

INVITATION FOR BIDS

TOWN OF KNIGHTDALE

950 Steeple Square
Knightdale, NC 27545
(919) 217-2200

ADVERTISEMENT DATE: 06/13/2025
TITLE: Breckenridge Drive Drainage Improvements
IFB#: 25-20250613
ISSUING DEPARTMENT: Public Works

All inquiries for information concerning instructions to the bidder, bid submission requirements, or procurement procedures shall be directed to:

Michelle Arnold, Business Analyst
(919) 217-2214
michelle.arnold@knightdalenc.gov

All inquiries for information concerning scope of work or project specifications shall be directed to:

Phillip Bunton, Director of Public Works
(919) 217-2250
phillip.bunton@knightdalenc.gov

This project will include installation of new storm utility piping, curb, gutter and associated repaving for stormwater management improvements along Breckenridge Drive in Knightdale, NC. It has received both 404 and 401 federal permits and is shovel ready.

Bids will be received by the Town of Knightdale at Town Hall until **1:00PM (EST Council Chambers Clock) on Tuesday, July 15, 2025**. Only sealed, hard copy bids will be accepted.

A pre-bid meeting will not be held for this project. Submit all questions via email no later than **5:00PM on Thursday, June 26, 2025**. An addendum with questions and answers, if necessary, will be published on the Town's website by 5:00PM on Wednesday, July 2, 2025.

In compliance with this Invitation for Bids and to all the terms and conditions imposed herein, the undersigned offers and agrees to furnish the goods and service described in accordance with the attached signed bid.

Table of Contents

ADVERTISEMENT FOR BIDS.....	3
PROPOSAL FORM	4
PROPOSAL SIGNATURE PAGE	5
ADDITIONAL BIDDER'S CERTIFICATION	6
BID BOND FORM.....	7
INSTRUCTIONS TO CONTRACTORS	9
CONSTRUCTION OR PUBLIC WORKS CONTRACT FORM.....	10
PERFORMANCE BOND FOR CONTRACT	21
PAYMENT BOND FOR CONTRACT	24
PROCEDURE FOR REPORTING NORTH CAROLINA SALES TAX EXPENDITURES.....	27
AFFIDAVIT FOR FINAL PAYMENT	28
GENERAL CONDITIONS	29

ADVERTISEMENT FOR BIDS

Location: Knightdale, North Carolina

Project: Breckenridge Drive Drainage Improvements # 25-20250613

Sealed bids will be received by the Town of Knightdale, NC for installation of new storm utility piping, curb, gutter and associated repaving for stormwater management improvements along Breckenridge Drive in Knightdale, NC. The project has received both 404 and 401 federal permits and is shovel ready.

Bids will be received by the Town of Knightdale, NC at Town Hall until **1:00PM (EST Council Chambers Clock), Tuesday, July 15, 2025**. Clearly marked bids may be mailed or hand delivered to:

Town of Knightdale
Attn: Breckenridge Drive Bid #25-20250613
950 Steeple Square Court
Knightdale, NC 27545

A pre-bid meeting will not be held for this project. Submit all questions via email no later than **5:00PM on Thursday, June 26, 2025**. An addendum with questions and answers, if necessary, will be published on the Town's website by 5:00PM on Wednesday, July 2, 2025.

The following attachments accompany this advertisement and are incorporated herein. Attachment C may only be received electronically, via email request to phillip.bunton@knightdalenc.gov.

Attachment A: Breckenridge Drive Unit Price Bid Schedule

Attachment B: Standard Specifications (Town of Knightdale and NCDOT)

Attachment C: Construction Drawings

The Town of Knightdale reserves the right to waive any informalities or minor defects, or reject any and all bids. This submittal request is neither a contractual offer or commitment to purchase services. The Town assumes no contractual obligation as a result of the issuance of this request, the preparation or submission of a bid by a respondent, the evaluation of bids, or final selection.

All Contractors must have proper licenses as required under the state laws governing their respective trades.

Bid Bond: Each proposal shall be accompanied by a cash deposit, a cashier's check or a certified check on some bank or trust company insured by the Federal Deposit Insurance Corporation in an amount not less than five percent (5%) of the proposal; or in lieu thereof, a bidder may offer a bid bond executed by a corporate surety licensed under the laws of North Carolina to execute such bond; conditioned that the surety will upon demand forth with make payment to the oblige upon said bond if the bidder fails to execute the contract in accordance with the bid bond, and upon failure to forthwith make payment, the surety shall pay to the oblige an amount equal to the amount of said bond. The deposit shall be retained if the successful bidder fails to execute the contract within ten days (10) after notice of award or fails to give satisfactory surety required herein. **Bid Bonds should be sealed in a separate envelope, marked as such, and attached to the envelope containing the bidder's proposal.** Facsimile bid bonds will not be accepted.



PROPOSAL FORM

PROPOSAL FOR BRECKENRIDGE DRIVE DRAINAGE IMPROVEMENTS # 25-20250613, IN THE TOWN OF KNIGHTDALE, NORTH CAROLINA

DATE: _____

TOWN COUNCIL

TOWN OF KNIGHTDALE

KNIGHTDALE, NORTH CAROLINA

BIDDER NAME: _____

We, the undersigned bidder, have received and carefully examined a complete set of the Bidding Documents and Specifications prepared by the Owner and have visited the job site to become familiar with all conditions and requirements of the work, and hereby agree to furnish all labor, materials, equipment, insurance, supervision, permits and abide by all local, state and federal codes, laws, rules, regulations and ordinances applicable to perform work described in these specifications and the requirements under them for the following sum to wit, and in submitting this Bid agree to the following:

1. To hold this Bid open for up to 60 days after the Date of Receipt of Bids.
2. To accept the provisions of the Instructions to Bidders.
3. To enter into and execute a Contract with the Town of Knightdale within 10 days, if awarded, based on this Bid as specified in the Instructions to Bidders and General Conditions.
4. To accomplish the Work in strict accordance with the Contract Documents; and
5. To complete the Work for this contract promptly from the Notice to Proceed. The Town reserves the right to extend the construction time for inclement weather or such reasons it judges as legitimate.

TOTAL BID – LUMP SUM (excludes NC tax, unit price bid schedule must also be submitted)

_____ **DOLLARS \$**_____

NUMBER of Calendar Workdays needed to complete the work: _____ (required)

The Town intends to award a single contract to the overall lowest responsible, responsive bidder, taking into consideration quality, performance, and the time specified in the bid for the performance of the contract.

PROPOSAL SIGNATURE PAGE

FAILURE TO COMPLETE AND INCLUDE THE FOLLOWING WITH THE BID IS CONSIDERED A NON-RESPONSIVE BID AND THE BID MAY NOT BE CONSIDERED:

- _____ Proposal Form with prices written in ink or typed in.
 - _____ Proposal Signature Page
 - _____ Breckenridge Drive Unit Price Bid Schedule
 - _____ Bid Bond
 - _____ Additional Bidder's Certification
 - _____ Addenda (if issued) – sign and include each Addendum signature page with the bid.
-

Bidder certifies that this proposal is made in good faith and without collusion or in connection with any other person bidding on the same work nor will any official or employee of the Town of Knightdale be admitted to any share or part of this contract should an award be made to the undersigned.

This bid must be signed by an officer of the bidding organization.

DATE

COMPANY NAME (as identified by the office
of the Secretary of State of North Carolina)

TELEPHONE NUMBER

AUTHORIZED SIGNATURE (required)

EMAIL ADDRESS

PRINTED NAME

NC CONTRACTOR'S LICENSE NO.

ADDRESS (P.O. BOX)

CITY, STATE AND ZIPCODE

ADDITIONAL BIDDER'S CERTIFICATIONAcceptance of Terms

In submitting this Proposal, the undersigned agrees that this bid will remain in effect for a period of 60 days following the opening of the Bids, that the undersigned agrees to enter into a Contract with the Owner, if awarded, on the basis of this Proposal, and that the undersigned agrees to complete the work in accordance with the Contract Documents.

Non-Collusion in Bidding

The Bidder specifically agrees to abide by all applicable provisions of Article 3 of Chapter 133 of the North Carolina General Statutes. By submission of this Bid, each Bidder and each person signing on behalf of any Bidder certifies, and in case of a joint Bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of knowledge and belief:

- (1) The prices in this Bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other Bidder or with any competitor;
- (2) Unless otherwise required by Law, the prices quoted in the Bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to opening, directly or indirectly, to any other Bidder or to any competitor; and
- (3) No attempt has been made or will be made by the Bidder to induce any other person, partnership, or corporation to submit or not to submit a Bid for the purpose of restricting competition.

Type of Business

The undersigned hereby represents that it is a (corporation, partnership, an individual or limited liability company). If a corporation, the undersigned further represents that it is duly qualified as a corporation under the Laws of the State of North Carolina and it is authorized to do business in this State.

Firm Name: _____

Firm Type: _____

Authorized Signature: _____

Title: _____

Date: _____

Address of Firm: _____

BID BOND FORM**NORTH CAROLINA BID BOND**

KNOW ALL MEN BY THESE PRESENTS, THAT WE _____ as PRINCIPAL, and _____ as SURETY, who is duly licensed to act as corporate surety in North Carolina, are held and firmly bound unto the Town of Knightdale, North Carolina, a municipal corporation, as Obligee, in the penal sum _____ Dollars, as 5% Bid Bond, lawful money of the United States of America, for the payment of which well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

SIGNED, sealed and dated this _____ day of _____, 20____. The condition of this obligation is such, that whereas, the said Principal is herewith submitting the attached proposal for the Breckenridge Drive Drainage Improvements Project and the Principal desires to file this bid bond in lieu of making the cash deposit as required by G.S. 143- 129, as amended.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if the Principal shall be awarded the contract for which the bid is submitted and shall execute the contract and give bonds for the faithful performance thereof, and the payment of all sums due for labor and materials, within ten days after the award of same to the Principal, then this obligation shall be null and void; but if the Principal fails to so execute such contract and give bonds as required by G.S. 143-29, as amended, the Surety shall, upon demand, forthwith pay to the Obligee the amount set forth in the first paragraph hereof. Power of Attorney from the Surety to its Attorney-in-Fact is attached hereto.

IN WITNESS WHEREOF, the above bound parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

(ATTACH POWER OF ATTORNEY)

Name of Principal: _____

(IF APPLICABLE)

ATTEST:

By: _____
(Indicate Capacity)



By: _____
(Indicate Capacity)

(AFFIX CORPORATE SEAL IF APPLICABLE)

Name of Corporate Surety

By: _____
Attorney-in-Fact

INSTRUCTIONS TO CONTRACTORS

DO NOT REMOVE FROM CONTRACT

Please observe the following in executing the attached contract:

1. The Town may contract with various categories of legal entities; and the legal requirements for proper execution (signing, witnessing, etc.) differ as to each:
 - a) If the contract is with an individual, that individual should sign the agreement exactly as his name is set out.
 - b) Execution on behalf of a corporation, authorized corporate officer must sign, with second officer signing to attest (which is second officer's verification of authority and signature authenticity), plus corporate seal affixed. The following are corporate officers allowed to sign for the corporation: president; vice-president; chairman; CEO; CFO; and Treasurer. The following officers are typically authorized to attest: secretary; vice president, trust officer; clerk to board; cashier (only for banks); and their assistants or deputies.
A sole corporate officer may sign, accompanied with a notary's acknowledgement, using the corporate acknowledgement form.
 - c) If the agreement is with a partnership (General Partnership or Limited Partnership), a general partner must sign and his/her/its signature must be notarized.
 - d) LLC - LLC "Manager" or "managing member" must sign with proper notary acknowledgement.
2. After signing the contract, the appropriate notary's acknowledgement, either in the corporate form or individual/partnership form should be completed.
3. The Performance and Payment Bonds should be attached to the Contract package. Bonds are required by law on construction and repair contracts subject to formal bidding requirements (N.C.G.S. § 143-129 et seq. They should be signed by the contractor, and his signature should be acknowledged with the appropriate acknowledgement form. Next, the bonds, in approved form, must be signed by the authorized agent of the Surety Company issuing the bonds, and an executed Power of Attorney document authorizing the agent to sign must accompany the bond documents. Bonds should not be dated. Bonds will be dated on or after the contract date by the Town.
4. The instrument should not be dated, except by the last person executing the contract, normally the Town Clerk
5. Non-discrimination provisions should be included with the contract, as should applicable Certificates of Insurance with proper and timely coverage indicated.
6. All modifications or deletions should be initialed or signed by representatives of both the Contractor and the Town.

North Carolina**Wake County****CONSTRUCTION OR PUBLIC WORKS CONTRACT FORM
TOWN OF KNIGHTDALE**

CONTRACT FOR: Breckenridge Drive Drainage Improvements (hereinafter “Project”), as defined and set forth in detail in the “Invitation for Bids”, included as a part of the “Contract Documents”. The “Contract Documents” are further defined in Paragraph 14 herein. The Invitation for Bids is incorporated herein by reference and the description of the work is made a part of this Contract.

This Contract is made and entered into as of the ____ day of July, 2025, by the Town of Knightdale (hereinafter “Town”) and _____ (hereinafter “Contractor”), () a corporation, () a professional corporation, () a professional association, () a limited partnership, () a sole proprietorship, or () a general partnership; organized and existing under the laws of the State of North Carolina.

Sec. 1. Work. Contractor agrees to procure and furnish the labor, materials, equipment, and services necessary to complete the construction of the Project in accordance with the Contract Documents (as defined below). In this contract, “Work” means all construction and other services required by the Contract Documents, including procuring and furnishing all materials, equipment, services and labor reasonably inferable from the Contract Documents.

Sec. 2. Standards for Work. Contractor and its personnel will perform the Work and exercise best efforts to cause the Project to be completed in an efficient, professional, orderly, and economical manner in accordance with generally accepted industry standards and without violating applicable law or any term or condition set forth in this Agreement. Contractor understands time is of the essence in this Project. All of Contractor’s Work will conform to the plans and specifications and description of materials set forth in the Contract Documents, and to all applicable building codes.

Sec. 3. Contract Times. The Work will commence no later than thirty (30) days after an executed original of this contract. The day Work Commences will be noted by the Contractor and the Town. Contractor agrees to achieve Substantial Completion (as defined herein) within one hundred twenty (120) days after the Commencement Day of the Work. Final Completion (as defined herein) will be achieved as expeditiously as reasonably practicable after Substantial Completion. As used herein: (a) “Substantial Completion” means the date on which the Work is sufficiently complete in accordance with the Contract Documents so that the Town can occupy and use the Work for its intended purposes; provided, however, that Substantial Completion will be deemed achieved no later than the date a temporary certificate of occupancy is obtained from the applicable governmental authority; and (b) “Final Completion” is the date on which all Work is complete in accordance with the Contract Documents, including but not limited to, any punch list work.

Sec. 4. Contract Price. The price to be paid by the Town to the Contractor for the construction provided in this contract is \$ _____. Contractor guarantees the price will not exceed this amount, subject to additions and deductions by work change orders as provided in the Contract Documents. Contractor will be responsible for paying all costs of completing the Work which exceed the foregoing amount, as adjusted in accordance with the Contract Documents.

As used herein, "Cost of Work" mean the actual and documented costs necessarily incurred by the Contractor in the proper performance of the Work, including, without limitation: (i) labor costs, including wages of construction workers directly employed by Contractor to perform the construction of the Work; (ii) billing rates of Contractor's supervisory and administrative personnel engaged in the performance of the Work as set forth in the Proposal; (iii) subcontractor costs, being payments made by Contractor to subcontractors in accordance with the written requirements of any subcontracts; (iv) costs of materials, supplies and equipment, including rental equipment, incorporated or used in the Work; (v) building permits, tap fees, facility and capacity depletion fees; and (vi) costs due to emergencies incurred and actions taken to prevent threatened damage, injury or loss in case of an emergency affecting the safety of persons and property.

Sec. 5. Payment Terms. By the 20th day of each month during performance of the Work, Contractor will submit to the Town's project manager an application for progress payments based on the Work performed as of the date of such application. The Town's project manager prior to submitting the application to the Finance Department will verify the charges for quantities of work completed or services performed. If the Contractor's fee is a fixed amount, the amount of such fee to be included in the application will be proportional to the percentage of the Work completed, less payments previously made on account of such fee. For each progress payment made prior to Substantial Completion of the Work, the Town may withhold five percent (5%) as retainage. Upon Substantial Completion, Contractor will submit to the Town's project manager an application for final payment, which application will include an accounting of any retainage and any deposit balance. Each application will be accompanied by all documentation required by the Contract Documents or otherwise requested by the Town.

Sec. 6. Subcontractors. Those portions of the Work that Contractor does not customarily perform with Contractor's own personnel will be performed under subcontracts. Contractor will be responsible for the management of the subcontractors in the performance of their portion of the Work. Contractor will promptly pay all bills for labor performed and materials provided by its subcontractors and by its suppliers in the construction of the improvements. CONTRACTOR WILL PROVIDE TOWN WITH CERTIFICATES OF PAYMENT TO ALL SUBCONTRACTORS BEFORE FINAL PAYMENT TO CONTRACTOR.

Sec. 7. Changes in the Work. The Town may request changes in the Work, provided any additions, deletions, alterations, or other modifications to the Work are generally within the scope of the Contract Documents. Such changes will only be made pursuant to a written change order signed by the Town and Contractor stating their agreement on the change and any adjustments in the date of Substantial Completion and the price to be paid by the Town to Contractor for the Work. The Town reserves the right to refuse payment for any work outside that authorized herein or pursuant to a duly approved amendment or change order. Construction change directives to unit priced contracts will be paid at the unit price and non-unit priced contracts will be paid at the

contractor's cost plus the reasonable allowance for overhead and profit which shall be agreed to between the contractor and Town.

Sec. 8. Project Completion. Contractor will notify the Town when it believes Substantial Completion has been achieved. Within five (5) days of the Town's receipt of such notice, the Town and Contractor will jointly inspect the Project to verify Substantial Completion and to specify on a punch list any items that have not been completed or which are defective. Contractor agrees to promptly complete or correct all items on the punch list and shall inform the Town when the punch list work is finished. Contractor understands that if Substantial Completion is not attained by the date provided in Sec. 3, the Town will suffer damages which are difficult to ascertain and quantify. Contractor agrees that if Substantial Completion is not attained by ten (10) days after the date provided in Sec. 3, Contractor will pay the Town five hundred dollars (\$500.00) as liquidated damages for each calendar day that Substantial Completion extends beyond such ten (10)-day period.

Sec. 9. Insurance; Bonds.

(a) Contractor shall maintain insurance policies at all times with minimum limits as follows:

Coverage	Minimum Limits
Commercial General Liability	\$5,000,000 per occurrence (\$5,000,000 aggregate)
Automobile Liability	\$1,000,000
Professional Liability (E & O)	\$1,000,000 per occurrence (\$2,000,000 aggregate)
Workers' Compensation and Employer's Liability	Statutory Limits and must include \$1,000,000 Each Accident, \$1,000,000 Disease (Each Employee, \$1M Disease-Policy Limit)
Builder's Risk	Full cost of the completed project

Upon acceptance of the contract by the Town the contractor shall provide the Town with a **Certificate of Insurance** for review prior to the issuance of any contract or Purchase Order. All Certificates of Insurance will require thirty (30) days written notice by the insurer or contractor's agent in the event of cancellation, reduction or other modifications of coverage. In addition to the notice requirement above, the Contractor shall provide the Town with immediate written notice of cancellation, reduction, or other modification of coverage of insurance. Upon failure of the Contractor to provide such notice, the Contractor assumes sole responsibility for all losses incurred by the Town for which insurance would have provided coverage.

The Town shall be named as an **additional insured** under the general liability and automobile liability policies required hereunder and the statement should read "Town of Knightdale is to be added as an additional insured as evidenced by an endorsement attached to this certificate." In the event the contractor fails to maintain and keep in force the insurance

herein required, the Town reserves the right to cancel and terminate the contract without notice. For any claims related to the Contract Documents, Contractor's insurance coverage will be primary and non-contributory to any insurance maintained by the Town.

- (b) Contractor will provide the following performance bond and/or payment bond or other performance security:

Performance Bond:	\$ _____
Payment Bond:	\$ _____
Other Performance Security:	_____

Sec. 10. Records. Contractor agrees to keep and maintain true, complete, and accurate books and records for the Work, including originals of all invoices and all other financial records, notices, requests, communications, or documents that Contractor receives in connection with the Work. Upon the Town's request at any time during the term of the contract and the twelve (12)-month period thereafter, Contractor promptly will make available to the Town all such books and records for examination. Contractor shall provide a Contractor Sales Tax Report when applicable or requested.

Sec. 11. Warranty. Contractor warrants that: (a) the materials furnished under this contract will be new and of good quality; and (b) the Work will conform to the plans and specifications therefor and will be free from defects in material and workmanship for a period of twelve (12) months from Final Completion. In the event of a non-conformity or defect in breach of the foregoing warranty, Contractor will make all necessary repairs and corrections to the Work. Repairs and corrections performed under warranty are also warranted for an additional twelve (12)-month period from the date of repair. The foregoing warranty is not exclusive and all other warranties and conditions, whether written, oral, express, implied or statutory (including without limitation any warranty of merchantability and/or fitness for particular purpose) apply to the Work. Manufacturer or vendor warranties or guarantees if any, on materials, fixtures, appliances, and components, to the extent assignable, are deemed assigned by Contractor to the Town. Contractor agrees to: (i) deliver to the Town all information and forms in its possession for such warranties or guarantees; (ii) take such steps as may be reasonably necessary to effectively pass through to the Town such warranties or guarantees.

Sec. 12. Performance of Work by Town. If the Contractor fails to perform the Work in accordance with the schedule referred to in Sec. 3 above, the Town may, in its discretion, in order to bring the project closer to schedule, perform or cause to be performed some or all of the Work, and doing so shall not waive any of the Town's rights and remedies. Before doing so, the Town shall give the Contractor reasonable notice of its intention. The Contractor shall reimburse the Town for all costs incurred by the Town in exercising its right to perform or cause to be performed some or all of the Work pursuant to this section.

Sec. 13. Termination.

- (a) The Town may terminate this contract in whole or, from time to time, in part, for the Town's convenience or because of failure of the Contractor to fulfill the Contract obligations. The

Town shall terminate by delivering to the Contractor a Notice of Termination specifying the nature, extent, and effective date of the termination. Upon receipt of the notice, the Contractor shall – (1) Immediately discontinue all services affected (unless the notice directs otherwise);

- (b) If the termination is for the convenience of the Town, the Town shall make an equitable adjustment in the contract price but shall allow no anticipated profit on unperformed services.
- (c) If, after termination for failure to fulfill contract obligations, it is determined that the Contractor had not failed, the rights and obligations of the parties shall be the same as if the termination had been issued for the convenience of the Town.
- (d) The rights and remedies of the Town provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

Sec. 14. Contract Documents. The “Contract Documents” are comprised of the following and are included and incorporated herein by reference as if set out here in full:

- (a) This contract;
- (b) Advertisement for Bids;
- (c) Contractor’s Proposal dated _____;
- (d) Construction Drawings
- (e) Standard Specifications (Town of Knightdale and NCDOT)
- (f) General Conditions; and
- (g) Any written modifications, amendments, and change orders related to the above documents that are issued in accordance with the terms of this contract.

The Contract Documents constitute the entire agreement and understanding of the parties in respect of the subject matter hereof and supersede all prior understandings, agreements, or representations by or among the parties, written or oral, to the extent they relate in any way to the subject matter hereof. With respect to that subject matter, there are no promises, agreements, conditions, inducements, warranties, or understandings, written or oral, expressed or implied, between the parties, other than as set forth or referenced in this Contract.

Sec. 15. Notice.

- (a) All notices and other communications required or permitted by this contract shall be in writing and shall be given either by personal delivery, electronic delivery, fax, or certified United States mail, return receipt requested, addressed as follows:

To the Town:

Attn: Phillip Bunton

Town of Knightdale

950 Steeple Square Ct

Knightdale, NC 27545

Phone Number: 919-217-2250

To the Contractor:

Attn: _____

Phone Number: _____

Email: Phillip.Bunton@knightdalenc.gov

Email: _____

- (b) **Change of Address, Date Notice Deemed Given:** A change of address, fax number, or person to receive notice may be made by either party by notice given to the other party. Any notice or other communication under this contract shall be deemed given at the time of actual delivery, if it is personally delivered or sent by fax. If the notice or other communication is sent by US Mail, it shall be deemed given upon the third calendar day following the day on which such notice or other communication is deposited with the US Postal Service or upon actual delivery, whichever first occurs.

Sec. 16. Indemnification. To the maximum extent allowed by law, the Contractor shall defend, indemnify, and save harmless the Town of Knightdale, its agents, officers, and employees, from and against all Charges that arise in any manner from, in connection with, or out of: (a) this contract or the Work, to the extent proximately caused by the negligent acts, errors or omissions of the Contractor or subcontractors or anyone directly or indirectly employed by any of them; or (b) the failure of the Contractor, or those for whose acts it is responsible, to pay for any services, materials, labor, equipment, taxes or other items or obligations furnished or incurred for or in connection with the Work. In performing its duties under this section, the Contractor shall at its sole expense defend the Town of Knightdale, its agents, officers, and employees with legal counsel reasonably acceptable to the Town. As used in this subsection – “Charges” means claims, judgments, costs, damages, losses, demands, liabilities, duties, obligations, fines, penalties, royalties, settlements, expenses, interest, reasonable attorney’s fees, and amounts for alleged violations of North Carolina law or federal law, including but not limited to, sedimentation pollution, erosion control, pollution, or other environmental laws, regulations, ordinances, rules, or orders. Nothing in this section shall affect any warranties in favor of the Town that are otherwise provided in or arise out of this contract. Nothing in this section shall require the Contractor to defend the Town of Knightdale if the Contractor is a “design professional” as defined in N.C.G.S. § 22B-1(f)(4), or if this Contract includes “design professional services” as defined in N.C.G.S. § 22B-1(f)(6). This section is in addition to and shall be construed separately from any other indemnification provisions that may be in this contract. This section shall remain in force despite termination of this contract (whether by expiration of the term or otherwise) and termination of the services of the Contractor under this contract.

Sec. 17. Miscellaneous.

- (a) **Choice of Law and Forum.** This contract shall be deemed made in Wake County, North Carolina. This contract shall be governed by and construed in accordance with the laws of North Carolina. The exclusive forum and venue for all actions arising out of this contract shall be the appropriate division of the North Carolina General Court of Justice, in Wake County. Such actions shall neither be commenced in nor removed to federal court. This section shall not apply to subsequent actions to enforce a judgment entered in actions heard pursuant to this section.
- (b) **Waiver.** No action or failure to act by the Town shall constitute a waiver of any of its rights or remedies that arise out this contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

- (c) **Performance of Government Functions:** Nothing contained in this contract shall be deemed or construed so as to in any way stop, limit, or impair the Town from exercising or performing any regulatory, policing, legislative, governmental, or other powers or functions.
- (d) **Severability.** If any provision of this contract shall be unenforceable, the remainder of this contract shall be enforceable to the extent permitted by law.
- (e) **Assignment, Successors and Assigns.** Without the Town's written consent, the Contractor shall not assign (which includes to delegate) any of its rights (including the right to payment) or duties that arise out this contract. Unless the Town otherwise agrees in writing, the Contractor and all assigns shall be subject to all of the Town's defenses and shall be liable for all of the Contractor's duties that arise out of this contract and all of the Town's claims that arise out of this contract. Without granting the Contractor the right to assign, it is agreed that the duties of the Contractor that arise out of this contract shall be binding upon it and its heirs, personal representatives, successors, and assigns.
- (f) **Compliance with Law.** In performing all of the Work or services contained herein, the Contractor and Contractors Employees shall comply with all applicable laws and regulations of the State of North Carolina pertaining to such Work or Services including Occupational Safety & Health laws. Contractor represents and warrants to the Town that it is duly licensed by the State of North Carolina and is authorized by such license to perform the Work and it has and will maintain all necessary licenses, certifications and registrations required in order to perform the Work.
- (g) **Town Policy.** THE TOWN OPPOSES DISCRIMINATION ON THE BASIS OF RACE AND SEX AND URGES ALL OF ITS CONTRACTORS TO PROVIDE A FAIR OPPORTUNITY FOR MINORITIES AND WOMEN TO PARTICIPATE IN THEIR WORK FORCE AND AS SUBCONTRACTORS AND VENDORS UNDER TOWN CONTRACTS.
- (h) **EEO Provisions.** 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, national origin, political affiliation or belief, age, or handicap. The Contractor shall take affirmative action to ensure that applicants are employed and that employees are treated equally during employment, without regard to race, color, religion, sex, national origin, political affiliation or belief, age, or handicap. The Contractor shall post in conspicuous places available to employees and applicants for employment, notices setting forth these EEO provisions.
 - 2. The Contractor in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, political affiliation or belief, age, or handicap.
- (i) **Drug-Free Workplace.** The Principal Officer of the Contractor's firm shall, upon request of the Town, provide a statement of proof indicating that a Drug-Free Workplace Program is in place and that where required by law, company drivers meet the DOT/CDL licensing requirements.
- (j) **No Third Party Right Created.** This contract is intended for the benefit of the Town and the Contractor and not any other person.
- (j) **Principles of Interpretation.** In this contract, unless the context requires otherwise the singular includes the plural and the plural the singular. The pronouns "it" and "its" include the masculine and feminine. Reference to statutes or regulations include all statutory or regulatory provisions consolidating, amending, or replacing the statute or regulation. References to contracts and agreements shall be deemed to include all amendments to them. The word "person" includes natural persons, firms, companies, associations, partnerships, trusts, corporations, governmental agencies and units, and any other legal entities.

- (k) **Modifications.** A modification, or construction change directive of this Contract is not valid unless signed by both parties and otherwise in accordance with requirements of law. Any document which materially alters the terms and conditions contained herein, must be reviewed pursuant to the Town's Contract Review Procedure.

Sec. 18. E-Verify. Contractor shall comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes. Further, if Contractor utilizes a subcontractor, Contractor shall require the subcontractor to comply with the requirements of Article 2 of Chapter 64 of the General Statutes.

Sec. 19. Attorney's Fees. Should either party deem it necessary to retain an attorney or other counsel to defend and/or pursue the enforcement of this Contract, the prevailing party shall be entitled to recover reasonable attorney's fees and costs.



IN WITNESS WHEREOF, the Town of Knightdale and the Contractor have caused this Contract to be executed under seal by their respective duly authorized agents or officers.

TOWN OF KNIGHTDALE:

CONTRACTOR:

By: _____
Authorized Town Official

By: _____
Authorized Company Official

ATTEST BY:

ATTEST BY (if corporate):

Town Clerk

Corporate Secretary

SEAL:

SEAL:

This Instrument has been pre-audited in the manner required by the Local Government Budget and Fiscal Control Act.

Town Finance Officer

Date

CORPORATE ACKNOWLEDGMENT

STATE OF _____

COUNTY OF _____

This is to certify that on the ____ day of _____, 20____, before me personally came _____, with whom I am personally acquainted, who, being by me duly sworn, says that (s)he is the President and _____ is the Secretary of _____ Incorporated, the corporation described in and which executed the foregoing instrument; that (s)he knows the common seal of said corporation; that the seal affixed to the foregoing instrument is said common seal, and the name of the corporation was subscribed thereto by the said Secretary and the said corporate seal was affixed, all by order of the Board of Directors of said corporation, and that the said instrument is the act and deed of said corporation.

Witness my hand and official seal this the ____ day of _____, 20____,

My Commission Expires:

Notary Public

(SEAL)

INDIVIDUAL ACKNOWLEDGMENT

STATE OF _____

COUNTY OF _____

I, _____ a Notary Public do hereby certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

This the ____ day of _____, 20 ____.

My Commission Expires:

Notary Public

(SEAL)

PARTNERSHIP ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ Notary Public do hereby certify that

_____ General Partner of _____,
personally appeared before me this day and acknowledged the execution, with proper authorization, of
the foregoing instrument, all in accordance with partnership instruments recorded in Book _____,
Page _____, in the _____ County Registry, and that the instrument is the act and deed of the
partnership.

