable of producing a uniform, acceptable finished product consistent with the Plans and Specifications:

1. Installation of temporary pavement markings.

2. Installation of permanent pavement markings on projects having a total length of 1,000 feet or less.

3. Installation of permanent pavement markings on an individual project segment having a total length of 1,000 feet or less on an intermittent project.

Clean the pavement surface before placing any pavement marking material.

Locate and place temporary markings on final pavement surfaces to underlie or coincide with the permanent pavement markings.

Perform cleaning and painting using equipment of the kind and in the manner provided by previously specified equipment. On sections where no previously applied line is available to serve as a guide or if the line is to be re-located, spot the proposed location of the new line with paint in advance of the application. On tangent sections, space the control points no more than 500 feet apart and on curves at intervals that will ensure the accurate location of the line. Leave gaps in all lines at intersections in accordance with the MUTCD or as directed by the Engineer.

Do not apply any paint over a chalk line, wire, or cord, and instead offset such guide marks from the paint line to be placed. On sections where previously applied lines are visible, use the old lines unless otherwise directed. Do not apply any paint to areas of pavement when moisture remains on the surface, or when wind conditions may cause a film of dust to be deposited on the line areas after these areas have been prepared for painting.

Apply drop-on type glass beads uniformly to the painted surface at a uniform rate of not less than 6 pounds per gallon of paint applied.

Apply paint so as to deposit a uniform final film thickness of 0.015 inch (within a reasonable tolerance) and at a speed not to exceed 880 feet per

minute. Use this rate of application for all types of paint, making proper adjustments in gallons for an intermittent line or wider lines. Ensure that the quantity of paint does not under-run the designated amount by more than 5%. If a check of the rate of application indicates a greater variation, stop the work until the paint machine is properly adjusted or replaced. This percent of variation is set out to give the Contractor some leeway in starting the job and in getting the machine in adjustment; it is not expected that there will be either a continuous overrun or under-run, but that the final average rate of application will closely approach the rate established above.

When reflectorized paint is required for temporary or final marking, install the paint to permanent standards at the end of each day's work. Do not leave any short, unmarked sections.

Protect traffic lines and markings. Place warning and directional signs as shown on the Plans or as directed by the Engineer to control traffic in the marking area. If the drying time of the material being used exceeds 60 seconds, protect the newly applied markings by placing traffic cones or other approved warning devices at frequent intervals as directed. Leave these devices on the line until the material is dry or firm enough not to track or receive impressions from normal traffic. Remove these devices as soon as possible to prevent a traffic hazard. Do not leave such devices in the roadway overnight. If so directed, provide flaggers to direct traffic.

Apply paint to appear as clearly delineated lines with minimal crookedness and waviness, giving due consideration to the contours and roughness of the pavement. Segments of broken line stripe shall square off positively at each end. The paint lines shall be without mist, drip, or splatter. Remove and/or correct, to the Engineer's satisfaction and at no additional cost to the Department, lines that do not meet these requirements when placed.

Operate the paint equipment so that it will be unnecessary for traffic to cross the newly painted line behind the equipment in order to safely pass the painting machine, and to allow traffic to keep moving at all times.

B. Removal of Painted Markings

Remove painted pavement markings where specified or directed by the Engineer. Obtain the Engineer's approval of the paint removal method

before beginning the work. Do not remove existing painted pavement markings by painting over them with black paint or asphalt.

When the method of removal causes sand or other material to accumulate on the pavement, remove the residue as the work progresses. Remove painted markings by methods that cause the least possible damage to the pavement. Repair damage to the pavement or surface caused by pavement marking removal as directed by the Engineer and at no cost to the Department.

Where a plastic marking will replace the painted marking and paint removal is specified in the Contract, remove enough of the paint to ensure proper installation of the plastic. The paint removal shall be uniform and shall expose a minimum of 75% of the surface area that is to receive the plastic materials.

COMPENSATION

716.08 Method of Measurement

A. Pavement Marking (Broken lane lines), Pavement Marking (Dotted line), and Pavement Marking (Transverse Shoulder)

The Department will measure the length of each of these markings, complete in place and accepted, as listed in the bid schedule, along the center of each line. Only the marked line will be measured for payment.

B. Pavement Marking (Solid barrier line)

The Department will measure the length of solid barrier line, complete in place and accepted, along the center of each line. Where double solid barrier lines are used, each solid barrier line will be measured separately for payment.

C. Pavement Marking (Crosswalk Striping)

The Department will measure the length of crosswalk striping, complete in place and accepted, along the centerline of the crosswalk. The Department will not separately measure boundary lines on crosswalk.

D. Pavement Marking (Channelization Striping)

The Department will measure Channelization Striping, including the boundary lines, complete in place and accepted, by the square yard.

E. Pavement Marking (Stop line)

The Department will measure the length of stop lines, complete in place and accepted, in linear feet to the nearest foot along the centerline of the stop line.

F. Pavement Marking (Designs)

The Department will measure designs or lettering by the unit, per each, complete in place or as stipulated in the Contract and shown on the Plans.

G. Raised Reflective Pavement Markers and Snowplowable Reflective Pavement Markers

The Department will count the number of each type of pavement markers installed as directed and accepted.

H. Removal of Existing Painted Line

The Department will measure the removal of broken lane line and solid barrier line along the center of each line. Only the painted line will be measured for payment.

Adhesives will be considered incidental to the installation of raised reflective pavement markers and snowplowable reflective pavement markers.

716.09 Basis of Payment

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

Item	*Pay Unit*
Plastic Pavement Marking (__" Dotted Line)	Linear Feet
Plastic Pavement Marking (Transverse Shoulder)	Linear Feet
Plastic Pavement Marking (__" Barrier Line)	Linear Feet
Plastic Pavement Marking (Cross-Walk)	Linear Feet
Plastic Pavement Marking (Stop Line)	Linear Feet

Plastic Pavement Marking (Channelization Striping)	Square Yard
Painted Pavement Marking (__" Barrier Line)	Linear Feet
Painted Pavement Marking (Cross-Walk)	Linear Feet
Painted Pavement Marking (Stop Line)	Linear Feet
Painted Pavement Marking (Channelization Striping)	Square Yard
Plastic Pavement Marking (Word or Design)	Each
Raised Pavement Marker (Description)	Each
Snowplowable Pavement Marker (Description)	Each
Removal of:	
Pavement Marking (Dotted Line)	Linear Feet
Pavement Marking (Transverse Shoulder)	Linear Feet
Pavement Marking (__" Barrier Line)	Linear Feet
Pavement Marking (Cross-Walk)	Linear Feet
Pavement Marking (Stop Line)	Linear Feet
Pavement Marking (Channelization Striping)	Square Yard
Pavement Marking (Word or Design)	Each

Such payment is full compensation for layout, materials, labor, equipment, tools, royalties, and all other incidentals necessary to complete the work.

SECTION 717 – MOBILIZATION OF FORCES, SUPPLIES AND EQUIPMENT

DESCRIPTION

717.01 Description

This work consists of mobilizing and demobilizing the Contractor's and all Subcontractors' forces, supplies, equipment, and incidentals at the Project site. It shall include all Contractor and Subcontractor costs associated with obtaining performance bonds, insurance required by railroads, and other preconstruction costs incurred after Contract award that are necessary costs to the Project and are of a general nature rather than directly attributable to other pay items. Include all necessary preconstruction costs not attributable to a specific pay item in the lump sum price for Mobilization and not in any other pay item.

COMPENSATION

717.02 Method of Measurement

The Department will measure Mobilization by the unit for the completion of the work described in **717.01**.

717.03 Basis of Payment

The Department will pay for Mobilization on a lump sum basis.

The Department will make partial payments for Mobilization with the first and second partial pay estimates paid on the Contract. Payment will be made at the rate of 50% of lump sum price for Mobilization on each of these partial pay estimates provided the amount bid for Mobilization does not exceed 5% of the total amount bid for the Contract. If the amount bid for the item of Mobilization exceeds 5% of the total amount bid for the Contract, the Department will pay 2-1/2% of the total amount bid on each of the first partial

payment estimates, and that portion exceeding 5% on the last partial pay estimate.

As an exception to the above, where the Work covered by the Contract is limited exclusively to the resurfacing of an existing pavement, including projects involving the milling off of a portion of the existing pavement prior to the laying down of new asphalt cement concrete layer(s), the Department will pay the entire lump sum price for the item of Mobilization, less the retainage provided for in Title 54-5-121, TCA, with the first partial pay estimate paid on the Contract, provided the amount bid for Mobilization does not exceed 5% of the total amount bid for the Contract. If the amount bid for the item of Mobilization exceeds 5% of the total amount bid for the Contract, the Department will pay 5% of the total amount bid for the Contract on the first partial pay estimate, and the portion exceeding 5% on the last partial pay estimate.

SECTION 722 – FIELD OFFICE

DESCRIPTION

722.01 Description

This work consists of providing and maintaining an adequate, weatherproof field office for the exclusive use of the Engineer and Department staff during both the Contract period and for a maximum of 60 days thereafter.

GENERAL REQUIREMENTS

722.02 Location

Locate the field office or materials laboratory on a site that is both satisfactory to the Engineer and convenient to the Project site.

722.03 Minimum Spatial Requirements

Unless otherwise specified in the Special Provisions, the Engineer's field office shall meet the minimum floor area and headroom requirements specified Table 722.03-1. It shall contain a sufficient number of windows to provide at least 27 square feet of natural light. Existing building structures meeting these minimum requirements are acceptable.

Table 722.03-1: Field Office Spatial Requirements

Building Type	Width (feet)	Length (feet)	Headroom (feet)	Windows Required
Type 1	10	30	8	6
Type 2	12	50	8	10

722.04 Other Requirements

Arrange for and comply with all necessary local and State regulatory permits and inspections, including all costs associated therewith.

Fully equip the Engineer's field office and have it ready for occupancy at least 2 days before the start of actual construction operations.

Protect the field office against fire, flooding, and theft throughout the 24 hours of every day the unit is in service. Assume responsibility for Department property housed in the field office that is lost due to theft, fire, or natural causes.

722.05 Outside Utilities

A. Electrical Power

Arrange for electrical service for the field office. The power supply shall be 115-volt, 60-cycle current of sufficient amperage to provide for heat, interior and exterior lighting, operating office equipment, and air conditioning.

B. Sanitary Sewer Outfall

Provide an adequate temporary outfall into either the municipal sanitary sewer system or an approved individual sewage disposal system. Dispose of sanitary wastes in accordance with the applicable requirements of the municipal regulations.

722.06 Interior Utility Services

A. Lighting

Furnish lighting fixtures as required to provide minimum illumination of 70 foot-candles in all areas.

B. Electrical Receptacles

Provide six duplex convenience electrical receptacles throughout the field office as directed by the Engineer. At least two of these receptacles shall be 20-amp capacity.

C. Heating and Air Conditioning

Provide heating and air conditioning equipment capable of maintaining a year-round temperature between 70 °F and 78 °F.

D. Sanitary Facilities

Provide a water closet, lavatory, slop sink, vent fan, and a hot water heater having a minimum 5-gallon capacity.

E. Telephone, Answering Machine, and Facsimile Machine

Provide telephone service with an answering machine, a facsimile machine, and two incoming phone lines.

722.07 Doors and Windows

Provide doors of stock sizes and that have a key-in-knob lock of an approved manufacturer. Key all doors similarly. Provide operative windows except for picture windows. Operative windows shall be either double hung or casement type equipped with adequate locks. Provide all windows with either shades or Venetian blinds. Provide adequate screens for all window openings. Provide frosted glass for windows in sanitary areas.

722.08 Furnishings and Equipment

Provide the field office with the following:

A. Furnishings

1. Three office type desks, minimum top dimensions 32 x 60 inches, with two or more drawers on each side.

2. Three swivel desk chairs.

3. One work table, 30 inches high, with a minimum of 24 square feet of work area.

4. One drafting stool.

5. Two folding-type chairs.

6. One fire resistant drawer-type safe, legal size, with combination or key lock.

7. One four-drawer legal size metal filing cabinet equipped with lock.

8. Two two-drawer (14-1/2 x 16 inches) metal filing cabinets.

9. Two round wastebaskets.

10. One plan rack of an approved design to be equipped with ten rods.

B. Equipment

1. Two fully automatic electronic calculators with tape.

2. One office type copying machine.

3. One pencil sharpener.

4. One 5-pound CO2 fire extinguisher of approved manufacture for each 200 square feet of floor area.

5. One first-aid kit.

6. One electric sanitary water cooler with refrigerated storage compartment, with a continuous supply of paper cups.

7. Toilet paper holders, paper towel dispensers, and soap dispensers in the toilet rooms, with a continuous supply of each.

722.09 Concrete Cylinder Storage

Provide a storage shed/building for temporary storage of concrete acceptance cylinders. The storage facility shall be of sufficient size and construction to protect the concrete cylinders from the elements and damage. Obtain the Engineer's approval of the storage facility location. Department personnel will control access to the storage shed/building. Equip the storage shed with a concrete curing box or water curing tank with a heating/circulating system of sufficient size to properly cure all acceptance cylinders before transferring for final storage and testing. The curing box or curing tank and heater/circulator shall comply with AASHTO M 201, and proper curing of the cylinders shall be in accordance with AASHTO T 23. The storage facility shall be equipped with a measuring device that will record the minimum and maximum temperatures inside of the curing area.

722.10 Maintenance and Custodial Service

Provide the following maintenance and custodial services:

A. Maintenance

Perform all necessary repairs of damaged, defective, or vandalized parts of the field office and associated furnishings and equipment. Continue maintenance operations as long as the Engineer occupies the field office.

B. Custodial

1. Weekly trash removal.

2. A broom and dust pan or bi-monthly floor cleaning service.

3. Cleaning supplies or bi-monthly window and sanitary facility cleaning.

4. Replacement of supplies as required to maintain office equipment and sanitary facilities.

722.11 Project Sign

Equip the field office with a sign that identifies both the use of the structure and provides notice against trespassing.

COMPENSATION

722.12 Basis of Pavement

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

Item	*Pay Unit*
Field Office (Type __)	Lump Sum

Such payment is full compensation for providing all that is specified in this Section **722** for the duration of the Project.

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, 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 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 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.

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 ¼ 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 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" 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 ½-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 in diameter, unless otherwise specified or directed by the Engineer. Conduit for service connections shall be 1 inch 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 ¾-inch diameter conduit. Larger-sized conduit may be used, at no additional cost to the Department, 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.

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 ¼-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. 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 ½ 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 ½-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 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.

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. 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. 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.

Signal head housings shall be cast aluminum and all associated parts/hardware shall be of non-corrosive material. In addition to these requirements, comply with the following:

A. Optical Units

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.

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.

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.

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. Louvers shall be painted with a powder coated finish.

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.

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 ¼-inch edge clearance to any portion of the stud. Exterior wiring shall have a 360-degree drip loop in advance of entering the head.

F. Pedestrian Signals

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; and

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 a powder coated finish (if aluminum) or colored resin (if polycarbonate) in accordance to MUTCD specifications.

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

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:

1. have all timing values entered via a front panel mounted keyboard. This keyboard shall be an integral part of the controller unit;

2. have an English language menu for programming or reading all controller features;

3. continue to operate the intersection as values are inspected or altered;

4. 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); and

5. support Flashing Yellow Arrow for Permissive Left-turn Movements applications.

Surge Protection Devices. 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.

CABINETS – GENERAL

730.26 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 **730.26.6.k**, 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, they shall be dimmable and switchable to reduce glare at night time.

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. 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. 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. 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. A minimum of 12 available bare ground positions tied to AC Common Return.

i. Earth (driven) ground tie point to terminate a single No. 4 AWG copper ground.

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.

k. A panel (police subpanel) shall contain the following:

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.

   (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.

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.

l. 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 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.

730.27 Auxiliary Equipment for Traffic 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 affect 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:

1. **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 deep cycle 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.

2. **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.

3. **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. 50 ft. 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. Any necessary jumpers shall be provided for installed equipment.

730.28 Miscellaneous Traffic Signals

A. 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.

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 **730.27** – Auxiliary Equipment for Traffic Signal Controllers – Time Clock Switches except as superseded herein.

9. Unit shall have non-volatile program memory to allow retention during power loss.

B. 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. Obtain 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. Provide 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.

C. 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 meet the requirements of and be listed on the Department's QPL or Standard Drawings. 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 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 1/4 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 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 System

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 plus or minus 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;

6. ability to properly detect directionally;

7. ability to configure presence, pulse, extend and delay outputs;

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;

9. variable focus providing a minimum of 4 to at least 40-degree horizontal field of view; and

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 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 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 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.

The RVDS 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 shall comply with all applicable Federal Communications Commission (FCC) requirements. The manufacturer will provide documentation of compliance with FCC specifications.

The RVDS 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 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 radar sensor must be from the transient protected side of the AC power distribution system in the traffic control cabinet in which the RVDS is installed.

RVDS documentation shall include a comprehensive user guide as well as quick reference guide(s).

RVDS 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 WMDS 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 WMDS and system software for set-up and monitoring of the WMDS.

The WMDS 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.

WMDS shall have the ability to configure presence, pulse, extend and delay outputs.

WMDS 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.

WMDS detection accuracy must be comparable to properly operating inductive loops.

The WMDS 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 WMDS 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 WMDS.

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 WMDS. When the fault state is active contact closure will be applied to the appropriate detector channel.

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.

730.30 Reserved

730.31 Reserved

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, 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.

B. 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.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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.

L. 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.

M. 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.

N. Wood Pole

The Department will measure Wood Poles, of the type and size shown on the Plans, per each, installed.

O. 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.

P. 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.

Q. 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.

R. 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.

S. 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.

T. 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.

U. 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 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.

SECTION 740 – GEOSYNTHETICS

DESCRIPTION

740.01 Description

This work consists of placing geosynthetics in accordance with these Specifications and the Standard Drawings.

MATERIALS

740.02 Materials

Provide materials meeting the requirements of **921.12** for the type of geosynthetic shown on the Plans.

Furnish a certified laboratory test report from an approved testing laboratory with each shipment of materials. Laboratory test reports shall include the actual numerical test data obtained. Clearly label all rolls as being part of the same production run from which the test data was derived. Protect rolls to prevent damage during transportation, storage, and installation. Cover geosynthetic rolls during storage to protect against UV degradation, and store rolls elevated up off of the ground. Do not install material that is torn, punctured, or otherwise damaged.

CONSTRUCTION REQUIREMENTS

740.03 General

Place geosynthetics as shown on the Plans for the specific application. Compact the surface on which the geosynthetic is to be placed, as directed by the Engineer. Prepare the surface to be as smooth as possible and free from debris, obstructions, and depressions that could result in gaps, tears, or

punctures in the fabric during cover operations. Install the geosynthetic so that placement of cover material will not excessively stretch or tear the geosynthetic. After the geosynthetic is placed, install the initial lift of cover material within five calendar days. Do not operate equipment directly on the geosynthetic. Place cover material so that at least the minimum initial lift thickness, as specified by the Engineer, is between the geosynthetic and equipment tires or tracks at all times. Do not turn equipment and vehicles on the first lift above the geosynthetic.

Repair or replace, as directed by the Engineer and at no cost to the Department, materials that are damaged during or after placement.

COMPENSATION

740.04 Method of Measurement

The Department will measure geosynthetics of the type specified by the square yards, complete in place. No measurement for payment will be made for overlaps, splices, or sewn joints.

740.05 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Geomembrane	Square Yard
Geogrid Reinforcement	Square Yard
Cellular Confinement System (Description)	Square Yard
Geotextile (Type __) (Description)	Square Yard
Geotextile Tube	Linear Feet
Temporary Sediment Tube __" (Description)	Linear Feet

Such payment is full compensation for all labor, equipment, materials, tools, and incidentals necessary to complete the work.

PART 8 – ROADSIDE DEVELOPMENT

SECTION 801 – SEEDING

DESCRIPTION

801.01 Description

This work consists of furnishing and placing seed, commercial fertilizer, agricultural limestone, and mulch material on all newly graded earthen areas that are not to be paved, stabilized, or sodded.

MATERIALS

801.02 Materials

Provide materials as specified in:

Water **802.02.B.5**
Mulch Binder: Emulsified Asphalt, Type SS-1 or AE-3 ..... **904.03**
Grass Seed **918.01**
Commercial Fertilizer **918.02**
Agricultural Limestone **918.04**
Mulch Material **918.05**
Inoculant for Legumes **918.06**
Liquid Lime ..... QPL

801.03 Reserved

CONSTRUCTION REQUIREMENTS

801.04 General

Perform seeding work as specified in **209**.

At the start of permanent seeding operations, prepare, shape, and dress the area to be seeded as specified in **203.08** and **801.05**. Unless otherwise directed by the Engineer, do not sow the seed until after placing the topsoil as specified in **203.06**. Use topsoil with all permanent seeding activities except where its use would be detrimental to effective erosion and siltation control, as determined by the Engineer.

The Contractor may perform Temporary Seeding (with Mulch) or Temporary Seeding (without Mulch) without full preparation of the seedbed as specified in **801.05**, where approved by the Engineer, and application of permanent erosion and siltation control measures is not practicable.

Perform all seeding and related operations as continuous operations.

A unit in relation to seeding area is 1,000 square feet. For purposes of measuring water, a unit is 1 M.G., which equals 1,000 gallons.

801.05 Preparing the Seedbed

When the soil is in a tillable and workable condition, prepare the seedbed in the following manner and sequence:

1. Scarify, disc, harrow, rake, or otherwise work each area to be seeded until it has been loosened and pulverized to a depth as directed by the Engineer.

2. Incorporate fertilizer, at the rate of not less than 20 pounds of Grade 10-10-10, or equivalent, per unit (1,000 square feet), and agricultural limestone, at the rate of not less than 100 pounds per unit, uniformly into the soil for a depth of approximately 1/2 inch.

3. If the soil pH is below 5.5, in addition to the required agricultural lime, apply liquid lime selected from the Department's QPL at a rate of 7.5 gallons per acre (22 ounces per 1,000 square feet).

Incorporating fertilizer into the soil as specified above is not necessary when mixed with seed in water and applied with power sprayer equipment.

801.06 Seeding

The specific seed group will be shown on the Plans or as directed by the Engineer from those specified in **918.01**.

Sow the seed immediately after preparing the seedbed as specified in **801.05**. Sow the seed uniformly using a rotary seeder, hydraulic equipment, or other satisfactory means, at the rate specified in Table 801.06-1, unless otherwise specified or directed.

Table 801.06-1: Seed Application Rates

Seed Group	Application Rate, Pounds per Unit (1,000 square feet)
A, B, and C	2.5
B1	0.6
All other groups specified in **918.01**	1.5

Before sowing, inoculate Group C seed and seeds of legumes, when sown alone, in accordance with the recommendations of the inoculant manufacturer and as directed by the Engineer.

Do not perform any seeding during windy weather or when the ground surface is frozen, wet, or otherwise non-tillable. Do not perform seeding during December and January unless otherwise allowed.

801.07 Mulching

When seeding with mulch is specified, use hay, straw, or other approved mulch materials.

When using hay or straw as the mulching material, spread it evenly over the seeded area, immediately following the seeding operations, at an approximate rate of 100 pounds per unit for straw and 150 pounds per unit for hay. The Engineer may vary this rate, depending on the texture and condition of the mulch material and the characteristics of the area seeded.

To hold hay or straw mulch in place, apply an approved tackifier, listed on the QPL, as recommended by the manufacturer.

When using wood fiber mulching material, apply it at a rate of 28 to 35 pounds per unit, using hydraulic mulching equipment. Spray the material uniformly on the surface of the prepared seedbed. Adjust the application rate as directed by the Engineer.

801.08 Care During Construction

Maintain all seeded areas to the Engineer's satisfaction until acceptance of the Work.

Repair, as directed by the Engineer, all areas previously seeded and mulched in accordance with this Section but that incurred damage or failed to successfully establish an acceptable stand of grasses or legumes. Furnish all material and labor required to repair seeded areas damaged due to Contractor negligence at no cost to the Department. The Department will measure and pay for repairs made to seeded areas, except temporary seeding, required through no fault of the Contractor, in accordance with **801.09** and **801.10**. If the Engineer directs the Contractor to place additional fertilizer on the area to be reseeded, apply additional liquid lime at a rate of 5 gallons per acre (15 ounces per 1,000 square feet) if the pH of the soil is below 5.5.

After an acceptable stand of grass has been attained, top-dress seeded areas with not less than 10 pounds of fertilizer of Grade 10-10-10, or equivalent, per unit at approximately 6-month intervals, unless otherwise specified or directed.

COMPENSATION

801.09 Method of Measurement

A. Seeding

The Department will measure the seeded area for payment by the number of units seeded in accordance with these Specifications and accepted by the Engineer. Each unit shall consist of 1,000 square feet measured along the surface.

B. Mulch

The Department will measure mulch for payment complete and in place, including tackifiers used to hold the mulch in place.

C. Water

The Department will measure water necessary for seedbed preparation and maintenance by the M.G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

The Department will not measure water used in applying seed, fertilizer, and mulch binder.