This the _____ day of _____, 20____.

My Commission Expires:

Notary Public

(SEAL)

LIMITED LIABILITY COMPANY ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ a Notary Public for said State and County, do hereby certify

that _____ Manager of _____
personally appeared before me this day and acknowledged the execution of the foregoing instrument,
with proper authorization, on behalf of the company.

This the _____ day of _____, 20____.

My Commission Expires:

Notary Public

(SEAL)

PERFORMANCE BOND FOR CONTRACT

Bond No. _____

NOW ALL MEN BY THESE PRESENTS, that we, _____ the PRINCIPAL, hereinafter called Principal, and _____ as SURETY, hereinafter called Surety, and the above named, are held and firmly bound unto the Town of Knightdale, hereinafter called the Town, in the penal sum of \$ _____ DOLLARS (\$ _____), the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the Town, numbered as shown above and hereto attached;

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the Town, with or without notice to the Surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of such modifications to the Surety being hereby waived, then this obligation to be void; otherwise it shall remain in full force and effect.

IN WITNESS WHEREOF, the above-mentioned parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

Signed and sealed this _____ day of _____, 20____. (To be dated by the Town)

(ATTACHED POWER OF ATTORNEY, IF APPLICABLE)

By: _____
PRINCIPAL

ATTEST: _____
Indicate Capacity

Secretary: _____

(AFFIX CORPORATE SEAL IF APPLICABLE)

By: _____
Surety

Date: _____

ATTEST: _____
Indicate Capacity

STATE OF _____
COUNTY OF _____

Personally appeared before me the undersigned Notary Public _____ who, being first duly sworn, acknowledged the due execution of the foregoing instrument for the purpose therein stated.

Witness my hand and notarial seal this the _____ day of _____, 20____.

Notary Public

My Commission Expires: (SEAL)

CORPORATE ACKNOWLEDGEMENT

STATE OF _____
COUNTY OF _____

This is to certify that on the ____ day of _____, 20____, before me personally came _____, with whom I am personally acquainted, who, being by me duly sworn, says that (s)he is the President and _____ is the Secretary of _____ Incorporated, the corporation described in and which executed the foregoing instrument; that (s)he knows the common seal of said corporation; that the seal affixed to the foregoing instrument is said common seal, and the name of the corporation was subscribed thereto by the said Secretary and the said corporate seal was affixed, all by order of the Board of Directors of said corporation, and that the said instrument is the act and deed of said corporation.

Witness my hand and official seal this the _____ day of _____, 20____,

My Commission Expires:

Notary Public

(SEAL)



PARTNERSHIP ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ Notary Public do hereby certify that

_____ General Partner of _____,
personally appeared before me this day and acknowledged the execution, with proper authorization, of
the foregoing instrument, all in accordance with partnership instruments recorded in Book _____,
Page _____, in the _____ County Registry, and that the instrument is the act and deed of the
partnership.

This the _____ day of _____, 20__.

My Commission Expires:

Notary Public

(SEAL)

LIMITED LIABILITY COMPANY ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ a Notary Public for said State and County, do hereby certify

that _____ Manager of _____
personally appeared before me this day and acknowledged the execution of the foregoing instrument,
with proper authorization, on behalf of the company.

This the _____ day of _____, 20__.

My Commission Expires:

Notary Public

(SEAL)

PAYMENT BOND FOR CONTRACT

BOND No. _____

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

the PRINCIPAL, hereinafter called Principal, and _____ as
SURETY, hereinafter called Surety, and the above named, are held and firmly bound unto the Town of
Knightdale, hereinafter called the Town, in the penal sum of
_____ DOLLARS (\$ _____), the amount stated above, for the
payment of which sum well and truly to be made, we bind ourselves, our heirs, executors,
administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain
contract with the Town as referenced above and hereto attached;

NOW, THEREFORE, if the principal shall promptly make payment to all person supplying labor and
material in the prosecution of the work provided for in said contract, and any and all duly authorized
modifications of said contract that may hereafter be made, notice of which modifications to the surety
being hereby waived, then this obligation to be void; otherwise it shall remain in full force and effect.

IN WITNESS WHEREOF, the above-mentioned parties have executed this instrument under their several
seals on the date indicated above, the name and corporate seal of each corporate party being hereto
affixed and these presents duly signed by its undersigned representative pursuant to authority of its
governing body.

Signed and sealed this _____ day of _____, 20____. (To be dated by the Town)

(ATTACHED POWER OF ATTORNEY, IF APPLICABLE)

By: _____
PRINCIPALATTEST: _____
Indicate Capacity

Secretary: _____

(AFFIX CORPORATE SEAL IF APPLICABLE)

By: _____
Surety

Date: _____



ATTEST: _____
Indicate Capacity

STATE OF _____
COUNTY OF _____

Personally appeared before me the undersigned Notary Public _____ who, being first duly sworn, acknowledged the due execution of the foregoing instrument for the purpose therein stated.

Witness my hand and notarial seal this the _____ day of _____, 20____.

Notary Public

My Commission Expires: (SEAL)

CORPORATE ACKNOWLEDGEMENT

STATE OF _____
COUNTY OF _____

This is to certify that on the ____ day of _____, 20____, before me personally came _____, with whom I am personally acquainted, who, being by me duly sworn, says that (s)he is the President and _____ is the Secretary of _____ Incorporated, the corporation described in and which executed the foregoing instrument; that (s)he knows the common seal of said corporation; that the seal affixed to the foregoing instrument is said common seal, and the name of the corporation was subscribed thereto by the said Secretary and the said corporate seal was affixed, all by order of the Board of Directors of said corporation, and that the said instrument is the act and deed of said corporation.

Witness my hand and official seal this the _____ day of _____, 20____,

My Commission Expires:

Notary Public

(SEAL)

PARTNERSHIP ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ Notary Public do hereby certify that

_____ General Partner of _____,
personally appeared before me this day and acknowledged the execution, with proper authorization, of
the foregoing instrument, all in accordance with partnership instruments recorded in Book _____, Page
_____, in the _____ County Registry, and that the instrument is the act and deed of the
partnership.

This the ____ day of _____, 20__.

My Commission Expires:

Notary Public

(SEAL)

LIMITED LIABILITY COMPANY ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

I, _____ a Notary Public for said State and County, do hereby certify

that _____ Manager of _____
personally appeared before me this day and acknowledged the execution of the foregoing instrument,
with proper authorization, on behalf of the company.

This the ____ day of _____, 20__.

My Commission Expires:

Notary Public

(SEAL)

PROCEDURE FOR REPORTING NORTH CAROLINA SALES TAX EXPENDITURES

- I. The following procedure in handling the North Carolina Sales Tax is applicable to this project. Contractors shall comply fully with the requirements outlined hereinafter, in order that the owner may recover the amount of the tax permitted under the law.
 - (a) The Contractor shall be responsible for the payment of all applicable North Carolina sales and/or use taxes on the materials used in the performance of this project. It shall be the Contractor's responsibility to furnish the owner documentary evidence showing the materials used and sales tax paid by the general contractor and each of his subcontractors. Any county sales tax included in the Contractor's statements must be shown separately from the state sales tax. If more than one county is shown, each county shall be listed separately.
 - (b) The documentary evidence shall consist of a certified statement, by the general contractor and each of his subcontractors individually, showing total purchases of materials from each separate vendor and total sales taxes by each county paid each vendor. The certified statement must show the invoice number(s) covered and inclusive dates of such invoices. State sales tax shall be listed separately from county sales tax. If more than one county is shown, each county shall be listed separately.
 - (c) Materials used from general contractor's or subcontractor's warehouse stock shall be shown in a certified statement at warehouse stock prices.
 - (d) The general contractor shall not be required to certify the subcontractor's statements.
 - (e) The documentary evidence to be furnished to owners eligible for sales or use tax refunds covers sales and/or use taxes paid on building materials used by contractors and subcontractors in the performance of contracts with churches, orphanages, hospitals not operated for profit, educational institutions not operated for profit, and other charitable or religious institutions or organizations not operated for profit and incorporated cities, towns, and counties in this State. The documentary evidence is to be submitted to the above-named institutions, organizations, and governmental units to be included in claims for refunds to be prepared and submitted by them to obtain refunds provided by G.S. 105-164.14 and is to include the purchases of building materials, supplies, fixtures, and equipment which become a part of or annexed to buildings or structures being erected, altered, or repaired under contracts with such institutions, organizations or governmental units.
- II. The Contractor or contractors to whom an award is made on this project will be required to follow the procedure outlined above.
- III. The Contractor is advised that all requests for payment, partial or final, for work completed under this contract must include a sales tax report submitted in accordance with the procedures outlined above.



(REQUIRED AT TIME OF FINAL PAYMENT)

AFFIDAVIT FOR FINAL PAYMENT

PROJECT: Breckenridge Drive Drainage Improvements

Town of Knightdale Project No. 25-20250613

State of North Carolina

County of Wake

In the State of North Carolina, County of _____, being duly sworn, deposes and says that they are _____

and that they have full and official knowledge of all and every debt and obligation for labor and materials which have entered into and become a part of the public facilities constructed under Town of Knightdale Project Number _____; and, acting in their official Capacity, and for the specific purpose of obtaining the funds due on this final estimate, they further depose and say that all debts or obligations for such labor and materials have been fully and completely paid and discharged in good and lawful money of the United States of America or by evidence of exchange or trade acceptances endorsed and guaranteed by a solvent National or State bank, and that there are no suits for damages against the Contractor, pending, prospective or otherwise, in consequence of their operations on the said project except as follows:

In witness whereof they have set their hand and seal,

I, _____ a notary public of the County and State aforesaid, hereby certify that personally known to me to be the affiant in the foregoing affidavit, personally appeared before me this day and having been by me duly sworn, deposes and says that the facts set forth in the above affidavit are true and correct.

Witness my hand and official seal this the _____ day of _____, 20____.

Notary Public

My Commission Expires: _____ (SEAL)

GENERAL CONDITIONS

- 1) Definitions
 - a) The contract documents shall consist of the Contract, the Advertisement for Proposals, the accepted Proposal, Construction Drawings, the Project Manual Specifications, the General Conditions of the Contract, including all modifications thereof incorporated in the documents before their execution.
 - b) Whenever the term "Contractor" is used, it shall be understood as referring to the General Contractor, subcontractor, and all other contractors or their duly authorized agent to whom the work here described is awarded by contract.
 - c) Whenever the term "Town" is used, it is to mean the Town of Knightdale, North Carolina.
 - d) The term "Work" of the Contractor or subcontractor includes labor or materials, or both, equipment, transportation, or other facilities necessary to complete the contract.
- 2) Bidders Disqualification
 - a) The Town Manager may disqualify bidders from participation in bidding and award of contracts for Town construction projects based on the following conditions existing simultaneously:
 - i. The dollar value of the work completed is less than the dollar value of the work which should have been completed on the basis of the contractor's approved progress schedule by more than twenty percent of the current contract amount. The dollar amount of the work completed will be the total estimate to date shown in the latest partial pay estimate. The current contract amount will be the contract estimate plus accumulated overruns and less accumulated underruns shown in the latest partial pay estimate.
 - ii. The percentage of the work completed is less than the percentage of contract time elapsed on the work by more than twenty percent. The percentage of work completed will be the dollar value of the work complete as defined above divided by the current contract amount as defined above. The percentage of contract time elapsed will be the number of calendar days elapsed as shown in the latest partial pay estimate divided by the total contract time in calendar days.
 - b) The Town Manager shall not include any late days which are caused by the Town in any of his calculations directed at determining bid status.
 - c) Any contractor who wishes to contest the decision of the Town Manager declaring ineligibility may appeal to the Town Council by delivering a notice of appeal to the Town Clerk no later than ten days after receipt of the Town Manager's decision. The notice of appeal shall clearly set out the reasons why the Contractor believes that the terms of this Resolution have been inappropriately applied or the equitable arguments for not applying this Resolution's terms.
 - d) When considering an appeal the Town Council shall consider, among other things, the report of the Town Manager, the notice of appeal, and the Contractor's current status on any other current Town contracts and its performance on any other contracts to which the Contractor and the Town have been parties to within the two calendar years immediately preceding the filing of the notice of appeal.
- 3) Bidders so disqualified shall remain disqualified for any period in which they are still in conflict with the schedule provisions of this article.
- 4) Intent of Documents

- a) The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work. It is not intended, however, that materials or work not covered by or properly inferable from any heading, branch, class or trade of the Specifications shall be supplied unless distinctly so noted on the drawings. Materials or work described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards.
- 5) Detail Drawings and Instructions
 - a) The Town shall furnish with reasonable promptness, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the contract documents, true developments thereof, and reasonably inferable therefrom.
 - b) Please refer to the latest edition of the Town of Knightdale Standards and specifications for any elements, construction or materials on Town of Knightdale owned right of ways. Further, please refer to latest edition of NCDOT Standard Specification for Roads and Structures for any elements, construction or materials for NCDOT owned right of ways.
- 6) Contractor's Understanding
 - a) It is understood and agreed that the Contractor has, by careful examination satisfied himself as to the nature and location of the work, the character, quality and quantity of materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work under this contract. No verbal agreement or conversation with any officer, agent or employee of the Town, either before or after the execution of the contract shall affect or modify any terms or obligations herein contained.
- 7) Superintendence by Contractor
 - a) Except where the Contractor is an individual and gives his personal superintendence to the work, the Contractor shall provide a competent superintendent, satisfactory to the Town of Knightdale on the work at all times during working hours with full authority to act for him. The Contractor shall also provide an adequate staff for the proper coordination and prosecution of the work.
- 8) Materials, Appliances, Employees
 - a) Unless otherwise specified, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation, and other facilities necessary for the execution and completion of the work.
 - b) Unless otherwise specified, all materials shall be new and both workmanship and materials shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.
 - c) The Contractor shall at all times enforce strict discipline and good order among his employees; and shall not employ on the work any unfit person or anyone not skilled in the work assigned to them.
- 9) Technical Specifications and Drawings
 - a) Anything mentioned in the Technical Specifications and not shown on the Drawings or shown on the Drawings and not mentioned in the Technical Specifications shall be of like effect as if shown on or mentioned in both. In case of difference between Drawings and Technical Specifications, the Technical Specifications shall govern. In case of any discrepancy in Drawings, or Technical

Specifications, the matter shall be immediately submitted to the Town of Knightdale without whose decision, said discrepancy shall not be adjusted by the Contractor, save only at his own risk and expense.

10) Royalties and Patents

- a) The Contractor shall pay all royalties and patent fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Town harmless from loss on account thereof, except that the Town shall be responsible for such loss when a particular process or the product of a particular manufacturer or manufacturers is specified, but if the Contractor has information that the process or article specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Town.

11) Permits

- a) Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the Contractor unless otherwise stipulated.
- b) Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Town unless otherwise stipulated.

12) Protection of Work and Property

- a) The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Town's and private property from injury or loss arising in connection with this contract. He shall make good any such damages, injury, or loss, except such as may directly be due to errors in the contract documents or caused by agents or employees of the Town.

13) Cooperation with Utility Owners

- a) Prior to the beginning of construction, the Town will notify all utility owners known to have facilities affected by the construction of the project. The Contractor shall coordinate the schedule with the utility owners for the necessary adjustments of all affected public or private utility facilities. The utility adjustments may be made either before or after the beginning of construction of the project. The adjustments will be made by the utility owner or his representative or by the Contractor when such adjustments are part of the work covered by his contract.
- b) The Contractor shall use special care in working around and near all existing utilities that are encountered during construction, protecting them where necessary so that they will give uninterrupted service. The Contractor shall call the agency concerned for location of all utilities and shall be responsible for any damage to existing utilities and structures resulting from his work around these utilities or structures.
- c) The Contractor shall cooperate with the utility owner, and/or the owner's representative in the adjustment or placement of utility facilities when such adjustment or placement is made necessary by the construction of the project or has been authorized by the Town.
- d) In the event that utility services are interrupted by the Contractor, the Contractor shall promptly notify the owners and shall cooperate with the owners and/or the owner's representative in the restoration of service in the shortest time possible.
- e) Existing fire hydrants shall be kept accessible to fire department personnel at all times.
- f) Prior to submitting their bid, the Contractor shall make their own determination as to the nature and extent of the utility facilities, including proposed adjustments, new facilities, or temporary work to be performed by the utility owner or his representative; and as to whether any utility work is planned by the owner in conjunction with the project construction. The Contractor shall

consider in his bid all the permanent and temporary utility facilities in their present or relocated positions, whether or not specifically shown on the plans or covered in the project special provisions. It will be the Contractor's responsibility to anticipate any additional costs to him resulting from such utility work and to reflect these costs in his bid for the various items in the contract.

- g) Where changes to utility facilities are to be made solely for the convenience of the Contractor, it shall be the Contractor's responsibility to arrange for such changes and the Contractor shall bear all costs of such changes.

14) Inspection of Work

- a) The Town of Knightdale and its representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide facilities for such access and for inspection.
- b) If the specifications, instructions, laws, or ordinances or any public authority require any work to be specially tested or approved, the Contractor shall give the Town timely notice of its readiness for inspection. Inspections by the Town shall be promptly made, and where practicable at the source of supply. If any work should be covered up without approval or consent of the Town, it must, if required by the Town, be uncovered for examination at the Contractor's expense.

15) Changes in Work

- a) The Town, without invalidating the contract, may order extra work or make changes by altering, adding, or deducting from the work, the contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claims for extension of time caused thereby shall be adjusted at the time ordering such changes, as mutually agreed upon by the Town and Contractor. If additional work does not exceed original estimates, additional days will not be granted.
- b) The value of any such extra work or change shall be determined by the unit prices named in the contract, up to but not exceeding 15% of the original contract total price.
- c) For extra work which exceeds 15% of the original contract total, the value of any such extra work or change shall be determined in one or more of the following ways:
 - i) By estimate and acceptance of a lump sum.
 - ii) By unit prices named in the contract or subsequently agreed upon.
 - iii) By cost and percentage or by cost and a fixed fee.

16) Conformity with Plans and Specifications

- a) All work performed and all materials furnished shall be in reasonably close conformity with material requirements shown on the plans, or indicated in the specifications.
- b) In the event the Town finds the materials or the finished product in which the materials are used not within reasonably close conformity with the plans and specifications, but that reasonably acceptable work has been produced, it will then make a determination if the work is to be accepted and remain in place. If the Town agrees that the work is to be accepted, it will have the authority to make such adjustment in contract price as it deems warranted based upon sound engineering judgment and the final estimate will be paid accordingly.
- c) In the event the Town finds the materials or the finished product in which the materials are used or the work performed are not in reasonably close conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by the Contractor at no cost to the Town.

17) Liquidated Damages and Delays

- a) Liquidated Damages. If the work cannot be completed within the time stipulated in the contract, including any extensions of time for excusable delays as herein provided, the Contractor shall pay to the Town of Knightdale, a fixed and agreed amount, as liquidated damages for each calendar day of delay, until the work is completed, the amount as set forth in the contract and the Contractor and his sureties shall be liable to the Town of Knightdale for the amount thereof.
- b) Excusable Delays. The right of the Contractor to proceed shall not be terminated nor shall the Contractor be charged with liquidated damages for any delays in the completion of the work due to:
 - i) Any act or omission of the Town outside the scope of the contract, including extra work; acts of God; unusually severe and abnormal weather conditions; acts of any other contractor in the performance of work for the Town; or other conditions, events, or circumstances beyond the control and without the fault or negligence of the Contractor, which the Contractor could not have reasonably anticipated; or
 - ii) Any delay of any Subcontractor occasioned by any of the causes specified in subparagraph (a) above. Provided, however, the Contractor shall provide written notice to the Town within ten (10) days from the occurrence, condition, event, or other cause which is claimed to have delayed the completion of the work. Such notice shall state what effect, if any, such occurrence, condition, event, or other cause is claimed to have upon the time for completing the contract work, and shall state in what respects, if any, the contract completion deadline should be revised, and the reasons, therefore. Contractor shall also provide a report monthly to summarize all claims. This monthly summary report should be included in all pay application requests and demonstrate any new claims and provide a running balance of granted and requested days. No claim by the Contractor for an extension of time for completion shall be considered unless notice of such delay claim is given the Town in accordance with the provisions of this subparagraph.

18) No Damages for Delays

- a) The Town shall not be obligated or liable to the Contractor for, and the Contractor hereby expressly waives any claims against the Town for, any damages, costs, or expenses of any nature occasioned by delays, work disruptions or interference, changes in work sequence, work suspension or rescheduling arising from any act or omission of the Town outside the scope of the Contract, acts of God, unusually severe and abnormal weather conditions, or other causes beyond the Contractor's control, it being understood and agreed that the Contractor's sole and exclusive remedy in the event of his inability to achieve completion by the contract deadline due to claimed delays shall be an extension of the contract schedule, but only if a claim for such extension is properly made in accordance with the provisions of subparagraph (b) above.

19) Town's Right to Do Work

- a) If the Contractor should neglect to prosecute the work promptly or fail to perform any provisions of the contract, the Town, after 24 hours written notice to the Contractor, may without prejudice to any other remedy he may have, make good such deficiencies, and may deduct the cost thereof from the payment then or thereafter due the Contractor.

20) Correction of Work Before Final Payment

- a) Before issuing final payment, the Contractor shall promptly remove from the premises all materials condemned by the Town as failing to conform with the contract, whether

incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the contract and without expense to the Town and shall bear the expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.

21) Final Inspection, Clean Up and Project Final Acceptance

a) Final Inspection

- i) When the improvements contained in this contract are substantially completed, the Contractor shall notify the Town in writing that the work will be ready for final inspection on a definite date which shall be stated in the notice. The notice shall be given at least ten (10) days prior to the date stated for final inspection and bear the signed concurrence of the representative of the Town having charge of the inspection. If the Town determines that the status of the improvements are accurately represented, the Town will make the arrangements necessary to have the final inspection on the date stated in the notice, or soon thereafter as is practicable. The Final Inspection Team will include the Town's representatives and the Contractor.
- ii) The Final Inspection Team, on the date agreed upon in 24 (a)(i), shall make a thorough visual inspection to ensure that the project is satisfactorily completed according to the plans and specifications of the contract and that all cleanup work is complete.
- iii) The Final Inspection Team, following the final inspection, shall prepare a written list of the deficient items and cleanup work that needs to be corrected before the issuance of the Final Acceptance Document. The list shall include a reasonable period of time agreed upon with the Contractor, allowing for the completion of the deficient items and cleanup work. A copy of the list shall be provided to the Contractor.

b) Cleanup Work

- i) Clean up work shall include cleanup of trash in the medians and rights-of-way. Additionally, cleanup work shall include asphalt or concrete deposits left in any work or staging area, or transit or travel route for the contractor or their subcontractors.

c) Project Final Acceptance

- i) The Contractor, after finishing all cleanup work and correction of all deficient items, shall notify the appropriate party on the Inspection Team to make a final inspection of the project. If the Final Inspection Team, during its inspection finds that the deficient items and cleanup work have been satisfactorily completed according to the terms of this Article and the contract specifications, then the Final Inspection Team recommends to the Town to issue the Final Acceptance Document.

22) Payments to Contractor and Retainage

a) Partial Payments

- i) Partial payment, if applicable, will be based upon progress estimates prepared once each month.

b) Retainage

- i) An amount equal to five percent (5%) of the total amount due will be deducted and retained until 90 percent (90%) of the work is completed.
- ii) After 90 percent (90%) of work is completed, a reduction in retainage to two percent (2%), if warranted by job performance, may be approved by the Town.

c) Final Payment

- i) After final inspection and acceptance by the Town of Knightdale of all work under the contract, the Contractor shall prepare his requisition for final payment which shall be the sum of the Bid unit Prices multiplied by the quantities actually issued or this sum adjusted by approved change orders less prior payments. Final payment request must be accompanied by the Final Payment Affidavit.
 - ii) The Town of Knightdale before paying the final estimate may require the Contractor to furnish releases or receipts from all subcontractors having performed any work and all persons having supplied materials, equipment, and services to the Contractor, if the Town of Knightdale deems the same necessary in order to protect its interest. The Town of Knightdale, however, may, if it deems such action advisable, make payment in part or in full to the Contractor without requiring the furnishing of such releases or receipts and any payments so made shall in no way impair the obligations of any surety or sureties furnished under the contract.
 - iii) Withholding of any amount due the Town of Knightdale as "Liquidated Damages", shall be deducted from payments due to the Contractor.
 - iv) The Town may withhold on account of subsequently discovered evidence, nullify whole or part of any certificate to such extent as may be necessary to protect itself from loss on account of:
 - (1) Defective work not remedied.
 - (2) Claims filed or reasonable evidence indicating probable filing of claims.
 - (3) Failure of the Contractor to make payments properly to Subcontractor or for materials or labor.
 - (4) A reasonable doubt that the Contract can be completed for the balance unpaid.
 - (5) Damage to another Contractor.
 - (6) When the above items have been cleared to the satisfaction of the Town, payment shall be made for amounts withheld because of them.
- 23) Town's Right to Terminate Contract
- a) If the Contractor should be adjudged as bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of insolvency, or if he should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if they should fail to make prompt payment to Subcontractors or for material or labor, or persistently discharged laws, ordinances or the instructions of the Town, or otherwise be guilty of a substantial violation of any provision of the contract, then the Town, may without prejudice to any other right or remedy and after giving the Contractor seven days written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools, appliances, there and finish the work by whatever method it may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed the unpaid balance, the Contractor shall pay the difference to the Town. The expense incurred by the owner as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Town.
- 24) Contractor's Right to Stop Work or Terminate Contract

- a) If the work should be stopped under an order of any Court, or other public authority, for a period of three months, through no act or fault of the Contractor or of anyone employed by him, then the Contractor may, upon seven days written notice to the Town, stop work or terminate this contract and recover from the Town payment for all work executed and loss sustained upon any plant or materials and reasonable profit and damages.

25) Liability Insurance

- a) The Contractor must have the financial ability to undertake the work and assume the liability. The selected Contractor will be required to furnish proof of insurance coverage and shall maintain the limits as follows:

Coverage	Minimum Limits
Commercial General Liability	\$5,000,000 per occurrence (\$5,000,000 aggregate)
Automobile Liability	\$1,000,000
Professional Liability (E & O)	\$1,000,000 per occurrence (\$2,000,000 aggregate)
Workers' Compensation and Employer's Liability	Statutory Limits and must include \$1,000,000 Each Accident, \$1,000,000 Disease (Each Employee, \$1M Disease-Policy Limit)

Commercial General Liability: Coverage shall have minimum limits of \$5,000,000 per occurrence, general aggregate, products/completed operations aggregate, personal and advertising injury. This shall include premises and operations, independent contractors, products and completed operations, broad form property damage, XCU coverage and contractual liability.

Automobile Liability: Owned, non-owned, and hired Automobile Liability insurance, including property damage insurance, covering all owned, non-owned, borrowed, leased, or rented vehicles operated by the Contractor in furtherance of these services. In addition, all mobile equipment used by the Contractor in connection with the contract work, will be insured under either a standard Automobile Liability policy, or a Commercial General Liability policy. This insurance shall provide bodily injury and property damages limits of not less than \$1,000,000 combined single limit.

Professional Liability (Errors and Omissions): Professional Liability insurance of at least \$1,000,000 per occurrence (\$2,000,000 aggregate).

Workers' Compensation and Employer's Liability: Insurance covering all employees meeting statutory limits in compliance with the applicable state and federal laws. The coverage must include Employer's Liability with a minimum limit of \$1,000,000 for each accident and \$1,000,000 for each employee for injury by disease.

The selected Contractor shall provide the Town with a Certificate of Insurance for review prior to the issuance of any contract or Purchase Order. All Certificates of Insurance will require thirty (30) days written notice by the insurer or Contractor's agent in the event of cancellation, reduction or other modifications of coverage. In addition to the notice requirement above, the Contractor shall provide the Town with immediate written notice of cancellation, reduction, or other modification of coverage of insurance. Upon failure of the firm to provide such notice, the

Contractor assumes sole responsibility for all losses incurred by the Town for which insurance would have provided coverage. The failure of the Contractor to deliver a new and valid certificate will result in suspension of all payments until the new certificate is furnished to the Town. Insurance coverage required in these specifications shall be in force throughout the term. Municipal Exclusions, if any, for General Liability coverage shall be deleted. The Town shall be named as an additional insured and the statement should read "Town of Knightdale is to be added as an additional insured as evidenced by an endorsement attached to this certificate." Should the Contractor fail to immediately provide acceptable evidence of current insurance at any time during the Term, the Town shall have the absolute right to terminate the Contract without any further obligation to the Contractor, and the Contractor shall be liable to the Town for all available remedies, in equity and at law. The Contractor will secure evidence of all insurance policies of its subcontractors which shall be made available to the Town on demand. The Contractor shall require its subcontractors to name the Contractor and the Town as additional insured parties on the subcontractor's general and automobile liability insurance policies. The Contractor shall be as fully responsible to the Town for the acts and omissions of its subcontractors and of persons employed by them as it is for the acts and omissions of persons directly employed by it. Contractual and other Liability insurance provided under this Contract shall not contain a supervision inspection or engineering services exclusion that would preclude the Town from supervising and/or inspecting the project as to the end result.

26) Care of Work

- a) The Contractor shall be responsible for all damages to person or property that occur as a result of his fault or negligence in connection with the prosecution of the work and shall be responsible for the proper care and protection of all materials delivered and work performed until completion and final acceptance, whether or not the same has been covered in whole or in part by payments made by the Town of Knightdale.
- b) In an emergency affecting the safety of life or property, including adjoining property, the Contractor, without special instructions or authorization is authorized to act at his discretion to prevent such threatened loss or injury and he shall so act. He shall likewise act if instructed to do so by the Town of Knightdale. Any compensation claimed by the Contractor on account of such emergency work will be determined by the Town of Knightdale as provided in Section 15 "CHANGES IN WORK" under GENERAL CONDITIONS.
- c) The Contractor shall avoid damage as a result of his operations to existing sidewalks, streets, curbs, pavements, utilities (except those which are to be replaced or removed), adjoining property, etc., and he shall at his own expense completely repair any damage thereto caused by his operations.
- d) The Contractor shall shore up, brace, underpin, secure, and protect as may be necessary, all foundations and other parts of existing structures adjacent to, adjoining, and in the vicinity of the site, which may be in any way affected by the excavations or other operations connected with the construction of the improvements embraced in this contract. The Contractor shall be responsible for the giving of any and all required notices to any adjoining or adjacent property owner or other party before the commencement of any work. The Contractor shall indemnify and save harmless the Town of Knightdale from any damages on account of settlements or the loss of lateral support of adjoining property and from all loss or expense and all damages for

which the Town of Knightdale may become liable in consequence of such injury or damage to adjoining and adjacent structures and their premises.

- e) Any claim for damage arising under this contract shall be made in writing to the party liable within reasonable time of the first observance of such damage.

27) Indemnity

- a) The Contractor shall indemnify, save harmless, and defend the Town against all losses and claims, demands, payments, suits, actions, recoveries, and judgments of every nature and description brought or recovered against it by reason of any act or omission of the said Contractor, his agents, and employees, in the execution of work or in the guarding of it.

28) Safety and Accident Prevention

a) General

- i) The Contractor shall exercise proper precautions 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 Contractor shall abide by all applicable safety standards and regulations contained in the Occupational Safety and Health Act, for the construction industry and any other applicable Laws.
- ii) All excavation and trenching work shall conform to OSHA requirements under 29 CFR Part 1926 Subpart P and any other applicable requirements.
- iii) The Contractor shall have an employee who is a designated competent person as described under OSHA regulations, 29 CFR Part 1926 Subpart P. The person shall be capable of identifying existing or predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
- iv) The Contractor shall provide and maintain safety equipment as outlined under OSHA 29 CFR Part 1926 Subpart P and other applicable safety provisions, which include trench boxes, ladders, shoring, barricades, warning vests, gas monitors, meter for hazardous atmospheres and other necessary safety equipment to protect the employees and the job site.

b) Records

- i) The Contractor shall maintain an accurate record of all cases of death, occupational diseases, and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on work under the contract. The Contractor shall promptly furnish the Town of Knightdale with reports concerning these matters.

c) Indemnity

- i) The Contractor shall indemnify and save harmless the Town of Knightdale from any claims for damages resulting from personal injury and/or death suffered or alleged to have been suffered by any person as a result of any work conducted under this contract.

29) Bidding Process and Guaranty Bonds

a) Bidding Process

- i) The Town of Knightdale's bidding process policy is regulated by the North Carolina State GS 143-129, GS 143-131 and Town of Knightdale Standard Procedure 501-3 which define Formal and Informal bids.
 - (1) Formal Bids, as described by GS 143-129, are those contracts for construction or repair work that require expenditure of \$500,000.00 or more; and for the purchase or lease

purchase of apparatus, supplies, materials or equipment that require an expenditure of \$90,000.00 or more.

- (2) Informal Bids, as described by GS 143-131, are those contracts for construction or repair work that require expenditure of \$30,000 to \$499,999; and for the purchase or lease purchase of apparatus, supplies, materials or equipment that require expenditure of \$30,000 to \$89,999.
- ii) All Bids as described in 32 (a)(i)(1) shall be accompanied by a deposit equal to not less than 5 percent of the total amount of the Bid in the form of cash, cashier's check, a certified check or a bid bond by a surety authorized to do business in the State of North Carolina.
- b) Guaranty Bonds for Formal Contracts
 - i) The successful bidder in a formal contract, within ten (10) days after the notice of award is received by him, shall provide the Town of Knightdale with a contract payment bond and a contract performance bond, each in an amount equal to 100 percent of the amount of the contract. All bonds shall be in conformance with GS 44A-33. The corporate surety furnishing the bonds shall be authorized to do business in the State of North Carolina.
 - ii) The successful bidder's failure to execute the contract and file acceptable bonds within ten (10) days after the notice of award is received by him will be just cause for the forfeiture of the bid bond or bid deposit and rescinding the award of the contract.
 - iii) Award may then be made to the next lowest responsible bidder, or the work may be re-advertised and constructed under contract, or otherwise as the Town of Knightdale may decide.
- c) Guaranty Bonds for Informal Contracts (if Required)
 - i) The successful bidder, within ten (10) days after the notice of award is received by him, shall provide a payment bond in the amount of 100 percent of the amount of the contract.
 - ii) Under North Carolina law, performance and payment bonds must be furnished to the local government by each contractor with a contract costing over \$50,000 on construction or repair projects where the total of all contracts for the project exceeds \$300,000. Each bond must be for 100 percent of the contract amount and must be executed by a surety licensed in North Carolina. If the contractor does not provide performance and payment bonds, he forfeits the bid deposit. In place of the bonds the Contractor may deposit money, a certified check, or acceptable government securities.

30) Sanitary Facilities

- a) The Contractor shall furnish, install, and maintain ample sanitary facilities for the workers. As the needs arise, a sufficient number of enclosed temporary toilets shall be conveniently placed as required by the sanitary codes of the State and Town of Knightdale. Drinking water shall be provided from an approved source, so piped or transported as to keep it safe and fresh and served from single service containers or satisfactory types of sanitary drinking stands or fountains. All such facilities and services shall be furnished in strict accordance with existing and governing health regulations.

31) Use of Premises

- a) The Contractor shall confine his equipment, storage of materials, and construction operations to the contract limits as shown on the Drawings or if no contract limits are shown, to the right-of-way shown and as prescribed by ordinances or permits or as may be directed by the Town of

Knightdale and shall not unreasonably encumber the site or public rights of way with his materials and construction equipment.

- b) The Contractor shall comply with all reasonable instructions of the Town of Knightdale and the ordinances and codes of the Town of Knightdale, regarding signs, advertising, traffic, fires, explosives, danger signals, and barricades.

32) Liens

- a) Neither the final payment nor any part of the retained percentage shall become due until the Contractor, shall deliver to the Town a complete release of all liens arising out of the contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that so far as he has knowledge or information the releases and receipts include all labor and materials for which a lien could be filed but the Contractor may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Town, to indemnify the Town against any lien. If any lien remains unsatisfied after all payments are made, the Contractor, shall refund to the Town all monies that the latter may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.
- b) A copy of the Affidavit may be requested from the Town's Finance Department and shall be submitted with the Contractor's request for final payment.

33) Assignment

- a) Neither party to the contract shall assign the contract or sublet it as a whole without the written consent of the other, nor shall the Contractor assign any monies due or to become due to him hereunder, without previous written consent of the Town Council of the Town of Knightdale.

34) Citizen Notification

- a) The Contractor shall be responsible for notifying, in writing, all property owners/residents directly affected by this project just prior to beginning construction. A copy of this notification shall be submitted and approved by the Town prior to its issuance to the residents. This also includes all businesses whether owned, leased or rented by the property owner of record. Property owner addresses will be provided to the Contractor by the Town. Notices are to be mailed and/or hand delivered.
- b) The Contractor shall distribute Notices of Actual Work to be performed a minimum of 2 weeks prior to performing such work.

35) Separate Contracts

- a) The Town reserves the right to let other contracts in connection with this work. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with others.

36) Subcontracted Work and Subcontractors

- a) The Contractor shall, as soon as practicable after the signing of the contract, notify the Town in writing of the names of subcontractors proposed for the work and shall not employ any subcontractors that the Town may within a reasonable time object to as incompetent or unfit. The Contractor agrees that he is as fully responsible to the Town for the acts and omissions of his subcontractor and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him. Nothing in the Contract Documents shall create any contractual relation between any subcontractor and the Town.

- b) The Contractor shall obtain approval of subcontractors as well as any change in subcontractors during the work on the contract from the Town. A period of seven (7) days minimum is required for the approval of a subcontractor.

37) Points and Instructions

- a) The Contractor shall provide reasonable and necessary opportunities and facilities for setting points and making measurements. He shall not proceed until he has made timely demand upon the Town for, and has received from him, such points and instructions as may be necessary as the work progresses. The work shall be done in strict conformity with such points and instructions.
- b) The Contractor shall carefully preserve benchmarks, reference points and stakes, and in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

38) Lands for Work

- a) The Town shall provide the lands upon which the work under this contract is to be done, except that the Contractor shall provide land required for the erection of temporary construction facilities and storage of his materials, together with right of access to same.

39) Cleaning Up

- a) The Contractor shall, as directed by the Town, remove from the Town's property and from all other public and private property, at his own expense, all temporary structures, rubbish and waste materials resulting from his own operations.

40) Access to Property

- a) The Contractor shall, where necessary, provide and maintain access to and from all properties along the line of his work.

41) Safeguards

- a) The Contractor shall provide, erect, and maintain adequate barricades, warning signs, and lights at all excavations, closures, detours, and other points of danger.

42) Materials Sampling and Testing

- a) All tests of material shall be made by a recognized and approved testing laboratory designated by the Town. The expense of such tests shall be borne by the Town unless otherwise specified.
- b) The Town shall have the option to reject requests for testing due to the Contractor's inadequate preparation of material or other reasonable causes determined by the Engineer as necessary for the delay of testing. The Contractor shall notify the Town 48 hours ahead of time for the needed test.

43) Tools, Plant and Equipment

- a) If at any time before the commencement or during the work, tools, plant, or equipment appear to the Town to be insufficient, inefficient, or inappropriate to secure the quality of the work required or the proper rate of progress, the Town may order the Contractor to increase their efficiency, to improve their character, to augment their number, or to substitute new tools, plant or equipment as the case may be, and the Contractor must conform to such order; but the failure of the Town to give such an order shall not relieve the Contractor to secure the quality of work and the rate of progress necessary to complete the work within the time required.

44) Working Day Defined

- a) A day shall be counted as a working day in the opinion of the Town, whether conditions would permit the Contractor to do six (6) hours of work within daylight hours. Days of delay due to acts

of God, strikes, court orders, and things of like nature causing delay of the work shall not be counted a working day. The Town shall keep a daily record of working conditions and when requested to do so, he/she shall furnish the Contractor within a reasonable time the number of working days that have elapsed.

- b) Unless crews are on site prior to 1:00 p.m. of any workday, the Town has the right to refuse any work that the Contractor may do. To start work after 1:00 p.m. on a workday, the Contractor must have prior permission from the Town. Should this occur, it will be counted as a working day that the Contractor should have worked. It will not be counted as a day of delay. When work is to resume, one (1) day prior notice must be given to the Town. That work will begin the next day.

45) Project Time Defined

- a) Project time shall consist of all calendar days, including weekends and holidays, from the contract notice to proceed date through the specified number of days allowed for the completion of the project in the contract document. The Contractor has been given a project time inclusive of an anticipated amount of bad weather, be it due to the winter months or abnormal rainfall during the remainder of the calendar year.

46) Guarantee of Work

- a) The Contractor shall guarantee his work performed under his contract against failures or trouble due to faulty workmanship or materials for a period of twelve (12) months from the date of acceptance of the work.

47) Force Account Work

- a) Force account reports shall be submitted to and approved by the Town within five (5) days following completion of the work. Failure on the part of the Contractor to submit such a report on time may result in refusal to pay for the work done.

48) Disposal of Waste Materials from Street and any Other Types of Construction

- a) Disposal of all waste material from construction sites shall be made in strict accordance with all Town ordinances pertaining to disposal of construction waste. It shall be the responsibility of the Contractor to secure the necessary permits and provide all information required to secure said permits. The Contractor shall designate the disposal site prior to beginning construction and in the event waste material is to be disposed of on private property a letter from the property owner shall be furnished to the Town granting the Contractor or his agent such permission and listing the requirements made by the property owner or the Contractor, if any.

49) Contractor License

- a) All invited bidders and contractors shall be advised that those who submit formal bids on this project must be licensed in the State of North Carolina whether he (they) is/are a resident or nonresident of this State, in accordance with GS 87-10 and shall be advised that they must show evidence of a license issued by the North Carolina Licensing Board for General Contractors before the bid is considered. The bidders are advised that Article 40, Subcontractors, of the General Conditions shall be strictly adhered to during the term of this contract.

50) Emergency Work Crew

- a) The Contractor and/or the Contractor's subcontractors shall provide an emergency repair crew with adequate trucks and other equipment available when needed to make repairs, clean-up, signing, and other work required in connection with this contract. This repair crew shall be on call during non-working hours and during weekends and holidays. The name, address, and

phone number of at least two responsible members of this crew shall be provided to the Town prior to beginning any work. The members of this crew shall be based, reside, live, or stay in Wake County during the periods that they are on call. Should this "emergency" crew be unavailable for any reason when needed, the Town shall have the right to have the required work performed by the quickest means available and the Contractor shall be back-charged at a rate of two (2) times the total cost to the Town.

51) Construction Water

- a) Contractors are responsible for securing adequate construction water for their job sites.
- b) All construction water usage must be metered and will be billed to the Contractor. The Contractor must contact the City of Raleigh Public Utilities Department (919.996.3245) to make the applicable arrangements for billing the water usage. The Contractor may provide his own meter or if available upon advance notice to the Public Utilities Department, a "numbers changed to" meter will be provided. If the Contractor provides his own meter, it must meet Town standards for the meter and include a backflow device.
- c) Construction water for all Town contract projects shall be billed by the City of Raleigh, Public Utilities Department.
- d) Contractors must furnish the following information for water usage:
 - i) Meter location and project name.
 - ii) Address where applicable and responsible party name
 - iii) Duration of use and frequency of meter reading
- e) Contractors observed using unmetered water will be fined by the City of Raleigh, Public Utilities Department.
- f) Contractors are to reference the Public Utilities Handbook, Part 10, entitled Construction Specifications for Water and Sewer Mains, for additional regulations applicable to construction water usage.

52) Dust Control

- a) The Contractor shall, as directed by the Public Works Director provide adequate equipment and use other available means to control the dust during the term of this contract. Failure on the part of the Contractor to correct dust control problems as directed will result in the Town notifying the Contractor to comply with the contract provisions. In the event that the Contractor fails to begin such remedial action within 24 hours after receipt of such notice, the Town may proceed to have the work performed with other forces. The actual cost of the work so performed along with a 20% administrative fee will be deducted from monies due to the Contractor on his contract. Under adverse conditions, the Town may choose to suspend the Contractor's operations on the project until all dust control problems have been completed to his satisfaction. Such suspension will not justify an extension of contract time.

53) Traffic Control

- a) Any work performed without traffic control, as per MUTCD, will not be paid for by the Owner.

54) Sustainability

- a) The Town of Knightdale is committed to reducing the adverse environmental, social, and fiscal impacts of its purchasing decisions. It is committed to buying goods and services from contractors who share this concern and commitment. The Town encourages bidders to include in their responses sustainable product and service options that minimize waste, recycle, reduce, reuse, prevent pollution, and/or offer resource efficiency.

PROJECT NAME: Breckenridge Drive Drainage Improvements**MCADAMS PROJECT NO.:** KND21001**DATE:** May 28, 2025

ITEM NO.	DESCRIPTION	SPEC SECTION	PAY ITEMS PARAGRAPH	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Traffic Control Measures	ToK 2.07	-	1	LS		
2	Asphalt Concrete Intermediate Course, Type I19.0B	ToK 3.03	-	180	TN		
3	Asphalt Concrete Intermediate Course, Type I19.0C	NCDOT 610	610-16	11	TN		
4	Asphalt Concrete Surface Course, Type S9.5B	ToK 3.03	610-16	110	TN		
5	Asphalt Binder for Plant Mix	ToK 3.03	620-4	25	TN		
6	Aggregate Base Course, Type B25.0B	ToK 3.03	545-6	55	TN		
7	Aggregate Base Course, Type B25.0C	NCDOT 610	610-16	40	TN		
8	Remove, Store, and Reset Mailboxes	ToK 3.07	-	4	EA		
9	1' - 6" Concrete Curb and Gutter	ToK 4.00	846-4	530	LF		
10	6" Portland Cement Concrete Pavement	ToK 4.01	710-10	210	SY		
11	24" Drainage Pipe, HDPP	ToK 5.02	305-4	595	LF		
12	Custom Reinforced Concrete Endwall	ToK 5.03	838-4	25	CY		
13	Drainage Structures, 0'-5' deep	ToK 5.03	840-4	7	EA		
14	Drainage Structures, 5'-15' deep	ToK 5.03	840-4	30	LF		
15	Frame with Grate and Hood	ToK 5.03	840-4	5	EA		
16	Manhole Ring and Cover	ToK 5.03	840-4	2	EA		
17	Rip Rap, Class I	ToK 5.04	876-4	25	TN		
18	Rip Rap, Class II	ToK 5.04	876-4	60	TN		
19	Clearing and Grubbing	NCDOT 200	200-8	1	LS		
20	Comprehensive Grading	NCDOT 226	226-3	1	LS		
21	Borrow Excavation	NCDOT 230	230-5	1,340	CY		
22	Removal of Existing Pavement	NCDOT 250	250-3	350	SY		
23	Foundation Conditioning Material, Minor Structures	NCDOT 300	300-9	370	TN		

ITEM NO.	DESCRIPTION	SPEC SECTION	PAY ITEMS PARAGRAPH	QUANTITY	UNIT	UNIT PRICE	TOTAL
24	Foundation Conditioning Geotextile	NCDOT 300	300-9	790	SY		
25	Pipe Removal, 15" RCP	NCDOT 340	340-4	2	LF		
26	Pipe Removal, 24" RCP	NCDOT 340	340-4	48	LF		
27	Pipe Removal, 42" RCP	NCDOT 340	340-4	7	LF		
28	Removal of Existing Structure	NCDOT 402	402-3	1	LS		
29	Fine Grading	NCDOT 500	500-5	1	LS		
30	Conditioning Existing Base	NCDOT 535	535-3	2000	SY		
31	Asphalt Curing Seal	NCDOT 543	543-5	195	GAL		
32	Milling Asphalt Pavement, 0.0" to 3.00"	NCDOT 607	607-5	1,300	SY		
33	Mobilization (5% of Base Bid)	NCDOT 800	800-2	1	LS		
34	Construction Surveying	NCDOT 801	801-3	1	LS		
35	Pipe Plug	NCDOT 840	840-4	0.12	CY		
38	Geotextile for Drainage - Riprap	NCDOT 876	876-4	100	SY		
39	Select Materials	NCDOT 1016	-	1,900	TN		
40	HDPE/HDPP Flared End Section, 24"	NCDOT 1032	-	1	EA		
41	Tubelings	NCDOT 1060	-	14	EA		
42	Tree Planting (1-gal container)	NCDOT 1060	-	8	EA		
43	Level A Subsurface Utility Exploration	NCDOT 1500	1500-10	1	ALLOWANCE		
44	Utility Coordination	NCDOT 1500	1500-10	1	ALLOWANCE		
45	Temporary Silt Fence	NCDOT 1605	1605-5	470	LF		
46	Seed for Temporary Seeding	NCDOT 1620	1620-4	30	LBS		
47	Fertilizer for Temporary Seeding	NCDOT 1620	1620-4	0.13	TN		
48	Standard Gravel Yard Inlet Protection	NCDOT 1632	1632-5	1	EA		
49	Standard Pipe Inlet Protection (Plywood & Stone)	NCDOT 1635	1635-5	3	EA		
50	Selective Tree Removal, 12"	NCDOT 1651	1651-5	4	EA		
51	Selective Tree Removal, 16"	NCDOT 1651	1651-5	2	EA		
52	Selective Tree Removal, 17"	NCDOT 1651	1651-5	1	EA		
53	Selective Tree Removal, 18"	NCDOT 1651	1651-5	1	EA		
54	Seeding and Mulching	NCDOT 1660	1660-8	0.25	AC		
55	Standard Filter Bag for Dewatering Activities	-	-	1	EA		

ITEM NO.	DESCRIPTION	SPEC SECTION	PAY ITEMS PARAGRAPH	QUANTITY	UNIT	UNIT PRICE	TOTAL
56	Standard Silt Bag – Inlet Sediment Control Device	-	-	5	EA		
57	Stream Pump Around and Diversion Measures	-	-	1	LS		
58	As-Built Survey	-	-	1	LS		
59	Post-Construction CCTV	-	-	1	LS		
60	Geotechnical Services	-	-	1	LS		

Bid Alternate

ITEM NO.	DESCRIPTION	SPEC SECTION	PAY ITEMS PARAGRAPH	QUANTITY	UNIT	UNIT PRICE	TOTAL
61	Road Replacement	-	-	1	LS		

STANDARD SPECIFICATIONS
& CONSTRUCTION DETAILS MANUAL

SECTION 2 - GENERAL PROVISIONS

2.01 General

All construction shall conform to the requirements and dimensions on the approved construction plans, Town Standard Details, the Code of the Town of Knightdale, or as stated in these Specifications.

2.02 Abbreviations & Definitions

a. Abbreviations:

AASHTO - American Association of State Highway Transportation Officials

ASTM - American Society for Testing & Materials

AWWA - American Water Works Association

NC DOT - North Carolina Department of Transportation

ANSI - American National Standard Institute

b. Definitions:

Where the word "Engineer" is used in these Specifications, it shall be the Town Engineer of Knightdale, the Town's Consulting Engineer as designated by the Town Manager, or an assistant or other representative duly authorized by the Town Engineer or the Town's Consulting Engineer.

Where the words "Town Representative" are used in these Specifications, it shall be the Director of Public Works & Utilities of the Town of Knightdale or an assistant or other duly authorized representative of the Town of Knightdale, North Carolina.

Where the word "Town" is used in these Specifications, it shall be the Town of Knightdale, North Carolina.

Where the word "Developer" or "Contractor" is used in these Specifications, it shall be the developer of the project or his authorized contractor performing work on the site. For purposes of these Specifications, these words are to be considered synonymous. All Contractors performing construction or installation of public facilities shall be properly licensed for the work by the NC Licensing Board for General Contractors. Prior to commencing work, the Contractor shall submit proof of licensure. The Contractor shall also submit information including mailing and street address for the firm, ownership information, telephone numbers for contact during regular business hours and emergency telephone numbers for contact during nights, weekends and holidays.

Where the words "Project Engineer" are used in these Specifications, they shall mean the design engineer, land surveyor, or landscape architect retained by the developer, and the person responsible for the preparation of the final construction drawings.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

2.03 Insurance Requirements

If work is to be performed within any Town street right-of-way or on Town owned property, the Developer/Contractor shall submit a certificate of insurance to the Town stating that coverage is in effect during the project duration. The limits of coverage shall be no less than \$3,000,000 for general liability (bodily injury and property damage) plus \$2,000,000 for automobile liability (bodily injury and property damage).

2.04 Erosion & Sedimentation Control

a. General Requirements:

Temporary and permanent erosion control measures shall be provided in accordance with the erosion and sedimentation control plan approved by the Erosion, Flood and Stormwater Division of the Wake County Environmental Services Department. The approved Erosion and Sedimentation Control Plan shall be kept on site by the Contractor at all times that work is being performed.

All permanent erosion and sedimentation control measures shall be incorporated into the work at the earliest practicable time, and in no case shall an area remain denuded for more than 30 working days. Temporary erosion and sedimentation control measures shall be coordinated with permanent erosion and sedimentation control measures and all other work on the project to ensure economical, effective and continuous erosion and sedimentation control throughout the construction and post construction period and to minimize siltation of streams, lakes, reservoirs, and other water impoundments, ground surfaces, roadways, or other property.

b. Seeding & Mulching:

Seeding and mulching shall be carried out immediately behind construction in accordance with the following specifications:

SEEDING SPECIFICATIONS			
SHOULDERS, SIDE DITCHES, SLOPES (MAX. 3:1)			
SEEDING PERIOD	TYPE	APPLICATION RATE	
		Per Acre	Per 1000 SF
Aug 15 - Nov 1	Tall Fescue	300#	7#
Nov 1 - Mar 1	Tall Fescue <u>and</u>	300#	7#
	Abruzzi Rye	25#	0.6#
Mar 1 - Apr 15	Tall Fescue	300#	7#
Apr 15 - Jun 30	Hulled Common Bermudagrass	25#	0.6#
Jul 1 - Aug 15	Tall Fescue <u>and</u>	120#	2.8#
	*Browntop Millet	35#	0.8#
	* <u>or</u> Sorghum-Sudan Hybrids	30#	0.7#

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

SEEDING SPECIFICATIONS			
SLOPES (3:1 TO 2:1)			
SEEDING PERIOD	TYPE	APPLICATION RATE	
		Per Acre	Per 1000 SF
Mar 1 - Jun 1	Sericea Lespedeza (scarified)	50#	1.2#
	<u>and</u>		
(Mar 1- Apr 15)	<u>ADD</u> Tall Fescue	120#	2.8#
(Mar 1- Jun 30)	<u>OR ADD</u> Weeping Love grass	10#	0.2#
(Mar 1- Jun 30)	<u>OR ADD</u> Hulled Common Bermudagrass	25#	0.6#
Jun 1 - Sep 1	*Tall Fescue <u>and</u>	120#	2.8#
	*Browntop Millet	35#	0.8#
	* <u>or</u> Sorghum-Sudan Hybrids	30#	0.7#
Sep 1 - Mar 1	Sericea Lespedeza (unhulled, unscarified)	70#	1.6#
	<u>and</u> Tall Fescue	120#	2.8#
(Nov 1-Mar 1)	<u>ADD</u> Abruzzi Rye	25#	0.6#

*Temporary - Reseed according to optimum season for desired permanent vegetation. Do not allow temporary cover to grow over 12" in height before mowing, otherwise fescue may be shaded out.

Consult Wake Soil & Water Conservation District or North Carolina Division of Soil & Water Conservation for additional information concerning other alternatives for vegetation of denuded areas. The above vegetation rates are those that do well under local conditions; other seeding rate combinations are possible.

SEEDBED PREPARATION

- (1) Chisel compacted areas and spread topsoil three (3) inches deep over adverse soil conditions, if available.
- (2) Rip the entire area to 6-inch depth.
- (3) Remove all loose rock, roots, and other obstructions leaving surface reasonably smooth and uniform.
- (4) Apply agricultural lime, fertilizer, and superphosphate uniformly and mix with soil (see below*).
- (5) Continue tillage until a well-pulverized, firm, reasonably uniform seedbed is prepared 4 to 6 inches deep.
- (6) Seed on a freshly prepared seedbed and cover seed lightly with seeding equipment or cultipack after seeding.
- (7) Mulch immediately after seeding and anchor mulch.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

- (8) Inspect all seeded areas and make necessary repairs or reseedings within the planting season, if possible. If stand should be over 60% damaged, re-establish following original lime, fertilizer and seeding rates.
- (9) Consult Wake Soil & Water Conservation District on maintenance treatment and fertilization after permanent cover is established.

*Apply:	Agricultural Limestone	- 2 tons/acre (3 tons/acres in clay soils)
	Fertilizer	- 1,000 lb/acre - 10-10-10
	Superphosphate	- 500 lb/acre - 20% analysis
	Mulch	- 2 tons/acre - small grain straw
	Anchor	- Asphalt Emulsion @ 300 gals/acre

c. Construction Entrances:

Gravel construction entrance pads shall be constructed at each point of construction access to each property. The gravel pads shall be maintained in such a manner as to prevent the deposition of mud and debris onto existing public roadways adjacent to the site.

Gravel pads shall be constructed in accordance with the latest adopted Wake County's Erosion and Sedimentation Control Ordinance and published standard detail Temporary Construction Entrance/Exit.

Special Note: It shall be the developer's responsibility to see that the construction entrance pads are properly maintained so that mud is not tracked onto adjacent streets. In the event that the gravel construction entrances are not properly maintained, or are otherwise ineffective, **the Town Representative may issue a Stop Work Order** or any other equitable remedy provided by the Town of Knightdale UDO or NC General Statutes. The Stop Work Order, which shall remain in effect until such time as the pads are restored and replenished and until any resulting mud and debris, has been removed from the adjacent streets by the Contractor.

d. Clearing Limits:

All clearing limits shall be clearly identified and staked prior to any construction. The Town shall be given 24-hour notice prior to beginning clearing operations.

2.05 Earthwork

a. General:

Earthwork shall be defined as the removal of soil (including rock) from its natural location and the depositing of such material into the proper fill areas as indicated on the plan.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

b. Rock Excavation - by Blasting:

- (1) Permit - Where rock must be removed by blasting, a written permit must first be obtained from the Town of Knightdale Public Safety Department a minimum of 24 hours before any explosive materials or blasting agents are used within the corporate limits of the Town of Knightdale and its extra-territorial jurisdiction (ETJ). A certificate of insurance, as outlined in paragraph 2.03, must be submitted to the Town prior to any blasting operations regardless of the location of the blasting.
- (2) Hours of Blasting - Blasting for rock removal shall be conducted only Monday through Friday during normal business hours.
- (3) Blasting Procedures - Blasting for trench rock may be initiated only after the permitting requirements prescribed in (1) above of this Section have been complied with. The Contractor is also reminded of the work hour limitations for blasting, as also established in (2) above of this Section.

Blasting Procedures shall conform to all applicable local, state, and Federal laws and ordinances. The Contractor shall take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden. The Contractor shall keep explosive materials which are needed on the job site in specially constructed boxes provided with locks. These boxes shall be painted red and plainly identified as to their contents. After working hours, the boxes containing explosive material shall be removed from the job site.

Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion, or falling rock, the Contractor shall be required to keep a blasting log containing the following information for each and every shot:

1. Date of shot
2. Time of shot
3. Foreman's name
4. Number and depth of holes
5. Approximate depth of overburden
6. Amount and type of explosive used in each hole
7. Type of caps used (instant or delay)
8. The weather

This blasting log shall be made available to the Town Representative upon request and shall be kept in an orderly manner. Compliance by the Contractor with these specifications does in no way relieve him of legal liabilities relative to blasting operations.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

The Town Representative reserves the right to require removal of rock by means other than blasting where any utility, residence, structure, etc. is either too close to, or so situated with respect to the blasting hazardous.

c. Removal of Unstable Material:

Where unstable, organic material ("muck") is encountered in trenches or in roadways, the material shall be completely removed and replaced with suitable, thoroughly compacted material.

d. Placement of Fill:

Fill material for roadway embankments shall be free from stones greater than four (4) inches in size, construction material debris, frozen material, organic matter or other unstable material. Fill material placed in roadway embankments shall be placed in uncompacted lifts of eight (8) inches or less and compacted to a density of not less than 95% of maximum dry density as measured by AASHTO Method T-99. The compaction requirement shall be increased to 100% in the uppermost 12 inches of subgrade. These compaction requirements shall apply for that portion of the roadway measured from the back of curb and extending on a slope of 1 to 1 to the no cut/no fill line. Outside these limits soil may be compacted to a density of not less than 90% of maximum dry density as measured by AASHTO T-99.

In cut sections, the uppermost 12 inches of subgrade shall be scarified and recompacted to not less than 100 percent of maximum dry density as measured by AASHTO Method T-99.

Attention is called to Section 3 for the inspection and testing requirements.

e. Compaction Tests:

During roadway construction, the Town Representative shall require the developer or Contractor to provide compaction tests to demonstrate compliance with the compaction requirements outlined herein. Such tests may be required at any time that the Town Representative believes the compaction to be less than the required density.

All compaction testing shall be performed by a certified testing laboratory. The cost of such testing shall be borne by the developer.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

2.06 Safety

The Contractor shall provide for and maintain safety measures necessary for the protection of all persons on the work, to include; and shall fully complying with all laws, regulations and building code requirements to prevent accident or injury to persons on or about the location of the work, including all applicable provisions of OSHA regulations. The Contractor shall protect all trees and shrubs designated to remain in the vicinity of the operations and barricade all walks, roads, and areas to keep the public away from the construction. All trenches, excavations, or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.

The Contractor shall be responsible for the entire site and the necessary protection as required by the Town and by laws or ordinances governing such conditions. He shall be responsible for any damage to Town property, or that of others, by the Contractor, his employees, subcontractors or their employees and shall correct and/or repair such damages to the satisfaction of the Town of Knightdale and/or other affected parties. He shall be responsible for and pay for any such claims against the Town.

2.07 Maintenance of Traffic

Existing public streets or highways shall be kept open to traffic at all times by the Contractor unless permission to close the streets, or portions thereof, is granted by the Town Representative. When allowed to close any street, the Contractor shall contact the Town of Knightdale Public Safety Department a minimum of 24 hours before fully or partially closing any street. Proper and sufficient barricades, lights, signing and other protective devices shall be installed by the Contractor when deemed necessary by the Public Safety Department or the Town Representative. All traffic control measures shall comply with the MUTCD standards and guidelines for Work Zone Traffic Control. Failure to comply will result in issuance of a Stop Work Order.

2.08 Concrete

Concrete shall be only plant-mixed or transit-mixed concrete conforming to ASTM C33 for aggregates and to ASTM C94 for ready-mixed concrete. Any concrete poured that has a slump over four (4) inches as per ASTM C143, or has a batched time of more than 90 minutes, will be considered unacceptable and shall not be incorporated into the work. Concrete shall not be deposited on frozen subgrade. Concrete shall not be poured when the air temperature is falling and below 40° F and the predicted low temperature for the succeeding 24-hour period is less than 32° F. All concrete when placed in the forms shall have a temperature of between 50° and 90° F and shall be maintained at a temperature of not less than 50° F for at least 72 hours for normal concrete and 24 hours for high-early strength concrete or for as much time as is necessary to secure proper rate of curing and designed compressive strength.

Concrete shall be air entrained at five (5) percent, \pm one (1) percent. Retarders and accelerators shall be used only upon approval of the Town Representative.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

2.09 Installation of Utilities Not Furnished by the Town

The Developer shall arrange for the installation of all utilities that are not furnished by the Town or the City of Raleigh. This shall include electric service, telephone service, and, where available, cable television and natural gas. Restoration of Town right-of-way disturbed by installation of these types of utilities shall be the responsibility of the Developer. All utility installations shall be designed and installed in a manner to prevent the open cutting of public paved areas.