D. Repairs of Seeded Areas

The Department will measure supplemental items used to repair seeded areas on which a satisfactory stand of grasses or legumes has not been obtained due to causes not attributable to Contractor negligence as provided below. These items will only be used when the reseeding is confined to small areas that would not restrict the Contractor's operation. If the areas to be reseeded are of substantial size, thereby accommodating the Contractor's normal operation, the Contractor shall perform the work in accordance with these Specifications, and the Department will pay for such work under the applicable original seeding item.

1. The Department will not pay for seedbed repair directly but will consider the cost thereof as included in the unit price bid for Seed (Supplemental Application). If additional materials are required to repair the seedbed, the Department will make payment under the appropriate item or items in **203**.

2. The quantity of seed measured for payment to repair seeded areas will be the actual number of pounds of seed used, as determined by bag count of standard weight bags or by weighing the seed on approved scales.

3. The quantity of fertilizer measured for payment will be the actual number of tons of dry fertilizer used as determined by bag count of standard weight bags or by weighing the fertilizer on approved scales. If liquid fertilizer is used, the weight will be converted to its equivalent dry weight in tons.

E. Fertilizer

The Department will measure fertilizer applied, as specified or directed, to areas with an acceptable stand of grass as specified in **801.09.D.3**.

F. Lime

The Department will measure lime for payment complete and in place by the ton.

The Department will make no direct measurement or payment for agricultural limestone or liquid lime used in repairing seeding areas, but will consider the cost to be included in the unit price bid for Fertilizer.

801.10 Basis of Payment

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

Item	*Pay Unit*
Seeding (with Mulch)	Unit
Crown Vetch Mixture (with Mulch)	Unit
Temporary Seeding (with Mulch)	Unit
Seeding (without Mulch)	Unit
Crown Vetch Mixture (without Mulch)	Unit
Temporary Seeding (without Mulch)	Unit
Mulch	Unit
Seed (Supplemental Application)	Pound
Fertilizer (Supplemental Application)	Ton

Payment for Seeding, Crown Vetch Mixture, and Temporary Seeding is full compensation for preparing the seed bed, furnishing and placing all materials, including fertilizer, agricultural limestone, seed, mulch materials and mulch binder where mulch is used, and inoculant, if specified.

When the Contract does not provide for a unit bid price for Seeding (without Mulch) and this item is used for temporary or permanent erosion control, the Department will make payment at a rate per unit equal to 0.45 times the unit price bid for Seeding (with Mulch). In addition, if the Contract does not provide a unit bid price for mulch and mulch alone is required, the Department will make payment at a rate per unit equal 0.60 times the unit price bid for Seeding (with Mulch).

The Department will pay for Water used to prepare the seed bed and for maintenance at the contract unit price per M.G. (1,000 gallons) of water, which payment is full compensation for furnishing and applying the water as specified.

Payment for Seed (Supplemental Application) is full compensation for minor seedbed repair, mulch materials and mulch binder, and inoculant, if specified.

Payment for Fertilizer (Supplemental Application) and fertilizer applied after an acceptable stand of grass has been attained is full compensation for furnishing and applying fertilizer and, where required, liquid lime.

SECTION 802 – LANDSCAPE PLANTING

DESCRIPTION

802.01 Description

This work consists of furnishing and planting trees, shrubs, seedlings, and ground cover of the kinds and at the locations shown on the Plans or where directed by the Engineer.

MATERIALS

802.02 Materials

A. Planting Material Standards

Before performing any work, furnish proof of having secured a nursery dealer's certificate for each shipment of plants. The certificate shall

indicate the number of plants of each species in the shipment and the project number for which the plants are intended. The certificate shall also include a certification that the plant materials conform to the requirements of the Plans and these Specifications, and that all local, State, and Federal laws pertaining to the inspection, sales, and shipment of plant materials have been complied with.

Consider "collected plant material" to mean plants that are not nursery grown. Do not use collected plant material unless shown on the Plans. Dig collected plant material called for on the Plans with a ball of earth having a minimum diameter at least 25% greater than that specified for nursery grown stock and wrap in burlap. Handle plants to keep their roots protected at all times. During delivery, ensure that the entire load remains suitably covered. Coverings shall not be so tight as to cause heating.

1. Names and Grades. Plant material shall conform to the nomenclature of *Standardized Plant Names*, as adopted by the Joint Committee of Horticulture Nomenclature, latest revision. Size and grading standards shall conform to the latest approved revision of the *American Standard for Nursery Stocks*, Z60.1, published by the American Nursery and Landscape Association. Make no substitutions of size or grade without the Engineer's written permission. Properly identify each bundle of plants and all separate plants with legible, waterproof tags securely fastened to each plant or bundle of plants.

Ship plants as follows:

a. Seedlings in bundles of 100.
b. Bare Root in bundles of 10.
c. Ball and Burlap individually.

2. Health. Provide plants conforming to the following health requirements:

a. All plants, including their roots, shall be free of disease, insects, or other injurious qualities.

b. The trunk bark of all trees shall be sound, trees shall have no large wounds, and small wounds shall have a satisfactory callus roll formed or forming over them.

c. Plants shall show good annual growth.

d. Buds shall be plump and well filled for the species.

e. Evergreen foliage shall be of good intense color.

3. Quality. All plants shall:

a. Be true to type;

b. Have normal, well developed branch systems, and a vigorous fibrous root system;

c. Be sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation; and

d. Have been growing in the same climatic conditions as the location of the Project for at least 2 years prior to the date of the Contract.

4. Ball and Burlap/Wire Basket. All balled and burlapped plants shall conform to the *American Standard for Nursery Stock*, Z60.1, latest approved revision. All balls shall be of natural earth in which the plant had been growing. Manufactured or artificially produced or mudded-in balls are not acceptable. Ensure that balls are firm and unbroken. The Engineer may reject balled and burlapped plants if they fail to meet good digging and handling practices.

5. Container Grown Plants. In addition to the requirements of the *American National Standard for Nursery Stock*, Z60.1, container grown plants shall conform to the following:

1. The space between the rim or top of the container and the soil line within the container shall not be more than 1-1/2 inches for the 1-gallon and 2-gallon sizes and not more than 2-1/2 inches for the 5-gallon size.

2. Encircling roots shall not have grown in such a manner that they will cause girdling of the trunk or stems. If encircling roots do exist, they shall be cut.

3. Roots shall not protrude through drainage holes or over the rim of the container to the extent that they will be damaged while removing the root ball from the container.

4. Plants shall have been acclimated to outside conditions. Container grown plants may be used provided the Engineer approves of their use in writing.

B. Miscellaneous Planting Materials

Obtain the Engineer's approval of the following materials before incorporating them in the work:

1. Topsoil. Provide a natural, friable, fertile, fine sandy loam possessing the characteristics of representative topsoils in the vicinity that produce heavy growths of vegetation. The topsoil shall be free from subsoil, noxious weeds, stones larger than 1 inch in diameter, lime, cement, ashes, slag, and other deleterious matter. Topsoil shall be well drained in its original position and free from toxic quantities of acid or alkaline elements.

2. Mulch. Unless otherwise specified, provide a standard, commercial quality of aged hardwood bark mulch with a particle size of less than 3 inches and a contamination rate less than 0.5% by volume.

3. Fertilizer. Unless otherwise shown on the Plans, do not fertilize trees.

4. Tree Wrappings. Avoid using tree wrappings for any purpose other than providing protection during transport.

5. Water. For planting work, use water that is free from harmful or objectionable qualities or organisms.

6. Stakes for Bracing and Anchoring. Stakes used for guying trees shall be at least 6 feet long, of sound, sturdy material, reasonably capable of withstanding aboveground and underground conditions. Their top and bottom face dimensions shall be at least 2 x 2 inches, a minimum diameter of 2-3/4 inches, or a substitute approved by the Engineer.

7. Hose. For staking, use a new fabric-bearing rubber hose with an inside diameter of not less than 1/2 inch.

8. Straps. For staking, use straps consisting of flat, canvas belting with grommets.

802.03 Reserved

CONSTRUCTION REQUIREMENTS

802.04 Time and Condition of Planting

Unless otherwise specified, perform all planting after the growing season, between the dates of November 1 and April 1.

802.05 Staking

The Engineer, or the Contractor when specified, will stake all plant and bed locations in accordance with the plant list and approximate locations shown on the Plans.

Perform the planting at the approved locations. After planting is complete, outline the ground cover areas and seedling areas with painted stakes and twine as directed by the Engineer.

802.06 Tree Planting

A. Planting Pits

Form circular planting pits with vertical sides. Make the diameter of the pits at least 2 feet greater than the diameter of the ball of the tree. The depth of the pit shall be sufficient to accommodate the ball or roots of the tree when the tree is set to the finished grade, allowing for a maximum of 1 inch of tamped spoil below the roots of the plant.

B. Backfill

Backfill for tree planting shall consist of spoil material removed from the hole if suitable. If not, this material may be blended with 50% topsoil. Soil amendments are not recommended.

C. Setting of Trees

Place all plants at a level so that, after settlement, the natural relationship between the original grade at which the plant grew and the present one

shall be the same. The root flare should be level with the soil grade surrounding the tree. Plant trees plumb and orient them for desired effect as directed by the Engineer. Tamp spoil material from the hole around the base of each ball to fill all voids. Place material in 6 to 8-inch thick layers, thoroughly tamping each layer to prevent air pockets.

Cut back burlap and wire baskets and remove a minimum of one-third of the depth of the root ball. Remove all string from the root ball and around the trunk. When planting bare root trees, carefully work soil around the roots and spread them in a natural position before backfilling. Form, around all trees, shallow basins or saucers, which are slightly larger than the diameter of the ball, to hold additional water.

Thoroughly water all plants immediately after planting, fully saturating the backfill in the pits and beds during the same day of planting. Perform planting and watering as one continuous operation. If applying water by hose, use an open end hose at very low pressure to avoid air pockets and injury to the roots.

D. Guying and Staking

Only stake trees when necessary to keep them vertical on a slope or in an area with strong winds. Never stake trees less than 6 feet tall or under 1 inch caliper. When staking is necessary, use biodegradable underground staking, or soft straps or flexible hose without wire. Ensure that staking allows for free movement of the tree trunk.

802.07 Wrapping and Pruning of Trees

A. Wrapping

Wrap tree trunks for transport, and then completely remove all wrapping bandage and string at the time of planting.

B. Pruning

Except for branches damaged during digging and transport, do not prune trees at the time of planting unless otherwise directed.

Do not use tree paint on cuts.

802.08 Shrub Planting

A. Planting Beds and Pits

Prepare planting beds to a depth of 4 to 6 inches, or as directed by the Engineer. Make plant pits 6 inches deeper and 6 inches greater on all sides than the plant balls.

B. Prepared Topsoil

Backfill for shrub planting shall consist of "prepared topsoil" as specified in **802.06.B**.

C. Setting of Shrubs

Set shrubs as specified in **802.06.C**.

D. Pruning of Shrubs

Except for removing broken or badly bruised branches with a clean cut, do not prune trees at the time of planting unless otherwise directed.

Do not use tree paint on cuts.

802.09 Seedling Planting

This Specification is intended to produce natural appearing wooded areas similar to others in the vicinity. To achieve this effect, mix and plant seedlings specified for a given area as shown on the Plans.

Dig holes to receive these plants of sufficient size and depth to place the roots in a normal position and to allow the plant to be set slightly below grade, leaving a depression to receive and hold water.

After planting the seedlings, provide a thorough watering on the same day. Perform planting and watering as a continuous operation.

After completing the planting, ensure that each plant is solidly in the ground and thoroughly wetted.

802.10 Ground Cover Planting

Ground cover planting shall consist of an overplanting of existing grasses or other growing material. Dig holes to receive these plants of sufficient size and depth to accommodate the roots and to allow the plant to be set slightly below grade, leaving a slight depression to receive and hold water. Place 2 inches of topsoil under the plant and around the roots. Carefully remove containers, except those of organic material, from pot-grown plants to avoid damaging the soil ball.

Perform planting and watering as a continuous operation, thoroughly watering on the same day as planting. This may be done by mechanical means if adequate equipment is available. When watering is complete, ensure that each plant has been thoroughly wetted and that the plant is solidly in the ground.

802.11 Temporary Storage and Heeling-In

Ship plants directly from the nursery. When temporary storage or heeling-in is required, provide and prepare a suitable heeling ground or heeling-in nursery conveniently located near the planting site before shipping the plant material from the growing nursery or other source. Take care in requesting shipment to avoid long periods of temporary storage.

Immediately heel-in, or transport to the planting site and plant, all plant material delivered to the Project. The Engineer will reject material left out of ground overnight, left with its roots bare to the sun and wind, or otherwise left unprotected during transit, unloading, or storage.

802.12 Mulching

Within 2 days of planting trees and shrubs, apply a 4-inch depth of mulch, entirely covering the saucer of individual tree pits and the entire shrub beds. Ensure that mulch does not touch the tree trunk or the stems of shrubs.

802.13 Final Cleanup

Upon completion of all operations described in these Specifications, remove all refuse, brush, including standing dead and rejected plants, sticks, packaging, potting debris, and similar waste, regardless of whether it was directly connected with the Work or previously left by others. Leave the general area in a neat and orderly condition that meets the Engineer’s approval.

802.14 Period of Establishment

Installation of the plant material shall be regarded as partial completion of the horticultural work. The "period of establishment" will be April 1st through November 1st. The Contractor is responsible for all plantings for one full period of establishment.

Keep all plants and plant material installed in a living, healthy condition up to the date for termination of Contractor responsibility for care specified herein. Unless otherwise specified by the Engineer, perform the following work in a continuous manner during the period of establishment

A. Watering

During periods of low rainfall or drought, water all woody plants at weekly intervals unless otherwise directed by the Engineer. Slowly and gradually apply sufficient quantities of water until the root area of the plants is saturated. One inch of water is customary. Apply sufficient quantities of water slowly and gradually until the root area of the plants is saturated. Carefully adjust both the force and volume of water to ensure that no damage occurs to plants, backfill, and mulching material.

B. Cultivating

When shown on the Plans, keep all planting areas free from grass and weeds throughout the entire growing season. Always keep the area clean, open, and properly mulched, unless covered with plastic and mulched. Closely mow areas such as slope bed plantings.

802.15 Inspection and Replacement of Plants

A. Initial Inspection and Replacement of Plants

The Engineer will initially inspect the plants during and before the end of the planting season (April 1st) and will determine the necessity of replacing dead, degenerated, defective, or missing plants. Remove plants fitting into the above categories and plants that are stagnant, whether technically alive or not, and replace them with the specified plants at no cost to the Department. For each plant replaced, perform all necessary work to establish the plant, regardless of already fulfilled obligations regarding other plant material on the site. Based on the findings of the Engineer's initial inspection as addressed above, replace all plants that are required to be replaced on or before May 1st.

B. Final Inspection: Replacement and Acceptance of Plants

The Engineer will conduct a final inspection of planting during and before the end of the first full growing season and on or about October 1st, after the first full growing season. The Engineer will determine whether to require the Contractor to replace plants as specified in **802.15.A** or if such replacement would be inadvisable due to seasonal or other conditions.

The Contractor's responsibility for care of all plantings that are acceptable on the date of the final inspection mentioned above shall end on that date.

Based on findings of the inspection mentioned above, replace plants that require replacement with plants of the same species, size, and quality at no cost to the Department. Replace non-viable plants before the 15th of February. Upon completion of the work, the Engineer will inspect the replacement plantings and accept or reject the work. If accepted, the Contractor's responsibility for care of the replacement plantings shall end on the date of the Engineer's inspection.

COMPENSATION

802.16 Method of Measurement

The Department will measure:

1. Living trees, seedlings, and shrubs for payment by the unit (per each).

2. Ground cover by the square yard, in accordance with **109**.

3. Water required for the plant establishment by the M.G. (1,000 gallons).

The Department will only measure for payment those plants in a living, healthy condition at the time the Contractor's responsibility for care of the plants has ended.

The Department will not measure or make payment for water used in plant installation work.

802.17 Basis of Payment

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

Item	*Pay Unit*
Trees (Description)	Each
Seedlings (Description)	Each
Cuttings (Description)	Each
Shrubs (Description)	Each
Ground Cover (Description)	Square Yard
Water (Plant Establishment)	M.G. (1,000 gallons)

In making partial payments for planting items, the Department will consider:

1. Approximately one-third of the Contract price to be the value of preparing the holes for planting including placement of prepared mixtures,

2. Approximately one-third as the value of the furnishing and planting of the original plants, and the

3. Remaining one-third as the value of the plant establishment work.

The Department will make partial payments for the plant establishment work as the work progresses, at times to be established by the Engineer at intervals of not less than three months.

SECTION 803 – SODDING

DESCRIPTION

803.01 Description

This work consists of furnishing and placing sod at the locations shown on the Plans or where directed by the Engineer.

Ordinarily, this work will consist of furnishing and placing new sod originating from sources outside the right-of-way. In some cases, however, the work will include removing sod from areas where the requirements of the improvement would destroy existing sod, storing the sod so removed, and resetting it in areas shown on the Plans or designated by the Engineer.

MATERIALS

803.02 Sod

A. General

Provide new sod consisting of live, dense, well-rooted growth of permanent grasses, free from Johnson grass, nut-grass, and other

undesirable grasses or weeds, that is well-suited for the intended purpose and for the soil in which it is to be planted. Correct installed sod that does not meet these requirements as directed by the Engineer and at no additional cost to the Department.

Cleanly cut all sod in strips having a reasonably uniform soil thickness of not less than 1 inch and a reasonably uniform width of not less than 8 inches and a length of not less than 12 inches.

B. Department of Agriculture Inspection and Authorization

The sale or movement of turf grass or sod for propagation is controlled by Tennessee Plant Pest Act of 1955, TCA 43-515, et. seq. It requires inspection during the growing season and authorization by the Tennessee Department of Agriculture prior to removal. The authorization may be certificates for "Tennessee Certified Premium" sod, or "Tennessee Certified" sod. If the sod offered for use will not meet the requirements for certified sod but will meet the requirements of this Subsection, obtain a "Permit for Movement of Non-certified Turf Grass Sod."

Request the inspection from the Tennessee Department of Agriculture as early as possible to avoid undue delay. Include the following information in the request for inspection:

1. Project number, county, name and address of the owner or seller,
2. Name and address of purchaser,
3. Kind or variety,
4. Exact location of sod,
5. Location where sod will be used, and
6. Approximate date movement of sod will begin.

Direct the request for inspection to the following address:

Division of Plant Industries
Tennessee Department of Agriculture,
Ellington Agricultural Center
Melrose Station 40627
Nashville, Tennessee 37204
Telephone (615) 360-0130

Furnish a copy of the Department of Agriculture authorization to the Engineer before removing any sod.

803.03 Fertilizer Grade

Provide fertilizer conforming to **918.02** and that is of Grade 10-10-10 or 1-1-1 formula, unless otherwise shown on the Plans or specified in the Special Provisions.

803.04 Ammonium Nitrate

Provide ammonium nitrate conforming to **918.03**.

803.05 Agricultural Limestone

Provide agricultural limestone conforming to **918.04**.

803.06 Reserved

CONSTRUCTION REQUIREMENTS

803.07 Weather Limitations

Set or reset sod only when the soil is moist and favorable to growth. Do not perform any setting or resetting between December 1 and February 1, unless weather and soil conditions are considered favorable and permission is granted by the Engineer.

803.08 Removing and Storing Sod for Resetting

Cut, handle, and store sod removed from such areas as lawns, yards, and lots so that the sod can be reset in the same locations from which it was removed. Do not substitute sod unless approved by the Engineer. Unless resetting sod immediately after cutting, stack the sod in piles, and keep it moist until reset. Reset sod within 7 days after removal, unless otherwise approved by the Engineer.

803.09 Sodding

Bring the area to be sodded to the lines and grades shown on the Plans. Unless otherwise directed by the Engineer, place topsoil as specified in **203.06** before placing sod. When laying sod adjacent to structures, ditch paving, sidewalks, and similar features, ensure that water will not pond and will flow as designed. Loosen the surface of the ground to be sodded to a depth of not less than 1 inch with a rake or other device. If necessary, sprinkle

the ground until saturated for a minimum depth of 1 inch, and keep moist until the sod is placed. Immediately before placing the sod, apply fertilizer and lime uniformly to the prepared surface of the ground. Apply fertilizer at the rate of 12 pounds of Grade 10-10-10, or equivalent, per 1,000 square feet. Apply agricultural limestone at the rate of 100 pounds per 1,000 square feet.

Place sod as soon as practicable after removing from the point of origin and keep it in a moist condition during the interim. On urban projects, place the sod on all newly graded cut and fill slopes as work progresses to prevent damage to adjacent facilities and property due to erosion. Take care to retain the soil on the root system during excavating, hauling, and planting. Ensure that all sod is in an acceptable condition upon delivery and placement at the work site. Do not use sod damaged by heat or dry conditions.

Carefully place the sod by hand on the prepared ground surface, with the edges set in close contact and, as far as possible, in a position to break joints. Lay and fit each strip of sod into place, thoroughly wet it, and roll with an approved roller or hand-tamp, as approved by the Engineer. On slopes of 2:1 or steeper, pinning or pegging may be required to hold the sod in place.

803.10 Period of Establishment

A. Watering

Provide all labor and arrange for all watering necessary for rooting of the sod. If rainfall during the first 14 days of the period of establishment is inadequate to maintain a moist soil, perform the necessary watering, as approved by the Engineer. After 14 days, apply ammonium nitrate at the rate of 3.5 pounds per 1,000 square feet and re-water the sod.

B. Department Inspection

An authorized representative of the Department will conduct an inspection to determine the acceptability of the sodding no less than 90 days but not more than 150 days after completion of the sod work or at the acceptance of the entire Project, whichever is later, except that the Engineer may delay the inspection when conditions are such that the acceptability of the sodding cannot be determined at the end of the 150-day period or at the time the entire Project is accepted.

C. Contractor Guarantee

The Contractor shall guarantee, at the time of the Department inspection, a minimum of 95% live sod on the sodded areas and that there are no vacant areas of dead sod larger than 100 square feet. This guarantee shall apply to all permanent sodding performed in conjunction with the Project, regardless of the type protection used or the season in which the sodding is performed.

D. Repairs of Defective Areas

When the sodding does not meet the guarantee requirements at the time of inspection, repair the defective areas. Required repairs may include preparing the sod bed, refertilizing, resodding, and providing any erosion control items that were originally required. Perform such work as soon as favorable working conditions occur after being advised of the repairs required. The Department will not pay for the repair work and materials required to fulfill the guarantee requirements.

E. Care and Maintenance

From the time sodding and protection work begins until the date the entire Project is accepted, keep all sodded areas in good condition at all times.

Do not allow placement of any equipment or material on any planted area, and erect suitable barricades and guards to prevent equipment, labor, or the public from traveling on or over all areas planted with sod.

Promptly repair damage to sodded areas as directed by the Engineer. Perform all work and provide all materials necessary to protect, maintain, and restore sodded areas during the life of the Contract at no additional cost to the Department, except for additional work caused by Department-requested changes. If it becomes necessary to disturb previously sodded areas due to slope changes, addition of paved ditches not previously located by the Engineer, or other changes made at the direction of the Engineer, the Department will make payment for a reasonable amount of additional work, as determined by the Engineer, at the original contract unit prices. The Department will not pay for additional work due to changes made for the benefit of the Contractor, such as slope changes to obtain balance excavation instead of borrow excavation, nor will the Department pay for additional work required because the Contractor failed to properly coordinate its erosion control

schedule thus causing previously sodded areas to be disturbed by operations that could have been performed before sodding.

F. Contract Time

If, on Contracts involving sodding and other items of construction, the other items have already been completed, the time required for establishment under this item will not be charged against the time stipulated in the Contract for completion of the Project.

803.11 Disposal of Surplus Material

Dispose of all surplus material as directed by the Engineer.

COMPENSATION

803.12 Method of Measurement

The Department will measure:

1. Sod by the square yard in accordance with **109**.

2. Water by the M. G. (1,000 gallons) using calibrated tanks or distributors, or accurate water meters.

Only areas upon which sod has been set or reset will be measured for payment.

803.13 Basis of Payment

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

Item	*Pay Unit*
Sodding (New Sod)	Square Yard

The Department will pay for water applied during the first 14 days after sodding work is complete, including the water used in the re-watering of the sod after the application of the ammonium nitrate, at the contract unit price for Water per M.G. (1,000 gallons). Water applied after this period will not be paid for and will be considered incidental to other items.

SECTION 805 – EROSION CONTROL BLANKETS

DESCRIPTION

805.01 Description

This work consists of furnishing and placing erosion control blankets, listed on the QPL, over previously prepared and seeded areas as shown on the Plans or as directed by the Engineer.