2.10 Materials

All materials incorporated in work to be accepted by the Town of Knightdale for operation and maintenance shall be new, first quality material installed in accordance with the manufacturer's instructions or these Specifications, whichever, in the opinion of the Town Representative, is more stringent or applicable.

It is the intent of this Specification to provide materials and construction methods of high standard and quality and to provide materials free from defects in workmanship and product. Substitute materials not specified may be used provided documentation (shop drawings) and samples are furnished to the Town not less than fourteen days before their scheduled delivery to the construction site. A sufficient number of copies shall be submitted such that the Town may retain three copies. The Town will issue written approval, or disapproval, of the alternate materials. The Town shall assume no responsibility for disapproving the substitute material. Current Specifications and/or the latest revisions shall apply in all cases where materials are described by these Specifications.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

SECTION 3 - STREETS

3.01 General

Unless otherwise provided herein, all materials and street construction methods shall conform to the applicable requirements as outlined in the *Standard Specifications for Roads & Structures*, latest edition, as published by NCDOT.

Whenever the following terms are used in NCDOT specifications, the intended meaning of such terms shall be as follows:

"State" or "Commission" shall be replaced by the words "sampling and testing by the Town or its authorized testing agent."

"Inspection by Commission" shall be replaced by "inspection by Town or its duly authorized representative."

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

3.03 Construction Requirements

a. General:

All roadway subgrade, storm sewer and utility construction shall be inspected and approved by the Town Representative prior to placement of the base course materials.

All streets shall be cleared and graded for the full width of the right-of-way.

b. Placement of Aggregate Base Course:

Aggregate base course shall be placed and compacted in strict conformance with the standard requirements of NCDOT. Each layer shall be compacted to a density equal to at least 98 percent of the nuclear target density as determined by AASHTO Method T-180 as modified by NCDOT. Category One and Two streets shall have a thickness of no less than eight (8) inches. Category Three streets shall conform to the standard requirements of NCDOT.

c. Placement of Bituminous Surface Course:

The Superpave bituminous surface course pavements (for Category One streets) shall be in accordance with Type S 9.5A with a total thickness of not less than 2½ inches as shown on the standard details. The bituminous surface course material shall be placed in two lifts, each in strict conformance with the requirements of NCDOT. The second lift shall be 1¼ inch nominal thickness, and shall be delayed during the period of initial residential construction activity to allow the initial course of asphalt and underlying structure to withstand a full season's freeze thaw cycle. (eg. an initial course laid in the Spring/Summer/Fall of a given year will not be allowed to have the final lift placed until the Spring of the subsequent year). The final lift of asphalt shall be placed at the conclusion of the seasonal freeze thaw cycle, typically March of the following year, or as approved by the Town Engineer.

For Category Two streets requiring a combination of Type I 19.0B and Type S 9.5B, the Town will require the asphalt intermediate course (I19.0B) to be installed in a single lift of 2½ inches and the asphalt surface course (S9.5B) in a single lift of 1½ inches. The asphalt surface course shall be delayed during the period of initial residential construction activity to allow the intermediate course of asphalt and underlying structure to withstand a full season's freeze thaw cycle. (eg. an intermediate course laid in the Spring/Summer/Fall of a given year will not be allowed to have the final lift placed until the Spring of the subsequent year). The final lift of asphalt shall be placed at the conclusion of the seasonal freeze thaw cycle, typically March of the following year, or as approved by the Town Engineer. All asphalt shall be installed in strict conformance with the requirements of NCDOT.

For Category Three streets requiring a combination of Type I 19.0B and Type S 9.5B, the Town may require the asphalt intermediate course to be initially sealed with a 1½ inch layer of the asphalt surface course followed by placement of the final asphalt surface course layer at a later date. Asphalt pavement thickness shall conform to the requirements of NCDOT. Geotechnical reports and traffic volumes may be required.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

The contractor shall provide temporary drains through the concrete gutter at all low points to allow the first layer of asphalt to drain and eliminate ponding at the low points. Prior to placing the final layer of surface course, the initial course shall be thoroughly cleaned and repaired. Bituminous tack shall be applied prior to surfacing to assure bond between layers, along gutters and around castings.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

3.04 Inspection

a. Proof-Rolling:

Street embankments and cut areas shall be graded and compacted as described in Section 2 of these Specifications. After all utilities and storm sewers have been installed, the subgrade shall be fine graded and restored to required grade, and then proof-rolled, utilizing a fully loaded tandem axle truck having a gross weight not less than 40,000 pounds and with the tires inflated to not less than 70 psi.

Should any "pumping" or displacement be observed during the proof-rolling, the defective area(s) shall be excavated to a depth no less than 18 inches below subgrade and backfilled with suitable material, thoroughly compacted in not less than eight (8) inch lifts of uncompacted fill. If deemed appropriate by a geotechnical engineer, geotextile fabric may be utilized below the base course material in lieu of additional excavation. The geotextile shall be installed in strict accordance to the manufacturer's recommendations with respect to overlap, depth of cover, etc. Prior to installing geotextile fabric, a copy of the manufacturer's literature shall be submitted to the Town along with the geotechnical engineer's recommendations. The locations of geotextile fabric shall be indicated on the Record Drawings.

Proof-rolling shall be repeated until there is no evidence of "pumping" or displacement.

b. Compaction Testing - Subgrade:

Upon completion of the proof-rolling, the Developer/Contractor shall furnish to the Town Representative a report from a certified soils testing laboratory. The report shall present the results of a Proctor analysis demonstrating that the subgrade compaction is acceptable in accordance with standard requirements of NCDOT. The subgrade shall then be inspected by the Town Representative, and upon its acceptance and approval, the stone base course may be placed. However, no stone base may be placed prior to backfilling behind the curb.

One field density (compaction) test shall be required for each 3,000 SY of street surface and for each lift of fill material placed into the roadway embankment.

The cost of laboratory testing of subgrade compaction shall be borne by the Developer/Contractor.

c. Intermediate Course & Surface Course Inspection Requirements:

Prior to placement of bituminous surface course material, a Proctor analysis shall be furnished on the Aggregate Base Course placed in the roadway. The report shall be prepared by a certified testing laboratory and shall evidence compliance with the compaction requirements. Quarry tickets shall also be presented to the Town Representative to enable a check for yield at the specified final thickness. The base material shall then be inspected by the Town Representative, and upon acceptance and approval, the bituminous surface course may be placed. Bituminous intermediate course material shall be placed and compacted in accordance with NCDOT requirements. Copies of delivery tickets shall be furnished to the Town Representative to enable a check for yield at the specified final thickness.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

The frequency and number of intermediate course field density tests shall be in accordance with requirements of NCDOT or as may otherwise be directed by the Town Representative or the Engineer.

Bituminous surface course material shall be placed and compacted in accordance with NCDOT requirements. Copies of delivery tickets shall be furnished to the Town Representative to enable a check for yield at the specified final thickness.

Should there be a question as to the final thickness of Aggregate Base Course, bituminous intermediate course or bituminous surface course, the Town Representative reserves the right to require the Developer/ Contractor to provide random corings by an independent testing laboratory to demonstrate actual thickness of base, intermediate and surface courses. Core samples shall be taken by a certified testing laboratory, and the results shall be presented to the Town Representative. Should the corings reveal insufficient thickness, the Contractor shall provide additional surface course as may be required or shall furnish other remedial measures as may be acceptable to the Town Representative.

The cost of compaction testing and coring work shall be borne by the Developer.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

3.07 Mailboxes

Mailboxes located within Town right-of-way for the purpose of receiving delivery from the US Postal Service shall conform to the requirements set forth by the US Postal Service. All portions of the mailbox, support, or any appurtenance thereto shall be no less than 12" from the back of curb with a minimum height from pavement to mailbox of 42-inches. The Town shall reserve the right to review mailbox location with respect to site triangle, and require relocation accordingly.

STANDARD SPECIFICATIONS
& CONSTRUCTION DETAILS MANUAL

SECTION 4 - CURB & GUTTER, GREENWAYS, DRIVEWAYS AND SIDEWALKS

4.01 Materials

a. Concrete:

Concrete for curb and gutter, driveways, or sidewalks shall be Portland cement concrete having a 28-day strength of 3000 psi when tested in accordance with ASTM C39. Detailed specifications for concrete shall conform to the specifications contained in Section 2.08 hereof.

b. Bituminous Concrete (Asphalt):

Asphalt for public greenways shall meet the requirements as set forth in Section 610 of NCDOT Specifications for Type S 9.5A.

c. Joint Fillers:

Joint fillers shall be a non-extruding joint material conforming to ASTM D1751.

4.02 Dimensions

The minimum thickness of a sidewalk shall be 4 inches, except at driveway crossings where the sidewalk shall be 6" thick. Sidewalks shall have a uniform slope perpendicular to the curb of ¼ inch per foot toward the curb. The utility strip between the sidewalk and the back of curb shall be less ½ inch per foot toward the roadway. Where street trees are required a subgrade of soil aggregate mixture will be required by the Town.

Curb and gutter shall be standard 30" combination curb and gutter. Rolled or valley type gutter shall not be used. Standard median curb (18-inch) may be used on entrance islands and medians.

4.03 Construction Methods

a. Subgrade:

The subgrade shall be excavated to the required depth to allow placement a minimum of 5" of aggregate base course beneath the curb and shaped to the proper cross-section. Where tree roots are encountered, they shall be removed to a depth of 1 foot for the full width of the excavation. The subgrade shall be stable and thoroughly compacted as specified in paragraph 2.05 and tested in accordance with paragraph 3.04.

For sidewalks a 6" sub base mixture of #57 stone and ASTM c33 sand shall be provided. The mixture shall be 70 percent stone and 30 percent sand. An equal may be considered by the Town Engineer.

b. Forms:

Forms shall be set and maintained true to the required lines, grades, and cross sectional dimensions as shown in the Construction Details and on the Drawings. Forms shall be constructed with material of such strength and with such rigidity to prevent deflection between supports. Straight forms shall be within a tolerance of ½ inch in 10 feet from a true line

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

horizontally or vertically. Forms shall be thoroughly cleaned of all dirt, mortar and foreign material before being used. All inside form surfaces shall be thoroughly coated with commercial quality form oil before placing concrete.

Curbing forms or "stringline" guides shall be carefully placed to assure that the curbing will be constructed to accurate grades and without creating any depressions or "bird baths. Curved sections shall be placed such that the radii are smooth and continuous and without abrupt bends.

c. Expansion, Contraction and Control Joints:

Contraction and control joints shall be cut to a depth equal to at least $\frac{1}{3}$ of the total concrete thickness. Contraction or control joint spacing shall be 10 feet maximum for curbing and driveway aprons. Expansion joints for curbing shall be no more than 50 feet on centers, with the joint material extending the full depth of the concrete with the top of the filler $\frac{1}{2}$ inch below the finished surface. Expansion and contraction joints shall be spaced such that no final curb section shall be less than 5 feet long (including repair sections). Expansion joints for sidewalks shall be spaced no greater than 50 feet apart. Sidewalks shall be finished to grade and cross-section with a float, troweled smooth and finished with a broom. Contraction joints shall be no less than $\frac{1}{8}$ inch in width, to a depth equal to at least $\frac{1}{3}$ of the total slab thickness and cut at intervals equal to the width of sidewalk.

d. Driveway Aprons:

Where driveway aprons are to be installed in an existing curb, the entire curb and gutter section shall be removed. Saw cutting and removing the curbing, leaving the existing gutter in place, shall not be allowed. Contraction, control and expansion joints shall be located as previously specified and shown on the details. The flow line of the gutter shall be maintained across driveway aprons.

4.05 Inspection

No concrete shall be placed until the forms and subgrades have been inspected and authorized by the Town Representative. Offset or reference points shall be maintained in place to assure proper placement of the forms by the Town Representative. Where machine extruded curbing is used, the "stringline" shall be inspected by the Town Representative. A minimum of 24 hours notice shall be given for inspections.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

SECTION 5 - STORM DRAINAGE

5.01 Design

Storm drainage facilities shall be designed in accordance with the goals and guidelines set forth in the *Unified Development Ordinance*. The goal shall be to collect and dispose of stormwater generated upon or passing through the project location. The determination of the quantities of water that must be accommodated will be based upon peak flows from storms having the following return frequency:

<u>Drainage Structure</u>	<u>Storm Event - Return Frequency</u>
Curb inlets & Gutters	10-year storm
Storm Sewer Collector	10-year storm
Detention Facility	100-year Emergency Spillway
Cross Street Drainage	100-year storm
Roadways in Flood Plain	100-year storm*
BMP Devices	UDO & NCDENR Stormwater Best Management Practices

* Roadways in flood plain areas shall withstand the 100-year storm without over-topping or sustaining damage. The roadway embankments shall be fully protected from flows that may occur during a 100-year event.

Prediction of the peak flow rates resulting from a rainfall event shall be calculated using the procedure in the SCS TR-55, the Rational Method, or other calculation procedures acceptable to the Engineer. The size of storm water conduits shall be determined by utilizing the standard energy equation for inlet control or outlet control and/or headwater nomographs as published by various federal agencies such as Federal Highway Administration - HEC-5, HEC-RAS, Soil Conservation Service, etc. Calculations shall include analyses of pre- and post-development runoff rates from the project for the 1-year storm event. All calculations shall be performed under the responsible charge of an appropriately licensed design professional and sealed by that professional. Storm drainage facilities shall be designed in a manner such that upstream and downstream properties are not adversely affected.

The minimum pipe size to be used within any public right-of-way shall be 15-inch diameter. All public storm drainage facilities shall be installed in dedicated street rights-of-way (i.e. pipe inlets and outlets shall be within street rights-of-way or dedicated easement). If a property owner/developer desires to extend storm drainage piping to eliminate open channels on private property, such pipes shall be installed within a stormwater easement and maintained at the adjacent property owner's or owners' expense. A manhole or junction box shall be provided at the public right-of-way boundary. Minimum widths of storm drainage easements shall be the

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

greater of 1) the width as dictated by the appropriate following configurations listed below; or 2) the width necessary to contain the predicted 100-year water elevation plus two feet in depth:

- 20 feet for single pipes up to and including 36 inches nominal diameter or open channels up to 36 inches in top width
- 20 feet plus the maximum conduit (outside diameter at the barrel) or channel width (in feet) for single pipes or channels larger than 36 inches wide
- 10 feet from the edge line of the outside conduits where multiple, parallel pipes are installed.

Erosion and sedimentation control measures shall be so designed to provide control from the calculated peak rates from a 10-year frequency storm. Discharge from drainage systems shall not be of such a velocity as to cause damages after leaving the pipe. At pipe outlets, flared end sections or head walls shall be provided with rip-rap aprons designed to reduce velocity and dissipate energy so that downstream damage does not occur.

Catch basins, yard inlets, manholes or structures shall be installed at each deflection of line or grade. No "blind" junction boxes shall be permitted. The minimum cover for reinforced concrete pipe shall be 2 feet from finish subgrade to the top of pipe under roadways and 1 foot under a non-roadway area. For polyethylene storm drainage pipe, the minimum cover shall be two times the nominal pipe diameter.

Stormwater shall not be allowed to flow across streets. Drainage shall be provided to intercept flow in the radius of an intersection, or the design of the street shall indicate a continuous grade around the radius to allow the flow to continue down the intersecting street. Water shall be picked up before the spread into the street exceeds 8 feet from the face of the curb. The inlets shall be spaced using a maximum capacity of 5 CFS per single curb inlet. No curb inlet shall be installed in the curb radius of any intersection.

Detention ponds and other BMP devices shall reference and adhere to standards set forth by NCDENR in *Stormwater Best Management Practices*. Additional requirements by the Town include a maximum of 3:1 slopes on all sides of ponds, unless exempted by the Town Engineer.

5.02 Pipe Materials

a. General:

All storm sewer pipes to be installed in projects within the public street rights of way belonging (or to be dedicated) to the Town of Knightdale shall be reinforced concrete pipe (RCP) or high density polypropylene (HDPP) conforming to the specifications presented herein.

If an applicant desires to use any materials other than RCP or HDPP, the applicant's plan submittal must contain a formal request and be accompanied by complete background data to justify its use. Approval to use any materials other than RCP or HDPP may only be granted by the Town Manager upon the recommendation of the Town Representative and Town Engineer.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

a. Reinforced Concrete Pipe (RCP):

RCP shall be as per ASTM C76, Table III or TABLE IV with a minimum 15-inch diameter. All RCP shall be top quality material; no seconds or lesser quality pipe shall be used. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210 such as "Ram-Nek or a butyl rubber sealant."

b. High Density Polypropylene (HDPP) Storm Drainage Pipe:

HDPP storm drainage pipe shall conform to AASHTO M330 Type S or Type D. The pipe shall be smooth interior finish and be furnished in 20' laying lengths with an integral bell for gasket, bell and spigot joints. The pipe shall be a double wall type, having a corrugated outer surface and a smooth inner surface, with Manning's roughness not to exceed 0.010. End treatments and fittings shall meet the requirements of ASSHTO M330-20.

5.03 Materials - Storm Drainage Structures

a. General:

All structures including manholes, curb inlets, catch basins, yard inlets, junction boxes, etc., shall be constructed of clay brick masonry units, concrete brick masonry units, or precast concrete (waffle boxes are not acceptable). Endwalls and headwalls shall be constructed of clay brick masonry units, concrete brick masonry units, precast or structural cast-in-place concrete.

b. Clay Brick Masonry Units:

Clay brick shall be solid, rough, sound clay brick conforming to ASTM C32, Grade MS.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

c. Concrete Brick Masonry Units:

Concrete brick masonry units shall be solid units meeting the requirements of ASTM C55, Grade S-II.

d. Precast Concrete Structures:

Precast concrete structures shall meet the requirements of ASTM C478. Structures shall have joints sealed with a pre-formed plastic gasket per Federal Specifications SS-S-00210. Manholes shall be sized in accordance with the table below.

MANHOLE SIZE REQUIREMENTS		
DEPTH RANGE	OUTLET PIPE SIZE	
0' – 12'	6'	7'
12' – 18'	6'	7'
> 18'	7'	8'

e. Mortar:

Mortar shall be proportioned as shown below for either Mix No. 1 or Mix No. 2. All proportions are by volume. Water shall be added only in the amount required to make a workable mixture.

MIX NO. 1: 1 part Portland Cement
 $\frac{1}{4}$ part Hydrated Lime
 $3\frac{3}{4}$ parts Mortar Sand (maximum)

MIX NO. 2: 1 part Portland Cement
 1 part Masonry Cement
 6 parts Mortar Sand (maximum)

Portland cement shall be ASTM C150, Type 1. Hydrated lime shall conform to ASTM C207, Type S. Masonry cement shall meet the requirements of ASTM C91. Mortar sand shall be standard size 4S, per requirements of the NC DOT.

f. Castings:

- (1) General - All castings shall be of one of the manufacturers specified. If the Developer/ Contractor desires to use a casting of another manufacturer, samples of the casting(s) shall be provided to the Town Representative for review and approval. In addition to samples, the names of other users of the castings shall be furnished along with names and telephone numbers of persons whom the Town Representative may contact for an evaluation of the casting.

All castings shall meet the requirements of ASTM A48, Grade 30 iron.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

- (2) Curb Inlet Grate, Frame & Hood - Curb inlets shall be of the grate, frame and hood type conforming to NCDOT 840.03, Type E, F and G, based on flow direction. Castings shall be Type V-4066 (2-5) as manufactured by Vulcan Foundry Company, Southern Foundry SF-102 + SF-103 (C,E,F, or G) or US Foundry #5181. Grates with slots parallel to the curb are not permitted.
- (3) Grates & Frames - Cast iron grates and frames for yard inlets shall conform to NCDOT 840.16 and be of the size indicated on the approved plans. Grates and frames shall be Vulcan V-4870, Southern Foundry SF-131, US Foundry 4130+6230; or their equivalent with comparable features for other larger size openings as may be required.

Grates and frames shall only be used outside of street rights-of-way.

- (4) Manhole Rings & Cover - Cast iron manhole rings and covers shall conform to NCDOT 840.54, with the words "STORM SEWER" cast on the cover. Covers shall have four 1-inch holes. Manhole castings shall be machined to provide a continuous bearing around the full periphery of the frame. Covers shall be Vulcan V-1384, Southern Foundry SF-101 or US Foundry 669-KL.

g. Portland Cement Concrete:

Portland cement concrete used for storm drainage structures, endwalls, etc. shall conform to the technical requirements presented in paragraph 2.08 of these Specifications, and shall have a minimum compressive strength of 3,000 psi at 28 days. Primary structures, such as box culverts, may require concrete having a compressive strength greater than 3,000 psi and may require the submission of mix designs and testing of the concrete by an independent laboratory. These special requirements may be imposed by the Town Representative for all such structures where recommended by the Engineer.

h. Reinforcing Steel:

Reinforcing steel shall be new billet steel conforming to ASTM A615, Grade 60, deformed.

5.04 Miscellaneous Materials

a. Riprap:

Riprap shall be large aggregate of the size and class shown on the approved drawings.

b. Steps:

Steps shall be constructed using ½ inch diameter reinforcing steel encapsulated in polypropylene material. Steps shall be designed and installed to accommodate a vertical load of not less than 400 pounds and a horizontal pullout load of at least 1,000 pounds. Steps shall have a clear width of 12 inches.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

5.05 Construction Methods

a. Trenching & Bedding for Storm Sewers:

The trench shall be excavated to the line and grade indicated on the Drawings. The trench bottom shall provide a firm and uniform support for the pipe. Where bell and spigot type pipe is used, recesses shall be excavated to receive the pipe bell.

Where the foundation is found to be of poor supporting value, the pipe foundation shall be conditioned by undercutting the unacceptable material to the required depth as directed by the Town Representative and backfilling with stone or other approved material. Where necessary, surface water shall be temporarily diverted in order to maintain the pipe foundation in a dry condition. The flow of water from such temporary diversions shall be directed into suitable erosion control devices.

b. Pipe Laying:

Concrete pipe culverts shall be laid carefully with bells or grooves upgrade and ends fully and closely joined. Joints of concrete pipe shall be made with O-ring gasket or with plastic gasket material as specified. Joints shall be made in accordance with manufacturer's recommendations. Pipe which is not true to alignment, or which shows any settlement after laying, shall be taken up and relaid.

Corrugated steel pipe and pipe arch shall be laid similar to reinforced concrete pipe. Joints shall be of steel bands supplied by pipe manufacturer and installed according to manufacturer's instructions.

c. Backfilling:

The storm sewer trench shall be backfilled with approved material free from large stones or clods in 6-inch layers, loose measurement, and compacted to 95% of maximum dry density (AASHTO T-99), where the trench is within an area to be paved, or where the trench is immediately behind the curb. In streets the compaction requirement shall be increased to 100% of maximum dry density within 12" of subgrade. The backfilling shall be done on both sides of the pipe simultaneously to prevent displacement of the pipe. The backfill materials shall be moistened when necessary in the opinion of the Engineer to obtain maximum compaction. Water settling or puddling shall not be permitted. Backfill in trenches not within the limits to be paved may be compacted in 12-inch layers after backfill is one foot above the top of the pipe.

All trash, forms, debris, etc., shall be cleared from around all pipes and structures before backfilling. Backfilling around structures shall be done symmetrically and thoroughly compacted in 6-inch layers with mechanical tampers to the specified 95% density.

STANDARD SPECIFICATIONS & CONSTRUCTION DETAILS MANUAL

d. Masonry Structures:

Excavations shall be made to the required depth, and the foundation on which the brick masonry is to be laid shall be approved by the Town Representative. The brick shall be laid so that they will be thoroughly bonded into the mortar by means of the "shove-joint" method. Buttered or plastered joints will not be permitted. The headers and stretchers shall be so arranged as to thoroughly bond the mass. Brickwork shall be of alternate headers and stretchers with consecutive courses breaking joint. All mortar joints shall be at least 3/8 inches in thickness. The joints shall be completely filled with mortar. No spalls or bats shall be used except for shaping around irregular openings or when unavoidable to finish out a course. Competent masons shall be employed on the work, and all details of construction shall be in accordance with approved practice and to the satisfaction of the Town Representative.

Steps as shown on the plans shall be placed in all catch basins and inlets when they are greater than five feet in depth. The steps shall be set in the masonry as the work is built up, thoroughly bonded, and accurately spaced and aligned. Steps shall be set at 16 inches on center and project at least 5 inches from the face of the wall.

Inverts in the structures shall be shaped to form a smooth and regular surface free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation.

The castings shall be set in full mortar beds. All castings when set shall conform to the finish grade shown on the Drawings.

e. Concrete Construction:

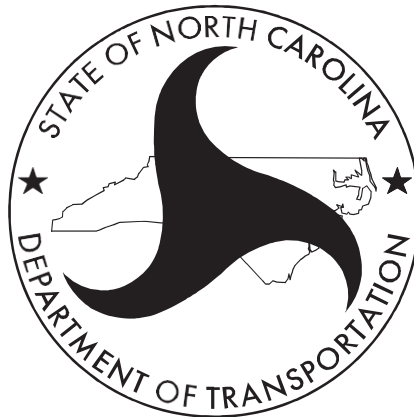
The forming, placing, finishing and curing of Portland cement concrete shall be performed in strict accordance with all applicable requirements as contained in the *Standard Specifications for Road & Structures*, latest edition, as published by the NC DOT.

f. Installation of Precast Concrete Structures:

Precast concrete catch basins, manholes, junction boxes, etc. shall be installed level and plumb and upon a firm, dry foundation, approved by the Town Representative. Structures shall be backfilled with suitable materials, symmetrically placed and thoroughly compacted so as to prevent displacement and deter settlement. Castings shall be set in full mortar beds to the required finished grade.

**NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH**

**STANDARD SPECIFICATIONS
FOR
ROADS AND STRUCTURES**



JANUARY 2024

FOREWORD

This publication has been prepared to provide a compilation of standard requirements used by the North Carolina Department of Transportation for construction contracts.

When this publication, entitled *Standard Specifications for Roads and Structures*, dated January 2024, is incorporated by reference into the Department's construction bid proposals or contracts; it is made a part of that document and shall be known as the *Standard Specifications*. The requirements stated herein may be revised or amended from time to time by supplemental specifications, by standard special provisions which are unique to a select group of projects or by project special provisions which are unique to the specific bid proposal or contract.

Working titles have a masculine gender, such as workman, workmen and foreman. Pronouns such as he, his, and him are used in the *Standard Specifications* for the sake of brevity and are intended to refer to persons of either sex or corporate entities.

Reference by title and date will be made to the governing provisions in the contract.

GENERAL INFORMATION

For general questions about this publication, please contact the Contract Standards and Development Unit at specs@ncdot.gov or (919) 707-6900.

ORDERING INFORMATION

Copies of the *Standard Specifications* and the *Roadway Standard Drawings* may be purchased through the Contract Standards and Development Unit:

North Carolina Department of Transportation
Contract Standards and Development Unit – Manual Distribution
1591 Mail Service Center
Raleigh, NC 27699-1591
Telephone: (919) 707-6944
Website: <http://www.ncdot.gov/>

The order form is available at <https://connect.ncdot.gov/letting/Pages/Order-Publications.aspx>.

Electronic copies of the *Standard Specifications* and the *Roadway Standard Drawings* are available for download on the Contract Standards and Development Unit's website at <https://connect.ncdot.gov/resources/Specifications/Pages/default.aspx>.

TABLE OF CONTENTS

Foreword.....ii

Table of Contents.....iii

DIVISION 2 – EARTHWORK

200 Clearing and Grubbing2-1

226 Comprehensive Grading.....2-17

230 Borrow Excavation.....2-18

250 Removal of Existing Pavement2-27

260 Proof Rolling.....2-29

270 Geotextile for Soil Stabilization2-31

DIVISION 3 – PIPE CULVERTS

300 Pipe Installation.....3-1

305 Drainage Pipe.....3-5

310 Pipe Culverts3-6

340 Pipe Removal3-8

DIVISION 4 – MAJOR STRUCTURES

DIVISION 5 – SUBGRADE, BASES AND SHOULDERS

500	Fine Grading Subgrade, Shoulders and Ditches	5-1
520	Aggregate Base Course	5-10
535	Conditioning Existing Base	5-13
543	Asphalt Curing Seal.....	5-24
545	Incidental Stone Base	5-25

DIVISION 6 – ASPHALT PAVEMENTS

607	Milling Asphalt Pavement.....	6-4
609	Quality Management System for Asphalt Pavements	6-7
610	Asphalt Concrete Plant Mix Pavements	6-15
620	Asphalt Binder for Plant Mix	6-32
654	Asphalt Plant Mix, Pavement Repair.....	6-39

DIVISION 7 – CONCRETE PAVEMENTS AND SHOULDERS

700	General Requirements for Portland Cement Concrete Pavement.....	7-1
710	Concrete Pavement.....	7-11

DIVISION 8 – INCIDENTALS

800	Mobilization	8-1
801	Construction Stakes, Lines and Grades	8-2
802	Disposal of Waste and Debris	8-7
806	Right-of-Way and Control-of-Access Markers	8-10
828	Temporary Steel Cover for Masonry Drainage Structures	8-19
830	Brick Masonry Construction	8-19
832	Reinforced Brick Masonry Construction	8-20
834	Block Masonry Construction.....	8-21
838	Endwalls	8-22
840	Minor Drainage Structures	8-23
846	Concrete Curb, Curb and Gutter, Concrete Gutter, Shoulder Berm Gutter, Concrete Expressway Gutter and Concrete Valley Gutter	8-27
848	Concrete Sidewalks, Driveways and Curb Ramps	8-29
876	Rip Rap.....	8-51

DIVISION 9 – SIGNING

DIVISION 10 – MATERIALS

1000	Portland Cement Concrete Production and Delivery.....	10-1
1003	Grout Production and Delivery	10-22
1005	General Requirements for Aggregate	10-26
1006	Aggregate Quality Control / Quality Assurance.....	10-30
1012	Aggregate for Asphalt Pavements and Surface Treatments	10-31
1014	Aggregate for Portland Cement Concrete	10-38

1016	Select Materials	10-41
1018	Borrow Material	10-43
1020	Asphalt Materials and Additives	10-44
1024	Materials for Portland Cement Concrete	10-49
1026	Concrete Curing Materials	10-52
1028	Joint Materials	10-53
1030	RFID Tracking Program for Manufactured Products	10-55
1032	Culvert Pipe.....	10-59
1040	Masonry.....	10-68
1042	Rip Rap Materials.....	10-70
1060	Landscape Development Materials.....	10-84
1070	Reinforcing Steel.....	10-90
1074	Miscellaneous Metals and Hardware.....	10-121
1077	Precast Concrete Units	10-125
1089	Traffic Control.....	10-194

DIVISION 11 – WORK ZONE TRAFFIC CONTROL

1101	Work Zone Traffic Control General Requirements.....	11-1
1105	Temporary Traffic Control Devices	11-5
1110	Work Zone Signs.....	11-6
1135	Cones.....	11-11

11000 - 11000

DIVISION 12 – PAVEMENT MARKINGS, MARKERS AND DELINEATION

DIVISION 14 – LIGHTING

DIVISION 15 – UTILITY CONSTRUCTION

DIVISION 16 – EROSION CONTROL AND ROADSIDE DEVELOPMENT

1605 Temporary Silt Fence 16-1

1610 Stone for Erosion Control..... 16-4

1615 Temporary Mulching..... 16-5

1620 Temporary Seeding 16-6

1632 Rock Inlet Sediment Trap..... 16-12

1635 Rock Pipe Inlet Sediment Trap 16-15

1651 Selective Vegetation Removal.....16-29

1660 Seeding and Mulching.....16-31

1670 Planting.....16-41

DIVISION 17 – SIGNALS AND INTELLIGENT TRANSPORTATION SYSTEMS

DIVISION 2 EARTHWORK

SECTION 200 CLEARING AND GRUBBING

200-1 DESCRIPTION

Perform the work of clearing and grubbing in all wooded areas between the construction limits. Perform the work of clearing and grubbing in all non-wooded areas between the construction limits and the limits of the project right of way or in easements shown on the project plans where seeding and mulching, sprigging, sodding or other work as indicated.

“Clearing” is defined as the cutting, removal and satisfactory disposal of all wooded vegetation and debris.

“Grubbing” is defined as the complete removal and satisfactory disposal of all grassy vegetative matter, root mat, ball and root, topsoil material high in organic content and surface debris.

200-2 MATERIALS

Refer to Division 10.

200-3 CONSTRUCTION METHODS

Perform the following as part of the work of clearing and grubbing:

(A) Remove and dispose of crops, weeds and other annual growth;

(B) Remove and dispose of surface debris such as fences, steps, walls, chimneys, column footings, other footings, foundation slabs, basements, other foundation components, signs, junked vehicles and other rubble and debris;

(C) Fill holes and depressions that exist or are created;

(D) Cut off and plug at the right-of-way or construction limits any private water or sewer line intercepted during the construction of the project;

(E) Cut off and remove from the right-of-way or construction area any septic tank or portion thereof encountered within the right-of-way or construction area during the construction of the project; and

(F) Remove materials in wetland areas to a depth of one foot below existing ground to be measured in accordance with Section 225.

Perform clearing and grubbing operations sufficiently before grading operations to prevent any debris from interfering with the excavation or embankment operations.

In environmentally sensitive areas shown on the original plans or permit drawings, perform grubbing operations no more than 7 calendar days before beginning continuous grading operations.

Perform all work under this section to minimize soil erosion and in accordance with Article 107-12. Coordinate the work with other operations such that no more than 17 acres of exposed, erodible surface area will be accumulated at any one time by the clearing and grubbing operation until erosion control measures are provided. Install temporary or permanent erosion control measures as soon as clearing and grubbing or land disturbing activities begin. Perform such erosion control work, temporary or permanent, as needed to minimize erosion resulting from clearing and grubbing operations.

Section 200

The Contractor may request an increase in the accumulated acres exposed by clearing and grubbing. If approved, establish and maintain such erosion control measures as needed.

Failure on the part of the Contractor to perform the required erosion control measures will be just cause for the Engineer to direct the suspension of clearing and grubbing operations in accordance with Article 108-7. The suspension will be in effect until such time as the Contractor has satisfactorily performed the required erosion control work. If the Contractor fails to perform the directed work within a reasonable length of time, the Engineer may have the work performed in accordance with Article 105-16.

200-4 CLEARING

Perform clearing within the limits established by the clearing method required by the plans and as directed by the Engineer.

The Engineer will designate all areas of growth or individual trees that shall be preserved due to their desirability for landscape or erosion control purposes. When the trees to be preserved are located within the construction limits, they will be shown in the plans or designated by the Engineer.

Trim or cut branches of trees that overhang the roadbed, utility easements or obstruct sight distances and that are less than 16 feet above the elevation of the finished grade so as to not endanger the health of the tree.

In embankment areas where the depth of the embankment measured under the roadbed exceeds 6 feet in height, cut sound trees at a height of not more than 6 inches above natural ground. When trees are to be cut outside the construction limits and the Engineer has designated that the area is not to be grubbed, cut the trees reasonably close to the natural ground surface. Cut trees to approximately 6 inches above low water level in swamp areas.

At a bridge site, clear the entire width of the right of way beginning at a station 3 feet back of the beginning extremity of the structure and ending at a station 3 feet beyond the ending extremity of the structure.

Prevent limb, bark or root injuries to trees, shrubs or other types of vegetation that are to remain growing and prevent damage to adjacent property. Repair scarred areas in accordance with generally accepted horticultural practice. Where plants are damaged by any construction operations to such an extent as to destroy their value for shade or other landscape purposes, cut and dispose of them.

200-5 GRUBBING

Perform grubbing on all areas cleared, with the following exceptions:

(A) In embankment areas, when the depth of embankment measured under the roadbed exceeds 6 feet in height, cut off sound stumps not more than 6 inches above the existing ground level and do not grub. Remove unsound or decayed stumps to a depth of approximately 2 feet below the natural ground surface.

(B) When authorized, leave stumps outside of construction limits in place. Cut such stumps off reasonably close to the natural ground surface.

(C) Cut off stumps in swamp areas to approximately 6 inches above low water level and do not grub.

(D) Do not grub in areas where waste or unsuitable material is to be deposited unless such areas are to become a part of a future roadway.

(E) Grub all areas where piles are to be driven regardless of fill height.

(F) Fill all holes and other depressions within the areas between the construction limits and the limits of clearing and grubbing. Bring all areas to a uniform contour where later mowing operations will take place.

Section 200

200-6 DISPOSITION OF TIMBER, STUMPS AND DEBRIS

The property owner will have no right to use or reserve for their use any timber on the project. All timber cut during the clearing operations shall become the property of the Contractor and shall be removed from the project or shall be satisfactorily disposed of as provided hereinafter.

Do not cut any trees and vegetation beyond the clearing limits established. Do not cut any trees and vegetation that is to be preserved for landscape or erosion control purposes as shown in the plans and permit drawings.

Remove from the project and properly dispose of all vegetation, roots, stumps, tree laps, limbs and timber remaining on the project by a satisfactory method.

When vegetation is disposed of by burning, burn so as to prevent injury to property within or outside of the right of way. Comply with all Federal, State and local laws, ordinances and regulations when burning. Secure all necessary burning permits. Perform all burning under the constant care of a competent watchman. Do not allow smoldering or dense smoke to occur during burning.

Before trees or vegetation are disposed of in locations off the right of way and out of sight of the project, furnish the Engineer with verification that the site is permitted. If required, file an approved reclamation plan and furnish a written release from the property owner, or his authorized agent, granting the servitude of his lands.

If it is not burned, dispose of all debris including vegetation in accordance with Section 802.

200-7 SELECT TREE REMOVAL

When the contract includes the item of *Select Tree Removal* and the work of clearing and grubbing has been completed to the original clearing limits, the Engineer may elect to have select trees removed from the project. Trees removed in this manner shall have an average cross section diameter of at least 4 inches at a point 2 feet above the ground level.

Completely remove the select trees including the root ball and properly backfill unless otherwise directed by the Engineer.

200-8 MEASUREMENT AND PAYMENT

Clearing and Grubbing will be paid on a lump-sum basis and no measurement will be made of any clearing and grubbing performed within the limits originally staked and within the right of way or easements shown on the original plans.

Supplementary Clearing and Grubbing that is directed by the Engineer and is performed on areas outside the limits originally staked or beyond the limits of the right of way or easements or within environmentally sensitive areas shown on the original plans will be measured and paid at the contract unit price per acre. All measurement of clearing and grubbing will be made horizontally.

Once the root mat is removed, material that consists predominately of soils will be measured and paid in accordance with Section 225.

Materials used to fill depressions in accordance with Subarticle 200-5(F) will be measured and paid in accordance with Sections 225 or 230, depending on the source of the material.

When the Contractor is required to furnish borrow sources, material sources or waste areas, or when the Engineer permits the Contractor to obtain borrow or deposit waste on any area within the right of way instead of borrow and waste areas which were to have been furnished by the Contractor, no measurement of clearing and grubbing will be made for such areas.

When an increase in accumulated acres exposed by clearing and grubbing is requested by the Contractor and approved by the Engineer, no payment will be made for the temporary seeding and mulching required by the increase in accumulated exposed acres.

Section 205

- 1 *Select Tree Removal* will be measured and paid as the actual number of select trees removed
- 2 from the project.
- 3 Work performed in cleaning up non-wooded areas between the construction limits and the
- 4 limits of the project right of way or easements shown in the plans; work performed in the
- 5 dressing up of areas between the construction limits and the clearing limits; and the removal
- 6 of weeds, vines, plant stalks, loose rock and small scattered trees will be incidental to the
- 7 work of clearing and grubbing.
- 8 Where plants are damaged by construction operations, the work to cut and dispose of them
- 9 will be incidental to the work of clearing and grubbing.
- 10 Payment will be made under:

Pay Item	Pay Unit
Clearing and Grubbing	Lump Sum
Supplementary Clearing and Grubbing	Acre
Select Tree Removal	Each

SECTION 226
COMPREHENSIVE GRADING

226-1 DESCRIPTION

The work covered by this section consists of all elements of work covered by Sections 200, 225, 230, 235, 250, 500 and 560, except that the requirements of the above-referenced sections pertaining to measurement and payment will not apply unless specific reference is made to such.

226-2 CONSTRUCTION METHODS

Perform the work in accordance with Sections 200, 225, 230, 235, 250, 500 and 560.

226-3 MEASUREMENT AND PAYMENT

Seeding and mulching of all borrow sources will be measured and paid at the contract unit prices for such items established in the contract.

Payment for material that the Engineer directs the Contractor to obtain from borrow sources to backfill box culverts, pipe culverts, drainage structures or structure bents will be made in accordance with Article 104-7, unless there is a line item for *Borrow Excavation*.

Payment for material that the Engineer directs to be removed beyond the limits of the original slope stakes will be made in accordance with Article 104-3.

Grading will be paid at the contract lump sum price. Partial payments will be equal to the percentage of such item that is complete as estimated by the Engineer. No separate payment will be made for clearing and grubbing, shoulder and fill slope material or draining borrow sources as such work will be incidental to the work covered by this section.

Section 230

Clearing and grubbing work that is directed to be performed on areas outside the limits originally staked or beyond the limits of the right of way or easements shown on the original plans will be measured and paid at the contract unit price per acre for *Supplementary Clearing and Grubbing*. All measurements will be made horizontally. Where the contract does not include this item, a unit price per acre will be established by supplemental agreement.

Undercut Excavation will be measured and paid at the contract unit price per cubic yard. No separate payment will be made for materials used in backfilling the undercut areas, shoulders and slope areas as payment at the contract unit price per cubic yard for *Undercut Excavation* will be full compensation for furnishing such material. Where the contract does not include a pay item for *Undercut Excavation*, payment for such excavation will be made in accordance with Article 104-7.

Payment will be made under:

Pay Item	Pay Unit
Grading	Lump Sum
Supplementary Clearing and Grubbing	Acre
Undercut Excavation	Cubic Yard

SECTION 230 BORROW EXCAVATION

230-1 DESCRIPTION

Excavate approved material from borrow sources. Haul and use such material as required in the plans or as directed by the Engineer. Do not use borrow excavation until all available suitable unclassified excavation has been incorporated into the embankments, subgrades and shoulders except by execution of a supplemental agreement documenting the conditions prescribed below.

(A) All suitable unclassified excavation wasted as a result of the early use of borrow material will be deducted from the total volume of borrow excavation paid under the contract.

(B) Reimburse the Department for all additional costs, including additional engineering cost, associated with the wasting of suitable unclassified excavation.

(C) Any claim for contract time extensions related to the early use of borrow is waived should the Contractor use borrow material before all suitable unclassified excavation being incorporated into the project pursuant to a supplemental agreement.

(D) The Contractor specifically waives rights to request additional compensation with regard to the early use of borrow under the compensation requirements of Section 104 except when unclassified excavation is a major contract item and that unclassified excavation overruns by more than 25%.

Where the work required to complete the project is so phased by the plans to preclude using suitable unclassified excavation, the Contractor will be permitted to construct the required embankments, subgrades or shoulders so controlled by the phasing from approved borrow materials without having to execute the above required supplemental agreement.

230-2 COORDINATION WITH SEEDING OPERATIONS

Coordinate the work in this section with the construction of embankments in accordance with Article 225-2.

230-3 MATERIALS

Refer to Division 10.

Section 230

Item	Section
Borrow Material	1018
Shoulder and Slope Material	1019

230-4 CONSTRUCTION METHODS

(A) General

Thoroughly clear and grub and clean the surface of the borrow area of all unsuitable material before beginning the excavation and, where applicable, before cross sections are taken. Dispose of material resulting from clearing and grubbing in accordance with Article 200-6. Remove and dispose of overburden in accordance with Section 802.

Do not accumulate exposed, erodible slope area in each borrow operation in excess of 1 acre at any one time without beginning permanent seeding and mulching of the borrow source or installing other approved erosion control measures.

Remove and stockpile topsoil at locations that will not interfere with the borrow operations and that meet the approval of the Engineer. Install temporary erosion control measures as needed to prevent the erosion of the stockpile material. Once all borrow has been removed from the source or portion thereof, uniformly spread the stockpiled topsoil over the area and permanently seed and mulch the area.

Where payment is made by cross section, notify the Engineer sufficiently before beginning excavation of the borrow material so that the area may be staked and cross sectioned. Excavate the material to the lines and slopes as staked in an orderly manner to facilitate measurement at any time.

Where payment is to be made by truck measurement, furnish trucks with bodies suitable for accurate measurement. Load trucks uniformly and load to prevent spillage.

When necessary to haul borrow material over existing roads or streets, comply with Article 105-15. Use all necessary precautions to prevent damage to the existing structures or pavement. Conduct hauling operations so as to not interfere with the normal flow of traffic and keep the traffic lanes free from spillage at all times.

Furnish borrow sources except where otherwise indicated in the contract.

(B) Contractor Furnished Sources

Before the approval of any borrow sources developed for use on any project, obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the removal of the borrow material from the borrow sources will have no effect on any known district, site building, structure or object, architectural and/or archaeological that is included or eligible for inclusion in the National Register of Historic Places. Furnish a copy of this certification to the Engineer before performing any work on the proposed borrow source.

Borrow sources will not be allowed in any area under the USACE regulatory jurisdiction until the Contractor has obtained a permit for such borrow sources from the USACE District Engineer having jurisdiction and has furnished a copy of this permit to the Engineer. Requests for additional contract time, additional compensation or for work stoppage due to permit violations will not be considered.

The approval of borrow sources furnished by the Contractor is subject to the following conditions:

(1) Proof of Rights

Provide written proof of the right to take the material and any rights of access that may be necessary for locating and developing the source and any clearing and grubbing and drainage ditches necessary. The proof shall include an agreement with

Section 230

the owner that the borrow source be dressed, shaped, seeded, mulched and drained as required by these specifications after all borrow has been removed.

(2) Sampling and Testing

Sampling and testing of contractor furnished borrow material will be in accordance with procedures set forth in the *Borrow Pit Sampling Manual*, as found on the Department's website, in effect on the date of advertisement for the project. The criteria for acceptance of the proposed contractor furnished borrow material is shown in Section 1018.

(3) Reclamation Plan

Except where borrow is to be obtained from a commercial source, jointly submit with the property owner a borrow source development, use and reclamation plan to the Engineer for his approval before engaging in any land disturbing activity on the proposed source other than material sampling that may be necessary. The Department's *Borrow, Waste and Staging Site Reclamation Procedures for Contract Projects* is available on the Department's website and shall be used for all borrow and waste sites on this project. Person preparing this reclamation plan must be Level III ESC/Stormwater Certified. Address the following in the plan:

(a) Topography

Detail the existing topography and locations of the proposed access and egress haul roads. Detail the proposed final topography of the waste or disposal area showing any proposed drainage systems. Excavate the source according to the plan and dress and shape it in a continuous manner to contours that are comparable to and blend in with the adjacent topography. Grade the source to drain such that no water will collect or stand. Provide a functioning drainage system for the source. If drainage is not practical and the source is to serve as a pond, the minimum depth shall be at least 4 feet as determined from the water table at the time the reclamation plan is executed. The slope of the soil below the water shall be between 5:1 and 2:1. The slope of the sides above the water line shall be 2:1 or flatter.

(b) Erosion Control

Detail the temporary and permanent erosion control measures, along with design calculations, that are intended during use of the site and as part of the reclamation. Unless considered impractical due to special circumstances, provide in the plan for the use of staged permanent seeding and mulching and appropriate fertilizer topdressing continually during site use and the immediate total reclamation of the site when the site is no longer needed. Define the seed mixture proposed for establishing temporary and permanent vegetation. Establish permanent stand of vegetation before acceptance of the project.

(c) Buffer Zones

Allocate sufficient area between the nearest property line and the tie-in of the slope to natural ground to allow for the operation of excavation, hauling and seeding equipment and for the installation of any and all erosion control devices required. Leave additional undisturbed area between the source and any water course or body to prevent siltation of the water course or body and the movement of the shore line either into the water course or body or into the waste areas. Determine if the adjoining property owners or other government agencies require any additional buffer zones and comply with those requirements. Suggested minimum distances are 10 feet from property lines and 50 feet from water bodies or water courses. Where it is necessary to drain the borrow source, perform work in accordance with Section 240.

Section 230

(d) Evaluation for Potential Wetlands and Endangered Species

Hire a prequalified environmental consultant to perform an assessment of the borrow site for potential conflicts with wetlands, Areas of Environmental Concern designated by the Coastal Area Management Act and federally protected species. This evaluation will not be required for permitted commercial sites.

Delineate the boundaries of any wetlands, jurisdictional surface waters and streams encountered. Follow the standard practice for documenting the wetland delineation including completion of the USACE's approved *Jurisdictional Determination Form*. Document information including data regarding soil, vegetation and hydrology. Maintain a minimum 25 foot buffer adjacent to all sides of the wetland boundary and a minimum 50 foot buffer adjacent to any stream. Depict the limits of the delineated wetland and surrounding buffer on the Reclamation Plan. Do not remove borrow material in any area under the USACE' or any other environmental agencies' regulatory jurisdiction unless and until the Department permit has been modified to allow such disposal activity in the jurisdictional area.

Perform a site assessment for federally listed threatened or endangered species to include habitats that may support these species. Provide a detailed technical report on the assessment findings. If federally listed threatened or endangered species or habitat that may support such species exist on the proposed borrow site, notify the Engineer before continued pursuit of such site.

(4) Approval

Obtain written approval from the Engineer before excavating any material within the proposed borrow source area.

Submit a revised or additional reclamation plan if the non-permitted waste or disposal area is expanded by more than one acre or is significantly changed from the previously approved submittal.

If the Contractor proposes a borrow source, the environmental assessment shall include wetland and stream delineation extending 400 feet beyond the proposed borrow source limits.

(a) If wetlands or streams are present within 400 feet of the borrow source, submit a hydrologic analysis (Skaggs Method) or equivalent to determine if lateral effects will permanently impact or cause degradation to wetlands or streams. Perform analysis with an environmental or hydraulics engineer with expertise in this discipline and include:

- (i) Hydric soil type,
- (ii) Average profile depth to restrictive soil layer,
- (iii) Effective hydraulic conductivity or permeability,
- (iv) Average drainable porosity or available water capacity and
- (v) Required buffer width, including safety factor.

(b) If wetlands or streams are present within 400 feet and the Contractor does not propose to excavate below the seasonal high water table or the water level in the adjacent stream, no documentation will be required.

(c) If wetlands or streams are not present within 400 feet, no additional documentation will be required.

During Department review of the proposed borrow area, the hydrologic analysis will be submitted to the USACE for evaluation. Obtain copy of *Skaggs Method for Determining Lateral Effects of a Borrow Pit on Adjacent Wetlands* from the Department's website.

Section 230

(C) Maintenance

During construction and until final acceptance, use any methods approved by the Engineer that are necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion.

230-5 MEASUREMENT AND PAYMENT

Borrow Excavation will be measured and paid in cubic yards. *Borrow Excavation* will be measured in place in its original position except that truck measurement will be made where called for in the contract or as determined by the Engineer.

If the quantity of borrow excavation used is excessive as evidenced by the presence of surplus suitable material from the roadway excavation, the measured quantity of borrow excavation will be reduced by the quantity of such surplus suitable material.

(A) In-Place Measurement

Borrow Excavation to be paid will be the actual number of cubic yards of approved material, measured in its original position by cross sectioning and computed by the average end area method, that has been excavated from the borrow source and incorporated into the completed and accepted work. No measurement will be made of any overburden, unsuitable material removed from the source or any material excavated before cross sections are taken.

(B) Truck Measurement

Borrow Excavation to be paid will be the actual number of cubic yards of approved material, measured in trucks excavated from the borrow source and incorporated into the completed and accepted work. Each truck will be measured and shall have a legible identification mark indicating its capacity. Load each truck to at least its measured capacity at the time it arrives at the point of delivery. The recorded capacity will be adjusted by making a 25% deduction to allow for shrinkage and the adjusted capacity will be the quantity to be paid.

Topsoil that is stockpiled and placed back on the source as part of the reclamation effort will be measured in the stockpile by cross sectioning and computed by the average end area method and paid per cubic yard for *Borrow Excavation*. No in-place measurement will be made of the topsoil.

Seeding, mulching and establishment of temporary erosion control measures for all borrow sources will be measured and paid at the contract unit prices established in the contract.

Payment includes, but is not limited to, furnishing the source of the borrow; providing and implementing a development, use and reclamation plan, evaluation of potential wetlands and endangered species, building, maintaining and obliterating haul roads, clearing and grubbing or draining the borrow source; removing, stockpiling and replacing topsoil, removing and disposing of overburden and other unsuitable material, excavation, hauling, formation of roadway embankments, subgrades and shoulders, restoration of the source and haul roads to an acceptable condition, obtaining permits and certifications and maintaining the work.

Payment will be made under:

Pay Item

Borrow Excavation

Pay Unit

Cubic Yard

SECTION 250

REMOVAL OF EXISTING PAVEMENT

250-1 DESCRIPTION

Break up, remove and satisfactorily dispose of the Portland cement concrete or asphalt components of an existing roadway pavement structure, including paved shoulders, within the limits shown in the plans or as directed by the Engineer. This work includes the removal of any temporary roadway pavement structure placed during construction to serve as a detour.

250-2 PAVEMENT REMOVAL AND DISPOSAL

Break up and remove the pavement for its entire depth. Where concrete or asphalt pavement is to be removed, provide a neat edge along the pavement being retained by sawing the pavement approximately 2 inches deep before breaking the adjacent pavement away. Properly dispose of all materials resulting from the pavement removal as provided herein.

Section 250

When existing pavement is located where embankment is to be constructed and the depth of the embankment is greater than 1 foot exclusive of base and pavement, do not remove existing pavement, but break up the existing pavement into pieces with the longest dimension no larger than 3 feet. Use all materials in the construction of embankments, unless otherwise directed by the Engineer. Stockpile materials that the Department desires to use, as indicated in the plans at approved locations.

Where the Contractor requests permission to use salvageable material in other parts of the work and such material has been intended for use in the construction of embankments, the Engineer may permit such use provided the Contractor furnishes at no cost to the Department an adequate quantity of material for embankment construction to replace the material used in all other parts of the work.

Dispose of all materials that cannot be used in the work in accordance with Section 802.

250-3 MEASUREMENT AND PAYMENT

Removal of Existing Asphalt Pavement will be measured and paid in square yards of existing asphalt pavement actually removed and disposed of properly. Removal of existing asphalt pavement will be measured by actual surface measurement of the asphalt pavement before its removal.

Removal of Existing Concrete Pavement will be measured and paid in square yards of existing concrete pavement actually removed and disposed of properly. Removal of existing concrete pavement will be measured by actual surface measurement of the concrete pavement before its removal.

Breaking of Existing Concrete Pavement will be measured and paid in square yards of existing concrete pavement actually broken up and left in place. The quantity will be determined by actual surface measurement of the pavement before breaking it up.

Breaking of Existing Asphalt Pavement will be measured and paid in square yards of existing asphalt pavement actually broken up and left in place. The quantity will be determined by actual surface measurement of the pavement before breaking it up.

Where the pavement removed or broken up is a combination of layers of both asphalt and concrete pavement, payment will be made at the contract unit price per square yard for *Removal of Existing Concrete Pavement* or *Breaking of Existing Concrete Pavement*.

Where the pavement removed is a combination of layers of both asphalt and concrete pavement and an item is not established for concrete pavement removal, the cost of removing the combination of layers of asphalt and concrete will be made in accordance with Article 104-7.

Payment includes, but is not limited to, breaking up, removing and disposing of existing concrete or asphalt pavement, including paved shoulders and removing any temporary roadway pavement structure placed during construction to serve as a detour.

This work does not include pavement removal for pipe installation; removing and disposing of sidewalks, driveways, curb and gutter; traffic islands and parking areas; or any other incidental paved structures that are not part of a final roadway pavement structure.

Payment will be made under:

Pay Item

Removal of Existing Asphalt Pavement
Removal of Existing Concrete Pavement
Breaking of Existing Concrete Pavement
Breaking of Existing Asphalt Pavement

Pay Unit

Square Yard
Square Yard
Square Yard
Square Yard

SECTION 260 PROOF ROLLING

260-1 DESCRIPTION

Furnish and operate at the direction of the Engineer, heavy pneumatic tired compaction equipment for compacting the roadbed and testing the roadbed for stability and uniformity of compaction.

260-2 EQUIPMENT

Provide equipment with the following features:

(A) Four rubber tired wheels mounted on a rigid steel frame,

(B) Wheels evenly spaced in one line across the width of the roller and arranged so that all wheels will carry approximately equal loads when operated over an uneven surface,

(C) Maximum center to center spacing between adjacent wheels is 32 inches,

(D) Load capacity from 48 to 50 tons unless otherwise permitted in writing,

(E) Cover or construct the loaded roller to not trap water that will add weight to the ballast,

(F) Other equipment of equal or better effectiveness may be substituted with written permission, and

(G) Tire pressures shall be between 68 and 72 psi unless otherwise permitted in writing. Inflate tires with air only; use no liquid.

Provide ballasts consisting of bulk sand, bulk stone, bags of sand, stone or other materials of known unit weight such that the total weight of the ballast used can be readily determined at all times. Have a sufficient amount of ballast available on the job site to load the equipment to a maximum gross weight of 50 tons.

Use rubber tired or other types of tractive equipment for operation of this equipment on the roadbed. The entire assembly including motivating equipment shall be capable of executing a 180° turn on a 27 feet wide area.

260-3 CONSTRUCTION METHODS

After the roadbed has been completed within 0.5 feet of final grade, compact and test the roadbed with one coverage, unless otherwise directed by the Engineer, with a heavy pneumatic tired roller in accordance with Article 260-2. Coverage is considered that stage in the rolling procedure when the entire width of the area being proof rolled has been in contact with the pneumatic tires of the roller. Operate the roller systematically so the number of coverages over all areas to be proof rolled can be readily determined and recorded.

Operate the equipment at a speed between 225 feet per minute and 300 feet per minute. Perform proof rolling only in the presence of the Engineer. Proof roll areas again following the completion of the necessary corrections.

Protect all structural facilities on the project, such as, but not limited to, bridges, box culverts, pipe culverts and utilities, from damage by the proof rolling equipment. Protection may include unloading and reloading of the roller, detouring, protective earth pads or other suitable measure to avoid damage.

260-4 MEASUREMENT AND PAYMENT

Proof Rolling will be measured and paid as the actual number of hours, measured to the nearest 0.1 hour, during which the heavy pneumatic tired roller has been engaged in proof rolling in the presence of the Engineer, exclusive of hours of proof rolling performed following corrective action made necessary by the negligence of the Contractor or by weather.

Section 265

- 1 Corrective work necessary, as determined by proof rolling, and not due to negligence of the
- 2 Contractor or to weather, will be paid at the applicable contract unit prices or as extra work,
- 3 whichever may apply.

- 4 Proof rolling after corrective work will be at no cost to the Department if the corrections are
- 5 necessary due to the negligence of the Contractor or weather.

- 6 Payment includes furnishing all labor, equipment, fuel and ballast for loading, loading and
- 7 unloading ballast as directed by the Engineer and increasing and decreasing tire pressure as
- 8 directed by the Engineer.

- 9 Payment will be made under:

Pay Item

Proof Rolling

Pay Unit

Hour

SECTION 270

GEOTEXTILE FOR SOIL STABILIZATION

270-1 DESCRIPTION

Supply and install geotextile for soil stabilization in accordance with the contract and as directed by the Engineer.

270-2 MATERIALS

Refer to Division 10.

Item	Section
Geotextile for Soil Stabilization, Type 4a	1056

270-3 CONSTRUCTION METHODS

Grubbing may not be required in areas where geotextile for soil stabilization will be used. Minimize the use of heavy equipment in these areas to limit rutting. Cut trees flush with the ground surface and place geotextiles on relatively undisturbed ground as directed by the Engineer.

Do not leave geotextiles exposed for more than 7 days before covering geotextiles with backfill material except geotextiles for erosion control devices. Place geotextiles on surfaces free of obstructions, debris and soft pockets. Install geotextiles with the long dimension parallel to the roadway centerline. Overlap adjacent geotextiles at least 18 inches. Overlap geotextiles in the direction that material will be placed to prevent lifting the edge of the top geotextile.

Pull geotextiles taut so that they are in tension and free of kinks, folds, wrinkles or creases. Hold geotextiles in place as needed with wire staples or anchor pins. Provide backfill material in accordance with the contract. Do not operate equipment on geotextiles until covered with material as directed by the Engineer. Do not use vibratory compaction equipment on initial lifts of backfill.

270-4 MEASUREMENT AND PAYMENT

Geotextile for Soil Stabilization will be measured and paid in square yards. Geotextiles will be measured along the ground surface as the square yards of exposed geotextiles before placing backfill material. No measurement will be made for overlapping geotextiles. The contract unit price for *Geotextile for Soil Stabilization* will be full compensation for providing, transporting and installing geotextiles, wire staples and anchor pins.

Payment will be made under:

Pay Item	Pay Unit
Geotextile for Soil Stabilization	Square Yard

DIVISION 3 PIPE CULVERTS

SECTION 300 PIPE INSTALLATION

300-1 GENERAL

Excavate, undercut, provide material, condition foundation, lay pipe, joint and couple pipe sections and furnish and place all backfill material as necessary to install the various types of pipe culverts and fittings required to complete the project.

Install pipe in accordance with the details in the plans.

Do not waste excavation unless permitted. Use suitable excavated material as backfill; or in the formation of embankments, subgrades and shoulders; or as otherwise directed by the Engineer. Furnish disposal areas for the unsuitable material. The Engineer will identify excavated materials that are unsuitable.

Where traffic is to be maintained, install pipe in sections so half the roadway width is available to traffic.

300-2 MATERIALS

Refer to Division 10.

Item	Section
Flowable Fill, Excavatable	1000-7
Grout, Type 2	1003
Geotextiles, Type 4a	1056
Joint Materials	1032-6(F)
Select Materials	1016

Provide foundation conditioning material in accordance with Article 1016-3 for Class V or VI select material as shown in the contract.

Provide bedding material in accordance with Article 1016-3 for Class II (Type 1 only) or Class III select material as shown in contract.

Provide backfill material in accordance with Article 1016-3 for Class II (Type 1 for flexible pipe) or Class III select material as shown in the contract.

Provide filtration geotextile in accordance with Section 1056 for any type of geotextile.

Provide foundation conditioning geotextile and geotextile to wrap pipe joints in accordance with Article 1056 for Type 4a geotextile.

Do not use corrugated steel pipe in counties listed in Article 310-2.

300-3 UNLOADING AND HANDLING

Unload and handle pipe with reasonable care. Do not roll or drag metal pipe or plates over gravel or rock during handling. Take necessary precautions to ensure the method used in lifting or placing the pipe does not induce stress fatigue in the pipe. Use a lifting device that uniformly distributes the weight of the pipe along its axis or circumference. Repair minor damage to pipe when permitted. Remove pipe from the project that is severely damaged or is rejected as being unfit for use. Undamaged portions of a joint or section may be used where partial lengths are required.

Section 300

300-4 PREPARATION OF PIPE FOUNDATION

Prepare the pipe foundation in accordance with the applicable method as shown in the contract, true to line and grade and uniformly firm.

Where material is found to be of poor supporting value or of rock and when the Engineer cannot make adjustment in the location of the pipe, undercut existing foundation material within the limits established in the plans. Backfill the undercut with foundation conditioning material. Encapsulate the foundation conditioning material with foundation conditioning geotextile before placing bedding material. Overlap all transverse and longitudinal joints in the geotextile at least 18 inches.