MATERIALS

805.02 Materials

Provide materials as specified in:

Erosion Control Blankets **920.01**
Staples **920.02**

805.03 Reserved

CONSTRUCTION REQUIREMENTS

805.04 Surface Preparation and Blanket Placement

Shape, fertilize, and seed the areas to receive the erosion control blankets as shown on the Plans or as directed by the Engineer. The surface shall be smooth and free of depressions and eroded areas that would allow water to collect or flow under the blanket.

Place the appropriate type of blanket as specified within 24 hours after the area has been seeded and prior to any rain or watering. If using a jute mesh blanket, after stapling the blanket into place, press it into the ground with a light lawn roller or by other means approved by the Engineer.

Place the blankets as shown on the Plans and Standard Drawings. Drive staples vertically into the ground to anchor the plastic mesh. Space staples as shown on the Plans and Standard Drawings. Where blankets are laid side by side, place the staples so that the staple will anchor mesh from each blanket.

In waterways, ditches, flumes, and channels, unroll the blanket and place in contact with the soil in the direction of the flow of water. The Engineer may specify additional staples or check slots in waterways where slopes are steep or large water volumes or velocities are anticipated.

805.05 Maintenance

Maintain the blanket installation during the life of the Contract. Prior to Project acceptance, if any staples have become loosened or raised, or if the blanket becomes loose, torn, or undermined for any reason, reshape, re-seed, and re-fertilize the damaged areas, and satisfactorily repair or replace the blanket at no additional cost to the Department.

COMPENSATION

805.06 Method of Measurement

The Department will measure blankets of the specified type(s), installed and accepted, by the square yards complete in place. The Department will consider overlaps, over width, and cut anchor slots to be incidental to the work.

805.07 Basis of Payment

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

Item	*Pay Unit*
Erosion Control Blanket (Type __)	Square Yard
Turf Reinforcement Mat (Class __)	Square Yard
Flexibly Channel Liner (Class __)	Square Yard

Such payment is full compensation for all materials, equipment, tools, labor, and incidentals, including maintenance.

The Department will pay for the preliminary preparation of the areas on which the blanket is to be placed, including placing topsoil and furnishing and applying all seed, fertilizer, and water, under their specific item numbers.

SECTION 806 – ROADSIDE MAINTENANCE

DESCRIPTION

806.01 Description

This work consists of litter/debris removal, mowing, and trimming as specified or as directed by the Engineer for the entire highway right-of-way where accessible (fence-to-fence where applicable), including shoulders for the length of the Project.

CONSTRUCTION REQUIREMENTS

806.02 General

Remove litter and debris as directed by the Engineer for the entire construction limits. Dispose of litter and debris in accordance with all applicable permits and state and local ordinances.

Mowing and vegetation removal work shall consist of mowing and trimming of the right-of-way for vegetation control to maintain a neat aesthetic appearance as directed by the Engineer.

806.03 Definitions

A. Litter

Litter refers to any object or group of objects foreign to the right-of-way that 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, construction, 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.

B. Mowing

Mowing refers to the work associated with cutting or trimming vegetation, primarily consisting of, but not limited to, grasses, invasive weeds, and small trees or shrubs to provide a consistent and aesthetically pleasing standing vegetation height as directed by the Engineer.

C. Trimming

Trimming refers to the work associated with cutting or trimming vegetation in close proximity to objects or in areas not accessible to conventional mowers in an attempt to prevent damage and provide a consistent vegetation height.

806.04 Time and Frequency

Perform litter/debris removal a minimum of twice per year or as directed by the Engineer.

Perform mowing and trimming a minimum of twice per growing season or as directed by the Engineer. The Engineer will issue a notice to begin to the Contractor at least 5 days before the date the mowing cycle is to begin.

Only perform work during the hours of daylight Monday through Saturday, or as directed by the Engineer. Do not perform this work on Sunday.

806.05 Mowing Operations

Perform all mowing to the satisfaction of the Engineer. Cut standing vegetation to a height of 4 inches while maintaining a consistent vegetation profile within the construction limits. 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. To cut vegetation, including small trees, shrubs, and bushes with a stem diameter of up to 1 inch that are inside of and encroaching upon the established mowing limits, use a mower or hand trimming methods as directed by the Engineer. Take care not to damage the trees, plants and shrubs that are designated by the Engineer to remain. Hand trimming may be required as directed by the Engineer for areas of vegetation inside the designated mowing limits that are not accessible to mechanical mowers. As

work progresses, conduct mowing and trimming to provide a consistent standing vegetation height in all mowing limits adjacent to the roadway. Mow as close as practicable to all fixed objects. Perform hand atop earth berms, within all rip rap areas, and around all fixed objects, including but not limited to earth berms, guardrails, cable rail, utility installations, utility poles, mailboxes, delineators, sign posts, wildflower plots, bridge abutments, and bridge piers. Do not apply chemicals unless authorized by the Engineer. Actual dimensions and mowing limits shall be discussed at the Preconstruction Conference.

Mowing for site distance shall be performed as frequently as necessary to provide adequate visibility and will not be considered as part of a mowing cycle.

COMPENSATION

806.06 Method of Measurement

The Department will not measure litter/debris removal for payment but will consider it incidental to the Work unless otherwise specified in the Contract.

The Department will pay for Mowing and Vegetation Removal by the mowing cycle. A mowing cycle includes the mowing of all areas within Project limits with overgrown vegetation one time.

The Department will not measure mowing for site distance but will consider it incidental to the Work.

806.07 Basis of Payment

The Department will pay for accepted quantities at the contract prices as follows:

Item	*Pay Unit*
Mowing and Vegetation Removal	Mowing Cycle

All costs associated with mowing and vegetation removal shall be included in the unit bid price for mowing. If the Contract does not contain a pay item for Mowing and Vegetation Removal, it will be incidental to other items of Work.

PART 9 – MATERIALS

SECTION 901 – HYDRAULIC CEMENT

901.01 Hydraulic Cement

Provide hydraulic cement, selected from the Department's Producer List, that 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 alkalis 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.

Use Type I, Type IL, or Type IS cement unless otherwise specified. Do not mix different types of cement.

Provide suitable means for storing and protecting the cement against dampness. The Engineer will reject cement that has become partially set or that contains lumps of caked cement.

Ensure that the temperature of the cement at the time of delivery to the mixer does not exceed 160 °F.

Do not use cement containing air-entraining materials.

SECTION 903 – AGGREGATES

903.01 Fine Aggregate for Concrete

For concrete provide aggregate conforming to AASHTO M 6, with the following exceptions and additions:

1. The option regarding alternate freeze-thaw tests for soundness is waived.

2. The fine aggregate shall be washed in the processing operations.

3. Provide fine aggregate meeting the quality requirements in **903.25**.

4. The amount of deleterious substances shall not exceed the limits specified in Table 903.01-1.

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%.

5. Provide fine aggregate that is well graded from coarse to fine within the limits specified in Table 903.01-2.

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%.

6. For use in flowable mortar, provide fine aggregate meeting the above requirements, except the gradation shall be as specified in Table 903.01-3.

Table 903.01-3: Gradation Requirements for Fine Aggregate used in Flowable Mortar

Sieve Size	Total Percent Passing by Weight
1/2 inch	100
No. 200	0-20

903.02 Fine Aggregate for Mortar

Provide mortar sand that conforms to AASHTO M 45, meets the quality requirements in **903.25**, and that is uniformly graded from coarse to fine within the limits specified in Table 903.02-1.

Table 903.02-1: Gradation Requirements for Mortar Sand

Sieve Size	Total Percent Passing by Weight
No. 8	100
No. 50	15-40
No. 100	0-10
No. 200	0-5

903.03 Coarse Aggregate for Concrete

For any type or class of Portland cement concrete, provide coarse aggregate consisting of crushed stone, crushed slag, or crushed or uncrushed gravel, unless otherwise specified.

For Portland cement concrete base and pavement, furnish coarse aggregate in two sizes: Size No. 4 and Size No. 67, graded as specified in **903.22**. Manufacture the two sizes, within the specified limits, to produce Size No. 467, in accordance with **903.22**, when combined in the proper proportions at the batching plant, or a size No. 467, manufactured within the specified limits of **903.22**.

Coarse aggregate in Portland cement concrete pavements for finished riding surfaces of travel lanes including mainline pavements and ramps shall consist of Size No. 467. Ensure that either the Size No. 4 or Size No. 67 fractions meet **903.24**. Ramps using Class A paving concrete or any riding surface travel lane consisting of Size No. 57 shall meet **903.24**.

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.

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.

For other uses of concrete, provide coarse aggregate of the sizes specified in Table 903.03-1, or as otherwise shown or directed.

Table 903.03-1: Coarse Aggregate Sizes

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 for Bridge Repair [2]	No. 57 or 67
Concrete curbing placed by machine-extrusion methods	No. 7, 57, 67, or 78
Cement treated permeable base	No. 57

[1] Gradation shall conform to **903.22**.

[2] If proposing to use a coarse aggregate size not specified submit a written request to Regional Materials and Tests explaining the necessity for the change.

The coarse aggregates shall otherwise conform to the requirements of AASHTO M 80, with the following exceptions and additions:

A. Deleterious Substances

The amount of deleterious substances shall not exceed the limits specified in Table 903.03-2.

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.

B. Quality Requirements

The coarse aggregate shall meet the quality requirements in **903.25**.

903.04 Reserved

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 aggregate or screened recycled 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 at any percentage and up to full replacement by weight per **903.05.C** or recycled 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.

Provide individual or blended materials meeting the following requirements:

1. **Crushed Stone.** Provide stone free of silt and clay and having a coarse aggregate portion (retained on the No. 4 sieve) that conforms to the requirements specified in **903.25**.

2. **Crushed Slag.** Provide material that:

    a. Is free of silt and clay,
    b. Meets the quality requirements in **903.25**,
    c. Is reasonably uniform in density, and
    d. Has a dry-rodded weight of at least 70 pounds per cubic foot.

3. **Gravel and Chert.** Screen gravel and chert. All oversize material may be crushed and fed uniformly back over the screen. The coarse aggregate portion shall conform to the quality requirements specified in **903.25**. The portion of the material passing the No. 40 sieve shall be non-plastic or shall have a liquid limit of not greater than 30 and a plasticity index of not more than 8.

If fine aggregate, coarse aggregate, or binder, in addition to that present in the base material, is necessary to meet the gradation or density requirements or to ensure satisfactory bonding of the material, blend such material uniformly with the base course material at the mixing plant by a mechanical feeder to maintain a uniform flow on the belt to the mixer. Do not blend materials on the stockpiles or in the pits using a bulldozer, clamshell, dragline, or similar equipment.

The composite gradation of Type A aggregate shall be the grading specified in the Contract or shown on the Plans and shall conform to the limits specified in Table 903.05-2.

B. Type B Aggregate

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 at any percentage and up to full replacement by weight per **903.05.C** or recycled asphalt pavement at a maximum rate of 30% by weight for Type B aggregate, provided the combined aggregate blend meets all the requirements specified. 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.

Provide Type B aggregate meeting the same requirements as specified in **903.05.A** for Type A aggregate, with the following exceptions:

1. The aggregate shall meet the quality requirements in **903.25**.

2. Screen Type B aggregate. Oversize materials may be wasted or crushed and returned over the screen and uniformly blended with the other material.

3. Do not use material having a 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:

$$\frac{\%\ \text{Passing No. 40 sieve} \times \text{P.I. of Minus No. 40 Material}}{100}$$

If an excess of binder occurs, uniformly incorporate crushed stone, crushed slag, gravel, chert, sand, or other approved granular materials in such proportions, not to exceed 20% of the total mix, as directed by the Engineer.

If the quantity of binder is insufficient to bond the base or surface course properly, uniformly incorporate additional binder of approved quality, in

an amount not to exceed 15% of the total mix, as directed by the Engineer.

Do not use material requiring the addition of coarse aggregate or binder in excess of the above limits, unless otherwise shown on the Plans or specified in the Contract.

The Contractor may blend additional material, if required, at the screening or mixing plant. When blending is done at the plant, use mechanical feeders that will maintain a uniform flow of the materials on the conveyor belt to the mixer or screening plant. Do not blend materials on the stockpile or in the pit using a bulldozer, clamshell, or similar equipment.

The composite gradation of Type B aggregate shall be the grading shown on the Plans or specified in the Contract, and shall conform to the limits specified in Table 903.05-2.

Table 903.05-2: Grading Table for Type A and Type B Aggregate for Mineral Aggregate Base and Surface Courses

Sieve Size	Total Percent by Weight, Passing Sieves				
	Grading A	Grading B	Grading C	Grading D	Grading E
2-1/2 inch	100	--	--	--	--
2 inch	95-100	100	--	--	--
1-1/2 inch	--	95-100	100	100	--
1 inch	--	--	90-100	85-100	100
3/4 inch	--	65-95	--	60-95	90-100
3/8 inch	35-65	--	45-74	50-80	65-100
No. 4	--	35-55	30-55	40-65	--
No. 16	--	15-45	--	20-40 (1)	--
No. 100	0-10	4-15	4-15	9-18 (2)	5-15

(1) For gravel and chert bases containing clay, the range is 20-43.

(2) For gravel and chert bases containing clay, the range is 7-18.

C. **Recycled Concrete Aggregate**

Provide material comprised of concrete reclaimed from the demolition of a concrete structure or pavement. Recycled 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 aggregate shall meet the quality requirements in **903.25**. 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

903.06 Aggregate for Plant Mix Base and Leveling Courses (Hot Mix)

For plant mix base and leveling courses, provide coarse aggregate, fine aggregate, and mineral filler when required.

If at any time the sources of materials are changed, prepare and submit a new mix design as specified in **407.03**.

A. Coarse Aggregate (retained on a No. 4 sieve)

Provide crushed stone, crushed granite, crushed gravel, crushed slag, or a combination of these materials. This material shall conform to the physical properties of ASTM D692 and the quality requirements of **903.25**. The aggregate shall contain no more than 5% soft or nondurable particles.

Crushed gravel shall consist of particles processed from washed material. At least 70% by count of the gravel 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.

For virgin coarse aggregate for Grading A, ACRL, and AS mixes, use crushed stone, crushed slag, or a combination of these materials.

B. Fine Aggregate (passing a No. 4 sieve)

Provide limestone fines, natural sand, sand manufactured from stone, gravel, or slag, or combinations of these materials, consisting of hard, tough grains free from injurious amounts of deleterious substances. The fine aggregate shall meet the quality requirements in **903.25**. Fine aggregate containing gypsum ($CaSO_4$) shall not chemically contain more than 5% sulfur trioxide (SO_3) as determined by analysis of the material passing the No. 8 sieve. In natural sand or sand manufactured from gravel, the percentage of material finer than No. 200 sieve shall not exceed 5%.

For use in Grading A and AS mixes, provide virgin fine aggregate consisting of crushed stone or crushed slag only, and store the material separately from the coarse aggregate.

Ensure that the amount of deleterious substances in natural sand does not exceed the limits specified in Table 903.06-1.

Table 903.06-1: Maximum Limits for Deleterious Substances in Natural Sand

Substance	Maximum Permissible Limits, Percent by Weight
Clay Lumps	0.5
Coal and Lignite	0.5
Other deleterious substances (such as shale, alkali, mica, coated grains, soft and flaky particles) and organic impurities as determined by AASHTO T 267	3.0

C. Combined Aggregate Grading

Provide the appropriate combination of coarse aggregate and fine aggregate to achieve the combined grading. Use a minimum of three sizes of virgin aggregate for all mix designs except for C, CS, and CW mixes, which shall be designed from a minimum of two sizes of virgin aggregate.

Establish a gradation for each aggregate used in the mix. Table 903.06-2 specifies the stockpile gradation tolerance on each sieve for each virgin aggregate component used in the mix.

Table 903.06-2: Stockpile Gradation Tolerance

Sieve Size	Gradation Tolerance
3/8-inch sieve and larger	± 10%
No. 4 sieve	± 7%
No. 8 sieve	± 5%
No. 30 sieve	± 4%
No. 200 sieve (coarse aggregate)	± 2%
No. 200 sieve (fine aggregate)	± 4%

When the coarse aggregate portion of Grading CW mix is crushed limestone, use no less than 20% and no more than 50% by weight natural sand, or sand manufactured from slag or other approved polish-resistant aggregate. When the coarse aggregate portion is crushed gravel or

crushed slag, between 15% and 40% by weight of the mineral aggregate shall be agricultural limestone or Size No. 10 limestone screenings.

The gradations of the coarse and fine fractions of aggregate shall be such that, when combined in proper proportions, the resultant mixture will meet one of the gradings specified in Tables 903.06-3 and 903.06-4.

Table 903.06-3: Hot Plant Mix Base Course Mixture Design Range of Gradations

Sieve Size	Total Percent Passing, by Weight			
	Grading A	**Grading AS**	**Grading ACRL**	**Grading B**
2 inch	100	100	100	100
1-1/2 inches	81-100	75-100	80-93	95-100
3/4 inch	50-71	55-80	60-75	70-85
3/8 inch	35-50	--	--	49-72
No. 4	24-36	7-11	12-16	34-51
No. 8	13-27	--	--	23-42
No. 30	7-17	--	--	11-22
No. 50	--	--	--	9-14
No. 100	0-10	0-6	0-4	4-10
No. 200	0-4.5	0-4.5	0-3.5	2.5-6.5

Table 903.06-4: Hot Plant Mix Leveling Course
Mixture Design Range of Gradations

Sieve Size	Total Per Cent Passing, by Weight				
	Grading BM	**Grading BM2 (1)**	**Grading C**	**Grading CW**	**Grading CS**
1-1/4 inch	--	100	--	--	--
1 inch	100	--	--	--	--
3/4 inch	85-100	81-93	100	100	--
3/8 inch	59-79	57-73	70-90	75-100	100
No. 4	42-61	40-56	39-66	--	89-94
No. 8	29-47	28-43	23-47	43-67	53-77
No. 30	13-27	13-25	10-27	23-47	23-42
No. 50	7-20	9-19	8-15	--	--
No. 100	4-10	6-10	4-8	4-10	9-18
No. 200	0-6.5	2.5-6.5	2.5-6.5	2.5-6.5	6-13.5

(1) When using natural sand as the fine aggregate, limit it to a maximum amount of 20% by weight of the mineral aggregate.

For asphalt treated permeable base as specified in **313**, meet the gradation requirements specified in Table 903.06-5.

Table 903.06-5: Gradation Requirements for Asphalt Treated Permeable Base

Sieve Size	Total Percent Passing by Weight
2 inch	100
1-1/2 inch	70-100
3/4 inch	55-80
No. 4	0-11
No. 100	0-4
No. 200	0-3

903.07 Reserved

903.08 Reserved

903.09 Reserved

903.10 Aggregate for Bituminous Plant Mix Surface Course (Cold Mix)

For cold bituminous plant mix, provide mix aggregate, consisting of crushed stone or crushed slag, meeting the quality requirements of ASTM D692. Crushed slag aggregate retained on the No. 4 sieve shall contain no more than 20% by weight of glassy particles.

The amount of material finer than the No. 200 sieve, as determined in accordance with AASHTO T 11, shall not exceed 1%. If all material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, this percentage may be increased to 1.5.

For leveling and surface course mixtures, provide mix aggregate meeting the gradation requirements specified in **903.22** for Size No. 68.

For key or choker aggregate, provide crushed stone, crushed slag, or crushed gravel meeting the gradation requirements specified in **903.22** for Size No. 8 and the same quality requirements as the mix aggregate.

903.11 Aggregate for Asphaltic Concrete Surface Courses (Hot Mix)

Provide aggregate, consisting of a combination of coarse and fine aggregate, and mineral filler when required or specified. Use a minimum of three sizes of virgin aggregates for all mix designs.

If at any time the sources of materials are changed, provide a new mix design as specified in **407.03.C.2**.

A. Coarse Aggregate (retained on a No. 4 sieve)

Provide aggregate, consisting of crushed stone, crushed slag, crushed gravel, crushed granite, crushed quartzite, crushed gneiss, or natural combinations of these materials. The coarse aggregate shall meet the physical requirements of ASTM D692, with the following exceptions and additions:

1. The aggregate shall meet the quality requirements in **903.25**.

2. Material retained on the No. 4 sieve shall contain a maximum of 10% by weight elongated pieces (length greater than five times the average thickness).

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.

4. Crushed slag coarse aggregate shall contain no more than 20% by weight of glassy particles.

B. Fine Aggregate (passing a No. 4 sieve)

Provide fine aggregate, consisting of natural sand, fines prepared from stone, slag, gravel, granite, quartzite, gneiss, or combinations of these materials. The fine aggregate shall meet the following requirements:

1. Fine aggregate shall consist of hard tough grains free from injurious amounts of clay, loam, or other deleterious substances.

2. Fine aggregate shall meet the quality requirements in **903.25**.

3. Manufactured sand shall have no more than 5% passing the No. 200 sieve when tested in accordance with AASHTO T 11.

4. Fine aggregate containing gypsum ($CaSO_4$) shall not chemically contain more than 5% sulfur trioxide (SO_3) as determined by analysis of the material passing the No. 8 sieve.

5. Wash and grade natural sand so that not more than 5% will be retained on the No. 4 sieve.

6. For fine aggregate consisting of natural sand, the amount of material finer than a No. 200 sieve, as tested in accordance with AASHTO T 11, shall not exceed 4% by weight.

   The amount of deleterious substances in natural sand shall not exceed the limits specified in Table 903.11-1.

Table 903.11-1: Limits of Deleterious Substances in Natural Sand used in Hot Mix

Substance	Maximum Permissible Limits Percent by Weight
Clay Lumps	0.5
Coal and Lignite	0.5
Other deleterious substances (such as shale, alkali, mica, coated grains, soft and flaky particles) and organic impurities as determined by AASHTO T 267	3.0

7. When using agricultural limestone as a portion of the fine aggregate, manufacture it from sound, durable stone that is crushed so that at least 85% will pass the No. 8 sieve and at least 50% will pass the No. 30 sieve.

C. Combined Aggregate Grading

Provide aggregate fractions sized, graded, and combined in proportions that will ensure the resulting composite blend will meet one of the

gradation requirements specified in Table 903.11-2, together with the additional requirements pertaining to the constituents of the blend specified thereafter.

Establish a single value for each sieve size required in the mix for each virgin aggregate stockpile, with an allowable stockpile tolerance on each sieve as specified in Table 903.06-2.

When using Gradings D or E for the surfacing of shoulders or for other non-traffic lane construction, the Contractor may modify the design with the Engineer's approval.

Table 903.11-2: Asphalt Concrete Surface Course Mixture Designation Design Range of Gradations

Sieve Size	Total Percent Passing by Weight				
	Grading D	Grading E	Grading TL	Grading TLD/TLE	Grading OGFC
3/4 inch	--	--	--	--	100
5/8 inch	100	100	--	--	--
1/2 inch	95-100	95-100	100	100	85-100
3/8 inch	80-93	80-93	100	90-100	55-75
No. 4	54-76	54-76	89-94	54-76	10-25
No. 8	35-57	35-57	53-77	35-57	5-10
No. 30	17-29	17-29	23-42	17-33	--
No. 50	10-18	10-18	--	10-18	--
No. 100	3-10	3-11	9-18	3-10	--
No. 200	0-6.5	0-8	6-14	3-7	2-4

1. **Grading D and TLD.** Use fine aggregate consisting of natural sand or sand manufactured from gravel, slag, or from crushed stone aggregate meeting the physical and chemical requirements specified in **903.24**. The use of carbonate rocks such as limestone and dolomite or other aggregates that tend to polish under traffic will not be permitted in the coarse aggregate and will be permitted only to the extent specified herein in the fine aggregate.

When using limestone screenings or agricultural limestone, the maximum amount by weight of the mineral aggregate shall be 25% unless the material is shown to meet the same requirements for limestone as specified in Table 903.24-1 for Surface Mixtures. In no case shall the combined aggregate blend consist of less than 75% polish-resistant material. When using natural sand as fine aggregate, limit it to a maximum amount of 25% by weight of the mineral aggregate. The Contractor may substitute a maximum of 5% mineral filler meeting the requirements of **903.16** for an equal quantity of the limestone fines. If the mixture does not comply with the design criteria, provide another source of aggregate.

When using gravel as the coarse aggregate for a 411 Grading D mix, use a minimum of 20% by weight limestone screenings, agricultural limestone, or mineral filler.

Recycled asphalt pavement (RAP) milled from Department or other State Highway Agency projects shall be assumed to contain 75% polish-resistant material.

2. Grading E and TLE. When using Grading E as a surface for traffic lanes, 50% to 80% of the mineral aggregate shall be composed of crushed limestone, and the remaining 50% to 20% shall be natural sand, slag sand, sand manufactured from gravel or other approved polish-resistant aggregates, or any combination of these materials, with the following exceptions:

a. The sand percentage on the Job Mix Formula (JMF) shall range from 20% to 50%. However, if needed to meet or improve the specified design criteria, the Contractor may alter the limestone and sand percentage by 5% from the percentage shown on the original JMF. If altering the aggregate percentages shown on the original JMF, submit a revision of the original design showing the altered percentages of aggregate.

b. When using Grading E for surfacing of shoulders or other non-traffic lane construction, the mineral aggregate may be composed entirely of limestone, including Size No. 10 (screenings) and manufactured sand, but in no case shall the mineral aggregate for this construction consist of less than 50% limestone.

c. Recycled asphalt pavement (RAP) milled from Department or other State Highway Agency projects shall be assumed to contain 75% polish-resistant material.