Maintain the pipe foundation in a dry condition.

300-5 INVERT ELEVATIONS

The proposed pipe culvert invert elevations shown on the Drainage Summary Sheets are based upon information available when the plans were prepared. If proposed invert elevations are adjusted during construction based upon actual conditions encountered, no claim for an extension of time for any reason resulting from this information will be allowed.

When a pipe culvert is to be installed in a trench and the average actual elevation of the pipe between drainage structures deviates from the average proposed elevation shown on the Drainage Summary Sheets by more than one foot, a pay adjustment will be made as follows:

$$\text{Pay Adjustment (per linear foot)} = [(APE - AAE) \pm 1](0.15 \times CUP)$$

Where:

$$APE = \text{Average Plan Elev.} = \frac{(\text{Plan Inlet Elev.} + \text{Plan Outlet Elev.})}{2}$$

$$AAE = \text{Average Actual Elev.} = \frac{(\text{Actual Inlet Elev.} + \text{Actual Outlet Elev.})}{2}$$

$$CUP = \text{Contract Unit Price of Pipe Culvert}$$

When the actual location of a pipe culvert is changed from the location shown in the plans, the Engineer will make a pay adjustment deemed warranted based upon the relation of the pipe culvert as shown in the plans to the finished roadway and the relation of the pipe culvert as constructed to the finished roadway.

The top elevation column on the drainage summary sheet indicates the flow elevation at the top of structures intended to collect surface water.

The top elevation column on drainage structures not intended to collect surface water indicates the elevation at the top of the cover.

300-6 LAYING PIPE

The Department reserves the right to perform forensic testing on any installed pipe.

(A) Rigid Pipe

Concrete and welded steel pipe will be considered rigid pipe. Lay pipe on prepared foundation, bell or groove end upgrade with the spigot or tongue fully inserted. Check each joint for alignment and grade as the work proceeds.

Use flexible joint material except when material of another type is specified in the contract. Joint material of another type may be used when permitted.

Section 300

Repair lift holes in concrete pipe, if present. Thoroughly clean and soak the lift hole and completely fill the void with grout. Submit alternate details for repairing lift holes to the Engineer for review and approval.

For all pipes 42 inches in diameter and larger, wrap geotextile around all pipe joints. Extend geotextile at least 12 inches beyond each side of the joint. Secure geotextile against the outside of the pipe by methods approved by the Engineer.

(B) Flexible Pipe

Corrugated steel, corrugated aluminum, polypropylene, HDPE and PVC pipe will be considered flexible pipe. Place flexible pipe carefully on the prepared foundation starting at the downstream end with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.

Handle coated corrugated steel pipe with special care to avoid damage to coatings.

Join corrugated steel and corrugated aluminum pipe sections with coupling band, fully bolted and properly sealed. Provide coupling bands for annular and helical corrugated metal pipe with circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections and prevent backfill infiltration. Match-mark all pipe 60 inches or larger in diameter at the plant for proper installation on the project.

Only at locations with rod and lug connectors indicated in the plans, join corrugated steel pipe sections together with rod and lug coupling bands, fully bolted. Use sleeve gaskets in conjunction with rod and lug couplings and seal the joints properly.

For HDPE, polypropylene, and PVC pipe use a gasketed bell and spigot connection where not otherwise specified in the plans.

Only at locations with couplers indicated in the plans, join HDPE and polypropylene pipe sections together with coupling bands. Provide coupling bands with circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections and prevent infiltration of backfill material.

300-7 BACKFILLING

Loosely place bedding material, in a uniform layer, a depth equal to the inside diameter of the pipe divided by 6 or 6 inches, whichever is greater. Leave bedding material directly beneath the pipe uncompacted and allow pipe seating and backfill to accomplish compaction. Excavate recesses to receive the bells where bells and spigot type pipe is used.

Place fill around the pipe in accordance with the applicable method shown in the plans in layers not to exceed 6 inches loose unless otherwise permitted by the Engineer. Compact to the density required by Subarticle 235-3(C). Approval of the backfill material is required before its use. Use select material as shown in the contract.

Take care during backfill and compaction operations to maintain alignment and prevent damage to the joints. Keep backfill free from stones, frozen lumps, chunks of highly plastic clay or other objectionable material.

Grade and maintain all pipe backfill areas in such a condition that erosion or saturation will not damage the pipe foundation or backfill.

Flowable fill may be used for backfill when approved by the Engineer. When using flowable fill, ensure that the pipe is not displaced and does not float during backfill. Submit methods for supporting the pipe and material placement to the Engineer for review and approval.

Do not operate heavy equipment over any pipe until it has been properly backfilled with at least 3 feet of cover. Place, maintain and finally remove the required cover that is above the

Section 300

proposed finished grade. Remove and replace pipe that becomes misaligned, shows excessive settlement or has been otherwise damaged by the Contractor's operations.

300-8 INSPECTION AND MAINTENANCE

Ensure proper jointing and that deformations do not exceed allowable limits as described in the Department's *Guidelines for Post Installation Evaluation and Repair of Newly-Installed Drainage Pipe*. Maintain all pipe installations in a condition such that they will function continuously from the time the pipe is installed until the project is accepted by the Engineer. The Engineer will randomly video, deflection test, and/or manually inspect installations of completed pipelines prior to final acceptance.

300-9 MEASUREMENT AND PAYMENT

No measurement will be made of any work covered by this section except as listed below. Removal and disposal of existing pavement and unsuitable material above the pipe invert are a part of the excavation for the new pipe culvert installation. Repair of the pavement will be made in accordance with Section 654. Placing, maintaining and removing the required cover is incidental to the work of this section. Removing and replacing pipe that becomes misaligned, shows excessive settlement or has been otherwise damaged by the Contractor's operations is incidental to the work of this section.

(A) Using Local Material

Undercut Excavation is all excavation removed by undercutting below the bottom of the trench as staked. *Undercut Excavation* will be measured as the actual number of cubic yards of undercut excavation, measured in its original position and computed by the average end area method, that has been removed as called for in the contract and will be paid at double the contract unit price for *Unclassified Excavation* in accordance with Article 225-7.

Local material used for conditioning the foundation will be measured and paid in accordance with Article 225-7 for *Unclassified Excavation* or in accordance with Article 230-5 for *Borrow Excavation* depending on the source of the material.

Local material used to replace pipe undercut excavation will be measured and paid in accordance with Article 225-7 or Article 230-5.

(B) Using Other than Local Material

No measurement and payment will be made for *Undercut Excavation*. The material used to replace pipe undercut excavation will be classified as foundation conditioning material.

Foundation Conditioning Material, Minor Structures will be measured and paid as the actual number of tons of this material weighed in trucks on certified platform scales or other certified weighing devices.

No direct payment will be paid for *Undercut Excavation*. Payment at the contract unit price for *Foundation Conditioning Material, Minor Structures* will be full compensation for all work of pipe undercut excavation.

(C) Foundation Conditioning Geotextile

Foundation Conditioning Geotextile will be measured and paid in square yards. The measurement will be based on the theoretical calculation using length of pipe installed and two times the standard trench width. No separate measurement will be made for overlapping geotextile or the vertical geotextile dimensions required to encapsulate the foundation conditioning material.

Section 305

(D) Bedding and Backfill with Select Material

No measurement will be made for select bedding and backfill material required in the contract. The select bedding and backfill material will be included in the cost of the installed pipe.

Where unclassified excavation or borrow material meets the requirements for select bedding and backfill and is approved for use by the Engineer, no deductions will be made to these pay items to account for use in the pipe installation.

Payment will be made under:

Pay Item	Pay Unit
Foundation Conditioning Material, Minor Structures	Ton
Foundation Conditioning Geotextile	Square Yard

**SECTION 305
DRAINAGE PIPE**

305-1 DESCRIPTION

Where shown in the plans, the Contractor may use reinforced concrete pipe, aluminum alloy pipe, aluminized corrugated steel pipe, galvanized corrugated steel pipe, HDPE pipe, polypropylene pipe or PVC pipe in accordance with the following requirements.

305-2 MATERIALS

Refer to Division 10.

Item	Section
Aluminized Corrugated Steel Pipe	1032-3(A)(7)
Corrugated Aluminum Alloy Pipe	1032-2(A)
Corrugated HDPE Pipe	1032-7
Polypropylene Pipe	1032-4
Elbows	1032
PVC Pipe	1032-8
Reinforced Concrete Pipe, Class II, III, IV, or V	1032-6(B)

Corrugated steel pipe will not be permitted in counties listed in Article 310-2.

Only pipe with smooth inside walls will be allowed for storm drain systems. Define "storm drain systems" as pipe under curb and gutter, expressway gutter and shoulder berm gutter that connects drainage structures and is not open ended. Corrugated pipe without a smooth interior is only for use at storm drain system inlets and outlets if pipe slope is greater than 10%.

305-3 CONSTRUCTION METHODS

Install pipe culverts in accordance with Section 300. Where allowed by the plans, use any of the several alternate pipes shown herein, but only one type of pipe and elbow will be permitted between drainage structures or for the entire length of a cross line pipe.

305-4 MEASUREMENT AND PAYMENT

" *Drainage Pipe* will be measured and paid as the actual number of linear feet of pipe that has been incorporated into the completed and accepted work. Measurement of pipe will be made by counting the number of joints used and multiplying by the length of the joint to obtain the number of linear feet of pipe installed and accepted. Measurements of partial joints will be made along the longest length of the partial joint to the nearest 0.1 foot. Select bedding and backfill material will be included in the cost of the installed pipe.

" *Drainage Pipe Elbow* will be measured and paid in units of each.

Section 310

Payment will be made under:

Pay Item

___" Drainage Pipe

___" Drainage Pipe Elbows

Pay Unit

Linear Foot

Each

**SECTION 310
PIPE CULVERTS**

310-1 DESCRIPTION

Furnish and install drainage pipe at locations and size called for in the contract. The work includes construction of joints and connections to other pipes, endwalls and drainage structures.

310-2 MATERIALS

Refer to Division 10.

Item

Section

Concrete Pipe Tees and Elbows

1032-6(D)

Corrugated Aluminum Alloy Culvert Pipe and Pipe Arch

1032-2(A)

Corrugated Aluminum Alloy Pipe Tees and Elbows

1032-2(B)

Corrugated Steel Culvert Pipe and Pipe Arch

1032-3(A)

Corrugated Steel Eccentric Reducers

1032-3(D)

Corrugated Steel Pipe Tees and Elbows

1032-3(C)

HDPE Smooth Lined Corrugated Plastic Pipe

1032-7

Polypropylene Pipe

1032-4

Precast Concrete Pipe End Sections

1032-6(C)

Prefabricated Corrugated Steel Pipe End Sections

1032-3(B)

PVC Pipe

1032-8

Reinforced Concrete Culvert Pipe

1032-6(B)

Use suppliers of metal pipe culverts, fittings and all other accessories covered by this section that meet the Department's Brand Certification program requirements for metal pipe culverts and are listed on the Materials and Tests Unit's pre-approved producer/suppliers list. The pre-approved list is available on the Department's website.

Do not use plain galvanized or aluminized corrugated steel pipe in the following counties:

Beaufort, Bertie, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus,
Craven, Currituck, Dare, Gates, Hertford, Hyde, Jones, Martin, New Hanover,
Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrell and Washington.

310-3 PIPE INSTALLATION

Install pipe, pipe tees, couplers and elbows according to Section 300.

310-4 SIDE DRAIN PIPE

Define "side drain pipe" as storm drain pipe running parallel to the roadway to include pipe in medians, outside ditches, driveways and under shoulder berm gutter along outside shoulders greater than 4 feet wide.

Where shown in the plans, side drain pipe may be Class II, III, IV, or V reinforced concrete pipe, aluminized corrugated steel pipe, galvanized corrugated steel pipe, corrugated aluminum alloy pipe, polypropylene pipe, HDPE pipe or PVC pipe. Use of plain, galvanized, aluminized or other coated corrugated steel pipe is restricted in the counties listed in Article 310-2. Install side drain pipe in accordance to Section 300. Cover for side drain pipe shall be at least one foot.

Section 330

310-5 PIPE END SECTIONS

Choose which material to use for the required end sections. Both corrugated steel and concrete pipe end sections will work on concrete pipe, corrugated steel pipe, polypropylene smooth lined corrugated plastic pipe and HDPE smooth lined corrugated plastic pipe.

310-6 MEASUREMENT AND PAYMENT

Pipe will be measured and paid as the actual number of linear feet of pipe that has been incorporated into the completed and accepted work. Measurement of pipe will be made by counting the number of joints used and multiplying by the length of the joint to obtain the number of linear feet of pipe installed and accepted. Measurements of partial joints will be made along the longest length of the partial joint to the nearest 0.1 feet. Select bedding and backfill material will be included in the cost of the installed pipe. Such price and payment will be full compensation for all materials, labor, equipment, and other incidentals necessary to complete the work.

Pipe End Sections, Tees, Elbows, Couplers and Eccentric Reducers will be measured and paid in units of each that have been incorporated into the completed and accepted work.

Payment will be made under:

Pay Item	Pay Unit
__ " R.C. Pipe Culverts, Class ____	Linear Foot
__ " x __ " x __ " R.C. Pipe Tees, Class ____	Each
__ " R.C. Pipe Elbows, Class ____	Each
__ " C.A.A. Pipe Culvert, __ " Thick	Linear Foot
__ " x __ " x __ " C.A.A. Pipe Tees, __ " Thick	Each
__ " C.A.A. Pipe Elbows, __ " Thick	Each
__ " C.A.A. Pipe Arch Culvert, __ " Thick	Linear Foot
__ " x __ " x __ " C.A.A. Pipe Arch Tees, __ " Thick	Each
__ " C.A.A. Pipe Arch Elbows, __ " Thick	Each
__ " C.S. Pipe Culverts, __ " Thick	Linear Foot
__ " x __ " C.S. Pipe Arch Culverts, __ " Thick	Linear Foot
__ " x __ " x __ " C.S. Pipe Tees, __ " Thick	Each
__ " C.S. Pipe Elbows, __ " Thick	Each
__ " x __ " C.S. Eccentric Reducers, __ " Thick	Each
__ " HDPE Pipe Culverts	Linear Foot
__ " Polypropylene Pipe Culverts	Linear Foot
__ " PVC Pipe Culverts	Linear Foot
__ " Side Drain Pipe	Linear Foot
__ " Side Drain Pipe Elbows	Each
__ " Side Drain Pipe Couplers	Each
__ " Pipe End Section	Each

Section 340

**SECTION 340
PIPE REMOVAL**

340-1 DESCRIPTION

Remove and dispose of all existing roadway drainage pipe, including flared end sections, where the removal of the existing pipes is required by the plans or as directed by the Engineer. Unless otherwise indicated in the plans, this work excludes the removal and disposal of any existing public or private water or sewage pipe or subsurface and shoulder drain pipe.

The Contractor has the option of leaving pipes in place and filling with flowable fill.

Section 340

340-2 MATERIALS

Refer to Division 10.

Item	Section
Chemical Admixtures	1024-3
Fine Aggregate	1014-1
Flowable Fill	1000-7
Fly Ash	1024-5
Portland Cement	1024-1
Type IP Blended Cement	1024-1
Type IS Blended Cement	1024-1
Water	1024-4

For fine aggregate, bottom ash may be used with permission of the Engineer.

For chemical admixtures, high-air generators or foaming agents may be used instead of conventional concrete air-entraining agents with the permission of the Engineer.

For fly ash, certain requirements of this article and ASTM C618 may be waived with the permission of the Engineer.

340-3 CONSTRUCTION METHODS

Remove existing pipe when so designated in the plans or as directed by the Engineer. When an existing pipe is encountered that is not shown in the plans, do not remove until the Engineer is notified of its presence and has directed its removal.

Remove pipe in sections so traffic is maintained. Remove existing pipe so nearby facilities will not be damaged.

Backfill the area disturbed by the removal of an existing pipe in accordance with the *Standard Specifications* applicable to the adjacent construction.

Salvaged pipe is the property of the Contractor unless otherwise indicated by the contract.

Discharge flowable fill material directly from the truck into the space to be filled or by other methods approved by the Engineer. The mix may be placed full depth or in lifts as site conditions warrant.

340-4 MEASUREMENT AND PAYMENT

Pipe Removal will be measured and paid as the actual number of linear feet of pipe and flared end sections, measured to the nearest 0.1 feet that has been removed in accordance with this section. No measurement and payment will be made for pipe removal when a new pipe is placed back in the same trench.

Flowable Fill will be measured and paid as the item for which it was substituted. In no case will payment for the use of flowable fill as a substitute be made for more than one deleted item of work.

Any additional backfill material that is necessary will be paid at the contract unit price for *Unclassified Excavation* in accordance with Article 225-7 or at the contract unit price for *Borrow Excavation* in accordance with Article 230-5, depending on the source of the material.

Payment includes but is not limited to removing pipe, hauling pipe and all excavating and backfilling that may be necessary.

Payment will be made under

Pay Item	Pay Unit
Pipe Removal	Linear Foot

DIVISION 5 SUBGRADE, BASES AND SHOULDERS

SECTION 500

FINE GRADING SUBGRADE, SHOULDERS AND DITCHES

500-1 DESCRIPTION

Perform the work covered by this section on all portions of the project which will be paved under the contract including, but not limited to, preparing, grading, shaping, manipulating moisture content and compacting either an unstabilized or stabilized roadbed to a condition suitable for placement of base course, pavement and shoulders. Clean, shape and maintain roadway ditches; strip existing vegetation; and place and compact in accordance with Sections 235 and 560 all materials resulting from the shaping operation. Stockpile surplus material for the construction of shoulders and dispose of any necessary surplus stockpile material as waste.

On those portions of the project where there is no pavement to be placed under the contract, perform the work of Sections 225 or 230, depending upon the source of the material. This section will not be applicable to such work.

500-2 CONSTRUCTION METHODS

(A) General

Shape the roadway to conform to the lines, grades and typical sections shown on the plans. Strip all existing vegetation from the ground surface wherever shaping of the roadway is to be done. Use all suitable surplus material in the construction of the roadway or stockpile for use in shoulder construction. Dispose of surplus material in excess of that needed for roadway or shoulder construction as waste. Obtain additional material, if needed, from roadway excavation or borrow sources.

Remove all unsuitable material, boulders and all vegetative matter and replace with suitable material. Obtain suitable material, when not available from the shaping or fine grading operation, from roadway excavation or borrow sources.

Clean, reshape and maintain roadway ditches in a satisfactory condition until final acceptance of the project. Conduct operations so as to avoid damage to any previously constructed structures and facilities.

(B) Preparation of Subgrade

Shape the subgrade to the lines, grades and typical sections shown on the plans. Where the Engineer directs that areas of the subgrade are to be stabilized with aggregate, the subgrade surface in such areas may, subject to the approval of the Engineer, be left uniformly below grade to provide for the addition of the stabilizer material.

Store or stockpile material excavated in preparing the subgrade so as to not interfere with proper drainage or later operations of stabilization, placing base or placing pavement.

(C) Compaction of Subgrade

Compact all material to a depth of 8 inches below the finished surface of the subgrade to a density equal to at least 100% of that obtained by compacting a sample of the material in accordance with AASHTO T 99 as modified by the Department. Copies of these modified testing procedures as described in the *Conventional Density Operator's Manual* are available from the Materials and Tests Unit on the Department's website.

Section 500

Compact the subgrade at a moisture content which is approximately that required to produce the maximum density indicated by the above test method. Dry or add moisture to the subgrade when required to provide a uniformly compacted and acceptable subgrade.

Where the subgrade is to be stabilized with lime, aggregate or cement, the above density requirements will not apply before the incorporation of the stabilizing material; however, perform compaction in accordance with Articles 501-10, 510-3 or 542-9, as appropriate.

500-3 TOLERANCES

A tolerance of $\pm 1/2$ inch from the established grade will be permitted after the subgrade has been graded to a uniform surface. Subgrade tolerance of $\pm 1/4$ inch from the established grade is required for subgrade under concrete pavement mainline lanes.

Perform the grading operation such that the maximum difference between the established grade and the graded subgrade within any 100 foot section is $1/2$ inch for normal subgrade and $1/4$ inch for subgrade for concrete pavement.

500-4 MAINTENANCE OF SUBGRADE

Provide and maintain ditches and drains to drain the subgrade satisfactorily. Where previously approved subgrade is damaged by natural causes, hauling equipment or other traffic, restore the subgrade to the required lines, grades, typical sections and density.

500-5 MEASUREMENT AND PAYMENT

Fine Grading will be paid at the contract lump sum price. Such lump sum price will be full payment for all material excavated to a depth of 0.4 feet below the existing graded surface.

Any material which has been excavated from the subgrade at the depth greater than 0.4 feet below the existing graded surface will be *Unclassified Excavation* and will be paid in accordance with Article 225-7.

As an exception to the above, on those areas in which the Contractor is responsible for constructing the embankment on which the subgrade is located, no payment will be made for that excavation that may be necessary to bring the grade to the established subgrade elevation and typical section. Incorporate such surplus material into the project at no additional cost to the Department.

When sufficient material is not available from the fine grading operation to complete the work of fine grading, additional material will be paid in accordance with Article 225-7 for *Unclassified Excavation* or Article 230-5 for *Borrow Excavation*, depending on the source of material.

Surplus material stockpiled for shoulder construction and incorporated into the work will be paid in accordance with Article 560-4 for *Shoulder Borrow*. No payment will be made for the removal and disposal of any surplus material remaining in the stockpile after the shoulders have been completed.

Maintenance, repair and restoration of the subgrade to the required lines, grades, typical sections and density as it applies to fine grading is incidental to the work of this section.

Payment will be made under:

Pay Item

Fine Grading

Pay Unit

Lump Sum

SECTION 520
AGGREGATE BASE COURSE

520-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, constructing a base composed of an approved aggregate material hauled to the road, placed on the road, mixed, compacted and shaped in accordance with the lines, grades, depths and typical sections shown in the plans; applying a sand seal in accordance with Article 520-5; and maintaining the base.

520-2 MATERIALS

Refer to Division 10.

Item	Section
Aggregate Base Course	1005, 1006 and 1010

520-3 METHODS OF PRODUCTION

Furnish aggregate upon which no restrictions are placed on the production or stockpiling, except as provided in Sections 1005, 1006 and 1010. Place aggregates on the roadway which have been sampled, tested and approved in accordance with Article 520-6.

520-4 SUBGRADE PREPARATION

Prepare the subgrade in accordance with Section 500 before placement of the base material.

Section 520**520-5 HAULING AND PLACING AGGREGATE BASE MATERIAL**

Place the aggregate material on the subgrade with a mechanical spreader box capable of placing the material to a uniform loose depth and without segregation; except, for areas inaccessible to a mechanical spreader box, the aggregate material may be placed by other methods approved by the Engineer. In addition, as approved by the Engineer, place by end dumping aggregate on approved sandy subgrade soils to provide a working platform and reduce wheel rutting of the subgrade. When allowed, end dumping will be limited to a uniformly spread thickness of 2 to 3 inches prior to placing the remaining aggregate thickness with a mechanical spreader box.

Where the Contractor elects to use more than one source of aggregate as described in Section 1005, place the various types of aggregate used in an approved manner which will permit the sampling and testing required by Section 1006 and 1010.

Where the required compacted thickness of base is 10 inches or less, the base material may be spread and compacted in one layer. Where the required compacted thickness is more than 10 inches spread the base material and compact in 2 or more approximately equal layers. Compact the base material to a minimum thickness of approximately 4 inches for any one layer.

Have each layer of material sampled, tested, compacted and approved before placing succeeding layers of base material or pavement.

Do not place base material on frozen subgrade or base.

Base course that is in place on November 15 shall immediately be covered with a subsequent layer of pavement structure or with a sand seal. Base course that has been placed between November 16 and March 15 inclusive shall be covered within 7 calendar days with a subsequent layer of pavement structure or with a sand seal. Apply sand seal in accordance with Section 660, except Articles 660-3 and 660-12 will not apply.

Failure by the Contractor to cover the base course as required above will result in the Engineer notifying the Contractor in writing to cover the base course with a sand seal and to suspend the operations of placing aggregate base course until such cover has been placed. If the Contractor fails to apply the sand seal within 72 hours after receipt of such notice, the Engineer may proceed to have such work performed with other forces and equipment. The application of the sand seal by the Contractor or by others will in no way relieve the Contractor of the responsibility to maintain or repair the damaged base or subgrade, no matter what the cause of damage.

Do not allow traffic on the completed base course other than necessary local traffic and that developing from the operation of essential construction equipment as may be authorized by the Engineer. Repair any defects that develop in the completed base or any damage caused by local or construction traffic acceptably. Hauling equipment may be operated with the approval of the Engineer, over a lower layer of base, however, acceptably repair any rutting, weaving or soft areas that develop.

Do not exceed 35 mph with hauling equipment traveling over any part of the base.

Use methods of handling, hauling and placing which will minimize segregation and contamination. If segregation occurs, the Engineer may require that changes to the Contractor's methods and may require mixing on the road to correct segregation. Remove and replace all aggregate which is contaminated with foreign materials to the extent that the base course will not adequately serve its intended use. The above requirements will be applicable regardless of the type of aggregate placed and regardless of prior acceptance.

520-6 SAMPLING, TESTING AND ACCEPTANCE

Perform sampling for the determination of gradation, LL and PI for the various types of aggregate, as defined in Section 1010.

Section 520

Where visual observation indicates the need to do so, the Engineer may require the Contractor to road mix areas of nonuniform gradation. The Engineer reserves the right to take samples in addition to the lot acceptance samples from within the lot in areas exhibiting nonuniform gradation. When the test results from such an additional sample is outside the gradation limits in Section 1010 and the nonuniformity cannot be corrected by road mixing, the aggregate base course represented by the sample will be rejected and replaced by the Contractor.

520-7 SHAPING AND COMPACTION

Machine and compact the layer of base within 48 hours after beginning the placing of a layer of the base. Maintain each layer to the required cross section during compaction and compact each layer to the required density before placing the next layer.

Compact the base material at a moisture content which is approximately that required to produce a maximum density. Dry or add moisture to the material when required to provide a uniformly compacted and acceptable base. If it is necessary to add water after the material is placed, scarify the material and add water uniformly throughout the full depth of the layer of the base course material. Density determination will be based on Article 520-9.

Shape the final layer of base material in accordance with the lines, grades and typical section as shown on the plans. Construct the base course so that it is smooth, hard, dense, unyielding and well bonded upon completion. A broom drag may be used in connection with the final finishing and conditioning of the surface of the base course.

520-8 TOLERANCES

After final shaping and compacting of the base, the Engineer will check the surface of the base for conformance to the grade and typical section and determine the base thickness.

Construct the base so that the thickness of the base is within a tolerance of $\pm 1/2$ inch of the base thickness required by the plans. When the base course will be used under concrete pavement, the tolerance will be $\pm 1/4$ inch.

Construct the base so that the maximum differential between the established grade and the base within any 100 feet section is $1/2$ inch or $1/4$ inch when used as a base course under concrete pavement.

520-9 DENSITY DETERMINATION

The Engineer may use nuclear or conventional means as described below to determine the density of selected base course materials required by Sections 520 and 540. The target density will be from the material's most recent AASHTO T 180 test results, which may be obtained from the Materials and Tests Unit.

A new target density is to be obtained when there is a change in the source of material, when a significant change occurs in the composition of the materials from the same source or when determined necessary.

(A) Conventional Method

When electing to use conventional density test number 3 (ring test) to determine density, compact each layer of the base to a density equal to at least 100% of that obtained by compacting a sample of the material in accordance with AASHTO T 180 as modified by the Department. Information on these modified testing procedures are available in the *NCDOT Conventional Density Operator's Manual* on line in the Materials and Tests Unit's website.

(B) Nuclear Method

When electing to use a nuclear density gauge to determine density, compact each layer of the base to a density meeting requirements in the *NCDOT Nuclear Density Testing*

Section 535

Manual – Base Course, FDR and Select Materials. Copies of this manual are available upon request from the Materials and Tests Unit.

520-10 MAINTENANCE

Where the base material is placed in a trench section, provide adequate drainage through the shoulders to protect the subgrade and base until such time as the shoulders are completed.

Maintain the surface of the base by watering, machining, rolling or dragging when necessary to prevent damage to the base by weather or traffic.

Where the base or subgrade is damaged, repair the damaged area; reshape the base to required lines, grades and typical sections; and recompact the base to the required density at no cost to the Department.

520-11 MEASUREMENT AND PAYMENT

Aggregate Base Course will be measured and paid at the contract unit price per ton for the actual number of tons of aggregate which has been incorporated into the completed and accepted work. Sampling and acceptance will be determined in accordance with Section 1010.

The aggregate will be measured by being weighed in trucks on certified platform scales or other certified weighing devices. If permitted by the contract, the weight of base course material shipped by barge may be determined from water displacement measurements.

No deductions will be made for any moisture contained in the aggregate at the time of weighing.

Sand seal applied due to the failure of the Contractor to cover the base course as required will be incidental to the work of this section. If the Contractor fails to provide sand seal as required and the Engineer has the work performed by other forces, the cost of such work will be deducted from monies due or to become due to the Contractor.

Maintenance, repair and restoration of the base course and subgrade is incidental to the work of this section. If segregation during handling, hauling or placing occurs and the Engineer requires a change in methods or mixing on the road to correct this segregation, this work will be incidental to the work of this section. Removal and replacement of aggregate which is contaminated with foreign materials or outside the gradation limits will be incidental to the work of this section.

Payment will be made under:

Pay Item	Pay Unit
Aggregate Base Course	Ton

**SECTION 535
CONDITIONING EXISTING BASE**

535-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, scarifying, shaping, furnishing water, compacting and maintaining the base. Included in the work is:

(A) Conditioning of an existing base to prepare it for the placement of a pavement directly upon the base. Included in the conditioning is scarifying, shaping and compacting the base to conform to the required lines, grades, depths and typical sections established by the plans.

(B) Conditioning of an existing base in preparation for the placement of additional layers of base material. Included in the conditioning is scarifying, shaping and compacting the base to conform to the approximate lines, grades, depths and typical sections established by the plans.

Section 540

535-2 CONSTRUCTION METHODS

- Compact the base to a degree satisfactory to the Engineer. Dry or add moisture to the material when required to provide a uniformly compacted and acceptable base.
- Do not condition the existing base when it contains excess moisture or is frozen.
- Maintain the base in accordance with Article 520-10.

535-3 MEASUREMENT AND PAYMENT

Conditioning Existing Base will be measured and paid at the contract unit price per 1,000 square yards for the actual number of units of 1,000 square yards of base over which the work of conditioning existing base has been acceptably performed. The length will be measured along the centerline of the surface of the base. The width will be the width required by the plans or established by the Engineer measured across the top surface of the base.

Payment will be made under:

Pay Item	Pay Unit
Conditioning Existing Base	1,000 Square Yards

SECTION 543 ASPHALT CURING SEAL

543-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, keeping the stabilized layer moist; furnishing and applying the asphalt curing seal; correcting, maintaining and repairing the asphalt curing seal; and blotting sand where directed by the Engineer, to either a chemically stabilized soil layer or to a cement-stabilized base course.

543-2 MATERIALS

Refer to Division 10.

Item	Section
Asphalt, Grade CRS-1	1020-3
Asphalt, Grade CRS-1H	1020-3
Asphalt, Grade CRS-2	1020-3
Asphalt, Grade RS-1	1020-3
Asphalt, Grade RS-1H	1020-3

543-3 EQUIPMENT

Use equipment to apply the asphalt material in accordance with Article 600-5.

Use equipment to apply water, curing seal and blotting sand that is of such type and weight that it will not damage the completed stabilized layer.

543-4 CONSTRUCTION METHODS

Continuously moisten the finished stabilized layer or base course until the asphalt curing seal is placed. Place the curing seal as soon as possible, but no later than 24 hours after completing finishing operations except where delayed by wet weather. If wet weather delays application of the curing seal, apply the curing seal as soon as the surface becomes sufficiently dry.

At the time the asphalt curing seal is applied, prepare the surface of the stabilized layer or base so that it is free of all loose or extraneous material and contains sufficient moisture to prevent excessive penetration of the asphalt material. If deemed necessary, sweep the base surface clean of loose material before applying the curing seal. Apply the curing seal in accordance with Section 600.

Apply the asphalt material to the surface of the completed stabilized layer or base at a target rate of 0.14 +/- 0.04 gal/sy with approved equipment. Apply the asphalt material at the exact rate and temperature of application as established by the Engineer.

Cure the underlying materials for 7 curing days. Curing time will be counted in at least 1/2 day units and only when the air temperature measured at the location of the operation is at least 50°F. Complete the curing before placement of subsequent layers of pavement.

Maintain the curing material during the curing period so that all of the stabilized layer or base will be covered effectively during the period. Provide sufficient protection from freezing to the stabilized layer or base during the entire curing period and until it has hardened. Replace excessive loss of curing seal caused by heavy rains within 8 hours of placement.

Section 545

If the Engineer determines that it is necessary to allow local traffic to use parts of the stabilized layer or base before the asphalt material has cured sufficiently, protect those areas by applying blotting sand in accordance with Section 818.

543-5 MEASUREMENT AND PAYMENT

Asphalt Curing Seal will be measured and paid at the contract unit price per gallon that has been placed on the stabilized layer or base. Seal material placed on the stabilized layer or base in excess of the authorized rate plus 0.02 gal/sy will not be measured for payment. Measurement will not be made of any curing seal used to replace curing seal lost by heavy rains which occur after placing the curing seal.

Blotting Sand will be paid as provided for in Article 818-4.

Payment will be made under:

Pay Item	Pay Unit
Asphalt Curing Seal	Gallon

**SECTION 545
INCIDENTAL STONE BASE**

545-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, furnishing, hauling, placing and shaping a graded stone material for use in driveways, temporary maintenance of traffic, adjacent to mailboxes, beneath traffic island, median covers and at any other locations, other than use as a part of any base course on which pavement is to be placed; shaping; tamping when required; maintaining the base; and disposing of any surplus stockpiled material.

545-2 MATERIALS

Use stone, gravel or recycled concrete for the graded stone material which is well graded from the 1-1/2 inches through the No. 200 sieve sizes in accordance with Section 1006. The liquid limit of the recycled concrete is raised 5 points to no more than 35.

545-3 GRADATION SAMPLING, TESTING AND ACCEPTANCE

Acceptance of the graded stone material will be made by visual inspection and approval by the Engineer as being satisfactory for the purpose intended before its use. No sampling or testing of the graded stone material will be performed.

545-4 PLACING AND SHAPING STONE

Spread the stone material uniformly over the area required and then shape and dress to the satisfaction of the Engineer.

Uniformly spread, grade to the required depth and firmly tamp the stone material beneath traffic island and median covers. If the Contractor desires, the surface of the stone material may be covered with a sufficient amount of fine material to facilitate grading and shaping.

545-5 MAINTENANCE

Maintain the stone material until final acceptance of the project by reshaping and by the addition of incidental stone base material when directed by the Engineer.

Maintain all stone material beneath traffic islands and median covers in satisfactory condition until the covers are placed.

545-6 MEASUREMENT AND PAYMENT

Incidental Stone Base will be measured and paid at the contract unit price per ton that has been stockpiled or incorporated into the completed and accepted work. This quantity will be

Section 560

- 1 measured as provided for in Article 520-11. Incidental stone base which has been stockpiled
- 2 will not be measured more than one time.
- 3 Payment will be made under:

Pay Item	Pay Unit
Incidental Stone Base	Ton

DIVISION 6
ASPHALT PAVEMENTS

Section 607

**SECTION 607
MILLING ASPHALT PAVEMENT**

607-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, milling and re-milling the pavement at locations, depths, widths and typical sections indicated in the contract; cleaning the milled surface; loading, hauling and stockpiling the milled material for use in recycled asphalt mixtures; and disposal of any excess milled material.

Section 607

Except where the milled material is used in the work or where otherwise directed by the Engineer, provide areas outside the right of way to dispose of milled material, which shall be property of the Contractor.

607-2 EQUIPMENT

Use a self-propelled unit capable of removing the existing asphalt pavement to the depths, widths and typical sections shown in the contract. Use milling machines designed and built exclusively for pavement milling operations and with sufficient power, traction and stability to accurately maintain depth of cut and slope. Use milling machines equipped with an electronic control system that will automatically control the longitudinal profile and cross slope of the milled pavement surface. Accomplish this through the use of a mobile grade reference, an erected string line, joint matching shoe, slope control systems or a combination of approved methods. Use an erected fixed stringline when required by the contract. Otherwise, use a mobile grade reference system capable of averaging the existing grade or pavement profile over at least 30 feet. Use either a non-contacting laser or sonar type ski systems with at least 3 referencing stations mounted on the milling machine at a length of at least 24 feet. Coordinate the position of the grade control system such that the grade sensor is at the approximate midpoint of the mobile reference system. Use a machine capable of leaving a uniform surface suitable for handling traffic without damage to the underlying pavement structure. Use a milling machine and other loading equipment capable of loading milled material to be used in other parts of the work without segregation.

Provide additional equipment necessary to satisfactorily remove the pavement in the area of manholes, water valves, curb, gutter and other obstructions.

Equip the milling equipment with a means of effectively limiting the amount of dust escaping from the removal operation in accordance with Federal, State and local air pollution control laws and regulations.

607-3 CONSTRUCTION METHODS

Mill the existing pavement to restore the pavement surface to a uniform longitudinal profile and cross section in accordance with typical sections shown in the plans. Where indicated in the contract, remove pavement to a specified depth and produce a specified cross slope. Mill intersections and other irregular areas unless otherwise directed by the Engineer.

The Contractor may elect to make multiple cuts to achieve the required depth of cut or cross slope required by the plans.

Establish the longitudinal profile of the milled surface by a mobile string line on the side of the cut nearest the centerline of the road. Establish the cross slope of the milled surface by an automatic cross slope control mechanism or by a second skid sensing device located on the opposite edge of the cut. The Engineer may waive the requirement for automatic grade and cross slope controls where conditions warrant.

Operate the milling equipment so as to prevent damage to the underlying pavement structure, utilities, drainage facilities, curb and gutter, paved surfaces outside the milled area and any other appurtenances. Produce milled pavement surfaces that are reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves or other damage. Repair any leveling or patching required as a result of negligence by the Contractor with hot asphalt plant mix in a manner acceptable to the Engineer. Coordinate the adjustment of manholes, meter boxes and valve boxes with the milling operation in accordance with Article 858-3 including a temporary asphalt ramp. Variable depth milling is intended to improve the cross-sectional slope of the pavement.

Section 607

When necessary, the contractor may remove the top section of a utility and use a bridge steel plate placed to cover the entire width of the structure, ensuring no debris is dropped inside the structure. Backfill with compacted material and hot mix asphalt as a temporary riding surface as well as any further necessary requirements of the utility owner. This steel plate must be capable of carrying any traffic load carried by the facility. Where necessary, double-reference the location of each structure that has been removed and maintain a map of their location. Construct a temporary ramp of asphalt plant mix to extend a minimum of 3 feet around raised structures before opening to traffic.

The Engineer may require re-milling of any area exhibiting pavement laminations, scabbing or other defects. "Scabbing" is defined as a thin layer of existing pavement that remains after milling and has the potential to delaminate. Thoroughly clean the milled pavement surface of all loose aggregate particles, dust and other objectionable material. Disposing or wasting of oversize pieces of pavement or loose aggregate material will not be permitted within the right of way.

Conduct pavement removal operations so as to effectively minimize the amount of dust being emitted. Plan and conduct the operation so it is safe for persons and property adjacent to the work including the traveling public.

607-4 TOLERANCE

Remove the existing pavement to the depth required by the contract. The Engineer may vary the depth of milling by not more than one inch. In the event the directed depth of milling cut is altered by the Engineer more than one inch, either the Department or the Contractor may request an adjustment in unit price in accordance with Article 104-3. In administering Article 104-3, the Department will give no consideration to value given to RAP due to the deletion or reduction in quantity of milling. Article 104-3 will not apply to the item of *Incidental Milling*.

607-5 MEASUREMENT AND PAYMENT**(A) Milled Asphalt Pavement**

Milled Asphalt Pavement, ___" Depth will be measured and paid as the actual number of square yards of pavement surface milled in accordance with this specification. In measuring this quantity, the length will be the actual length milled, measured along the pavement surface. The width will be the width required by the plans or directed by the Engineer, measured along the pavement surface. Areas to be paid under this item include mainline travel lanes, full width turn lanes greater than 500 feet in length, collector lanes, shoulders, and any additional equipment necessary to remove pavement in the area of manholes, water valves, curb, gutter and other obstructions.

(B) Variable Depth Milled Asphalt Pavement

Milling Asphalt Pavement, ___" to ___" will be measured and paid as the actual number of square yards of pavement surface milled in accordance with this specification. In measuring this quantity, the length will be the actual length milled, measured along the pavement surface. The width will be the width required by the plans or directed by the Engineer, measured along the pavement surface. Areas to be paid under this item include mainline travel lanes, full width turn lanes greater than 500 feet in length, collector lanes, shoulders, and any additional equipment necessary to remove pavement in the area of manholes, water valves, curb, gutter and other obstructions.

For each square yard that the Engineer directs to be milled, including, but not limited to, the mainline, turn lanes, bus loading and unloading areas, widening for bus or truck U-turns, shoulders, intersections and crossovers requiring any additional equipment necessary to remove pavement in the area of manholes, water valves, curb, gutter and other obstructions, compensation will be made at the contract unit price per square yard for *Milling Asphalt Pavement, ___" Depth* or *Milling Asphalt Pavement, ___" to ___"*.

Section 609

(C) Incidental Milling

Incidental Milling to be paid will be the actual number of square yards of surface milled where the Contractor is required to mill butt joints, irregular areas, full width turn lanes 500 feet or less, intersections and re-mill areas that are not due to the Contractor's negligence. In measuring this quantity, the length will be the actual length milled, measured along the pavement surface. The width will be the width required by the plans or directed by the Engineer, measured along the pavement surface. Where the Contractor elects to make multiple cuts to achieve the final depth, no additional measurement will be made. Compensation will be made at the contract unit price per square yard for *Incidental Milling*.

(D) Milling of Defects

If defects are determined to be the result of the Contractor's negligence, then measurement for the re-milling or repairs will not be made. If the Engineer directs re-milling of an area and is not due to the Contractor's negligence, the re-milled area will be measured as provided in Subarticle 607-5(C) and paid at the contract unit price per square yard for *Incidental Milling*.

Payment will be made under:

Pay Item

Milling Asphalt Pavement, ___" to ___"
Milling Asphalt Pavement, ___" Depth
Incidental Milling

Pay Unit

Square Yard
Square Yard
Square Yard

SECTION 609

QUALITY MANAGEMENT SYSTEM FOR ASPHALT PAVEMENTS

609-1 DESCRIPTION

Produce and construct asphalt mixtures and pavements in accordance with a quality management system as described herein. Apply these *Standard Specifications* to all materials and work performed in accordance with Division 6. Perform all quality control (QC) activities in accordance with the Department's *Asphalt Quality Management System (QMS) Manual* in effect on the date of contract advertisement.

(A) Quality Control (QC)

Define a "quality control (QC) program" as all activities, including mix design, process control, plant and equipment calibration, sampling and testing and necessary adjustments in the process that are related to production of a pavement that meet the *Standard Specifications*. Provide and conduct a QC program in accordance with this section.

(B) Quality Assurance (QA)

Define a "quality assurance (QA) program" as all activities, including inspection, sampling and testing related to determining that the quality of the completed pavement conforms to specification requirements. The Department will conduct a QA program in accordance with Article 609-9.

609-2 MIX DESIGN/JOB MIX FORMULA REQUIREMENTS

Apply all requirements of Article 610-3.

609-3 FIELD VERIFICATION OF MIXTURE AND JOB MIX FORMULA ADJUSTMENTS

Conduct field verification of the mix at each plant within 45 calendar days before initial production of each mix design, when required by the *Allowable Mix Adjustment Policy* as

Section 609

defined in Section 7.4 of the *Asphalt QMS Manual* and when directed by the Engineer as deemed necessary.

Field verification testing consists of performing a minimum of one full test series on mix sampled and tested in accordance with Subarticle 609-6(B). Mix obtained from Department or non-Department work may be used for this purpose provided it is sampled, tested and the test data handled in accordance with the *Asphalt QMS Manual* and this article.

Obtain the mix verification sample and split in accordance with procedures in the *Asphalt QMS Manual*. Do not begin normal plant production until all field verification test results have been completed and the mix has been satisfactorily verified by the Contractor's Level II technician.

In addition to the required sampling and testing for field verification, perform all preliminary inspections and plant calibrations as outlined in the *Asphalt QMS Manual*. Retain records of these calibrations and mix verification tests at the QC laboratory. Furnish copies to the Engineer for review and approval within one working day after beginning production of the mix.

Failure by the Contractor to fully comply with the above mix verification requirements will result in immediate production stoppage by the Engineer. Do not resume normal production until all mix verification sampling, testing, calibrations and plant inspections have been performed and approved by the Engineer.

609-4 CONTRACTOR'S QUALITY CONTROL PERSONNEL REQUIREMENTS

Obtain all certifications in accordance with the Department's QMS Asphalt Technician Certification Program as outlined in the *Asphalt QMS Manual*. Perform all sampling, testing, data analysis and data posting by or under the direct supervision of a certified QMS asphalt plant technician.

Provide a certified asphalt plant technician Level I to perform QC operations and activities at each plant site at all times during production of material for the project. A plant operator who is a certified asphalt plant technician Level I may be used to meet this requirement when daily production for each mix design is less than 100 tons provided the randomly scheduled increment sample as defined in Section 7.3 of the *Asphalt QMS Manual* is not within that tonnage. When performing in this capacity, the plant operator will be responsible for all QC activities that are necessary and required. Absences of the Level I technician, other than those for normal breaks and emergencies shall be pre-approved by the appropriate Engineer or his designated representative. Any extended absence of the technician that has not been approved will result in immediate suspension of production by the Engineer. All mix produced during this absence will be accepted in accordance with Article 105-3.

Provide and have readily available a certified asphalt plant technician Level II to supervise, coordinate and make any necessary adjustments in the mix QC process in a timely manner. The Level II technician may serve in a dual capacity and fulfill the Level I technician requirements specified above.

Provide a certified QMS roadway technician with each paving operation at all times during placement of asphalt. This person is responsible for monitoring all roadway paving operations and all QC processes and activities, to include stopping production or implementing corrective measures when warranted. Provide a certified density gauge operator when density control is being used.

Post in the QC laboratory an organizational chart, including names, telephone numbers and current certification numbers of all personnel responsible for the QC program while asphalt paving work is in progress.

Section 609

609-5 CONTRACTOR'S QUALITY CONTROL FIELD LABORATORY REQUIREMENTS

For a contract with 5,000 or more total tons of asphalt mix, furnish and maintain a Department certified laboratory at the plant site meeting the minimum requirements outlined in Section 7.2 of the *Asphalt QMS Manual*.

For a contract with less than 5,000 total tons of asphalt mix, the QC testing may be conducted in a Department certified off-site laboratory meeting the requirements.

Provide testing equipment as required in Section 7.2 of the *Asphalt QMS Manual*. Provide equipment that is properly calibrated and maintained. Allow all measuring and testing devices to be inspected to confirm both calibration and condition. If at any time the Engineer determines that the equipment is not operating properly or is not within the limits of dimensions or calibration described in the applicable test method, the Engineer may stop production until corrective action is taken. Maintain and have available a record of all calibration results at the laboratory.

609-6 PLANT MIX QUALITY CONTROL

(A) General

Include in the QC process the preliminary inspections, plant calibrations and field verification of the mix and JMF in accordance with the *Asphalt QMS Manual*. Obtain all scheduled samples at randomly selected locations in accordance with the *Asphalt QMS Manual*. Log all samples taken on forms provided by the Department. Split and retain all samples taken in accordance with the *Asphalt QMS Manual*. Provide documentation as required in Article 609-8. Identify any additional QC samples taken and tested on the appropriate forms. Process control test results shall not be plotted on control charts nor reported to the QA Laboratory.

Retain and store all samples in accordance with the requirements of Section 7.5 of the *Asphalt QMS Manual*.

(B) Required Sampling and Testing Frequencies

Maintain minimum test frequencies as established in the schedule below. Complete all tests within 24 hours of the time the sample is taken, unless specified otherwise within these provisions. If the specified tests will not be completed within the required time frame, cease production at that point until such time the tests are completed.

If the Contractor's testing frequency fails to meet the minimum frequency requirements as specified, all mix without the specified test representation will be unsatisfactory. The Engineer will evaluate if the mix may remain in place in accordance with Article 105-3.

Sample and test the completed mixture from each JMF at the following minimum frequency during mix production:

<u>Accumulative Production Increment</u>	<u>Number of Samples per Increment</u>
750 tons	1

If production is discontinued or interrupted before the accumulative production increment tonnage is completed, continue the increment on the next production day(s) until the increment tonnage is completed. Obtain a random sample within the specified increment at the location determined in accordance with the *Asphalt QMS Manual*. Conduct QC testing on each random sample in accordance with Section 7.3 of the *Asphalt QMS Manual*. When daily production of each mix design exceeds 100 tons and a regularly scheduled full test series on a sample from a random sample location for that JMF does not occur during that day's production, perform at least one partial test series in accordance with Section 7.3 of the *Asphalt QMS Manual*. These partial test series and

Section 609

associated tests do not substitute for the regularly scheduled random sample for that increment.

(C) Control Charts

Maintain standardized control charts furnished by the Department at the field laboratory. For mix incorporated into the project, record full test series data from all regularly scheduled random samples or samples directed by the Engineer that replace regularly scheduled random samples, on control charts the same day the test results are obtained.

Record QC sample data on the standardized control charts in accordance with Section 7.4 of the *Asphalt QMS Manual*.

Maintain a continuous moving average with the following exceptions.

Re-establish a new moving average only when:

- (1) A change in the binder percentage, aggregate blend or G_{mm} is made on the JMF, or
- (2) When the Contractor elects to stop or is required to stop production after one or two moving average values, respectively, fall outside the moving average limits as outlined in Table 609-1, or
- (3) Failure to stop production after 2 consecutive moving averages exceed the moving average limits occurs, but production does stop at a subsequent time, re-establish a new moving average beginning at the actual production stop point.

In these cases, re-establish the moving averages for all mix properties. Moving averages will not be re-established when production stoppage occurs due to an individual test result exceeding the individual test limits or the *Standard Specifications*.

All individual test results for regularly scheduled random samples or samples directed by the Engineer that replace regularly scheduled samples are part of the plant QC record and shall be included in moving average calculations with the following exception. When the Contractor's testing data has been proven incorrect, use the correct data as determined by the Engineer instead of the Contractor's data to determine the appropriate pay factor in accordance with Section 7.20.1 of the *Asphalt QMS Manual*. In this case, replace the data in question and any related data proven incorrect.

(D) Control Limits

Establish control limits for mix production in accordance with Table 609-1. Control limits for the moving average limits are based on a moving average of the last 4 data points. Apply all control limits to the applicable target source.

TABLE 609-1 CONTROL LIMITS			
Mix Control Criteria	Target Source	Moving Average Limit	Individual Limit
2.36 mm Sieve	JMF	± 4.0%	± 8.0%
1.18mm Sieve (S4.75A only)	JMF	± 4.0%	± 8.0%
0.075 mm Sieve	JMF	± 1.5%	± 2.5%
Binder Content	JMF	± 0.3%	± 0.7%
VTM @ N_{des}	JMF	± 1.0%	± 2.0%
VMA @ N_{des}	Min. Spec. Limit	Min. Spec. Limit	- 1.0%
$P_{0.075}/P_{be}$ Ratio	1.0	± 0.4 %	± 0.8%
% G_{mm} @ N_{ini}	Max. Spec. Limit	-	+ 2.0%
TSR	Min. Spec. Limit	-	- 15%

Section 609

(E) Corrective Actions

All required corrective actions are based upon initial test results and shall be taken immediately upon obtaining those results. If more than one corrective action or adjustment applies, give precedence to the more severe of these actions. Stopping production when required takes precedence over all other corrective actions. Document all corrective actions.

If the process adjustment improves the property in question such that the moving average after 4 additional tests is on or within the moving average limits, the Contractor may continue production.

When any of the following occur, production of a mix shall cease immediately:

- (1) An individual test result for a mix control criteria (including results for required partial test series on mix) exceeds both the individual test control limits and the applicable specification design criteria, or
- (2) Two consecutive field TSR values fail to meet the minimum specification requirement, or
- (3) Two consecutive binder content test results exceed the individual limits, or
- (4) Two consecutive moving average values for any one of the mix control criteria fall outside the moving average limits.

Do not resume normal plant production until one of the following has occurred.

Option 1: Approval has been granted by the appropriate QA supervisor.

Option 2: The mix in question has been satisfactorily verified in accordance with Section 7.4 of the *Asphalt QMS Manual*. Normal production may resume based on the approval of the contractor's Level II technician, provided notification and the verification test results have been furnished to the QA Laboratory.

Failure to fully comply with any of the above corrective actions will result in immediate production stoppage by the Engineer. Normal production shall not resume until a complete verification process has been performed and approved by the Engineer.

Failure to stop production when required will make all mix unacceptable from the stop point tonnage to the point when Option 1 or Option 2 occurs or to the tonnage point when production is actually stopped, whichever occurs first.

In any case, remove and replace this mix with materials that comply with the *Standard Specifications*, unless otherwise approved by the Engineer. The Engineer will evaluate acceptance of the mix in question based on Articles 105-3 and 609-11.

Immediately notify the Engineer when any moving average value exceeds the moving average limit. If two consecutive moving average values for any one of the mix control criteria fall outside the moving average limits, immediately cease production of that mix and make adjustments. The Contractor may elect to stop production after only one moving average value falls outside the moving average limits. In either case, do not determine a new moving average until the fourth test after the elective or mandatory stop in production.

(F) Allowable Resampling and Retesting for Mix Deficiencies

The Contractor shall resample and retest for plant mix deficiencies when warranted as outlined in Section 7.19 of the *Asphalt QMS Manual*. Perform the retesting within 10 days after initial test results are determined. Retests for any mix deficiency other than as listed below will not be allowed, unless otherwise permitted.

Section 609

The Department reserves the right to require the Contractor to resample and retest at any time or location as directed by the Engineer.

**TABLE 609-2
RETEST LIMITS FOR MIX DEFICIENCIES**

Property	Limit
VTM	by more than $\pm 2.5\%$
VMA	by more than $\pm 2.0\%$
% Binder Content	by more than $\pm 1.0\%$
0.075 mm sieve	by more than $\pm 3.0\%$
2.36 mm sieve	exceeds both the Specification mix design limits and one or more of the above tolerances
TSR	by more than - 15% from Specification limit

609-7 FIELD COMPACTION QUALITY CONTROL

(A) General

Perform QC of the compaction process in accordance with these provisions and applicable requirements of Article 610-10. The Contractor may elect to use either pavement core samples or density gauge readings as the method of density control. Provide to the Department at the pre-construction conference the method of density QC that will be used on the project.

Establish acceptable control strips when required at locations approved by the Engineer and in accordance with the *Asphalt QMS Manual*. In addition, place control strips anytime deemed necessary by the Engineer.

Perform density sampling and testing on all pavements as outlined in Sections 10.4 and 10.6 of the *Asphalt QMS Manual* unless otherwise approved by the Engineer.

Perform the sampling and testing at the minimum test frequencies as specified. If the density testing frequency fails to meet the minimum frequency as specified, all mix without the required density test representation will be unsatisfactory. The Engineer will evaluate if the mix may remain in place in accordance with Article 105-3.

(B) Limited Production Procedures

Define “resurfacing” as the first new uniform layer placed on an existing pavement. Proceed on limited production when, for the same mix type and on the same contract, one of the following conditions occur (except as noted below).

(1) Two consecutive failing lots, except on resurfacing,

(2) Three consecutive failing lots on resurfacing, or

(3) Two consecutive failing density gauge control strips.

As exceptions to the above, pavement within each construction category (New and Other), as defined in Section 10.3.3 of the *Asphalt QMS Manual*, and pavement placed simultaneously by multiple paving crews will be evaluated independently for limited production purposes.

Limited production is defined as the production, placement and compaction of a sufficient quantity of mix to construct a 300 feet control strip plus 100 feet of pavement adjacent to each end of the control strip.

Remain on limited production until such time as satisfactory density results are attained or until two control strips have been attempted without achieving acceptable density test results. If the Contractor fails to achieve satisfactory density after two control strips have been attempted, cease production of that mix type until such time as the cause of the failing density test results can be determined. As an exception, the Engineer may grant

Section 609

approval to produce a different mix design of the same mix type if Quality Control and Quality Assurance plant mix test indicate the failing densities are attributed to the mix problem(s) rather than compaction related problems and limited production startup would not be required. The determination of whether a mix problem exists at this time will be made by QA personnel.

If the Contractor does not operate by the limited production procedures when conditions as specified in Section 10.9 of the *Asphalt QMS Manual*, all mix produced thereafter will be unacceptable. Remove this material and replace with material that complies with the *Standard Specifications*, at no additional cost to the Department.

609-8 CONTRACTOR QUALITY CONTROL DOCUMENTATION (RECORDS)

Document all QC activities, records of inspection, samples taken, adjustments to the mix and test results on a daily basis. Note the results of observations and records of inspection as they occur in a permanent field record. Record adjustment to mix production and test results on forms provided. Process control sample test results are for the Contractor's informational purposes only.

Make all such records available to the Engineer, upon request, at any time during project construction. Complete and maintain all QC records and forms and distribute in accordance with the *Asphalt QMS Manual*. Submit data electronically using the Department's software. Failure to maintain QC records and forms as required, or to provide these records and forms to the Engineer upon request, may result in production stoppage, placement stoppage, technician certification revocation and removal from the NCDOT Certified Asphalt Plant List until the problem is resolved.

Falsification of test results, documentation of observations, records of inspection, adjustments to the process, discarding of samples and/or test results or any other deliberate misrepresentation of the facts will result in the revocation of the applicable person's QMS certification. The Engineer will determine acceptability of the mix and/or pavement represented by the falsified results or documentation. If the mix and/or pavement in question is determined to be acceptable, the Engineer may allow the mix to remain in place at no pay for the mix, asphalt binder and other mix components. If the mix or pavement represented by the falsified results is determined not to be acceptable, remove and replace with mix that complies with the *Standard Specifications*.

609-9 QUALITY ASSURANCE

The Department's QA program will be conducted by a certified QMS technician(s) and will be accomplished based on the requirements of Section 7.6 for mix and Sections 10.5 and 10.7 for density in the *Asphalt QMS Manual*.

Differences between the Contractor's and the Department's split sample test results will be acceptable if within the limits of precision in Table 609-3.

Section 609

**TABLE 609-3
LIMITS OF PRECISION FOR TEST RESULTS**

Mix Property	Limits of Precision
25.0 mm sieve (Base Mix)	± 10.0%
19.0 mm sieve (Base Mix)	± 10.0%
12.5 mm sieve (Intermediate & Type P-57)	± 6.0%
9.5 mm sieve (Surface Mix)	± 5.0%
4.75 mm sieve (Surface Mix)	± 5.0%
2.36 mm sieve (All Mixes, except S4.75A)	± 5.0%
1.18 mm sieve (S4.75A)	± 5.0%
0.075 mm sieve (All Mixes)	± 2.0%
Asphalt Binder Content	± 0.5%
Maximum Specific Gravity (G_{mm})	± 0.020
Bulk Specific Gravity (G_{mb})	± 0.030
TSR	± 15.0%
QA retest of prepared QC Gyratory Compacted Volumetric Specimens	± 0.015
Retest of QC Core Sample	± 1.2% (% Compaction)
Comparison QA Core Sample	± 2.0% (% Compaction)
QA Verification Core Sample	± 2.0% (% Compaction)
Density Gauge Comparison of QC Test	± 2.0% (% Compaction)
QA Density Gauge Verification Test	± 2.0% (% Compaction)

The Engineer will immediately investigate the reason for differences if any of the following occur: QA test results of QC split sample does not meet above limits of precision, QA test results of QC split sample does not meet the individual test control limits or the specification requirements or QA verification sample test results exceed the allowable retesting tolerances.

If the potential for a pavement failure exist, the Engineer may suspend production, wholly or in part, in accordance with Article 108-7 while the investigation is in progress. The Engineer's investigation may include, but not be limited to: review and observation of the QC technician's sampling and testing procedures, evaluation and calibration of QC and QA testing equipment, comparison testing of other retained quality control samples, and/or comparison testing of additional density core samples.

The Engineer will periodically witness the sampling and testing being performed by the Contractor. If the Engineer observes that the sampling and QC tests are not being performed in accordance with the applicable test procedures, the Engineer may stop production until corrective action is taken. The Engineer will promptly notify the Contractor of observed deficiencies, both verbally and in writing. The Engineer will document all witnessed samples and tests.

609-10 ACCEPTANCE

Final acceptance of the asphalt pavement will be made by the Department in accordance with the following:

(A) Mix Acceptance

The Engineer will base final acceptance of the mix on the results of random testing made on split samples during the assurance process, verification samples, retests (if applicable) and validation of the Contractor's quality control process conducted in accordance with specifications.

(B) Density Acceptance

The Department will evaluate the asphalt pavement for density compliance after the asphalt mix has been placed and compacted using the Contractor's quality control test

Section 610

results, the Department’s quality assurance test results (including verification samples) and by observation of the Contractor’s total density quality control process conducted in accordance with specifications.

609-11 MEASUREMENT AND PAYMENT

Any mix produced that is not verified may be assessed a price reduction at the Engineer’s discretion in addition to any reduction in pay due to mix or density deficiencies.

Produce and construct all asphalt mixtures and pavements in accordance with these *Standard Specifications*. There will be no direct payment for work covered by this Specification. Payment at the contract unit prices for the various asphalt items will be full compensation for all work covered by these specifications.

If the mix or pavement represented by the falsified results is removed and replaced, payment will be made for the actual quantities of materials required to replace the falsified quantities, not to exceed the original amounts.

**SECTION 610
ASPHALT CONCRETE PLANT MIX PAVEMENTS**

610-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, the construction of one or more courses of asphalt mixture placed on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical sections shown on the plans. This work includes producing, weighing, transporting, placing and compacting the plant mix; furnishing aggregate, asphalt binder, anti-strip additive and all other materials for the plant mix; furnishing and applying tack coat as specified; furnishing scales; maintaining the course until final acceptance of the project; making any repairs or corrections to the course that may become necessary; providing and conducting QC as specified in Section 609; and surface testing of the completed pavement. The design requirements for the various mix types are given in Section 610 for dense-graded mix types, Section 650 for OGFC, Section 652 for PADC and Section 661 for UBWC.

Perform all activities in accordance with the Department’s *Asphalt Quality Management System (QMS) Manual* in effect on the date of contract advertisement

Provide and conduct the QC and required testing for acceptance of the asphalt mixture in accordance with Section 609.

Define “warm mix asphalt (WMA)” as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed. Use only NCDOT approved WMA additives listed on the NCDOT APL maintained by the Materials and Tests Unit.

610-2 MATERIALS

Refer to Division 10.

Item	Section
Anti-Strip Additives	1020-8
Asphalt Binder, Performance Grade	1020-2
Coarse Aggregate	1012-1(B)
Fine Aggregate	1012-1(C)
Mineral Filler	1012-1(D)
Reclaimed Asphalt Pavement (RAP)	1012-1(F)
Reclaimed Asphalt Shingles (RAS)	1012-1(E)
Silicone	1020-9

Section 610

610-3 COMPOSITION OF MIXTURES (MIX DESIGN AND JOB MIX FORMULA)**(A) Mix Design-General**

Prepare the asphalt mix design using a mixture of coarse and fine aggregate, asphalt binder, mineral filler and other additives when required. Size, uniformly grade and combine the several aggregate fractions in such proportions that the resulting mixture meets the grading and physical requirements of the *Standard Specifications* for the specified mix type. Materials that will not produce a mixture within the design criteria required by the specifications will be rejected, unless otherwise approved by the Engineer.