3. Grading OGFC. A minimum of 75% of the aggregate shall meet the requirements specified in **903.24** for Surface Mixtures (Polish-Resistant 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%.

Recycled asphalt pavement (RAP) milled from Department or other State Highway Agency projects shall be assumed to contain 75% polish-resistant material.

4. **Grading TL.** A minimum of 75% of the aggregate shall meet the requirements specified in **903.24** for Surface Mixtures (Polish-Resistant Aggregates) for the appropriate traffic level. The mixture shall contain a maximum of 15% natural sands.

Recycled asphalt pavement (RAP) milled from Department or other State Highway Agency projects shall be assumed to contain 75% polish-resistant material.

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 1,000, 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.

Recycled asphalt pavement (RAP) milled from Department or other State Highway Agency projects shall be assumed to contain 75% polish-resistant material.

903.12 Aggregate for Slurry Seal and Micro-Surface

A. Aggregate for Slurry Seal

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 meet the quality requirements in **903.25**. The aggregate shall have a minimum sand equivalent, as determined in accordance with AASHTO T 176, of 45.

Table 903.12-1: Gradation Limits for Aggregate for Slurry Seal Based on Wash Gradation

Sieve	Design Master Range (Total Percent Passing)	Mixture Control Tolerances
3/8 inch	100	
No. 4	90-100	±6.0
No. 8	65-90	±5.0
No. 16	45-70	±5.0
No. 30	30-50	±4.0
No. 50	20-38	±4.0
No. 100	12-28	±3.0
No. 200	8-16	±3.0

B. Aggregate for Micro-Surface

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 meet the quality requirements in **903.25**. 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.

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 uniform stockpile meeting the job mix formula gradation. Proportion and blending equipment shall be calibrated at the beginning of production. All aggregate sources shall be polish-resistant as specified in **903.24**. The contractor shall provide a Type A laboratory as defined by **106.06** capable of verifying gradation at the location where blending occurs.

Table 903.12-2: Gradation Limits for Aggregate for Micro-Surfacing Based on Wash Gradation

Sieve	Design Master Range (Total Percent Passing)	Mixture Control Tolerances
3/8 inch	100	
No. 4	70-98	±6.0
No. 8	45-70	±5.0
No. 16	28-50	±5.0
No. 30	19-34	±4.0
No. 50	12-25	±4.0
No. 100	7-18	±2.0
No. 200	4-15	±2.0

903.13 Aggregate for Bituminous Seal Coat

Provide aggregate consisting of crushed stone, crushed slag, or crushed gravel, meeting the physical requirements of ASTM D692, except that at least 50% by count of crushed gravel aggregates shall have at least one fractured face. The aggregate shall meet the quality requirements of **903.25**. 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.

The amount of material finer than the No. 200 sieve shall not exceed 1%. If all material finer than the No. 200 sieve consists of the dust of fracture, essentially free from clay or shale, the percentage may be increased to 1.5.

Use aggregate meeting the gradation requirements in **903.22** for the size identified on the Plans and in accordance with Table 405.06-1.

903.14 Aggregate for Double Bituminous Surface Treatment

Provide aggregate meeting **903.13**. In the mat, use aggregate meeting the gradation requirements specified for Size No. 7 in **903.22**. In the seal, use aggregate meeting the gradation requirements specified for Size No. 8 in **903.22**. Ensure that at least 90% of the aggregate particles retained on the

No. 4 sieve have one or more fractured faces fractured for the approximate average diameter or thickness of the particle.

903.15 Aggregate for Aggregate-Cement Base Course

Provide coarse aggregate, composed of sound, tough, durable fragments of crushed stone, crushed slag, crushed or uncrushed gravel, or crushed or uncrushed chert, which may be blended with crushed recycled concrete or screened recycled asphalt pavement (RAP), and fine aggregate composed of natural or manufactured sand, and silt-clay or other finely divided mineral matter.

Provide gravel or chert aggregate that is screened and of such gradation that 100% will pass a 1-1/2-inch sieve, not more than 75% will pass the No. 4 sieve, and not less than 5% nor more than 15% will pass the No. 200 sieve. The fraction passing the No. 40 sieve shall have liquid limit not greater than 35, and a plasticity index not greater than 10. Provide crushed stone or slag aggregate that is sized and proportioned to meet the gradation requirements specified in **903.05** for Grading D. Blend materials, if required, at the screening plant or at the stationary mixing plant.

Recycled concrete aggregate per **903.05.C** or recycled asphalt pavement (RAP) may be used 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 recycled asphalt pavement stockpiles free of bricks, steel, wood, and all other deleterious materials. The virgin aggregate shall meet the quality requirements specified in **903.25**.

Ensure that the combined total of shale, organic material, and other unwanted substances does not exceed 5% by weight.

903.16 Mineral Filler

Provide mineral filler conforming to AASHTO M 17, except that the mineral filler shall be non-plastic.

903.17 Aggregate for Underdrains

Provide crushed stone, crushed slag, or washed gravel meeting the physical requirements of ASTM D692, the quality requirements of **903.25**, and the gradation requirements specified for Size 6, 7, 8, 57, or 78 in **903.22**.

903.18 Reserved

903.19 Lightweight Aggregates for Structural Concrete

Provide lightweight aggregate conforming to AASHTO M 195, with the following additions:

1. Produce the lightweight aggregate by fusing raw shale, slate, or clay in a rotary kiln.

2. The lightweight coarse aggregate shall conform to the gradation requirements for size 3/4 inch to No. 4, as shown in Table 1 of AASHTO M 195.

3. The aggregate shall meet the quality requirements in **903.25**.

4. Concrete with approximately 6% air content made from the aggregate shall have a minimum durability factor of 90% when tested in accordance with AASHTO T 161.

5. Use material listed on the Department's Producer List.

903.20 Stockpiling Aggregates

Clean and grub sites for aggregate stockpiles before storing aggregates, and ensure the ground is firm, smooth, and well-drained. Maintain a cover of at least 3 inches of aggregate to prevent contamination by soil or foreign material. Build the stockpiles in layers not exceeding 4 feet in height and have each layer completely in place before starting the next layer to prevent segregation. Deposit the material to prevent coning, except in the case of aggregate composed essentially of material finer than the No. 4 sieve and base material.

Do not dump, cast, or push material over the sides of stockpiles, except in the case of aggregate for base material and fine aggregate materials.

Unless otherwise approved, store aggregates from different sources or of different gradings, or that differ in specific gravity by more than 0.03, in separate stockpiles. To prevent the aggregates from mixing, either locate stockpiles of different types or sizes of aggregates far enough apart or separate them with suitable walls or partitions.

When building stockpiles, only operate trucks or other equipment on a stockpile in a manner approved by the Engineer. Use stockpiling methods that will prevent both excessive degradation of the aggregate and contamination of the stockpile with foreign matter. The Engineer will determine excessive degradation by conducting sieve tests of samples taken from any portion of the stockpile over which equipment has operated; failure of such samples to meet all gradation requirements for the aggregate is cause for discontinuing such stockpiling procedure.

903.21 Test Methods

In stating requirements for most materials in **903**, reference has been made to AASHTO and ASTM Standard Specifications for materials. The current AASHTO or ASTM Standard Specification effective at the time of letting for a Contract shall be the governing specification. Those Specifications, in turn, include reference to the respective AASHTO and ASTM methods of sampling and testing. In a few instances, however, properties of materials in **903** have been specified without reference to corresponding AASHTO and ASTM Standard Specifications. In such instances, the methods of sampling and testing specified in Table 903.21-1 will govern.

Table 903.21-1: Aggregate Sampling and Testing Methods

Test	Test Method
Unit Weight	AASHTO T 19
Percentage of Wear	AASHTO T 96
Soundness	AASHTO T 104
Liquid Limit	AASHTO T 89
Plastic Limit and Plasticity Index	AASHTO T 90
Sieve Analysis	AASHTO T 27
Hydrometer Analysis	AASHTO T 88
Material Passing No. 200 Sieve in Aggregate	AASHTO T 11
Ten Minute Boil Test	**407.03.E.2**
Resistance to Plastic Flow by Marshall Method	AASHTO T 245 [(1)]

[(1)] Use a mechanically operated hammer with a rotating base. The compaction hammer shall have a slanted, circular tamping face. The slant on the face shall be 1.6% + 0.0/-0.1.

903.22 Sizes of Coarse Aggregate

Provide coarse aggregate meeting the gradation requirements of AASHTO M 43.

Table 903.22-1: Standard Sizes of Processed Aggregate

Size	Nominal Size, Square Openings	Amounts Finer than Each Laboratory Sieve (Square Openings), Percent by Weight																
		4"	3-1/2"	3"	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No.4	No.8	No.16	No.50	No.100
1	3-1/2" - 1-1/2"	100	90-100	--	25-60	--	0-15	--	0-5	--	--	--	--	--	--	--
2	2-1/2" - 1-1/2"	--	--	100	90-100	35-70	0-15	--	0-5	--	--	--	--	--	--	--
24	2-1/2" - 3/4"	--	--	100	90-100	--	25-60	--	0-10	0-5	--	--	--	--	--	--
3	2"-1"	--	--	--	100	90-100	35-70	0-15	--	0-5	--	--	--	--	--	--
357	2" - No. 4	--	--	--	100	95-100	--	35-70	--	10-30	--	0-5	--	--	--	--
4	1-1/2" - 3/4"	--	--	--	--	100	90-100	20-55	0-15	--	0-5	--	--	--	--	--
467	1-1/2" - No. 4	--	--	--	--	100	95-100	--	35-70	--	10-30	0-5	--	--	--	--
5	1" - 1/2"	--	--	--	--	--	100	90-100	20-55	0-10	0-5	--	--	--	--	--
56	1" - 3/8"	--	--	--	--	--	100	90-100	40-85	10-40	0-15	0-5	--	--	--	--
57	1" - No. 4	--	--	--	--	--	100	95-100	--	25-60	--	0-10	0-5	--	--	--
6	3/4" - 3/8"	--	--	--	--	--	--	100	90- 100	20-55	0-15	0- 5	--	--	--	--
67	3/4" - No. 4	--	--	--	--	--	--	100	90-100	--	20-55	0-10	0-5	--	--	--
68	3/4" - No. 8	--	--	--	--	--	--	100	90-100	--	30-65	5-25	0-10	0-5	--	--
7	1/2" - No. 4	--	--	--	--	--	--	--	100	90-100	40-70	0-15	0-5	--	--	--
78	1/2" - No. 8	--	--	--	--	--	--	--	100	90-100	40-75	5-25	0-10	0-5	--	--
8	3/8" - No. 8	--	--	--	--	--	--	--	--	100	85-100	10-30	0-10	0-5	--	--
89	3/8" - No. 16	--	--	--	--	--	--	--	--	100	90-100	20-55	5-30	0-10	0-5	--
9	No. 4 - No. 16	--	--	--	--	--	--	--	--	--	100	85-100	10-40	0-10	0-5	--
10	No. 4 – 0 (1)	--	--	--	--	--	--	--	--	--	100	85-100	--	--	--	10-30

(1) Screenings

903.23 Reserved

903.24 Aggregates for Riding Surfaces (Polish-Resistant Aggregates)

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.

Table 903.24-1: Quality Requirements for Type I, II, III, and IV Aggregate

Aggregate Property	Test Method	Type I (all roads)	Type II (all roads)	Type III (15,000 ADT max, excluding Interstates)	Type IV (5,000 ADT max)
Silica Dioxide Content, % min	ASTM C25	40%	30%	20%	10%
Calcium Carbonate Content, % max		32%	--	--	--
Acid Insoluble Residue, % min	ASTM D3042	50%	35%	25%	--
British Pendulum Number,[(1)] min	AASHTO T 278 AASHTO T 279	30	30	25	22

[(1)] After 9 hours of accelerated polishing using the British Wheel in accordance with AASHTO T 279

In addition to the requirements specified in Table 903.24-1, Type II, III, and IV aggregates shall have met the preapproval process of the Division of Materials and Tests. All aggregate types must also maintain a satisfactory level of field performance to remain an approved source.

Process and stockpile the material as an independent and separate operation. The Engineer will sample and test each stockpile for approval prior to use.

903.25 Aggregate Quality Requirements

Table 903.25-1: Fine Aggregate Quality Requirements

Application	Sodium Sulfate Soundness Loss AASHTO T 104, %max	L A Abrasion AASHTO T 96, %max	Absorption AASHTO T 84, %max
Concrete (**903.01**)	10	40 [(1)]	N/A
Mortar (**903.02**)	10	N/A	N/A
Hot Mix Asphalt Mix Base and Leveling Courses (**903.06**)	12	40 [(1)]	N/A
Hot Mix Asphalt Surface Courses (**903.11**)	12	40 [(1)]	N/A
Slurry Seal (**903.12**)	12	40 [(1)]	N/A
Microsurface (**903.12**)	12	40 [(1)]	N/A

[(1)]Applicable for fine aggregate manufactured from limestone or dolomite.

Table 903.25-2: Coarse Aggregate Quality Requirements

Application	Sodium Sulfate Soundness Loss AASHTO T 104, %max	L A Abrasion AASHTO T 96, %max	Absorption AASHTO T 85, %max
Concrete (**903.03**)	9	40	5
Mineral Aggregate Base – Type A (**903.05**)	15	50	N/A
Mineral Aggregate Base – Type B (**903.05**)	20	50	N/A
Recycled Concrete Aggregate (**903.05**)	N/A	50	N/A
Hot Mix Asphalt Mix Base and Leveling Courses (**903.06**)	9	50	5 [(1) (2)]
Hot Mix Asphalt Surface Courses (**903.11**)	9	40	5 [(1) (3)]
Bituminous Seal Coat (**903.13**)	12	40	N/A
Double Bituminous Surface Treatment (**903.14**)	12	40	N/A
Aggregate Cement Base Course (**903.15**)	15	50	N/A
Underdrains (**903.17**)	12	50	N/A
Lightweight Concrete (**903.19**)	9	40	10
Machined Riprap (**709.02**)	12	N/A	N/A
Graded Solid Rock (**203.02**)	12	N/A	N/A
Solid Rock (**203.02**)	12	N/A	N/A
Masonry Stone (**921.07**)	12	N/A	N/A

[(1)] To be based on the properties of the combined coarse aggregate blend.

[(2)] For Grading CW only.

[(3)] Maximum absorption for OGFC is 3.0%.

SECTION 904 – BITUMINOUS MATERIALS

904.01 Asphalt Cements

Only obtain asphalt cement for use on Department projects from Certified Asphalt Suppliers that are on the Department's Producer List.

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, properly blend one or more modifier(s) consisting styrene butadiene (SB), styrene butadiene styrene (SBS), styrene butadiene rubber (SBR), or Ground Tire Rubber (GTR) to a PG 64-22 or PG 67-22 base asphalt. The use of Re-refined Engine Oil Bottoms (REOB) or Vacuum Tower Asphalt Extender (VTAE) is prohibited.

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.

Polyphosphoric acid may be used as a modifier but shall not exceed 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.

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 T 53), between the top and bottom thirds of a specimen prepared per ASTM D7173.

In addition to the above requirements, the 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 3.2 kPa, 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 T 350.

** Shall be waived if Jnr(3.2) is equal to or less than 0.5

PG 76-22 and PG 82-22 grade asphalts shall meet the requirements for Indication of Elastic response as defined in AASHTO R 92. PG 70-22 grade asphalts shall have a minimum percent recovery at 3.2 kPa of 29%.

Furnish certifications to the Engineer for all shipments utilized in the work, 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.

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.

904.02 Reserved

904.03 Emulsified Asphalts

Provide emulsified asphalts meeting the test requirements specified in Table 904.03-1.

Table 904.03-1(a): Test Requirements for Emulsified Asphalt

Practices	AASHTO Test Method	CAE-P	CSS-1	CSS-1H	SS-1H	CQS-1H
Saybolt-Furol Viscosity @ 77 °F, seconds	T59	10-50	20-100	20-100	20-100	20-100
Saybolt-Furol Viscosity @ 122 °F, seconds	T59	n/a	n/a	n/a	n/a	n/a
Storage Stability Test, 24-h, %	T59	1 Max	1 Max	1 Max	1 Max	n/a
5-day Settlement, %	T59	n/a	n/a	n/a	n/a	n/a
Particle Charge	T59	Positive	Positive	Positive	n/a	Positive
Sieve Test, %	T59	0.1 Max	0.1 Max	0.1 Max	0.1 Max	0.1 Max
Residue by	T59	Distillation	Distillation	Distillation	Distillation	Distillation
Residue, %	T59	n/a	57 Min	57 Min	57 Min	62 Min
Demulsibility, %	T59	n/a	n/a	n/a	n/a	n/a
Distillate, %	T59	55 Max	n/a	n/a	n/a	n/a
Oil Test, %	T59	12 Max	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	300 Min	100-250	40-90	40-90	40-90
Elastic Recovery, % [(1)]	T301	n/a	n/a	n/a	n/a	n/a
Ductility @ 77 °F, cm	T51	40 Min	40 Min	40 Min	40 Min	40 Min
Ductility @ 40 °F, cm	T51	n/a	n/a	n/a	n/a	n/a
R&B Softening Point, °F	T53	n/a	n/a	n/a	n/a	n/a
Original G*/sind @ 82 °C	T315	n/a	n/a	n/a	n/a	n/a

[(1)] Straight-sided mold, 20-cm elongation, 5 min hold, 25 °C

Table 904.03-1(b): Test Requirements for Emulsified Asphalt

Practices	AASHTO Test Method	CQS-1HP	SS-1	AEP	CRS-2	AE3
Saybolt-Furol Viscosity @ 77 °F, seconds	T59	20-100	20-100	10-50	n/a	n/a
Saybolt-Furol Viscosity @ 122 °F, seconds	T59	n/a	n/a	n/a	100-400	50 Min
Storage Stability Test, 24- h, %	T59	n/a	1 Max	n/a	1 Max	n/a
5-day Settlement, %	T59	n/a	n/a	5 Max	n/a	5 Max
Particle Charge	T59	Positive	n/a	n/a	Positive	n/a
Sieve Test, %	T59	0.1 Max	0.1 Max	0.1 Max	0.1 Max	n/a
Residue by	T59	Distillation[1]	Distillation	Distillation	Distillation	Distillation
Residue, %	T59	62 Min	57 Min	n/a	65 Min	n/a
Demulsibility, %	T59	n/a	n/a	n/a	40 Min	n/a
Distillate, %	T59	n/a	n/a	55 Max	n/a	30 Max
Oil Test, %	T59	n/a	n/a	12.0 Max	3.0 Max	6.0 Max
Stone Coating	T59	n/a	n/a	n/a	n/a	90 Min
Float Test, seconds	T50	n/a	n/a	20 Min	n/a	200 Min
Penetration	T49	40-90	100-200	n/a	100-250	n/a
Elastic Recovery, % [2]	T301	n/a	n/a	n/a	n/a	n/a
Ductility @ 77 °F, cm	T51	70 Min	40 Min	n/a	40 Min	n/a
Ductility @ 40 °F, cm	T51	n/a	n/a	n/a	n/a	n/a
R&B Softening Point, °F	T53	135 Min	n/a	n/a	n/a	n/a
Original G*/sind @ 82 °C	T315	n/a	n/a	n/a	n/a	n/a

[1] Distill at 350 °F

[2] Straight-sided mold, 20-cm elongation, 5 min hold, 25 °C

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
Elastic Recovery, % [(1)]	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

[(1)] Straight-sided mold, 20-cm elongation, 5min hold, 25 °C

The producer may conduct a 24-hour (1% Max) storage stability test instead of the 5-day settlement test if the emulsions are to be used within 5 days.

Obtain emulsified asphalts for use on Department projects from Certified Emulsified Asphalt Suppliers that are on the Department's Producer List.

All emulsified asphalts shall be homogeneous and shall adhere firmly to the surface of the mineral aggregate. Failure of the emulsified asphalt to perform satisfactorily on the job is cause for rejection, regardless of its ability to pass laboratory tests.

Use the AE-3 of such stability that it will remain constant and uniform while being mixed with dry or approximately dry aggregate, and that will thoroughly and uniformly coat the entire surface of each fragment while being manipulated and incorporated into the Work. The emulsified asphalt after being incorporated into the Work shall show no signs of re-emulsifying.

Use latex, polymer, and other emulsifiers of styrene butadiene rubber (SBR) or natural latex when manufacturing CQS-1hp. Mill such emulsifiers into the asphalt cement to show no separation after mixing.

When using modified emulsions in micro-surface mixtures, the blended mixture when combined with aggregate and mineral filler shall be:

1. Capable of filling up to 1/2 inch wheel ruts in one pass;
2. Capable of field regulation of the setting time; and
3. Suitable for nighttime placement.

Combine the latex with the asphalt emulsion at the emulsion mill to produce a homogeneous mixture. Latex modified emulsions, upon standing undisturbed for a period of 24 hours, shall have a uniform color throughout, showing no color striations.

SECTION 905 – JOINT MATERIALS

905.01 Preformed Joint Fillers (Non-Extruding and Resilient Types)

Provide preformed joint fillers 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.

C. Polypropylene Foam Type

Provide semi-rigid, closed-cell, polypropylene foam, preformed expansion joint filler conforming to ASTM D8139.

905.02 Joint Mortar

Provide pipe joint mortar consisting of one part Portland cement and two parts sand, adding water as necessary to obtain the required consistency. Use Portland cement conforming to the requirements of **901.01**, Type I, and sand

conforming to the requirements of **903.02**. Obtain the Engineer's approval of the water quality. Use mortar within 30 minutes after its preparation.

905.03 Rubber Gaskets

Provide gaskets conforming to ASTM C443.

905.04 Hemp or Oakum Gaskets

Provide gaskets of hemp or oakum packing for joint filler that are closely twisted, and of the size and type required for the pipe under construction. Gaskets shall be in one piece of sufficient length to pass around the pipe and lap.

905.05 Joint Sealants

A. Sealing Longitudinal Joints between Portland Cement and Asphaltic Concrete

To seal the longitudinal joint between Portland cement and asphaltic concrete, use hot-poured elastic type sealants that comply with the following requirements:

1. Use hot poured elastic type sealants conforming to ASTM D6690, with the following exceptions:

    a. The joint sealer shall be a mixture of virgin synthetic rubber, reclaimed rubber, or a combination of these materials with asphalt and plasticizers and tackifiers.

    b. Do not use ground cured rubber scrap.

    c. The sealer shall be free of foreign material and, when melted, free of lumps.

    Furnish the Engineer a certified statement from the manufacturer indicating compliance with the above composition.

2. The flow at 140 °F shall not exceed 0.4 inch in 5 hours. Ductility at 77 °F shall be not less than 16 inches, when tested in accordance with AASHTO T 51.

3. Furnish the Engineer a certified copy of the test results, showing the batch number and indicating that the material supplied conforms to the requirements of the specifications.

B. Sealing Longitudinal and Transverse Joints and Random Cracks in PCC Pavement

To seal longitudinal and transverse joints and random cracks in Portland cement concrete pavement, use one of the following materials, as shown on the Plans:

1. Hot poured elastic type sealant meeting the requirements of **905.05.A**.

2. Silicone sealant having a low modulus silicone that is specially manufactured to seal Portland cement concrete pavements joints. Furnish silicone sealant in a one part silicone formulation that is non-acid curing and meets the requirements specified in Table 905.05-1.

Table 905.05-1: Requirements for Silicone Sealants

Property	Test Method	Value
Flow	MIL S 8802	5 inches, maximum
Extrusion rate	MIL S 8802	90-250 grams per minute
Tack free time (1)	SAE-AMS-S-8802	35-75 minutes
Specific gravity	ASTM D792, Method A	1.010-1.515
Durometer hardness Shore A (1)	ASTM D2240	10-25
Joint movement and tensile stress at 150% elongation (1)	ASTM D 412, Die C	± 50% joint movement; 75 psi maximum tensile stress
Peel (Adhesion): Unprimed aluminum panel with aluminum screen (1)	MIL S 8802	20 pounds, minimum,with at least 75% cohesive failure
Bond to concrete mortar concrete briquets air cured 7 days at 77 ± 3 °F (2)	AASHTO T 132	50 psi, minimum

(1) 7-day cure at 77 ± 3 °F and 45-55% relative humidity

(2) Determine the bond to concrete mortar by molding briquets in accordance with AASHTO T 132, sawed in half and bonded with a thin section of sealant. Test the briquets in accordance with AASHTO T 132. Dry briquets to constant weight in an oven at 212 ° ±40 °F.

If shown on the Plans, provide a backer rod (bond breaker) that is compatible with the sealant and will ensure no bond or reaction will occur between the rod and the sealant.

Use joint fillers and sealants selected from the Department's QPL. Certify that the product meets the applicable specifications and that the material is identical to that previously tested and placed on the QPL.

The Department reserves the right to perform any testing deemed necessary to ensure compliance with these Specifications.

SECTION 906 – DAMPPROOFING AND WATERPROOFING MATERIALS

906.01 General

This Section covers materials used in dampproofing and waterproofing concrete surfaces.

Provide the Class of waterproofing shown on the Plans or as otherwise specified or directed.

906.02 Class I Dampproofing and Waterproofing

Provide materials conforming to the following:

1. Asphalt seal for use below ground level: ASTM D449, Type I

2. Asphalt seal for use above ground level: ASTM D449, Type II or Type III, as specified

3. Bituminous fabric: ASTM D173

906.03 Class II Dampproofing and Waterproofing

Provide materials conforming to the following:

1. Asphalt seal for use below ground level: ASTM D449, Type I

2. Asphalt seal for use above ground level: ASTM D449, Type II or Type III, as specified

3. Bituminous fabric: ASTM D173

4. Plain asphalt plank: ASTM D517, Type I

906.04 Bridge Deck Sealants

A. System A

1. Membrane. Provide a membrane laminate formed with suitably plasticized coal tar and reinforced with non-woven synthetic fibers or glass fibers. The membrane shall be a uniformly well-manufactured product, free from blemishes, discontinuities, and other defects. Furnish the membrane in rolls, having a width of 30 or 48 inches or other widths as approved by the Engineer. Ensure that the membrane conforms to the requirements specified in Table 906.04-1.

Table 906.04-1: Requirements for Membrane (System A)

Property	Test Method	Value
Thickness	-	70 ± 5 mils
Pliability 180-degree Bend over 1/4-inch mandrel at -25 °F	ASTM D146	No cracks
Softening Point (minimum)	ASTM D36 (R & B)	230 °F

2. Mastic. Use a cold-applied type mastic, recommended by the membrane manufacturer, that is compatible with the membrane.

B. System B

1. Membrane. Provide a laminate of rubberized asphalt, reinforced with synthetic fibers or mesh. The membrane shall be a uniformly well-manufactured product, free from blemishes, discontinuities, and other defects. Furnish membrane in rolls having a width of 36 inches or other widths as approved by the Engineer. Ensure that the membrane conforms to the requirements specified in Table 906.04-2.

Table 906.04-2: Requirements for Membrane (System B)

Property	Test Method	Value
Thickness (minimum	--	65 mils
Tensile strength (minimum)	ASTM D882	300 psi
Elongation at Break (minimum)	ASTM D882	150%
Pliability 180-degree Bend over 1/4-inch mandrel at -25 °F	ASTM D146	No cracks
Peel Adhesion, 7 days at 120 °F +7 days water immersion (minimum)	TT-S-00230 Modified	5 psi

2. Mastic. Use a cold-applied type mastic, recommended by the membrane manufacturer, that is compatible with the membrane.

Provide bridge deck sealants listed on the Department's QPL. Prior to approval and use of the materials for bridge deck sealant, submit to the Materials and Test Engineer a notarized certification by the formulator of these materials, stating that the materials proposed for use, or materials of identical formulation, have been tested and meet all the specified requirements. Include with this notarized certification a certified laboratory test report, containing numerical test data of all the specified requirements, for the materials, or materials of identical formulation, proposed for use, and a sample of the proposed materials for preliminary evaluation. The approval granted based on these certifications will remain in effect until such time that the formulation is changed or the Materials and Tests Engineer requires, at its discretion, requalification of the materials for use, in which event the qualifying procedure shall be repeated.

Submit a certification from the manufacturer of the materials with each subsequent shipment of materials. The certification shall identify the shipment by lot or batch number, state the quantity of material shipped, and state that the material is identical to a lot or batch number (designate) that the Department previously qualified for use.

The Department reserves the right to require samples of all materials to be submitted to the Laboratory for testing.

SECTION 907 – CONCRETE REINFORCEMENT

907.01 Bar Reinforcement for Concrete Structures

Unless otherwise specified, for all steel reinforcement for concrete, provide billet steel bars conforming to the requirements of ASTM A615, Grade 60. Use standard CRSI hook details unless otherwise shown on the Plans. Provide epoxy-coated reinforcing steel that is listed on the Department's QPL.

Package, in an airtight container, a representative 8-ounce sample of the coating material from each batch, identify it by batch number, and furnish to the Engineer. In addition, for repair of any damage incurred during shipment or installation, the fabricator initially shall furnish to the Project a repair kit containing a touch-up roller and 16 ounces of touch-up coating material with each shipment of epoxy coated reinforcing steel, with additional supplies being furnished as needed.

Provide metal chairs and supports coated with plastic, epoxy, or other approved material that is chemically and electrically inert in concrete. Provide plastic-coated tie wires for use with epoxy-coated reinforcing steel. Obtain the Engineer's approval of such tie wires before use.

907.02 Dowel and Tie Bars

Provide plain dowel bars conforming to ASTM A36 or A615. Use paint meeting the requirements of SSPC Paint Specification No. 15, Type 1 (red oxide paint) or SSPC Paint Specification No. 25. For plastic coated dowels, meet the coating requirements of AASHTO M 254. For epoxy coated dowels, meet the coating requirements of ASTM D3963.

Provide bond breakers, of the type recommended by the coating manufacturer, for all dowel bars except for Type A coated dowels conforming to AASHTO M 254.

Provide deformed tie bars conforming to ASTM A615.

907.03 Welded Wire Reinforcement

Provide welded wire reinforcement conforming to ASTM A1064. Refer to the Plans for gauges, spacing, and arrangement of wires and coating.

907.04 Prestressing Reinforcement Steel and Anchorages

Assign a lot number to all wire, strand, and bars, and tag them for identification purposes. Likewise, identify anchorage assemblies, and provide certification that the assemblies meet the Post-Tensioning Institute's *Acceptance Standards for Post-Tensioning Systems*.

Furnish a minimum of two samples from each lot or shipment received. Furnish additional samples as directed by the Engineer.

The Engineer will base acceptance of the steel on the results of physical tests conducted by the Department and a manufacturer's certification showing results of the required tests, including stress-strain curves representative of the lot to be used.

Provide wire that is free from injurious defects and that has a workmanlike finish with a smooth surface. The Engineer will reject material that shows injurious defects during or prior to its installation in the Work.

In addition to the above, the prestressing steel and anchorages for post-tensioned tendons shall comply with the following requirements:

A. Seven-Wire Strand for Prestressed Concrete

Provide strand conforming to ASTM A416 for the Grade specified. The strand manufacturer shall certify that the strand has been tested and will bond to concrete of normal strength and consistency in conformance with the prediction equations for transfer and development lengths given in ACI/AASHTO Specifications.

B. Parallel Wire Assemblies for Post-Tensioning

Provide assemblies consisting of parallel wires of the number and size shown on the Plans. Wires shall be high-tensile, hard-drawn, stress-relieved, and uncoated, and shall conform to ASTM A421.

C. Bars for Post-Tensioning

Stress-relieve high tensile strength alloy bars, and then cold-stretch to a minimum of 130,000 pounds per square inch. After cold-stretching, the bars shall meet the physical properties specified in Table 907.04-1.

Table 907.04-1: Physical Properties for Post-Tensioning Bars

Property	Value
Minimum ultimate tensile strength	145,000 psi
Minimum yield strength, measured by the 0.7% extension-under-load method	130,000 psi
Minimum modulus of elasticity	25,000,000 psi
Minimum elongation in 20 bar diameters after rupture	4%
Diameter tolerance	+0.03 inch/-0.01 inch

D. Anchorages for Post-Tensioned Tendons

1. **For Bars.** Use wedge type anchorages that will develop the minimum ultimate stress specified for the nominal bar area. Wedge type anchorages shall bear against anchorage plates fabricated of hot rolled steel of type and quality approved by the Engineer.

2. **For Parallel Wire Assemblies.** Unless otherwise specified, use wedge type anchorages of the sandwich plate or conical type, that can develop the ultimate strength of the total number of wires anchored. Embed conical type anchorages within the ends of the concrete members unless otherwise specified. Generally, anchorages shall bear against embedded grids of reinforcing steel approved by the Engineer.

3. **Alternate Types.** The Contractor may use alternate anchorage types conforming to the general physical requirements specified above for wedge type anchorages if approved by the Engineer.

   Before obtaining the Engineer's approval, demonstrate alternate type anchorages are capable of withstanding at least 3,000,000 cycles of twice the maximum live load stress.

SECTION 908 – STRUCTURAL STEEL AND APPURTENANT MATERIALS

908.01 Structural Steel

Unless otherwise specified, provide steel plate conforming to ASTM A709, Grade 50 or 50W, and bar stock and rolled shapes conforming to ASTM A709 Grade 50S.

908.02 Plate for Cold Working

Provide plate, that is to be bent or formed cold during fabrication, that conforms to ASTM A283, Grade C.

908.03 Permanent Steel Bridge Deck Forms

Fabricate permanent steel bridge deck forms and supports from steel conforming to ASTM A653 (SS Grades 33 through 80) and having a coating Class G 165 in accordance with ASTM A653.

908.04 High Strength Structural Bolts

Provide bolts, nuts, and washers that are manufactured in the United States, from steel smelted and manufactured in the United States, and that conform to the following requirements:

A. Specifications

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. Provide bolts, nuts, and washers that conform to the following requirements:

1. **Bolts.** ASTM F3125, Grade 325 and Grade 490 – High Strength Bolts for Structural Joints.

2. **Nuts.** ASTM A563 - Carbon and Alloy, heat treated Steel Nuts, Grades DH and DH3.

3. **Washers**

    a. ASTM F436 – Hardened Steel Washers.
    b. ASTM F959 – Compressible Washer Type Direct Tension Indicators for Use with High Strength Bolts.

B. Manufacturing

1. **Bolts.** Hardness for bolt diameters 1/2 to 1 inch inclusive shall be as specified in Table 908.04-1.

Table 908.04-1: Hardness Number

Bolt Size	Brinell		Rockwell C	
	Min	Max	Min	Max
1/2 to 1 inch	248	311	24	33

2. Nuts. Provide plain nuts of grades DH or DH3, and galvanized nuts of grade DH.

3. Marking. Mark all bolts, nuts, and washers in accordance with the appropriate AASHTO/ASTM Specifications.

C. Testing

Only provide high strength bolts, nuts, and washers that have been certified to have met the specified tests identified in their individual ASTM Specification designations, both as individual components, and as assemblies (bolts, nuts, and washers).

1. Bolts

a. Perform proof load tests, in accordance with ASTM F606 Method 1, at the minimum frequency of testing specified in ASTM A325 paragraph 9.2.4.

b. Perform wedge tests on full size bolts, in accordance with ASTM F606 paragraph 3.5, at the minimum frequency of testing specified in ASTM A325 paragraph 9.2.4.

2. Nuts. Perform proof load tests, in accordance with ASTM F606 paragraph 4.2, at the minimum frequency of testing specified in ASTM A563 paragraph 9.

3. Assemblies. The manufacturer or distributor shall perform rotational-capacity tests on all bolt, nut, and washer assemblies prior to shipping as specified in **602.17.E.1** and **602.17.E.2**.

Perform this testing for complete assemblies each day at the site of bolting in accordance with the following:

a. Except as modified herein, perform the rotational-capacity test in accordance with the requirements of ASTM F3215 Grade A325.

b. Test each combination of bolt production lot, nut lot, and washer lot as an assembly. Where washers are not required by the installation procedures, do not include them in the lot identification.

c. Assign a rotational-capacity lot number to each combination of lots tested.

d. Test a minimum of two assemblies per rotational-capacity lot.

e. Assemble the bolt, nut, and washer assembly in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device (note - this requirement supersedes the current ASTM F3125 Grade A325 requirement that the test be performed in a steel joint). For short bolts that are too short to be assembled in the Skidmore-Wilhelm Calibrator, see **908.04.C.3.i**.

f. 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.)

g. The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension as specified in Table 908.04-3.

Table 908.04-3: Installation Tension and Turn Test Tension

Bolt Diameter (inches)	Required Installation Tension (kips)	Turn Test Tension (kips)
1/2	12	14
5/8	19	22
3/4	28	32
7/8	39	45
1	51	59
1-1/8	56	64
1-1/4	71	82
1-3/8	85	98
1-1/2	103	118

h. After the required installation tension, as specified in Table 908.04-3 has been exceeded, take and record one reading of tension and torque. The torque value shall conform to the following:

$$\text{Torque} < 0.25\,PD$$

Where:

Torque = measured torque (foot-pounds)
P = measured bolt tension (pounds)
D = bolt diameter (feet)

i. Bolts that are too short to test in a Skidmore-Wilhelm Calibrator may be tested in a steel joint. The tension requirement of **908.04.C.3.g** shall not apply. Compute the maximum torque requirement, as specified in **908.04.C.3.h**, using a value of P equal to the turn test tension shown in Table 908.04-3.

D. Documentation

1. Mill Test Report(s) (MTR)

a. Furnish MTR for all mill steel used in the manufacture of the bolts, nuts, and washers.

b. In the MTR, indicate the place where the material was melted and manufactured.

2. Manufacturer Certified Test Report(s) (MCTR)

a. Provide MCTR from the manufacturer of the bolts, nuts, and washers for the items furnished.

b. Each MCTR shall show conformance to all applicable test requirements, the sites where tests were performed, and the date of the tests.

c. In addition to the requirements of **908.04.D.2.a** and **908.04.D.2.b**, the manufacturer performing the rotational-capacity test shall include on the MCTR:

1. The lot number of each of the items tested.
2. The rotational-capacity lot number as required in **908.04.C.3.c**.
3. The results of tests required in **908.04.C.3**.
4. The location where the bolt assembly components were manufactured.

3. Distributor Certified Test Report(s) (DCTR)

a. The DCTR shall include the MCTR data required in **908.04.D.2** above for the various bolt assembly components.

b. The DCTR shall report the rotational-capacity test performed by the distributor or manufacturer.

E. Shipping

Ship bolts, nuts, and washers from each rotational-capacity lot in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Permanently mark each container with the rotational-capacity lot number to allow identification at any stage before installation.

908.05 Cast Steel

Provide steel castings conforming to ASTM A27, Grade 65-35.

908.06 Steel Forgings

Provide steel forgings conforming to ASTM A668, Class C1, Annealed. The manufacturer shall furnish the Engineer a record of the annealing charges, showing the forgings in each charge, the melt or melts from which they were secured, the chemical analyses of the respective melts, and the details of the annealing treatment.

908.07 Gray Iron Castings

Provide castings of the type specified and within reasonably close conformity with the dimensions shown on the Plans. The castings shall conform to AASHTO M 105, with the following additions:

1. Unless otherwise specified, all castings shall be Class 30.

2. Cast test bars for tension testing in accordance with AASHTO M 105, Table 2, Test Bar B.

3. Clean all castings of sand and scale by sand blasting or other effective methods to present a smooth, clean, and uniform surface.

4. Cast the date of manufacture into all gray iron castings.

5. The lid and lid seat of the rim of manhole castings shall be machined to form a true bearing.

6. All castings shall weigh at least 95% of the theoretical weight shown on the Plans.

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.

908.08 Malleable Castings

Provide castings conforming to ASTM A47, Grade 35018.

908.09 Bronze Bearing Plates, Plain

Provide plates conforming to ASTM B22, Alloy UNS No. C 91100, or ASTM B100, Alloy No. 510.

908.10 Bronze Bearing Plates, Self-Lubricating

Prepare plates from metal conforming to **908.09**. Provide plates with trepanned or drilled recesses (not grooves) to the extent of not less than 25% of their surface areas. The recesses shall be filled by pressure to produce dense non-plastic, lubricating inserts consisting of graphite and metallic substances, held together by a lubricating binder. With each lot of plates, the manufacturer shall supply additional lubricating material in stick form for applying to the surfaces of the steel plates that bear on and move over the lubricating bronze plates.

Furnish the plates from standard production stock by approved manufacturers.

908.11 Corrosion Resistant Steel

Provide corrosion resistant steel conforming to ASTM A588.

Furnish the Engineer a certification from the manufacturer that covers each heat number to be used in the Work and that clearly shows that all requirements of this Specification have been met.

908.12 Elastomeric Bearing Pads

For use as bearings for bridge beams, provide elastomeric bearing pads conforming to Section 18 of the AASHTO LRFD Bridge Construction Specifications.

Unless otherwise specified, provide bearing pads having a shear modulus between 0.080 and 0.175 ksi.

The manufacturer shall provide certified reports on the lot from which each shipment is made, based on tests conducted in its own laboratory or a commercial laboratory designated or approved by the Engineer.

908.13 Copper Sheet for Flashing

Provide sheet copper conforming to ASTM B152 and having a weight per square foot as shown on the Plans.

908.14 Pig Lead

Provide pig lead, conforming to ASTM B29, of common desilverized lead.

908.15 Structural Steel Piles

Provide rolled steel sections of the weight and shape shown on the Plans and that meet the requirements of ASTM A572 or A992, Grade 50 (H-piles) and ASTM A252, Grade 2 or 3 (pipe piles). Do not use steel manufactured by the acid-bessemer process. Ensure that steel piles, when placed in the leads, will not exceed the camber and sweep permitted by the allowable mill tolerance. The Engineer will reject piles that are bent or otherwise damaged.

908.16 Steel Shells

Use steel shells of sufficient strength and rigidity to withstand being driven and to prevent harmful distortion caused by soil pressures or the driving of adjacent piles. Ensure that the shells are sufficiently tight to exclude water during the placing of concrete. The tip and butt diameters shall be as shown on the Plans. Equip shells to be driven without a mandrel with heavy steel driving points. Ensure that the driving points and the connecting welds do not project beyond the perimeter of the pile tips.

908.17 Steel Pipes

Steel pipe to be filled with concrete shall conform to ASTM A252, Grade 2. Closure plates for closed end piles shall conform to ASTM A36.

Provide pipes of the diameter shown on the Plans. The wall thickness shall not be less than that shown on the Plans, but in no case less than 3/16 inch.

Provide pipe, including end closures, of sufficient strength to be driven by the specified methods without harmful distortion. Ensure that closure plates and connecting welds do not project beyond the perimeter of the pile tips.

SECTION 909 – FENCE, GUARD RAIL AND BARRIER

909.01 Stock Fence

Unless otherwise specified, the Contractor may choose the type and kind of line post to use, whether wood or steel, and the finish, whether painted or galvanized. Do not change from using one type or kind to the other without the Engineer's written permission. Provide corner posts, end posts, braced line posts, and all fittings and accessories of the same kind and finish as the line post.

A. Fabric

Unless otherwise specified, provide fabric conforming to one of the following:

1. Galvanized steel woven wire meeting ASTM A116 for No. 11 Farm Design No. 1047-6-11, Class III Coating, or

2. Galvanized high tensile strength steel woven wire meeting ASTM A116 for No. 12-1/2 Farm Design, Class III Coating, except that the top and bottom strand shall be 10-1/2 gauge and the yield strength shall be equivalent to No. 11 Farm Design No. 1047-6-11.

B. Steel Posts and Braces

Provide one of the following types of steel line posts, of the lengths shown on the Plans:

1. Studded Tee posts, weighing 1.33 pounds per foot.
2. Lug-U posts, weighing 1.33 pounds per foot.

Furnish each post with a standard anchor plate securely attached to the post.

Provide the following types of end, corner, and braced line posts, of the lengths shown on the Plans:

1. 2-1/2 x 2-1/2 x 1/4 inch angle steel, weighing 4.10 pounds per foot. The braces shall be 2 x 2 x 1/4 inch angle, weighing 3.19 pounds per foot.

2. 2.0-inch (2.375 outside diameter), standard steel black or galvanized pipe, or 2.0 inch (2.375 outside diameter), triple coated steel pipe, with a 0.130-inch minimum wall thickness and coated as specified in **909.02**. Construct the braces of 1.25-inch (1.660 outside diameter) standard steel black or galvanized pipe or 1.25 inch (1.660 outside diameter) triple coated steel pipe with a 0.111-inch minimum wall thickness and coated as specified in **909.02**.

Furnish the round end, corner, and braced line posts complete with ball caps and other necessary fittings. Furnish galvanized round posts and braces that are galvanized inside and outside in accordance with ASTM F1083.

Galvanize, in accordance with ASTM A123, all steel line posts and steel angle for end, corner, and braced line posts, and braces.

Provide round posts at all corners that vary from 90 degrees.

C. Wood Posts and Braces

Provide wood posts, braces, and anchors of southern pine, oak, Douglas fir, or gum. Cut wood from sound and live trees to the dimensions and shapes shown on the Plans or as otherwise designated. Ensure that the wood contains no unsound knots. Sound knots are allowable, provided the diameter of the knot does not exceed one-third of the diameter of the piece at the point where it occurs. Trim all knots smooth with the face of the timber. The posts shall be free of decayed wood, rot, and ring shake.

The Plans show post and brace sizes in inches. The size refers to the diameter for round pieces and to the edge dimension for square pieces.

The Engineer will allow a tolerance from the dimensions shown on the Plans of 1/4 inch for sawed pieces and 1/2 inch for round pieces. A tolerance of 2% will be allowed in the length of both round and sawed posts. Saw the ends square, unless otherwise specified.

Peel round posts, braces, and anchors to remove all bark and inner skin. Provide timbers having a uniform taper with a slope not greater than 1 1/2 inches in 10 feet. The alignment shall be such that when a line is drawn from the center of the tip to the center of the butt, it shall not fall outside the center of the timber by more than 1% of the length.

Saw sawed posts, braces, and anchors with parallel edges and to not vary more than 1/4 inch from the specified dimensions, except that wane (lack of wood) not exceeding 1/8 of the dimensions of the face and 1/4 of the length of the piece on one corner or the equivalent on two or more corners will be permitted on not more than 10% of the pieces.

Treat posts, braces, and anchors with a preservative treatment, conforming to **911.02**. All preservatives must be registered with the U.S.EPA under FIFRA. Fabricate or frame the timbers before treatment.

D. Barbed Wire

Provide either galvanized or aluminum-coated barbed wire consisting of two No. 12-1/2 gauge twisted steel line wires with No. 14 gauge 4-point barbs spaced not more than 5 inches apart. The galvanized wire shall meet ASTM A121, chain link fence grade.

The Contractor may use high tensile strength wire, meeting the requirements of ASTM A121, chain link fence grade, for the respective wire size, with barb spacings as designated above.

909.02 Chain Link Fence

Unless otherwise specified, provide one of the following kinds of chain link fence fabric:

1. Zinc coated steel,
2. Aluminum coated steel, or
3. Aluminum alloy.

Do not change from using one kind of fabric to another without the Engineer's written permission.

A. Fabric

Provide fabric of the chain link type, conforming to AASHTO M 181. If galvanized, the fabric shall be of Type I, Class D. Manufacture all chain link fabric of No. 9 gauge wire pickets, forming a uniform 2-inch mesh, and to be of the height shown on the Plans or specified in the Contract.

B. Posts and Braces

1. Description. Manufacture the pipe by cold rolling and electric resistance welding of steel strip conforming to ASTM A1011, ASTM A1008 and A1011, or ASTM A653, Grade D.

Provide corrosion protection to all tubing by in-line application of hot-dip galvanizing, followed by a chromate conversion coating and an electrostatically applied clear acrylic or polyester coating on the outside surface. Provide corrosion protection to the inside surface by hot-dip galvanizing or in-line application of a zinc rich paint after fabrication.

2. Protective Coatings

a. External

i. Apply hot-dipped zinc coating according to ASTM B6 high grade and special high grade. The weight of the hot-dipped zinc coating shall be a minimum of 0.8 ounces per square foot, as determined in accordance with ASTM A90.

ii. Provide an electrostatically applied clear acrylic or polyester coating thickness of at least 0.1 mils.

b. Internal. Hot-dip galvanize the interior surface with a minimum of 0.9 ounce of zinc, or apply a 0.3-mil thickness of zinc rich paint after welding. Use a coating having at least 80% zinc powder by weight and that is capable of providing galvanic protection.

Provide posts and braces conforming to one of the types specified in 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 standard (ANSI Schedule 40) pipe	B429, Alloy 6063, Temper T6	1.5	1.900
	Triple coated steel pipe with a 0.120-inch wall thickness	F1043, Group I-C	1.5	1.900
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

C. Top Rail

Provide top rail conforming to one of the types specified in Table 909.02-2.

Table 909.02-2: Top Rail

Material	Specification	Nominal Diameter (inches)	Outside Diameter (inches)
Galvanized standard steel pipe	ASTM F1083	1.25	1.660
Aluminum alloy standard (ANSI Schedule 40)	ASTM B429, Alloy 6063, Temper T6	1.25	1.660
Triple coated steel pipe with a 0.111-inch minimum wall thickness	ASTM F1043, Group I-C	1.25	1.660

D. Barbed Wire

1. Steel. Provide steel barbed wire meeting **909.01.D**.

2. Aluminum Alloy. Provide aluminum alloy barbed wire consisting of two twisted strands of 0.110-inch line wire with 0.080-inch diameter 4-point barbs spaced not more than 5 inches apart. Use ASTM B211 alloys of 5052-0 for the wire and 5052-H38 for the barbs.

E. Miscellaneous Fittings and Hardware

1. Steel. Provide zinc-coated miscellaneous fittings and hardware of commercial grade steel or better quality, pressed, wrought, or cast as appropriate to the article, and of sufficient strength and other properties to provide a balanced design when used in conjunction with fabric, posts, and wires of the quality specified herein. Galvanize all steel fittings and hardware in accordance with AASHTO M 111.

2. Aluminum Alloy. Provide aluminum alloy miscellaneous fittings and hardware of wrought or cast aluminum conforming to AASHTO M 181, Table I.

F. Wire Ties

Provide No. 9 gauge wire ties of zinc-coated steel, aluminum-coated steel, or aluminum alloy, of sufficient strength and other properties to provide a balanced design when used in conjunction with fabric, posts, and wire of the qualities specified herein.

G. Tension Wire

Provide tension wire meeting AASHTO M 181.

H. Truss Rods and Turnbuckle

Provide truss rods, 5/16 inch in diameter and equipped with a turnbuckle having a take-up of not less than 4 inches. Galvanize rods in accordance with AASHTO M 111.

I. Polyvinyl Chloride Chain Link Fence

Fabricate all posts, fabric and other hardware out of steel meeting the dimensional and material requirements specified herein and coated in accordance with AASHTO M 181, Type IV, Class B.

Fit posts with ornamental tops or extension arms as shown on the Plans. Ornamental tops for tubular posts shall have a base fitting into the post with a flange extending over the top of the posts to protect the post against moisture. Extension arms shall be vertical or extend in or out from the fence line at approximately 45 degrees as shown on the Plans. Provide suitable notches or slots in the extension arms to support and space the barbed wire.

All materials shall be within reasonably close conformity to the sizes, shapes, dimensions, and other factors set out in these Specifications or shown on the Plans, and shall show careful, finished workmanship.

909.03 Fence Gates

Provide swing-type fence gates of the kinds and sizes shown on the Plans, complete with latches, stops, keepers, hinges, and fabric. Provide latches that allow for fastening with a padlock. Cover the gates with fabric matching the fence. Provide hinges of adequate strength to support the gate and to not twist or turn under action of the gate. Provide gates, gate posts, and braces of the

same kind and finish as the adjoining fence. Furnish all gate posts and rails complete with ball caps and rail ends.

A. Stock Fence Gates

Provide the following for stock fence gates:

1. Posts and braces of standard weight steel pipe conforming to ASTM F1083, or triple coated steel pipe meeting **909.02.B**, furnished with all necessary fittings and of the nominal diameter and length shown on the Plans for the particular gate opening.

2. Gate frames of the type and size specified, constructed in accordance with the details and of the materials shown on the Plans.

3. Fabric of the woven wire type meeting ASTM A116, Class II coating, and of the design shown on the Plans.

4. Barbed wire meeting the requirements of **909.01.D**, and attached to the gate frame as shown on the Plans.

5. Fittings of approved design, made of malleable iron or pressed steel.

Galvanize all gate frames, posts, braces, and fittings in accordance with ASTM F1083 or ASTM A123, as applicable.

B. Chain Link Fence Gates

Provide the following for chain link fence gates:

1. Posts, braces, and framing members of standard weight pipe meeting **909.02.B**. The size and length of the posts and braces and the size and dimensions of framing members shall be as shown on the Plans.

2. Fabric of the chain-link type, meeting **909.02.A**. The height of the fabric shall be that shown on the Plans.

3. Barbed wire meeting the requirements of **909.02.D**.

4. Miscellaneous fittings and accessories meeting the applicable requirements of **909.02.E**, **F**, and **G**, including hinges that will allow the gate to swing back 180 degrees, parallel with the fence line.

909.04 Water Gates and Water Crossings

Provide posts, braces, and accessories of the types, kinds, and dimensions shown on the Plans or directed by the Engineer, and that meet the applicable quality requirements of **909.01** or **909.02**.

Provide timber for water gates of the dimensions shown on the Plans or directed by the Engineer, and that meet the requirements of **911.02**.

909.05 Metal Beam Rail

Provide rail elements of corrugated sheet steel beams conforming to AASHTO M 180, with the following exceptions:

1. Galvanize the beams.

2. Provide the class and type of rail shown on the Plans.

909.06 Timber Rail

Provide timber rail having the dimensions shown on the Plans and meeting the requirements of **911.01**.

Provide treated timber, when specified, conforming to **911.02**.

909.07 Guard Rail Posts

Provide railing posts of the section, weight, and length shown on the Plans. The posts may be made of wood, conforming to **911.02**, or steel, conforming to ASTM A36 and galvanized in accordance with ASTM A123.

909.08 Guard Rail Hardware

Provide offset brackets of the resilient and non-resilient types of the type specified.

Provide splices and end connections of the type and design specified and of such strength as to develop the full design strength of the rail elements.

Provide end spring assemblies, when specified, that are positive and of a type and design conforming to the intent, design, and strength of the railing structure, as shown on the Plans.

Provide end anchor rods and accessories as specified and of such size and strength as to develop the full design strength of the rail elements.

Unless otherwise specified, galvanize all steel fittings, bolts, washers, and other accessories in accordance with AASHTO M 111 or ASTM A153, whichever may apply. Perform all galvanizing after fabrication. Mechanically applied zinc coating conforming to ASTM B695 and meeting Class 50 coating thickness is an acceptable alternate for the hot-dipped galvanizing specified in AASHTO M 232.

Provide aluminum alloy fittings, bolts, washers, and other accessories as shown on the Plans.

SECTION 910 – PAINT

910.01 General Requirements

Before having any paint manufactured under these Specifications, contact the Department for a sampling, testing, and inspection procedure. Proportion all paint furnished under these Specifications in accordance with the characteristics specified herein. Perform compounding using ingredients or component materials that have been found to conform with the appropriate detailed Specifications as set forth below by reference or otherwise.

Provide paint that will not compact on settling and will readily return to a smooth, uniform consistency for brushing or spraying when stirred vigorously with suitable paddles or when boxed from container to container.

The Contractor may use 55-gallon drums, equipped with efficient mechanical stirring devices, to deliver shop coat paint to fabricating shops that are equipped to handle them. With the Department's written authorization, the Contractor may also use 55-gallon drums equipped with stirring devices to deliver paints to projects requiring large quantities. In all other cases, deliver lots of 5 gallons or more in 5-gallon circular type metal pails constructed of 26 gauge or heavier metal. Equip each container with a full-top removable and replaceable lid and with a bail of sufficient strength to support the pail when completely filled with the specified paint. Label each container with the name and address of the manufacturer, the kind and color of paint, formula, net content of container, date of manufacture, and lot number.

Have paint that has been stored for longer than 6 months re-inspected and approved prior to use.

910.02 Quick Dry Traffic Marking Paint (White and Yellow)

The following requirements apply to quick dry white and yellow traffic paint, also referred to as pigmented binder, for use in marking traffic lanes or barrier lines on bituminous and concrete highways.

A. General Requirements

Provide pigmented binder formulated to allow for application by spray equipment when heated to 130 °F maximum and applied on bituminous or Portland cement concrete pavements.

B. Drop-on Glass Beads

Use glass beads conforming to AASHTO M 247, Type 1.

1. General. For pavement markings, use beads that are clear, transparent, colorless glass, smooth and spherically shaped, free of milkiness, pits, or excessive air bubbles, and that conform to the requirements specified herein.

Glass beads shall not contain more than 200 parts per million of lead or 200 parts per million of arsenic. Certify and ensure that all glass beads meet all Federal requirements. Provide certified test reports demonstrating that all glass beads contain no more than 200 parts per million of arsenic or lead as determined by a certified independent (third party) laboratory, in accordance with Environmental Protection Agency testing methods 3052, 6010B, or 6010C.

Silica content of the glass beads shall be no less than 60%.

2. Color and Clarity. Beads shall be colorless, clear, and free from carbon residues.

3. Roundness. Ensure minimum true spheres overall are 80% when tested in accordance with ASTM D1155; for larger beads use visual inspection.

4. Index of Refraction. Minimum of 1.50, when tested by the liquid emersion method at 77 °F.

5. Air Inclusions. Maximum of 3% overall.

C. Paint

1. Characteristic Requirements. Provide paint meeting the following requirements:

a. Pigment Content. 58% to 65% by weight. Pigment for white paint shall contain 0.99 pounds per gallon of 94% titanium dioxide. Pigment for yellow paint shall be lead free and contain 0.22 pounds per gallon minimum of 94% titanium dioxide.

b. Total Non-Volatile. 76% by weight, minimum.

c. Vehicle Non-Volatile. 41% by weight, minimum. Vehicle shall be Rohm and Haas E-2706, DOW DT211NA, or an approved equal.

d. Minimum Weight. 13.3 pounds per gallon.

e. Paint Viscosity. 78 to 95 Kreb units when tested at 77 plus or minus 2.0 °F in accordance with ASTM D562.

f. Drying Time

(1) Field: The paint shall dry to a no-tracking condition in 3 minutes when applied at 15 plus or minus 1 mil wet film thickness with a bead application rate of 6 pound per gallon of glass spheres per gallon of binder, when the pavement temperature is between 40 and 120 °F and the relative humidity is not exceeding 80%. Apply the pigmented binder with specialized equipment ensuring the binder will have a temperature of 100 to 130 °F at the spray gun. Determine the no-tracking condition by passing over the line as applied above in a simulated passing maneuver with a passenger car travelling 35 miles per hour. Consider a line showing no visual deposition when viewed from a distance of 50 feet as conforming to this drying requirement.

(2) Lab: The pigmented binder without glass spheres shall dry to no-pick-up condition in 10 minutes or less when tested in accordance with ASTM D711.

g. Volatile Organic Compounds (VOCs). Meet the current EPA VOC requirements or 150 grams per liter, whichever is lower.

h. Paint pH. 9.6, minimum.

2. Qualitative Requirements. Provide finished paint meeting the following quality requirements:

a. Condition in Container. The paint received shall show no livering, skinning, mold growth, corrosion of the container, or hard settling of the pigment. Stirring by hand shall readily disperse any settling, with no persistent foaming.

b. Color.

(1) White: After drying, the color shall be flat white, free from tint, furnishing good opacity and visibility under both daylight and artificial light.

(2) Yellow: Color shall closely match chip 33538 of Federal Standard 595B.

c. Flexibility. No cracking or flaking when tested on a 1/2-inch mandrel in accordance with Federal Specification TT-P-1952B.

d. Dry Opacity (Minimum Contrast Ratio). 0.95 when drawn with a 0.005 Bird Applicator.

e. Daylight Directional Reflectance. Not less than 85% for white paint and not less than 50% for yellow (relative to manganese oxide) when measured in accordance with Federal Test Method No. 1416.

f. Bleeding Ratio. 0.97, minimum, when tested in accordance with Federal Specification TT-P-1952B.

g. Scrub Resistance. 300 cycles when tested in accordance with ASTM D2484.

h. Freeze-Thaw Stability. No change in consistency greater than 10% when tested in accordance with Federal Specification TT-P-1952B.

i. Storage Stability. When stored at 77 plus or minus 4.0 °F in a 3/4-filled can for a period of 30 days, the paint shall be in a homogeneous state with no skinning, curdling, hard settling, or caking that cannot be readily remixed.

D. Inspection, Testing, Packaging, and Marking

After manufacture, send, to the Division of Materials and Tests, a 0.5-pint sample of paint along with certified laboratory analysis for each batch.

For each batch or lot of glass beads shipped for use on Tennessee projects, send, to the Division of Materials and Tests, a 1-quart sample and a manufacturer's certification that the glass beads meet the requirements of AASHTO M 247 for the type beads.

With each shipment of paint and beads, include a detailed analysis for that particular batch and certification that all ingredients meet the requirements set forth in this Specification.

The Department reserves the right to perform in-plant sampling of ingredients and finished product during manufacturing operations and to sample the packaged product when it is received by the Department. The Department may withhold acceptance of the product until it completes its analysis of the samples.

Ship all paint in new containers that can be properly sealed.

Plainly mark or label all containers to show the following information: name and address of manufacturer, kind and color of paint, formula, net content of container, date of manufacture (month and year), and batch number.

910.03 Structural Steel Coatings

Structural steel coating systems for new and existing structures shall be listed on the Department's QPL for Structural Steel Coatings.

Do not apply any paint, either in the shop or in the field, until the manufacturer has submitted to the Engineer a certification stating that the material supplied has the same formulation as the prequalified material. The Engineer reserves the right to sample and test the materials supplied.

SECTION 911 – LUMBER, TIMBERS, AND TIMBER PILES

911.01 Lumber and Timbers

A. General

Refer to AASHTO M 168 for grading and terminology. This Section primarily addresses bridge and miscellaneous roadway materials.

B. Species of Wood

Use Southern Yellow Pine in accordance with Southern Pine Inspection Bureau (SPIB) Specifications or as otherwise shown on the Plans.

C. Grades of Lumber and Timber

Provide lumber and timbers for permanent use in structures that is grade marked or hammer stamped by a recognized acceptance agency that conforms to the following:

1. **Yard Lumber.** Provide yard lumber with a grade of C Finish, when a choice quality grade for finish purposes and appearance is a requirement, especially when painted.

    a. **No. 1.** Provide #1 Grade lumber and timbers for general construction and utility purposes where strength is a consideration.

    b. **No. 2.** Provide #2 Grade lumber and timbers for general construction and utility purposes where strength is not a consideration.

2. **Structural or Stress Rated Lumber and Timber.** As specified or otherwise noted in the plans, provide lumber and timbers of a

structural grade conforming to the grading rules of the Southern Pine Inspection Bureau (SPIB). Allowable stress shall be in accordance with the current SPIB grading rules.

911.02 Treated Lumber and Timbers

Treated lumber and timbers shall conform to the requirements of **911.01** and are to be treated by a pressure method to retain the minimum retention of preservative per cubic foot of wood for the designated use as outlined in American Wood Protection Association (AWPA) Standard U1, Commodity Specification A: Sawn Products. All preservatives must be registered with the USEPA under FIFRA.

The Engineer will not accept treated structural lumber or timbers for use unless it has been inspected and found satisfactory both before and after treatment. Material that is grade marked and or tagged bearing the mark of an agency accredited under the American Lumber Standards Committee, Inc. (ALSC) shall be acceptable. Alternatively, the manufacturer may furnish a notarized Certificate of Compliance which includes the tally, grade, and preservative retention of material provided.

911.03 Timber Piles

A. General

Provide untreated or treated timber piles in accordance with ASTM D25 Standard Specification for Round Timber Pile.

Fabricate round piles to meet the minimum diameters specified in Table 911.03-1.

Table 911.03-1: Timber Pile Diameters

Length of Pile	Tip Diameter (inches)	Butt End Diameter (inches)
20 feet and under	8	11
Over 20 feet up to 40 feet	8	12
Over 40 feet up to 60 feet	7	12
Over 60 feet	6	13

The diameter of the piles at the butt shall not exceed 18 inches.

Provide piles that have a uniform taper from butt to tip, are straight grained.

B. Preservative Treatment

Pressure preservative treat timber piles with a preservative specified in AASHTO M133 and in accordance with AWPA U1, Commodity Specification E: Round Timber Piling, UC4C. All preservatives must be registered with the USEPA under FIFRA.

SECTION 912 – BRICK

912.01 Building Brick

Provide brick of the kind and grade specified.

A. Clay or Shale Brick

Provide brick conforming to ASTM C62.

B. Concrete Brick

Provide brick conforming to ASTM C55.

912.02 Sewer Brick

Provide brick conforming to ASTM C32.

912.03 Masonry Mortar

Compose mortar of one part Portland cement and two parts sand. The Contractor may add hydrated lime to the Portland cement in an amount not to exceed 10%. Add water to the mixture in quantities that will allow a stiff paste to form.

Either hand-mix or machine-mix the mortar. To prepare hand-mixed mortar, thoroughly mix the sand, cement, and hydrated lime together in a clean, tight, mortar box. Once the mixture is of uniform color, add water. Prepare machine-mixed mortar in an approved mixer and mix not less than 1-1/2 minutes.

Use mortar within 30 minutes after mixing. Do not retemper mortar.

Use materials conforming to the following:

Cement	**901.01**
Hydrated Lime	ASTM C207
Sand	**903.02**
Water	**921.01**

912.04 Concrete Masonry Units

Provide concrete masonry units conforming to the types, sizes, and dimensions shown on the Plans, and meeting the following requirements, unless otherwise specified:

1. Hollow load-bearing masonry units: ASTM C90, Grade 5, Type II.
2. Hollow non-load-bearing masonry units: ASTM C129, Type II.

Furnish the Department representative samples of the masonry units for testing.

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

SECTION 913 – CEMENT CONCRETE CURING MATERIALS

913.01 Water

For use in curing Portland cement concrete, provide water that is free from all substances that may damage the concrete when applied on the surface as a curing agent.

913.02 Reserved

913.03 Reserved

913.04 Burlap

Provide burlap conforming to AASHTO M 182, Class 3 or Class 4. If Class 1 or Class 2 burlap is allowed, use at least two layers.

913.05 Liquid Membrane-Forming Compounds

Provide compounds listed on the Department's QPL for Coatings for Concrete and conforming to ASTM C309, and use as follows:

1. Where applied texture finish is specified, use a Type 1-D, Class B, membrane that is compatible with the texture finish.
2. Use either a Type 2 membrane or Type 1-D, Class B, membrane on bridge decks when applied in combination with the water method of curing.
3. Use Type 2 membrane in all other applications.

913.06 Sheeting Material for Curing Concrete

Provide material conforming to the water vapor transmission rates specified in ASTM C171.

SECTION 914 – NON-METALLIC PIPE

914.01 Non-reinforced Concrete Pipe

Provide pipe conforming to ASTM C14 for the specified diameters and strength classes.

Manufacture all non-reinforced concrete pipe to meet the Department's procedure for the Manufacture and Acceptance of Precast Drainage Structures, Noise Wall Panels, and Retaining Wall Panels.

914.02 Reinforced Concrete Pipe (RCP)

Provide pipe conforming to ASTM C76 for the specified diameters and strength classes. Elliptical pipe shall conform to ASTM C507. Arch pipe shall conform to ASTM C506.

Precast reinforced concrete end sections shall conform to the cited Specifications to the extent to which they apply.

Manufacture all reinforced concrete pipe to meet the Departmental procedures.

914.03 Perforated Concrete Pipe

Provide pipe conforming to AASHTO M 175 or to ASTM C444 for the specified diameters, and, unless otherwise specified, of the standard strength.

914.04 Drain Tile

Provide pipe conforming to AASHTO M 178 for the specified material and diameters, and, unless otherwise specified, of standard quality class. When specified, the pipe spigot shall have integral spacer lugs to provide for an annular opening and self-centering feature.

914.05 Clay Pipe

Provide pipe conforming to ASTM C700 for pipe with full circular cross-section for the specified diameter and strength class. When specified, the bell shall have integral spacer lugs to provide for an annular opening and self-centering feature.

914.06 Vitrified Clay Pipe

Provide pipe conforming to ASTM C700 for the specified diameters and strength classes for circular, unperforated pipe.

914.07 Plastic and Polyethylene Corrugated Tubing

Provide tubing conforming to AASHTO M 252 or ASTM F667 for Heavy Duty Tubing, with the following exception:

> Tubing having an elongation greater than 5% but less than 10% is acceptable provided the minimum pipe stiffness requirements in Table 1 are met when tested in accordance with ASTM F667, Section 9.7, using a 12-inch base plate.

914.08 Precast, Concrete Box Sections

For culverts, storm drains, and sewers, provide precast reinforced concrete box sections conforming to ASTM C1577. Manufacture all precast concrete box sections in accordance with the Departmental procedures.

914.09 Polyvinyl Chloride (PVC) Pipe

Provide PVC pipe from the Department's Producer List.

914.10 High Density Polyethylene (HDPE) Pipe

Provide HDPE pipe from the Department's Producer List.

914.11 Steel Reinforced Thermoplastic Ribbed Pipe (SRTRP)

Provide SRTRP for pipe from the Department's Producer List.

914.12 Polypropylene (PP) Pipe

Provide PP pipe for pipe from the Department's Producer List.

SECTION 915 – METALLIC PIPE

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 (CMP)

A. Corrugated Steel Pipe, Pipe Arches, and Underdrains

Provide corrugated steel pipe from the Department's Producer List, 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 M 274. 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. 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.

C. 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, Grade 250/250, unless otherwise specified.

SECTION 916 – HIGHWAY SIGNING MATERIALS

916.01 General Requirements

In constructing highway signs, use all new parts that conform to the requirements of these Specifications, the Plans, and the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, latest edition. To request any departures from the materials and fabrication shown on the Plans or specified in the Specifications, submit details of such departures, and the reasons they are necessary, to the Engineer for approval. Do not make any such departures without the Engineer's prior written approval.

Furnish the Department notarized certified copies of the chemical and physical properties of all materials incorporated in the structures and accessories that are required for this work.

916.02 Aluminum and Composite Material Signs

Provide aluminum and composite materials conforming to the requirements in Table 916.02-1, unless otherwise specified.

Table 916.02-1: Aluminum and Composite Sign Components

Item	ASTM Specification	Alloy and Temper
Flat sign sheets (sign blanks) and plates (permanent and temporary) (1)	B209	6061-T6 or 5052-H38
Extruded shapes (sign panels), bars, rods	B221	6063-T6
Posts and truss chords	B221	6061-T6
Structural shapes	B308	6061-T6
Delineator sheets	B209	6061-T6
Post and truss bracing members	B221	6063-T6
Bolts other than anchor bolts (2)	B211	2024-T4
Nuts, 5/16 inch and larger	B211	6262-T9
Nuts, 1/4 inch and under, tamper-proof type	B211	2024-T4
Washers, Alclad	B209	2024-T4
Flange splicing material	B209	6061-T6
Post caps and chord caps	B26	SG-70A-F
Rivets	B316	6053-T6
Shims	B209	1100-0
Posts clips	B308	6061-T6
Letters, numerals, and symbols	B209	3003-H14

(1) Recycled aluminum flat sheet (sign blanks) meeting ASTM B209, Alloy 6061-T6 or 5052-H38 may be used for temporary signing only. Select composite material sign blanks (temporary signing only) from the Department's QPL. The sign blanks shall be flat and shall contain no visible lateral bow.

(2) Apply chromated sealed anodic coating at least 0.0002 inch thick to all finished bolts.

916.03 Steel

Use steel conforming to the requirements in Table 916.03-1, unless otherwise specified:

Table 916.03-1: Structural Steel and Components

Item	ASTM Specification	Grade
Steel structural shapes [(1)]	A709	50 S
Steel structural plates [(1)]	A709	36
Posts, chord, and bracing members, galvanized	A53	B
Post caps and chord caps [(1)]	A27	--
Bolts, nuts, and washers, galvanized	A307	--

[(1)] Galvanize in accordance with ASTM A123.

916.04 Stainless Steel

Use stainless steel conforming to the following:

1. Stainless steel bolts, washers and screws: ASTM A193, Austenitic steel.

2. Stainless steel nuts: ASTM A194, Grade 8F, except that the nuts shall be lock nuts with semi-finished hex nuts equivalent to American Standard Heavy Series.

916.05 Fabrication

A. General

Fabricate all signs and supports as shown on the Plans. Submit departures from the Plans in the form of shop drawings, as specified in **916.05.B**. Perform work in a uniform, workmanlike manner.

Complete the fabrication of steel components specified to be galvanized, including the forming of holes or perforations, prior to galvanization.

Fabricate all signs and supports in a plant operated by a fabricator who has the necessary experience to manufacture quality signs and supports meeting these Specifications. Before starting fabrication, provide the Department with the name of the proposed fabricators of the signs and supports, and, if requested by the Department, furnish information as to the fabricator's qualifications and experience.

B. Shop Drawings

For departures from the Plans, submit, for the Engineer's approval, eight copies of shop drawings showing complete detail designs of such departures and all other information necessary to complete the sign assembly.

C. Flat Sheet Signs

Fabricate flat sheet signs of a single piece of sheet aluminum, or composite material (when allowed), without joints and without supporting frame, unless otherwise specified.

D. Multiple Panel Signs

Fabricate multiple panel signs of extruded sections that are 12 inches wide, mounted horizontally, and without vertical joints. Ensure that all panels are flat and straight, and within the commercial tolerances established by the aluminum and composite industry.

E. Overhead Sign Supports

Fabricate overhead sign supports in accordance with the Plans and approved shop drawings. Fabricators must be AISC certified as specified in **602.04.A.4**.

Perform all welding in the shop in accordance with the Plans and the Contract Special Provisions.

Provide brackets for mounting signs (including future signs) of the type to be supported by the structure. They shall be adjustable to allow mounting of the sign faces at any angle between a truly vertical position and 3 degrees from vertical. Obtain this angle by tilting the top of the sign toward traffic. All brackets shall be of a length equal to the heights of the signs being supported.

Thoroughly clean all steel fabricated components other than stainless steel parts, including clamps and brackets, and galvanize by the hot-dip process, meeting the applicable ASTM Specifications specified in **916.03**.

F. Cutting (Metals)

Saw or mill materials over 1/2 inch thick. Materials 1/2 inch thick or less may be sheared, blanked, sawed, or milled. Ensure that cut edges are true and smooth and free from excessive burrs or ragged breaks.

Fillet re-entrant cuts by drilling prior to cutting.

Do not flame cut aluminum.

G. Bolt Holes (In Metals)

Either drill or blank bolt holes to finished size, provided the diameter of the blanked hole is at least twice the thickness of the metal being blanked.

H. Preparation of Sign Surfaces

Before preparing the surface, complete all fabrication, including cutting, welding, and punching of holes, excluding mounting holes for demountable letters, numerals, symbols, and borders.

Before painting or applying reflective sheeting to the aluminum, treat sign panels in strict accordance with the following procedure:

1. **Preliminary Cleaning.** Completely submerse the surface in a 6% solution of an inhibited alkaline cleaner at 160 to 180 °F for 3 minutes followed by a cold water rinse.

2. **Etching.** Follow preliminary cleaning with a surface etch by immersing the sign for three minutes in a 6 to 8% dilute phosphoric acid solution followed by spraying with a cold water rinse and immersing for 1 minute in circulating hot water at 180 °F.

3. **Handling.** Do not handle any metal, except by device or clean canvas gloves, between cleaning and etching operations and the application of paint or reflective sheeting. Do not allow the metal to come in contact with grease, oils, or other contaminating substances after cleaning and etching and prior to the application of paint or reflective sheeting.

Treat composite material sign panels in accordance with the manufacturer's recommendations.

I. Shop Painting and Reflectorization

All legends, borders and background shall be of the color and placed on the sign as shown on the Plans.

1. Application. Apply reflective sheeting to properly treated base panels with mechanical equipment in the manner specified by the sheeting manufacturer. Type II adhesive coated sheeting shall be pre-perforated.

For sign faces consisting of two or more pieces or panels of reflective sheeting, carefully match pieces for color at the time of sign fabrication to provide uniform appearance and brilliance, both day and night. Apply alternate, successive width sections of either sheeting or panels to be reverse and consecutive to ensure that corresponding edges of reflective sheeting lie adjacent on finished sign. Nonconformance may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting that will not be acceptable. Limit splices. When spliced, overlap Type I adhesive coated sheeting not less than 3/16 inch. Type II adhesive coated sheeting may be spliced with an overlap of not less than 3/16 inch or butted; when butted, ensure that the gaps do not exceed 1/32 inch. Only use butt splices on signs screen processed with transparent color. Extend sheeting applied to extruded sections over top edges and down side legs a minimum of 1/16 inch. Ensure that, after aging 48 hours at 75 °F, adhesion of reflective sheeting to sign surface is strong enough to resist stripping from the panel when tested with a stiff putty knife, and will meet other applicable requirements as specified for Reflective Sheeting in **916.06**.

2. Silk Screening. Apply all legends and borders on signs, except demountable or cut-out legends and borders, by silk screening after the sheeting is attached to the panels, unless otherwise approved by the Engineer. Perform all screening in a workmanlike manner and as recommended by the manufacturer of the reflective sheeting.

The Contractor may apply black legends and borders to signs having silver reflectorized backgrounds by equally effective methods when approved by the Engineer. Use proper size screen mesh in reverse screening to ensure that the finished colors match the prescribed Standard Interstate Colors (AASHTO Manual). Noticeable deviation from the shades is cause for rejection of the sign.

After silk screening, or reverse silk screening, bake the sign in an approved oven for a period of one hour, at a temperature of 200 °F.

J. Packaging

Package signs in a manner that will prevent damage to any part of the sign, including demountable legends or borders, during shipment and storage. Before packaging, ensure that signs are free of moisture and paints are thoroughly dry. Do not apply adhesive tapes to any sign surfaces. Keep all packaged signs entirely dry.

Securely attach braces to all assembled or partially assembled signs, other than flat sheet signs, to prevent buckling or warping from the time of assembling to attaching on permanent supports.

916.06 Reflective Sheeting

Provide reflective sheeting from the Department's QPL conforming to AASHTO M 268 and the supplementary requirements for fungus resistance of AASHTO M 268. The sheeting material shall have a precoated adhesive backing or a heat and pressure activated adhesive backing protected by a removable liner.

For all signs with a SILVER-WHITE and ORANGE background when used on temporary barricades and channelizing drums, provide reflective sheeting of Type B or better as specified by AASHTO M 268.

For all signs with a SILVER-WHITE, YELLOW, RED, GREEN, BROWN, or BLUE background, provide reflective sheeting of Encapsulated Lens or Micro-prismatic Lens material meeting or exceeding the minimum requirements for Type B or better as specified by AASHTO M 268.

FLOURESCENT ORANGE background material shall meet or exceed the requirements for Type B, as specified by AASHTO M 268.

916.07 Legends, Borders, and Accessories

Provide letters, numerals, symbols, borders, and route markers conforming to the MUTCD.

A. Type "A" Class I (Demountable)

Provide silver-white letters, numerals, symbols, borders, and route markers of a pre-coated pressure sensitive or a tack-free heat-activated adhesive reflective sheeting permanently adhered to the sign panel. The reflective sheeting shall meet the requirements of **916.06** (Type B or better as specified by AASHTO M 268).

Mechanically apply the reflective sheeting to the properly prepared sign panel with the equipment and in a manner prescribed by the sheeting manufacturer. Letters, numerals, symbols, borders, and route markers shall be 0.032 inch thick aluminum sheet of 3003 H14 Alloy or approved composite material. Properly degrease and etch aluminum, or treat with a light, tight, amorphous chromate type coating.

Supply each letter, numeral, symbol, and route marker with mounting holes, and secure to the sign surface with corrosion-resistant screws, bolts, or rivets.

B. Type "A" Class 2 Cut-Out (Direct Applied Reflective Sheeting Copy)

Provide silver-white cut-out letters, numerals, symbols, borders, and route markers of a pre-coated pressure sensitive or a tack-free heat-activated adhesive reflective sheeting. The reflective sheeting shall meet the requirements of **916.06** (Type B or better as specified by AASHTO M 268).

916.08 Flexible Delineator Posts

Provide delineator posts of the height shown on the Plans and of a width that presents a minimum 3-inch wide profile in the direction of approaching traffic. The top 14 inches of the front of the delineator post shall have a smooth surface capable of readily bonding the pressure sensitive reflective sheeting.

Provide delineator posts that are white in color unless otherwise shown on the Plans. Reflectorize the posts with reflective sheeting that conforms to AASHTO M 268, Type B or better retroreflection performance level.

The reflective sheeting strip on the delineators shall be 9 inches long and 3 inches wide profile and facing approaching traffic. Locate the top of the reflective sheeting 1/2 inch from the top of the delineator post.

For Flexible Type II Object Markers, use reflective sheeting consisting of three yellow squares spaced 4-1/2 inches center to center, each square being 3 inches long with sufficient width to present a 3-inch wide profile when mounted on a post. Locate the top square 1/2 inch from the top of the object marker post.

Select material from the Department's QPL. The manufacturer shall certify that the materials to be supplied are formulated the same as when tested by the National Transportation Products Evaluation Program and will conform to the requirements of this Specification. The Department reserves the right to periodically sample and test delineator posts.

SECTION 917 – ROADWAY AND STRUCTURE LIGHTING MATERIALS

917.01 General Requirements

Prior to making any purchases, submit for approval a complete list of all proposed materials. Include on the list the manufacturer's name, catalog number, and such other definitive or descriptive data as is necessary to adequately define the item. When requested by the Engineer, furnish samples of the material and notarized certificates by the manufacturer that the material meets the requirements of these Specifications and all industry standards referred to herein.

Obtain all guarantees on mechanical and electrical equipment furnished by the manufacturer and submit them to the Engineer. The Engineer will then transmit these guarantees to the agency responsible for future maintenance of the equipment.

Provide material and equipment that is designed, manufactured, and tested in accordance with the requirements of at least one of the following societies: ASTM, IPCEA, NEMA, IEEE, ANSI, and AASHTO. Provide material that is UL approved and bears the UL label.

Only furnish new materials and equipment under these Specifications.

917.02 Roadway Lighting Standards

Meet the following requirements for prestressed concrete, aluminum, and steel lighting standards.

Furnish standards of the design and dimensions shown on the Plans, and that conform with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Include calculations for the design of each type of pole and bracket arm length with the shop drawings when submitted for approval.

A. Prestressed Concrete

1. **Scope.** These Specifications apply only to the manufacture of concrete lighting standards used to support lighting units.

2. **Method of Manufacture.** Manufacture all standards by an approved method that will ensure dense and uniform concrete. Place the concrete in one continuous operation. Use a manufacturing method that will produce a smooth cable raceway of 2 inches up to the hand hole, and a 1-inch raceway above the hand hole.

3. **Curing.** Following the casting operation, cure the concrete with low temperature saturated steam. Following the steam curing and while reducing the curing temperature, do not subject the standards to severe temperature changes.

4. **Anchor Base.** Furnish standards with the type of base shown on the Plans. Cast the base as an integral part of the standard.

5. **Foundations.** Where shown on the Plans, furnish the standards with a precast butt foundation that is cast as an integral part of the standard. Provide a conduit entrance slot of not less than 2 x 9 inches in the precast butt base at the location shown on the Plans.

6. **Anchor Bolts.** Use anchor bolts of high strength steel meeting the requirements of ASTM F1554, Grade to be determined by design. Fit each anchor bolt with a hex nut and lock-washer.

7. **Aluminum Bracket Arm.** Fabricate aluminum bracket arms, if specified, from aluminum alloy pipe or tapered tubes. Use pipe conforming to the requirements for nominal 2-inch diameter or larger Schedule 40 pipe of aluminum alloy 6063-T6, ASTM B241. Use tapered tubes conforming to the requirements for aluminum alloy 6063-T6, ASTM B221. Use cast aluminum clamps of Aluminum Alloy No. B-443.

8. **Steel Bracket Arms.** Fabricate steel bracket arms, if specified, from nominal 2-inch diameter or larger Schedule 40 pipe conforming to ASTM A53. Galvanize the steel bracket arm after fabrication in accordance with ASTM A123. Take precautions to obtain high quality galvanized coatings in accordance with ASTM A385.

   The design and dimensions of the bracket arm assembly shall be as shown on the Plans. Ensure that the installed bracket will provide a weather-resistant connection with smooth wiring raceway. Use stainless steel bolts and nuts. Hot-dip galvanize all other steel parts and associated hardware in accordance with ASTM A123 or ASTM A153.

B. Aluminum

1. **Scope.** These Specifications apply only to the manufacture of aluminum lighting standards used to support lighting units.

2. **General.** Provide poles consisting of an aluminum shaft having a base attached to the lower end and complete with anchor bolts where required. Use materials conforming to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Perform welding in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

3. **Shaft.** Provide a shaft of either spun seamless tubing or formed sheet aluminum. The shaft may have one continuous longitudinal weld. Provide the pole shaft with a uniform taper of approximately

0.14 inch per foot, or taper in increments as approved by the Engineer.

Furnish shafts in either one or two pieces in accordance with the manufacturer's current practices; however, if the required shaft length exceeds standard shipping limits, furnish the shaft in two pieces.

Assemble the two-piece shafts by telescoping the upper section over the lower section with a firm tapered fit. The telescoping length of the shaft shall be not less than 14 inches. Assemble the shaft in the presence of the Engineer or a qualified representative authorized by the Engineer. Ensure that the sections are correctly plumbed and force fitted. Do not weld the joint.

Provide an opening near the top of the shaft to provide a cable entrance from the shaft into the bracket arm. Design the opening to provide a smooth cable guide for wiring. Equip the top of the shaft with a removable pole top of aluminum alloy held securely in place with set screws. The shaft (excluding transformer base standards) shall have a reinforced handhole, of the size shown on the Plans, with a bolt-on cover. Provide a grounding nut or lug for accommodating a 1/2-inch UNC threaded bolt or stud in the shaft or base.

4. **Anchor Base.** The shaft shall have an anchor base that is strong enough to develop the full strength of the shaft it supports. Provide the base with four holes to receive the anchor bolts and a suitable means for attaching bolt covers. Provide four removable bolt covers with each base.

5. **Breakaway Device.** Provide a breakaway device conforming to the breakaway characteristics as established by Section 12 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

   To determine if an item meets the breakaway requirements of the AASHTO Standard Specifications, follow testing and reporting procedures comparable to those given in NCHRP Report 153. Acceptance may be based on a single test if the test change in momentum and the analytically inferred changes in momentum over the speed range are less than 750 pound-seconds. If the first dynamic test change in momentum is between 750 and 1,100 pound-

seconds, perform a second dynamic test unless assurance that the test results are representative of what would result from further dynamic tests can be demonstrated analytically and statically. The results of the second test must also meet the specification requirements. Furnish documentation of the breakaway characteristics to the Engineer prior to fabrication.

6. **Bracket Arm Aluminum.** Provide bracket arms for aluminum standards that meet the same requirements as specified in **917.02.A.7** for aluminum bracket arms for concrete standards.

7. **Anchor Bolts.** Provide anchor bolts of high-strength steel, each fitted with a hex nut and lock-washer. Each anchor bolt shall be capable of anchoring the bottom end in the concrete foundation and shall be threaded at the top end. The exposed portion of the threaded end of the anchor bolt, all nuts, washers, couplings, studs, and other fasteners shall be zinc coated, unless otherwise specified, in accordance with ASTM A153. Ensure that the anchor bolts are capable of resisting, at yield strength stress, the bending moment of the shaft at its yield strength stress.

8. **Finish.** All hardware not otherwise specified shall be aluminum or stainless steel. Furnish all materials in natural aluminum color. Furnish pole shafts with either a polished or brush finished surface. Tire-wrap shaft and bracket arm assemblies with a heavy water-resistant paper to provide protection during shipment and installation.

C. Steel

1. **Scope.** These Specifications apply only to the manufacture of steel lighting standards used to support lighting units.

2. **General.** Provide poles consisting of a steel shaft having a base welded to the lower end and complete with anchor bolts. All castings shall be clean, smooth, with details well defined and true to pattern. Provide gray iron castings conforming to ASTM A126, Class A, or ASTM A48, Class 20. Provide steel castings conforming to ASTM A27, Grade 65-35.

3. **Anchor Base.** Secure a one-piece cast steel base, having adequate strength, shape, size, and chamfer, to the lower end of the shaft by two continuous electric arc welds. The base shall telescope the

shaft. Make one weld on the inside of the base at the end of the shaft; make the other weld on the outside at the top of the base so that the welded connection will develop the full strength of the adjacent shaft section to resist bending action.

Provide four removable anchor bolt covers with each base. Attach each cover to the body of the base using suitable means. Provide a transformer base, if specified, of the design, dimensions, and material shown on the Plans.

4. Breakaway Device. Provide breakaway devices conforming to the same requirements as specified in **917.02.B.5** for aluminum poles.

5. Shaft. The steel shaft may have only one longitudinal electrically welded joint and shall not have any intermediate horizontal joints or welds. Use only one length of steel sheet and form it into a continuous shaft.

Fabricate the shaft from not less than No. 11 gauge steel conforming to the requirements of ASTM Sandards: A242, A595, A606 or A1008, and A1011.

After forming and welding, longitudinally cold-roll the shaft under sufficient pressure to flatten the weld and increase the physical characteristics of the shaft so that the metal will have a minimum guaranteed yield strength of 48,000 pounds per square inch. The shaft (excluding transformer base standards) shall have a reinforced handhole, of the size shown on the Plans, with a bolt-on cover. Provide a ground nut or lug for accommodating a 1/2-inch UNC threaded bolt or stud in the shaft or base. Equip the top of the shaft with a pole cap held securely in place by set screws.

6. Bracket Arm Steel. Provide bracket arms for steel standards that meet the same requirements as specified in **917.02.A.8** for steel bracket arms for concrete standards.

7. Anchor Bolts. Provide anchor bolts for steel standards that meet the same requirements as specified in **917.02.B.7** for anchor bolts for aluminum standards.

8. Finish. Either paint or galvanize steel lighting standards as shown on the Plans and in accordance with the following:

a. When painting is permitted or specified, thoroughly clean all materials not to be galvanized and shop paint with one coat of zinc chromate primer meeting the requirements of **910.03** before the parts are handled or packaged for shipment.

b. Galvanize steel standards and bracket arms, and fittings, except hardware and anchor bolts, in accordance with ASTM A123. Galvanize hardware and anchor bolts in accordance with ASTM A153.

D. High Mast

1. Scope. These Specifications apply only to the manufacture of steel lighting standards over 55 feet in length used to support head frame, ring assembly, suspension, and power cables and luminaires.

2. General. Provide poles consisting of a steel shaft, handhole, anchor base, head frame, suspension cables, power cables, anchor bolts and foundation, and all equipment to complete the installation. Provide standards conforming to the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

3. Shaft. Provide shafts tapered from top to bottom, either cylindrical or multi-sided in cross-section, and of either single-piece or slip-fit multi-section construction. Slip-fit design shall consist of tapered sections that telescope each other and are fabricated so that the minimum length of the overlap joint is 1-1/2 times the maximum inside diameter of the overlapping section. Number each section and show minimum and maximum overlap.

a. Provide weathering steel shafts conforming to ASTM A595 Grade C; and miscellaneous plates, bars, and structural shapes conforming to ASTM A709 Grade 50 S. Fabricate and weld these poles in accordance with AWS 01.1.

b. Provide galvanized steel shafts of high strength steel, cold formed fabricated with one longitudinal weld and having a minimum yield strength of 50,000 pounds per square inch and a maximum specified yield strength of 65,000 pounds per square inch after fabrication. Base the design on the

yield strength of the material used but not to exceed 60,000 pounds per square inch. Hot-dip galvanize the shaft in accordance with ASTM A123.

917.03 Lighting Assembly Strength Test

Ensure that the complete assembly of all standards, except high mast, when placed upright on a suitable foundation meets the following strength requirements:

1. A vertical load of 100 pounds applied at the point of luminaire attachment shall not produce a deflection in excess of 5% of the horizontal length of the bracket.

2. A vertical load of 250 pounds applied at the same point as in (1) above shall not produce collapse, rupture, or permanent deformation of any portion of the assembly.

3. A horizontal load of 60 pounds applied at the point of luminaire attachment and normal to plans of bracket assembly shall not produce a horizontal deflection in excess of 5% of the horizontal length of the bracket.

4. A horizontal load of 500 pounds applied at the top of the shaft, in any direction, shall not produce a deflection in excess of 8% of the length of the shaft nor shall this load cause failure of any component part of the assembly.

Furnish a signed warranty from the manufacturer stating that the materials used in standard and bracket fabrication fully meet the requirements of these Specifications and will satisfactorily withstand the specified horizontal and vertical loads in the above tests.

917.04 Wiring

Use conductor cable of the size and type shown on the Plans and in strict compliance with the National Electrical Code, the National Electrical Safety Code, and local codes.

Unless otherwise shown on the Plans, for all conductor cable placed in conduits and light standards, use single-conductor AWG copper with UL

rated 600 volt type insulation suitable for wet or dry installation with the conductor temperature not exceeding 167 °F.

Provide direct-burial cable and cable in-duct as shown on the Plans.

917.05 Metallic Conduit

Provide rigid steel conduit conforming to Federal Specifications WW-C-581 or ANSI C 80.1. Galvanize the conduit inside and outside by one of the following processes: hot-dip galvanizing, metallized galvanizing, or electro-galvanizing.

Provide flexible metal conduit conforming to Federal Specification WW-C-566.

Provide aluminum conduit conforming to Federal Specification WW-C-540.

Where welded steel pipe for ordinary use is shown on the Plans, provide pipe that is hot-dip galvanized inside and out and that meets ASTM A53 for Welded Steel Pipe for ordinary uses.

917.06 Metallic Conduit Fittings

Provide galvanized steel conduit fittings conforming to Federal Specifications WW-C-581 or ANSI C-80.4.

917.07 Non-metallic Rigid Conduit

Provide non-metallic rigid conduits and fittings of polyvinyl chloride (PVC), of Schedule 40 or 80 as specified, and conforming to ASTM D1785 for conduit and ASTM D2466 for fittings; or polyethylene conduit meeting the requirements of ASTM D1248 or as specified in the Contract.

917.08 Luminaires

Provide luminaires, complete with power regulated ballast, lamps, insulating transformer (where required), and associated hardware and wiring. Luminaires shall use and include a high intensity discharge lamp of the type shown on the Plans.

Ensure that the luminaires are capable of providing the specified illumination level and uniformity of illumination when installed as shown on the Plans.

Photometric and electrical requirements shall equal or exceed the requirements shown on the Plans.

917.09 Fittings, Pull Boxes, and Bends

Provide fittings, pull-boxes, bends, and miscellaneous hardware in accordance with the Plans and the National Electrical Code, and that are compatible with the adjacent conduit and materials.

917.10 Relays, Switches, Control Cabinets, Etc.

Provide relays, switches, control cabinets, and miscellaneous electrical equipment in accordance with the applicable codes and as shown on the Plans.

917.11 Service Poles and Wood Standards

Provide wood service poles and standards of the class and length shown on the Plans. Unless otherwise specified, provide poles and standards of treated southern pine, classified according to the latest American Standard Dimensions of Southern Pine Poles, and that meet the requirements of ANSI 05.1. Treat the poles with pentachlorophenol or other approved treatment at the rate recommended by the local power authority, unless otherwise specified. The treatment shall conform to **911.03**.

Provide metal service poles of the kind, design, type, and dimensions shown on the Plans.

917.12 Guying Components

Provide guying components for wood poles consisting of zinc-coated wire strand, zinc-coated anchor rod, four-way expanding anchor, and necessary accessories. Use wire strand conforming to the requirements of ASTM A475 for the particular grade, size, and type specified. Hot-dip galvanize the anchor rod, anchor, and accessories.

All guying components shall be in accordance with the details shown on the Plans.

917.13 Grounding Materials

Provide grounding materials as shown on the Plans. Use clamps that are designed for use with the designated rods.

917.14 Splicing Materials

Use splicing materials as shown on the Plans and of a design and material consistent with the location and type of splice indicated.

917.15 Drag Wire

For drag wire to be installed in the conduit, use nine-gauge galvanized iron wire, unless otherwise specified.

917.16 Photoelectric Relay

For the photoelectric relay for operating the multiple relays in the control center, provide a unit type assembly with a locking type plug that will allow the unit to be easily removed for maintenance purposes.

The photoelectric relay shall operate from 105 to 285 volts, shall have a minimum control range of 0.5 to 5.0 footcandles, and shall have a sensitivity adjustment for both on and off for the total range. The relay contacts shall be able to handle a minimum of 1,000 watts at 250 volts.

SECTION 918 – LANDSCAPING MATERIALS

918.01 Grass Seed

A. General

Provide seed meeting the requirements of the Tennessee Department of Agriculture Chapter 0080-05-06. The Producer must be on the Department's Producer List.

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 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
Annual Rye Grass	5

Table 918.01-2: Group B (June 1-August 15)

Kind of Seed	Quantity, Percent by Weight
Kentucky 31 Fescue	75
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
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
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 separately and meets DOA requirements for purity and germination.

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)	Annual Rye Grass	33-1/3%
	Korean Lespedeza	33-1/3%
	Spring Oats	33-1/3%
Group E (May 1 – July 15)	Sorghum-Sudan Crosses [1]	100%
	or	
	German Millet [2]	100%
Group F July 15 – January 1	Cereal Rye	66-2/3%
	Annual Rye Grass	33-1/3%

[1] Dekalb Sudan SX11, Lindsey 77F, TN Farmer's Co-op GHS-1 or GHS-2A.

[2] German Millet, GaHi-1

918.02 Commercial Fertilizer

Provide a standard commercial fertilizer containing the specified percentages by weight of nitrogen, phosphoric acid, and potash.

Furnish the fertilizer in standard containers, with the name, weight, and guaranteed analysis of the contents clearly marked. Ensure that the containers will adequately protect the fertilizer during handling and transporting.

All commercial fertilizer shall comply with local, State, and Federal fertilizer laws.

918.03 Ammonium Nitrate

For ammonium nitrate, provide a standard commercial product, conforming to the requirements specified in **918.02** for other commercial fertilizers and having a minimum of 33-1/2% nitrogen.

918.04 Agricultural Limestone

Provide agricultural limestone meeting the Department of Agriculture Tennessee Liming Materials Act,

918.05 Mulch Material

Ensure that all hay and straw mulch materials are air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth on the highway or on adjacent agricultural lands.

Provide hay derived from stalks of approved grasses, sedges, or legumes seasoned before baling or loading.

Provide straw derived from stalks of rye, oats, wheat, or other approved grain crops.

Both hay and straw shall be suitable for spreading with standard mulch blower equipment.

Provide an approved tackifier, selected from the Department's QPL for Erosion Prevention and Sediment Control, to hold mulch in place.

918.06 Inoculants for Legumes

For treating legume seed, provide inoculants composed of standard cultures of nitrogen-fixing bacteria that are adapted to the particular kind of seed to be treated. Provide the inoculant in convenient containers, of a size sufficient to treat the amount of seed to be planted and that contain labels identifying the specified legume seed to be inoculated and the date period to be used.

SECTION 919 – PAVEMENT MARKING MATERIAL AND MARKERS

919.01 Thermoplastic Pavement Marking Material

Provide material conforming to AASHTO M 249, with the following additions.

A. Materials

Provide retroreflective pavement marking material of an alkyd/maleic based thermoplastic material consisting of homogeneously mixed pigments, filler, resins, and glass beads. Ensure that the pigment, beads, and filler are uniformly dispersed in the resin. The material shall be manufactured from virgin material using no reprocessed components.

Ensure that the material is free from all skins, dirt, and foreign objects, and conforms to the requirements specified in Table 919.01-1.

Table 919.01-1: Thermoplastic Pavement Marking Material

Component	White	Yellow
Binder, % minimum	19	19
TiO_2 Pigment, % minimum	10	N/A
Intermix Glass Beads, % minimum	35	35
Calcium Carbonate/Fillers, % maximum	36 (1)	46 (1)

(1) The amount of Calcium Carbonate and inert fillers shall be as recommended by the manufacturer, provided all other specifications are met.

Titanium dioxide shall be Rutile Type II, conforming to ASTM D476, with a minimum purity of 93%.

The premixed beads shall constitute the total silica content used in the formulation of the thermoplastic. Uniformly disperse the pigment, beads, and filler in the binder.

The Alkyd/Maleic binder shall consist of a mixture of synthetic resins and high boiling point plasticizers, one of which shall be solid at room temperature. At least one-half of the binder composition, and no less than 15% of the entire material formulation, shall be 100% maleic modified glycerol ester of resin. Do not use a binder containing any petroleum, hydrocarbon resins, tall oil resins, or rosins.

Provide thermoplastic material meeting the following requirements:

1. The thermoplastic material shall be free of contaminates and shall be dry-blended or hot-mixed from 100% virgin stock using no reprocessed materials.

2. The thermoplastic material shall be formulated so that when it is on the roadway surface at any natural temperature, it will exist in a hard, solid state with cold ductility that allows normal movement with the road surface without chipping or cracking.

3. The thermoplastic shall not deteriorate or discolor when held at the application temperature for periods of time up to 4 hours or upon repeated reheating (a minimum of four times).

4. The color, viscosity, and chemical properties versus temperature characteristics of the thermoplastic material shall remain constant for up to 4 hours at the application temperature and shall be the same from batch to batch.

5. The thermoplastic material shall be readily applicable at temperatures between 400 °F and 440 °F from the approved equipment to produce lines and symbols of the specified thickness above the pavement surface.

B. Physical Requirements: After 4 hours @ 425 °F

Ensure that the thermoplastic material meets the physical requirements specified in AASHTO M 249, with the following changes.

Test the material in accordance with AASHTO T 250 and/or with the appropriate method in Federal Test Method Standard #141 or ASTM Designation.

1. **Bond Strength.** 180 pounds per square inch, minimum, when tested in accordance with ASTM D4796.

2. **Specific Gravity.** Not to exceed 2.30.

C. Glass Beads

Provide glass beads that meet AASHTO M 247.

Provide beads of clear, transparent, colorless glass, smooth and spherically shaped, free of milkiness, pits, or excessive air bubbles and that conform to the following specific requirements.

Use glass beads containing no more than 200 parts per million of lead or 200 parts per million of arsenic. Certify and ensure that all glass beads meet all Federal requirements. Provide an independent test report certifying that all glass beads contain no more than 200 parts per million of arsenic or lead as determined by a certified independent (third party) laboratory, in accordance with Environmental Protection Agency testing methods 3052, 6010B, or 6010C.

1. **Color and Clarity.** Beads shall be colorless, clear and free from carbon residues.

2. **Roundness.** Minimum true spheres overall shall be 80% when tested in accordance with ASTM D1155; for larger beads use visual inspection.

3. **Index of Refraction.** Minimum of 1.50, when tested by the liquid emersion method at 77 °F

4. **Air Inclusions.** Maximum of 3% overall.

D. Intermix Glass Beads

Premix glass beads into the thermoplastic mixture, to amount to 35% of the overall thermoplastic formulation. Use uncoated intermix beads

defined by two distinct gradations and that meet the following requirements:

1. Type 1 Intermix glass beads shall make up at least 50% of 35% of the overall thermoplastic formulation (Intermix Glass Beads) and shall conform to AASHTO M 247, Type 1, with the exception that the minimum true spheres overall shall be 80% as specified in **919.01.C.2**.

2. Type 3 Intermix glass beads shall make up at least 50% of 35% of the overall thermoplastic formulation (Intermix Glass Beads) and shall conform to AASHTO M 247, Type 3 with the exception that the minimum true spheres overall shall be 80% as specified in **919.01.C.2**.

E. Double Drop System

The double drop system shall be capable of applying glass beads at the specified application rates. Apply beads across the entire line width, ensuring uniform application and embedment of the beads to 50 to 60% of the bead diameter.

Use Type 1 drop on beads that are dual-coated for moisture resistance and adhesion and that meet the requirements of AASHTO M 247 Type 1 with the exception that the beads shall be 80% round overall.

Use Type 4 drop on beads that are dual-coated for moisture resistance and adhesion and that meet the requirements of AASHTO M 247 Type 4 with the exception that the beads shall be 80% round overall.

F. Marking Compound. Use material having the following characteristics:

1. In the molten state, the material shall not give off fumes that are toxic or otherwise injurious to persons or property. Obtain material safety data sheets for the product from the manufacturer.

2. The temperature versus viscosity characteristic of the plastic material shall remain constant. In addition, the material shall not deteriorate in any manner during three reheating processes.

3. No obvious change in material color shall occur as a result of up to three reheatings, or in maintaining the material at application

temperature up to an aggregate time of 4 hours, or from batch to batch.

4. The maximum elapsed time after application at which normal traffic will leave no impression or imprint on the new pavement marking shall be 30 seconds when the air and road surface temperature is approximately 68 °F plus or minus 5 °F.

5. The applied pavement marking shall remain free from tack, and shall not lift from the pavement under normal traffic conditions, within a road temperature range of -20 ° to 150 °F.

6. The pavement marking shall maintain its original dimensions and placement.

7. Cold ductility of the material shall allow for normal dimensional distortion as a result of tall impact within the temperature range specified.

8. The material shall provide a pavement marking that has a uniform thickness throughout its cross-section.

919.02 Spray Thermoplastic Pavement Marking Material

Provide retroreflective pavement marking material that meets the requirements specified in **919.01**, except as noted below.

A. Materials

Spray thermoplastic pavement marking material shall conform to the requirements specified in Table 919.02-1.

Table 919.02-1: Spray Thermoplastic Pavement Marking Material

Component	White	Yellow
Binder, % min	26	26
TiO_2 Pigment, % min	10	N/A
Intermix Glass Beads, % min	35	35
Calcium Carbonate/Fillers, % max	29 (1)	29 (1)

(1) The amount of Calcium Carbonate and inert fillers shall be as recommended by the manufacturer, provided all other specifications are met.

Requirement **919.01.A.5** does not apply.

B. Physical Requirements: After 4 Hours at 425 °F

Ensure that the thermoplastic material, after being heated for 4 hours plus or minus 5 minutes at 425 plus or minus 3 °F and cooled to 77 plus or minus 3 °F, meets the physical requirements set forth in AASHTO M 249, with the following changes.

Test the material in accordance with AASHTO T 250.

1. **Specific Gravity.** 2.0 maximum

2. **Softening Point.** After heating the marking compound for 4 hours plus or minus 5 minutes at 425 plus or minus 3 °F and testing in accordance with ASTM E28, the material shall have a minimum softening point of 180 °F as measured by the ring and ball method.

C. Glass Beads

Use beads conforming to AASHTO M 247, Type 1.

D. Intermix Glass Beads. Premix Type 1 glass beads for intermix into the thermoplastic mixture, to amount to 35% of the overall thermoplastic formulation.

E. Drop on Glass Beads. Use drop on glass beads that may be applied at the specified application rates and that can flow freely through dispensing equipment in any weather suitable for pavement marking

application. Apply Type 1 beads at a minimum application rate of 10 pounds per 100 square feet. Apply beads across the entire line width, ensuring uniform application and embedment of the beads to 50 to 60% of the bead diameter. Treat Type I drop-on glass beads with a moisture resistant coating.

F. Marking Compound

Use marking compound conforming to **919.01.F**.

919.03 Preformed Plastic Pavement Marking Materials

Provide preformed plastic pavement marking material selected from the Department's QPL.

919.04 Raised Reflective Pavement Markers

Provide raised reflective pavement markers listed on the Department's QPL and classified as follows:

Type 1	One-Color, Reflective Markers (Two-way Traffic)
Type 2	One-Color, Reflective Markers (One-Way Traffic)
Type 3	Two-Color, Reflective Markers (One-way Traffic)

919.05 Snowplowable Reflective Pavement Markers

Provide reflectors consisting of an acrylic shell filled with tightly adherent potting compound. Select the potting compound based on strength, resilience, and adhesion adequate to pass the necessary physical requirements. The shell shall contain one or two reflective faces. Attach the reflector to an iron casting with an elastomeric pad.

Provide reflectors and castings selected from the Department's QPL and that conform to the following requirements.

A. Reflectors

1. **Dimensions.** Provide reflectors that are 4 plus or minus 0.5 inches by 2.0 plus or minus 0.25 inches at the base, with a height of 0.40 inch or no higher than 0.50 inch. The slope of the reflector shall be 30 degrees, and the minimum area of the reflective surface shall be 1.87 square inches.

2. **Outer Surface.** Provide the shell with a smooth outer surface, except as needed for identification purposes.

3. **Base Surface.** Ensure that the base of the marker is substantially free from gloss or substances that may reduce its bond to adhesive.

Attach the markers, either mono- or bi-directional as specified, to an iron casting that is shaped to be snow plowable in the two opposing longitudinal directions and designed to allow for removal and replacement when needed to restore reflectivity.

B. Castings

1. **General.** Provide casting that are 10 plus or minus 0.5 inches long by 5.5 plus or minus 0.5 inches wide. Ensure that the maximum projection of the casting above the roadway does not exceed 0.5 inch, and that snowplow blades will ride over the casting without contacting the reflective marker.

2. **Casting Material.** Provide castings of nodular iron conforming to ASTM A536, Grade 72-45-05, hardened to 52-54 RC.

3. **Identification.** Mark each casting with manufacturer's name and model number of marker.

SECTION 920 – EROSION CONTROL MATERIALS

920.01 Erosion Control Blankets

Provide erosion control blankets selected from the Department's QPL.

920.02 Staples

Use wire not smaller than 11 gauge, formed into a U shape with legs at least 6 inches in length and a crown 1 inch in width. Ensure that staples have sufficient thickness to penetrate the soil without undue distortion.

SECTION 921 – MISCELLANEOUS MATERIALS

921.01 Water

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)]

(1) Other methods (EPA or those used by water testing companies) are generally acceptable.

(2) No ASTM method available.

921.02 Calcium Chloride

A. Solid Form

Provide solid forms of calcium chloride conforming to the requirements of AASHTO M 144, for the type specified, except that the Department will waive requirements for total alkali chlorides and impurities when calcium chloride is to be used in mineral aggregate base or surface courses.

B. Liquid Form

Provide liquid forms of calcium chloride consisting of a clear liquid free from suspended matter and that meets the requirements specified in Table 921.02-1.

Table 921.02-1: Calcium Chloride Liquor

Component	Concentration of Calcium Chloride Liquor	
	32%	38%
Total Calcium Chloride by Weight, min.	32	38
Total Magnesium Chloride by Weight, max.	0.5	0.5

Do not use a calcium chloride solution of less than 32%.

Include with each shipment of calcium chloride liquor a certification from the manufacturer that states the concentration and net weight, and guarantees the percentage of calcium chloride.

921.03 Reserved

921.04 Lime

Provide lime conforming to the requirements of ASTM C977, for the type specified.

921.05 Select Material for Soil-Cement Base

Provide select material for soil-cement base of such general character as to be classified as Group A-1 or A-2, in accordance with AASHTO M 145, and of such size that all will pass the standard 1-1/2 inch sieve.

921.06 Chemical Admixtures and Additives

A. Admixtures

1. **Portland Cement Concrete Admixtures.** Provide admixtures that are listed on the Department's QPL and conform to AASHTO M 194 for the following seven types of admixtures:

   Type A - Water reducing admixtures
   Type B - Retarding admixtures
   Type C - Accelerating admixtures
   Type D - Water-reducing and retarding admixtures

Type E - Water-reducing and accelerating admixtures
Type F - Water-reducing, high range admixtures
Type G - Water-reducing, high range admixtures and retarding admixtures
Type S - Specific performance admixtures

2. **Air-Entraining Admixtures.** Use air-entraining admixtures that are listed on the Department's QPL and conform to AASHTO M 154, except that the tests for bleeding, bond strength, and volume change will not be required.

B. Bituminous Additives

1. **Anti-Stripping Additive.** Use hydrated lime conforming to AASHTO M 303 or 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.

   When hydrated lime is the anti-stripping additive, use an amount equal to 1% by weight of the aggregate. Uniformly coat the aggregate with the lime, to the Engineer's satisfaction, before adding the bituminous material to the mixture.

   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%.

   The Department's QPL identifies qualified antistripping additives. Do not use any product unless it appears on this list.

2. **Silicone Additives.** The amount of silicone added to asphalt cement shall not exceed 2 oz. of silicone per 5500 gallons asphalt cement.

3. **Warm Mix Asphalt (WMA) Additives.** The Contractor may add qualified WMA additives to bituminous plant mix to reduce placement temperatures as specified in **407.11**. Introduce the WMA additives into the mixture at a constant rate, sufficient to produce the mix temperatures specified in **407.11**, and in a manner approved by the Department. Record all changes to the proportions of the additive used during the course of mix production. The

Department's QPL identifies qualified WMA additives. Only use additives appearing on this list.

921.07 Masonry Stone

Provide sound, dense, and durable masonry stone, free from excessive cracks, pyrite intrusions, and other structural defects. Ensure that stones that will be used with mortar are free from dirt, oil, or other material that might prevent good adhesion with the mortar.

Masonry stone shall meet the quality requirements in **903.25**.

921.08 Waterstops

Provide waterstops of the type, shape, and dimensions shown on the Plans.

A. Metallic

Provide metallic waterstops of sheet copper conforming to the requirements of **908.13**.

B. Nonmetallic

Provide nonmetallic waterstops, manufactured from natural rubber, synthetic rubber, or polyvinyl chloride (PVC), that are dense, homogeneous, and free from holes and other imperfections. The cross-section of the waterstop shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the waterstop will be uniform.

Fabricate rubber waterstops from a high-grade thread-type compound, consisting of not less than 70% by volume of the basic polymer, with the remainder composed of reinforcing carbon black, zinc oxide, accelerators, anti-oxidants, vulcanizing agents, and plasticizers. The compound shall contain no factice. As the basic polymer, use natural rubber or a co-polymer of butadiene and styrene, or a blend of both.

Samples taken from the finished waterstop shall meet the requirements specified in Table 921.08-1.

Table 921.08-1: Requirements for Nonmetallic Waterstops

Property	ASTM Test Method	Value
Tensile Strength (Die "C")	D412	2,500 psi, min
Ultimate Elongation (Die "C")	D412	450%, min
Shore Durometer Hardness	D2240	60-70
Specific Gravity	D297 (Section 17)	1.15 ± 0.03
Water Absorption (% by weight)	D570	5%, max
Tensile strength after accelerated aging, oxygen-pressure method	D572	80%, min

C. Polyvinyl Chloride (PVC) Waterstop

Provide waterstops extruded from an elastomeric plastic compound, the basic resin of which shall be PVC. The compound shall contain additional resins, plasticizers, stabilizers, or other materials needed to ensure that when the material is compounded it will meet the performance requirements specified in Table 921.08-2. Do not use any reclaimed PVC.

Table 921.08-2: Requirements for PVC Waterstops

Property	Test Method	Value
Tensile Strength (Die "C")		
Sheet Material	ASTM D412	2,000 psi, min
Finished Waterstop	ASTM D412	1,700 psi, min
Ultimate Elongation (Die "C")		
Sheet Material	ASTM D412	350%, min
Finished Waterstop	ASTM D412	300%, min
Stiffness in Flexure	ASTM D747	750 psi, min
Accelerated Extraction	CRD-C 572	
Tensile Strength (Die "C")	ASTM D412	1,750 psi
Elongation (Die "C")	ASTM D412	300%
Effect of Alkali (after 7 days)	CRD-C 572	
Change in Weight		-0.1 to + 0.25%
Change in Hardness, Shore Durometer		± 5%
Low Temperature Brittleness	ASTM D746	-35 °F
Specific Gravity	ASTM D792	1.3

For PVC waterstops, the supplier shall submit a certificate stating that all the performance requirements specified above for the sheet material have been complied with. In addition, the supplier shall submit an affidavit to the effect that the sheet sample is of the same material in all respects as that to be used in the manufacture of the finished waterstop. The supplier shall also specify the value of the specific gravity of the finished waterstop material to within plus or minus 0.02.

Manufacture waterstops with an integral cross-section, uniform within plus or minus 1/8 inch in width, and with the web thickness or bulb diameter within plus 1/16 inch and minus 1/32 inch.

Furnish the Department a certified test report from an approved laboratory covering each lot or unit of finished waterstops and containing the numerical laboratory test data of all required tests.

921.09 Grout

Mix grout in small quantities as needed, and do not retemper or use grout after it has begun to set. Unless otherwise specified or directed, provide grout consisting of one part Portland cement and two parts sand by volume, mixed with sufficient water to form a grout of proper consistency. Use Portland cement conforming to the requirements of **901.01**, and sand conforming to the requirements of **903.02**. Use water that has been approved by the Engineer.

When non-shrinking or non-shrinking fast-setting grout is specified, either formulate it by incorporating an admixture, or use a pre-mixed grout. Obtain the Engineer's approval of the formulation and the admixture or the premixed grout. Mix and use the grout in accordance with the manufacturer's recommendations. These special grouts will be classified as follows:

Type I - Non-shrinking Grout
Type II - Non-shrinking, Fast-setting Grout

921.10 Precast Manholes and Catch Basins

Provide precast manholes and catch basins that conform to ASTM C478 and that are made in accordance with the Departmental procedures.

921.11 Manhole Steps

For use in manholes or catch basins, provide steps meeting ASTM C478, Article 11.2.1, or that are of the design shown on the Plans.

Provide cast iron steps conforming to **908.07**.

Provide aluminum steps fabricated from aluminum Alloy 6061, T6, with a minimum tensile strength of 38,000 pounds per square inch, a minimum yield strength of 35,000 pounds per square inch, and an elongation in 2 inches of not less than 10%.

Alternate manhole steps are listed on the Department's QPL.

921.12 Geotextile and Geosynthetic Material

Provide geotextiles and geosynthetics listed on the Department's QPL and that meet the material requirements shown on the Standard Drawing.

Furnish, with each shipment of materials, a certified laboratory test report from an approved testing laboratory and a certified letter stating the product provided is the same as on the Department's QPL. Laboratory test reports shall include the actual numerical test data obtained. Clearly label all rolls as being part of the same production run from which the test data was derived.

Protect geosynthetics to prevent damage during transportation, storage, and installation. Store geotextile and geosynthetic rolls elevated up off of the ground and covered to protect against UV degradation. Do not install material that is torn, punctured, or otherwise damaged.

921.13 Precast Prestressed Bridge Deck Panels

Construct and inspect the precast prestressed deck panels in accordance with the Plans, approved shop drawings, and the Standard Specifications. Fabricate the panels in a plant certified by the Precast/Prestressed Concrete Institute (PCI) category B-3.

Cast panels on beds that are clean, straight, level, and in good repair. Bulkheads and headers are to be of the size and configuration to adequately hold cables in place during casting operations. Keep forms, headers, cables, reinforcing bars or other steel that comes in contact with freshly placed concrete below 90 °F during casting operations. Cover and cure freshly cast panels as specified in **615.11**.

Provide projecting bars or other hardware for lifting and handling panels at the locations and in accordance with the details shown on the approved Shop Drawings. Protect projecting bars against impact and ensure that they are not bent in the shop, during handling and transporting, or in the field. Protect panels from damage during lifting, storing, and transporting.

Repair small damaged or isolated honeycombed areas that are purely surface in nature and not over 1 inch in depth at the fabrication plant with an approved epoxy grout. Replace panels with more extensive damage or honeycomb.

Inspect the panels at the point of delivery to the jobsite for identification, dimensional tolerances, cracks, and structural damage. Replace panels exhibiting excessive cracking or other structural damage.

Replace panels having any of the following defects:

1. Any crack that comes within 1 inch of a strand.

2. Corner cracks or breaks that involve one strand.

3. Isolated damage or honeycomb larger than approximately 6 inches in diameter or length and 1 inch in depth that involves one strand.

In evaluating for the above defects, consider a crack as a fissure of any length that extends from the surface of the panel to the mid-depth of the panel or to a strand, in accordance with any of the following conditions:

1. The crack is visible at the ends or edges of the panel.

2. The strand is visible within the crack.

3. The crack can be probed to mid-depth or to the strand.

4. The crack is visible on the top and bottom surface of the panel at approximately the same relative location.

Any new crack that appears in a panel after the deck is poured will be considered to extend to the mid-depth of the panel or to a strand. Replace, or repair to the Engineer's satisfaction, panels exhibiting new cracks after the slab is poured.

Defects not covered by the above will be subject to review by the Engineer.

921.14 Applied Textured Finish Material

The material for applied textured finish shall meet the requirements of Federal Specifications TT-C-00555, Type II, except as modified below:

A. Freeze-Thaw Test

1. Cast and cure three concrete specimens, not less than 4 x 6 x 6 inches, of a mix designed for structures. Moist cure for 14 days with a drying period in room air at 60 to 80 °F for 24 hours before coating with spray finish. Take caution to ensure that no excessive oil forms on specimen. Coat sides of specimens (brush permitted) and cure at room temperature for 48 hours; after which:

2. Immerse the specimen in water at room temperature (60 to 80 °F) for 3 hours; remove and,

3. Place in cold storage at -15 °F for 1 hour; remove and,

4. Thaw at room temperature (60 to 80 °F) for 1 hour.

5. Repeat Steps 3 and 4 to complete a total of 50 cycles.

B. Exposure Test

Subject the material to a 5,000-hour exposure test conforming to ASTM G155, operating a xenon arc light apparatus for non-metallic materials. At the end of the exposure test, the exposed sample shall not show any chipping, flaking, or peeling.

C. Fungus Growth Resistance

Material to be used must pass a fungus resistance test as described by Federal Specification TT-P-29b with a minimum incubation period of 21 days. There shall be no indication of growth after the test.

Submit to the Materials and Tests Engineer a 1-quart sample of the material proposed for use. This material will be tested and placed on the Department's QPL if it meets specifications.

After the material has been initially qualified and placed on the QPL, submit for each project on which the material is used, a certified statement from the formulator stating that the material furnished is identical in all respects to that which was initially qualified.

The Department reserves the right to require samples and to perform any or all the tests specified.

921.15 Fly Ash

Use fly ash meeting AASHTO M 295, Class F or Class C, for the class specified. Do not use fly ash of different classes or sources as a partial replacement for Portland cement in concrete mixes.

Provide fly ash meeting the requirements specified in Table 921.15-1.

Table 921.15-1: Fly Ash Requirements

Property	Fly Ash Class	
	F	C
A. Chemical Requirements: Uniformity Requirements		
The loss on ignition of individual samples shall not vary from the average established by the 10 preceding tests, or by all preceding tests if the number is less than 10, by more than: Loss on ignition, max variation, percentage points from average	1.0	1.0
B. Physical Requirements: Pozzolanic Activity Index		
With Portland cement, at 7 days, min, % of control	60	60
With Portland cement, at 28 days, min, % of control	75	75

Obtain fly ash from an approved source as shown on the Department's Producer List.

921.16 Slag Cement

Provide slag cement meeting the requirements of AASHTO M 302, Grade 100 or Grade 120. Do not use slag cement of different grades or sources as a partial replacement for Portland cement in concrete mixes.

Obtain slag cement from an approved source as shown on the Department's Producer List.

921.17 Ground Tire Rubber

Provide Class 30-1 Ground Tire Rubber (GTR) as defined by ASTM D5603 except for as noted in Table 921.17-1. The material shall also be certified to meet the requirements of Table 921.17-1. 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

921.18 Silica Fume

Use silica fume meeting AASHTO M 307.

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