At least 10 days excluding official state holidays before start of asphalt mix production, submit the mix design and proposed JMF targets for each required mix type and combination of aggregates to the Engineer for review and approval. Prepare the mix design using a Department certified mix design technician in an approved mix design laboratory and in accordance with the procedures outlined in Section 4.5 of the *Asphalt QMS Manual*.

For the final surface layer of the specified mix type, use a mix design with an aggregate blend gradation above the maximum density line on the 2.36 mm and larger sieves.

The Contractor has the option to use a recycled plant mix in lieu of virgin plant mix. However, all provisions of the specifications for virgin mixes apply to recycled mixes. This means that the same design criteria tests, test frequencies, and quality control requirements will apply.

Reclaimed Asphalt Pavement (RAP) or Reclaimed Asphalt Shingles (RAS) may be incorporated into asphalt plant mixes in accordance with Article 1012-1 and the following applicable requirements. However, use of RAP materials is not allowed in Open-Graded Friction Course (OGFC) mixes or Ultra-Thin Bonded Wearing Course (UBWC) mixes. Use of RAS materials is not allowed in Ultra-Thin Bonded Wearing Course (UBWC) mixes.

RAS material may constitute up to 6% by weight of total mixture, except for Open Graded Friction Course (OGFC) mixes, which are limited to 5% RAS by weight of total mixture. Also, when the percentage of RAP is greater than 30% by weight of total mixture, use Fractionated RAP (FRAP) meeting the requirements of Subarticle 1012-1(F)(c).

When RAP, RAS, or a combination of both is used in asphalt mixtures, the recycled binder replacement percentage (RBR%) shall not exceed the amounts specified in Table 610-4 for the mix type. For recycled mixtures, the virgin binder Performance Grade (PG) grade to be used is specified in Table 610-5 for the mix type based on the recycled binder replacement percentage (RBR%).

If the Contractor wishes to submit mix designs containing recycled material amounts exceeding the specified maximums, additional testing will be required to verify the Performance Grade (PG) of the reclaimed binder. Also, the Contractor has the option to have additional testing performed to determine if the mix can be approved using a virgin binder grade different than specified in Table 610-5. The Engineer will determine if the binder grade is acceptable for use based on the test data submitted with the mix design. If the mix design is acceptable, the Engineer will establish and approve the grade and percentage of virgin asphalt binder to be used.

If a change in the source of RAP or RAS be made, a new mix design and JMF may be required in accordance with Article 1012-1. Samples of the completed recycled mixture may be taken by the Department on a random basis and the recovered asphalt binder will be tested in accordance with Article 1020-2. If the grading is determined to be a value other than required for the specified mix type, the Engineer may require the Contractor to

Section 610

adjust any combination of the grade, the percentage of additional asphalt binder or the blend of reclaimed material to bring the grade to the specified value.

(B) Mix Design Criteria

Design and produce asphalt concrete mixtures that conform to the gradation requirements and design criteria in Table 610-2 and Table 610-3 for the mix type specified. The mix type designates the nominal maximum aggregate size and the design traffic level.

Surface mix designs will be tested by the Department for rutting susceptibility. Rut depth requirements for each surface mix type and traffic level are specified in Table 610-3. Mix designs that fail to meet these requirements will be unacceptable and shall be redesigned by the Contractor such that rut depths are acceptable.

Table 610-2 provides gradation control points to be adhered to in the development of the design aggregate structure for each mix type. Aggregate gradations shall be equal to or pass between the control points. Table 610-3 provides the mix design criteria for the various mix types.

Use an anti-strip additive in all asphalt mixes. It may be hydrated lime or a chemical additive or a combination of both as needed to meet the retained strength requirements as specified in Table 610-3. When a chemical additive is used, add at a rate of not less than 0.25% by weight of binder in the mix, or as approved by the Engineer. When hydrated lime is used, add at a rate of not less than 1.0% by weight of the total dry aggregate.

(C) Job Mix Formula (JMF)

Establish the JMF gradation target values within the design criteria specified for the particular type of asphalt mixture to be produced. Establish the JMF asphalt binder content at the percentage that will produce voids in total mix (VTM) at the midpoint of the specification design range for VTM, unless otherwise approved by the Engineer. The formula for each mixture will establish the following: blend percentage of each aggregate fraction, the percentage of reclaimed aggregate, if applicable, a single percentage of combined aggregate passing each required sieve size, the total percentage and grade of asphalt binder required for the mixture (by weight of total mixture), the percentage and grade of asphalt binder to be added to the mixture (for recycled mixtures), the percentage of chemical anti-strip additive to be added to the asphalt binder or percentage of hydrated lime to be added to the aggregate, the temperature at that the mixture is to be discharged from the plant, the required field density and other volumetric properties.

When WMA is used, document the additive or process used and recommended rate on the JMF submittal. Verify the JMF based on plant produced mixture from the trial batch.

The mixing temperature at the asphalt plant will be established on the JMF. The JMF mix temperature shall be within the ranges shown in Table 610-1 unless otherwise approved by the Engineer.

TABLE 610-1	
MIXING TEMPERATURE AT THE ASPHALT PLANT	
Binder Grade	JMF Temperature
PG 58-28; PG 64-22	250 - 290°F
PG 76-22	300 - 325°F

When RAS is used, the JMF mix temperature shall be established at 275°F or higher.

Have on hand at the asphalt plant the approved mix design and JMF issued by the Department, before beginning the work.

The JMF for each mixture will remain in effect until modified in writing, provided the results of QMS tests performed in accordance with Section 609 on material currently

Section 610

being produced conform with specification requirements. When a change in sources of aggregate materials is to be made, a new mix design and JMF will be required before the new mixture is produced. When a change in sources of RAP or RAS material is to be made, a new JMF is required and a new mix design may be required. When unsatisfactory results or other conditions make it necessary, the Engineer may revoke the existing JMF or establish a new JMF.

TABLE 610-2
AGGREGATE GRADATION CRITERIA
(Percent Passing Control Points)

Standard Sieves (mm)	Mix Type (Nominal Max. Aggregate Size)							
	4.75 mm		9.5 mm ^A		19.0 mm		25.0 mm	
	Min	Max	Min	Max	Min	Max	Min	Max
50.0	-	-	-	-	-	-	-	-
37.5	-	-	-	-	-	-	100	-
25.0	-	-	-	-	100	-	90.0	100
19.0	-	-	-	-	90.0	100	-	90.0
12.5	100	-	100	-	-	90.0	-	-
9.50	95.0	100	90.0	100	-	-	-	-
4.75	90.0	100	-	90.0	-	-	-	-
2.36	-	-	32.0 ^B	67.0 ^B	23.0	49.0	19.0	45.0
1.18	30.0	60.0	-	-	-	-	-	-
0.075	6.0	12.0	4.0	8.0	3.0	8.0	3.0	7.0

- A.** For the final surface layer of the specified mix type, use a mix design with an aggregate blend gradation above the maximum density line on the 2.36 mm and larger sieves.
- B.** For Type S9.5B, the percent passing the 2.36 mm sieve shall be a minimum of 60% and a maximum of 70%.

TABLE 610-3
MIX DESIGN CRITERIA

Mix Type	Design ESALs millions ^A	Binder PG Grade	Compaction Levels		Max. Rut Depth (mm)	Volumetric Properties ^B			
			G _{mm} @			VMA	VTM	VFA	%G _{mm}
			N _{ini}	N _{des}		% Min.	%	Min.-Max.	@ N _{ini}
S4.75A	< 1	64 - 22	6	50	11.5	16.0	4.0 - 6.0	65 - 80	≤ 91.5
S9.5B	0 - 3	64 - 22	6	50	9.5	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S9.5C	3 - 30	64 - 22	7	65	6.5	15.5	3.0 - 5.0	65 - 78	≤ 90.5
S9.5D	> 30	76 - 22	8	100	4.5	15.5	3.0 - 5.0	65 - 78	≤ 90.0
I19.0C	ALL	64 - 22	7	65	-	13.5	3.0 - 5.0	65 - 78	≤ 90.5
B25.0C	ALL	64 - 22	7	65	-	12.5	3.0 - 5.0	65 - 78	≤ 90.5
	Design Parameter					Design Criteria			
All Mix Types	Dust to Binder Ratio (P _{0.075} / P _{be})					0.6 - 1.4 ^C			
	Tensile Strength Ratio (TSR) ^D					85% Min ^E			

- A.** Based on 20 year design traffic.
- B.** Volumetric Properties based on specimens compacted to N_{des} as modified by the Department.
- C.** Dust to Binder Ratio (P_{0.075} / P_{be}) for Type S4.75A is 1.0 - 2.0.
- D.** NCDOT-T-283 (No Freeze-Thaw cycle required).
- E.** TSR for Type S4.75A & B25.0C mixes is 80% minimum.

Section 610

TABLE 610-4 MAXIMUM RECYCLED BINDER REPLACEMENT PERCENTAGE (RBR%)			
Recycled Material	Intermediate & Base Mixes	Surface Mixes	Mixes Using PG 76-22
RAS	23%	20%	18%
RAP or RAP/RAS Combination	45%	40%	18%

TABLE 610-5 BINDER GRADE REQUIREMENTS (BASED ON RBR%)			
Mix Type	%RBR ≤ 20%	21% ≤ %RBR ≤ 30%	%RBR > 30%
S4.75A, S9.5B, S9.5C, I19.0C, B25.0C	PG 64-22	PG 64-22 ^A	PG 58-28
S9.5D, OGFC	PG 76-22 ^B	n/a	n/a

A. If the mix contains any amount of RAS, the virgin binder shall be PG 58-28.

B. Maximum Recycled Binder Replacement (%RBR) is 18% for mixes using PG 76-22 binder.

610-4 WEATHER, TEMPERATURE AND SEASONAL LIMITATIONS FOR PRODUCING AND PLACING ASPHALT MIXTURES

Do not produce or place asphalt mixtures during rainy weather, when the subgrade or base course is frozen or when the moisture on the surface to be paved would prevent proper bond. Do not place asphalt material when the air or surface temperatures, measured at the location of the paving operation away from artificial heat, do not meet Table 610-6.

Do not place surface course material that is to be the final layer of pavement between December 15 and March 16 of the next year if it is 1 inch or greater in thickness, or between November 15 and April 1 of the next year if it is less than 1 inch in thickness, unless otherwise approved by the Engineer.

As an exception to the above, when in any day's operations the placement of a layer of asphalt base course material or intermediate material 2 inches or greater in thickness has started, it may continue until the temperature drops to 32°F.

Do not place plant mix base course that will not be covered with surface or intermediate course during the same calendar year or within 15 days of placement if the plant mix is placed in January or February. Failure by the Contractor to cover the plant mix as required above will result in the Engineer notifying the Contractor in writing to cover the plant mix with a sand seal. Apply the sand seal in accordance with Section 660, except that Articles 660-3 and 660-12 will not apply. In the event the Contractor fails to apply the sand seal within 72 hours of receipt of such notice, the Engineer may proceed to have such work performed with Department forces and equipment.

Section 610

TABLE 610-6 PLACEMENT TEMPERATURES FOR ASPHALT	
Asphalt Concrete Mix Type	Minimum Surface and Air Temperature
B25.0C	35°F
I19.0C	35°F
S4.75A, S9.5B, S9.5C	40°F ^A
S9.5D	50°F

A. For the final layer of surface mixes containing recycled asphalt shingles (RAS), the minimum surface and air temperature shall be 50°F.

610-5 ASPHALT MIXTURE PRODUCTION

Use plants that are either of the batch mixing, continuous mixing or drum mixing type, and so designed, equipped and operated that the weighing, proportioning and mixing of the materials will result in a uniform and satisfactory asphalt mixture meeting these specifications. All plants shall conform to requirements of Sections 5 and 6 of the *Asphalt QMS Manual*.

Before production of the mix, stockpile aggregates for a sufficient period of time to facilitate the drainage of free moisture. Keep the different aggregate sizes separated until they have been delivered to the cold feeders. Keep the separate stockpiles readily accessible for sampling. When mineral filler is required in the mix, feed or weigh-in separately from the other aggregates.

Introduce the asphalt binder and other additives, when required, into the mixture at the amounts and percentages specified by the JMF. No working tolerance will be allowed. Introduce the hot and dry aggregates, mineral filler, and recycled materials, in amounts and at temperatures such that the mixture produced is within the production control limits of Subarticle 609-6(D). Provide a positive means of controlling mixing time to obtain complete and uniform coating of the aggregate particles and thorough distribution of the asphalt binder throughout the aggregate. Produce the mixture at the asphalt plant within ± 25 °F of the JMF mix temperature. The temperature of the mixture, when discharged from the mixer, shall not exceed 350°F.

All asphalt plants shall be certified by the Department. Certification is effective from the date of issuance and is non-expiring subject to continued compliance. The Department will check the plant on an annual basis or as deemed necessary by the Engineer. Any plant that is relocated, modified or changes ownership shall be recertified before use.

Any completely automatically controlled asphalt plant that, due to the basic design of the plant, does not meet all these specifications for conventional batch mixing, continuous mixing or drum mixing may be used on a project by project basis provided a uniformly consistent mix meeting all mix requirements can be produced and the plant has been approved in writing by the Department.

Any asphalt plant that cannot consistently produce a high quality mix meeting these specifications will be in non-compliance with these specifications and may have its certification revoked.

Upon a malfunction of required automatic equipment on a batch mixing plant, the plant may continue to operate manually for the following 2 consecutive working days, provided acceptable mixture is being produced.

When a malfunction of required automatic equipment on a drum mixer or continuous plant occurs, manual operation of the plant will not be allowed except that if, in the opinion of the Engineer, an emergency traffic condition exists, the plant may be allowed to operate manually until the unsafe traffic condition is corrected. All mix produced by manual operation will be subject to Section 609.

Section 610

610-6 HOT MIX STORAGE SYSTEMS

When a storage system is used, provide a system capable of conveying the mix from the plant to the storage bin and storing the mix without a loss in temperature, segregation or oxidation of the mix. Limit storage time to the ability of the storage system to maintain the mix within the specification requirements. Material may be stored in storage bins without an approved heating system for no more than 24 hours.

Provide a continuous type or skip bucket type conveyor system. Enclose continuous type conveyors so that the mix temperature is maintained within specification requirements. Provide a system designed in such manner as to prevent segregation of the mix during discharge from the conveyor into the bins and equipped with discharge gates that will not cause segregation of the mix while loading the mix into trucks.

610-7 HAULING OF ASPHALT MIXTURE

Transport the mixture from the mixing plant to the point of use in vehicles that have tight, clean, smooth beds approved by the Department, that have been sprayed with an approved release agent material to prevent the mixture from adhering to the beds. Remove excess release agent before loading. Cover each load of mixture with a solid, waterproof tarp constructed of canvas, vinyl, or other suitable material. Provide a 3/8 inch to 5/8 inch diameter hole on each side of the vehicle body near the center of the body and above the bed of the vehicle for the purpose of inserting a thermometer.

Assure temperature of the mixture immediately before discharge from the hauling vehicle is within a tolerance of $\pm 25^{\circ}\text{F}$ of the specified JMF mix temperature.

610-8 SPREADING AND FINISHING

Apply tack coat in accordance with Section 605.

Mixtures produced simultaneously from different plant sources cannot be intermingled by hauling to the same paver on the roadway unless the mixtures are being produced from the same material sources and same JMF.

As referenced in Section 9.6.3 of the *Asphalt QMS Manual*, use the automatic screed controls on the paver to control the longitudinal profile. Where approved by the Engineer, the Contractor has the option to use either a fixed or mobile string line.

Perform this work in accordance with and using equipment meeting Section 9 of the *Asphalt QMS Manual*.

Use a material transfer vehicle (MTV) when placing all asphalt concrete plant mix pavements which require the use of asphalt binder grade PG 76-22 and for all types of OGFC, unless otherwise approved by the Engineer. Use a MTV for all surface mix regardless of binder grade on Interstates, US Routes, NC Routes (primary routes) that have 4 or more lanes and are median divided. Where required above, use the MTV when placing all full width travel lanes and collector lanes. Use MTV for all ramps, loops, and Y-lines that have 4 or more lanes and are median divided, and all full width acceleration lanes, full width deceleration lanes, and full width turn lanes that are greater than 1,000 feet in length. Use a MTV meeting Section 9.5(E) of the *Asphalt QMS Manual*.

Place asphalt concrete base course material in trench sections with asphalt pavement spreaders made for the purpose or with other equipment approved by the Engineer.

Request the Engineer to waive the requirement for use of pavers for spreading and finishing where irregularities or obstacles make their use impractical. Spread, rake and lute the mixture by hand methods or other approved methods in these areas.

Operate the paver as continuously as possible. Pave intersections, auxiliary lanes and other irregular areas after the main line roadway has been paved, unless otherwise approved by the

Section 610

Engineer. Place a wedge course at locations ahead of the paving operation as required by the Engineer.

Repair any damage caused by hauling equipment across structures at no additional cost to the Department.

610-9 COMPACTION

Immediately after the asphalt mixture has been spread, struck off and surface and edge irregularities adjusted, thoroughly and uniformly compact the pavement. Compact the mix to the required degree of compaction for the type of mixture being placed.

Provide sufficient number and weight of rollers, except as noted, to compact the mixture to the required density while it is still in a workable condition. Obtain approval of equipment used in compaction from the Engineer before use. Where uniform density is not being obtained throughout the depth of the layer of material being tested, change the type and/or weight of the compaction equipment as necessary to achieve uniform density even though such equipment has been previously approved.

Compact all final wearing surfaces, except OGFC, using a minimum of two steel-wheel tandem rollers, unless otherwise approved by the Engineer. Pneumatic-tire rollers with two tandem axles and smooth tread tires may be used for intermediate rolling.

Limit rolling for OGFC to one coverage with a tandem steel-wheel roller weighing a maximum of 10 tons, with additional rolling limited to one coverage with the roller where necessary to improve the riding surface.

Steel-wheel tandem vibratory rollers specifically designed for the compaction of asphalt pavements may be used on all layers 1 inch or greater in thickness during the breakdown and intermediate rolling phase. Do not operate vibratory rollers in the vibratory mode during the finish rolling phase on any mix type or pavement course, OGFC or on PADC.

When vibratory rollers are used, use rollers that have variable amplitude and frequency capabilities and that are designed specifically for asphalt pavement compaction. Provide rollers equipped with controls that automatically disengage the vibration mechanism before the roller stops when being used in the vibratory mode.

The Engineer may prohibit or restrict the use of vibratory rollers where damage to the pavement being placed, the underlying pavement structure, bridges, drainage structures, utilities or other facilities is likely to occur or is evident.

Do not use rolling equipment that results in excessive crushing of the aggregate or excessive displacement of the mixture.

In areas inaccessible to standard rolling equipment, thoroughly compact the mixture by the use of hand tampers, hand operated mechanical tampers, small rollers or other methods approved by the Engineer.

Use rollers that are in good condition and capable of being reversed without backlash to compact the mixture. Operate rollers with the drive wheels nearest the paver and at uniform speeds slow enough to avoid displacement of the mixture. Equip steel-wheel rollers with wetting devices that will prevent the mixture from sticking to the roller wheels.

Begin compaction of the material immediately after the material is spread and shaped to the required width and depth. Carry out compaction in such a manner as to obtain uniform density over the entire section. Perform compaction rolling at the maximum temperature at which the mix will support the rollers without moving horizontally. Complete the compaction (including both intermediate rolling) before the mixture cooling below a workable temperature. Perform finish rolling to remove roller marks resulting from the compaction rolling operations.

Section 610

610-10 DENSITY REQUIREMENTS

TABLE 610-7 DENSITY REQUIREMENTS	
Mix Type	Minimum % G _{mm} (Maximum Specific Gravity)
S4.75A	85.0 ^A
S9.5B	90.0
S9.5C, S9.5D, I19.0C, B25.0C	92.0

A. Compaction to the above specified density shall be required when the S4.75A mix is applied at a rate of 100 lbs/sy or higher.

Compact the asphalt plant mix to at least the minimum percentage of the maximum specific gravity listed in Table 610-7, except as noted in Section 10.3.4 of the *Asphalt QMS Manual*.

Compaction with equipment other than conventional steel drum rollers may be necessary to achieve adequate compaction. Occasional density sampling and testing to evaluate the compaction process may be required. The Contractor shall maintain minimum test frequencies as established. Should the Contractor's density testing frequency fail to meet the minimum frequency as, all mix without required density test representation shall be considered unsatisfactory and if allowed to remain in place, will be evaluated for acceptance in accordance with Article 105-3.

610-11 JOINTS

(A) Transverse Joints

When the placing of the mixture is to be suspended long enough to permit the mixture to become chilled, construct a transverse joint.

If traffic will not pass over the end of the paving, a butt joint will be permitted, provided proper compaction is achieved. If traffic will pass over the joint, construct a sloped wedge ahead of the end of the full depth pavement to provide for proper compaction and protection of the full depth pavement. Construct the joint square to the lane alignment and discard all excess material. Place a paper parting strip beneath this wedge to facilitate joint construction unless waived by the Engineer.

Before paving operations are resumed, remove the sloped wedge and cut back into the previously constructed pavement to the point of full pavement depth. Coat the exposed edge of the previously constructed pavement with tack coat.

When laying of the mixture is resumed at the joint, complete and then test the construction of the joint in accordance with Article 610-12 while the mixture is still in a workable condition.

(B) Longitudinal Joints

Tack the exposed edge of all longitudinal joints before placing the adjoining pavement.

Form longitudinal joints by allowing the paver to deposit the mixture adjacent to the joint to such depth that maximum compaction can be obtained along the joint. Pinch the joint by rolling immediately behind the paver.

When multi-lane multi-layer construction is required, offset the longitudinal joints in each layer from that in the layer immediately below by approximately 6 inches. Construct the joints in the final layer, where possible, between designated travel lanes of the final traffic pattern.

Section 610**610-12 SURFACE REQUIREMENTS AND ACCEPTANCE**

Construct pavements using quality-paving practices as detailed herein. Construct the pavement surface smooth and true to the plan grade and cross slope. Immediately correct any defective areas with satisfactory material compacted to conform with the surrounding area.

Pavement imperfections resulting from unsatisfactory workmanship such as segregation, improper longitudinal joint placement or alignment, non-uniform edge alignment or excessive pavement repairs will be unsatisfactory. Pavement imperfections will be evaluated for acceptance in accordance with Article 105-3.

When directed by the Engineer due to unsatisfactory laydown or workmanship, operate under the limited production procedures. Limited production for unsatisfactory laydown is defined as being restricted to the production, placement, compaction and final surface testing (if applicable) of a sufficient quantity of mix necessary to construct only 2,500 feet of pavement at the laydown width.

Remain on limited production until such time as satisfactory laydown results are obtained or until three consecutive 2,500 feet sections have been attempted without achieving satisfactory laydown results. If the Contractor fails to achieve satisfactory laydown results after three consecutive 2,500 feet sections have been attempted, cease production of that mix type until such time as the cause of the unsatisfactory laydown results can be determined. As an exception, the Engineer may grant approval to produce a different mix design of the same mix type if the cause is related to mix problems rather than laydown procedures.

Mix placed under the limited production procedures for unsatisfactory laydown or workmanship will be evaluated for acceptance in accordance with Article 105-3.

Each pavement layer will be tested by the Contractor and the Engineer using a 10 foot stationary straightedge furnished by the Contractor. Any location on the pavement selected by the Department shall be tested as well as all transverse joints. Apply the straightedge parallel to the centerline of the surface. Do not exceed 1/8 inch variation of the surface being tested from the edge of the straightedge between any two contact points. Correct areas found to exceed this tolerance by removal of the defective work and replacement with new material, unless other corrective measures are permitted. Provide the work and materials required in the correction of defective work.

610-13 FINAL SURFACE TESTING AND ACCEPTANCE

On portions of this project where the typical section requires two or more layers of new pavement, perform smoothness acceptance testing of the longitudinal profile of the finished pavement surface using either an Inertial Profiler or a North Carolina Hearne Straightedge (Model No. 1). Final surface testing is not required on ramps, loops and turn lanes.

Use an Inertial Profiler (Option 1) to perform smoothness acceptance testing of the longitudinal profile of the finished pavement surface. Furnish an inertial profiler(s) necessary to perform this work. Maintain responsibility for all costs related to the procurement, handling, and maintenance of these devices.

Furnish and operate the Hearne straightedge (Option 2) to determine and record the longitudinal profile of the pavement on a continuous graph.

Before beginning any paving operations, the Contractor shall select one of the above options and submit documentation to the Engineer on the selected option for smoothness acceptance.

(A) Option 1 - Inertial Profiler

Use an Inertial Profiler to measure the longitudinal pavement profile for construction quality control and smoothness acceptance. Use a profiler with line laser technology as single-point laser technology will not be allowed. Produce International Roughness Index (IRI) and Mean Roughness Index (MRI) values for measuring smoothness.

Section 610

1 Use testing and recording software to produce electronic inertial road profiles in a format
2 compatible with the latest version of FHWA's ProVAL (Profile Viewing and Analysis)
3 software.

4 The Inertial Profiler shall be calibrated and verified in accordance with the most current
5 version of AASHTO M 328. Provide certification documentation that the profiler meets
6 AASHTO M 328 to the Engineer before the first day the Inertial Profiler is used on the
7 project.

8 Configure the profiler to record the actual elevation of the pavement surface. Do not use
9 the profiler's internal IRI calculation mode. The profile data shall be filtered with a
10 300 feet Butterworth high-pass filter. The interval at which relative profile elevations are
11 reported shall be 1 inch.

12 Provide IRI data in accordance with most current version of ASTM E1926. Use
13 personnel trained to record and evaluate IRI data.

14 Provide an Inertial Profiler Operator that has been certified by the Department's Profiler
15 and Operator Certification Program as administered by the Materials and Tests Unit.
16 Provide the user selected Inertial Profiler settings to the Engineer for the project records.

17 In the presence of the Engineer, at the beginning of each day's data collection, perform a
18 block test to verify the Inertial Profiler's ability to accurately collect elevation data is met
19 and perform bounce test to verify that the Inertial Profiler's accelerometers are
20 performing correctly.

21 Remove all objects and foreign material on the pavement surface prior to longitudinal
22 pavement profile testing.

23 In the presence of the Engineer, operate the profiler at any speed as per the
24 manufacturer's recommendations to collect valid data. Operate the Inertial Profiler in the
25 direction of the final traffic pattern. Collect IRI data from both wheel paths during the
26 same run. Define a "wheel path" as the 3 feet from the edge of the travel lane. MRI
27 values are the average of the IRI values from both wheel paths. When using an inertial
28 profiler that collects a single trace per pass, take care to ensure that the measurements
29 from each trace in a travel lane start and stop at the same longitudinal locations. Unless
30 otherwise specified, multiple runs are not necessary for data collection.

31 Operate the automatic triggering method at all times unless impractical. Areas excluded
32 from testing by the profiler may be tested using a 10-foot straightedge in accordance with
33 Article 610-12. The profiler shall reach the intended operating speed before entering the
34 test section. The runup and runout distances should be sufficient to obtain the intended
35 operating speed and to slow down after testing is completed.

36 Divide the pavement surface for the project into sections which represent a continuous
37 placement (i.e. the start of the project to bridge, intersection to intersection). Terminate
38 a section 50 feet before a bridge approach, railroad track, or similar interruption.
39 (Separate into 0.10-mile sections).

40 The evaluation of the profiles will be performed on a section basis. A section is
41 0.10 mile of a single pavement lane. For any section, which is less than 0.10 mile in
42 length, the applicable pay adjustment incentive will be prorated on the basis of the actual
43 length.

44 Mark the limits of structures and other special areas to be excluded from testing using the
45 profiler's event identifier such that the exact locations can be extracted from the profile
46 data file during processing.

47 Unless otherwise authorized by the Engineer, perform all smoothness testing in the
48 presence of the Engineer. Perform smoothness tests on the finished surface of the
49 completed project or at the completion of a major stage of construction as approved by

Section 610

the Engineer. Coordinate with and receive authorization from the Engineer before starting smoothness testing. Perform smoothness tests within 7 days after receiving authorization. Any testing performed without the Engineer's presence, unless otherwise authorized, may be ordered retested at the Contractor's expense.

After testing, transfer the profile data from the profiler portable computer's hard drive to a write once storage media (Flash drive, USB, DVD-R or CD-R) or electronic media approved by the Engineer. Label the disk or electronic media with the Project number, Route, file number, date, and termini of the profile data. Submit the electronic data on the approved media to the Engineer immediately after testing and this media will not be returned to the Contractor.

Submit a report with the documentation and electronic data of the evaluation for each section to the Engineer within 10 days after completion of the smoothness testing. The report shall be in the tabular format for each 0.10 segment or apportion thereof with a summary of the MRI values and the localized roughness areas including corresponding project station numbers or acceptable reference points. Calculate the pay adjustments for all segments in accordance with the formulas in Sections (1) and (2) shown below. The Engineer shall review and approve all pay adjustments unless corrective action is required. Submit the electronic files compatible with ProVAL and the evaluation in tabular form with each 0.10 mile segment occupying a row. Include each row with the beginning and ending station for the section, the length of the section, the original IRI values from each wheel path, and the MRI value for the section. Each continuous run for a section will occupy a separate table and each table will have a header that includes the following: the project contract number, county, the roadway number or designation, a lane designation, the JMF used for the final lift, the dates of the smoothness runs, and the beginning and ending station of the continuous run. Summarize each table at the bottom.

Traffic control and all associated activities included in the pavement smoothness testing of the pavement surface will be the responsibility of the Contractor.

(1) Acceptance for New Construction

IRI and MRI numbers recorded in inches per mile will be established for each 0.10 mile section for each travel lane of the surface course designated by the contract. Areas excluded from testing by the profiler will be tested using a 10 foot straightedge in accordance with Article 610-12.

Table 610-8 provides the acceptance quality rating scale of pavement based on the final rideability determination.

TABLE 610-8	
MRI PRICE ADJUSTMENT PER 0.10-MILE SECTION	
MRI after Completion (Inches Per Mile)	Price Adjustment Per Lane (0.10-Mile Section)
45.0 and Under	\$200.00
45.1-55.0	$PA = 600 - (10 * MRI)$
55.1-70.0	Acceptable (No Pay Adjustment)
70.1-90.0	$PA = 650 - (10 * MRI)$
Over 90.1	Corrective Action Required

This price adjustment will apply to each 0.10-mile section or prorated for a portion thereof, based on the Mean Roughness Index (MRI), the average IRI values from both wheel paths.

When corrections to the pavement surface are required, the Engineer shall approve the Contractor's method of correction. Methods of correction shall be milling and inlay, remove and replace or other methods approved by the Engineer. To produce a uniform cross section, the Engineer may require correction to the adjoining traffic

Section 610

lanes or shoulders. Corrections to the pavement surface, the adjoining traffic lanes and shoulders will be at no cost to the Department.

Where corrections are made after the initial smoothness testing, the pavement will be retested by the Contractor to verify that corrections have produced the acceptable ride surface. No incentives will be provided for sections on which corrective actions have been required. The Contractor will have one opportunity to perform corrective action(s).

(2) Localized Roughness

Areas of localized roughness shall be identified through the “Smoothness Assurance Module (SAM)” provided in the ProVAL software. Use the SAM report to optimize repair strategies by analyzing the measurements from profiles collected using inertial profilers. The ride quality threshold for localized roughness shall be 165 inches per mile for any sections that are 15 feet to 100 feet in length at the continuous short interval of 25 feet. Submit a continuous roughness report to identify each section with project station numbers or reference points outside the threshold and identify all localized roughness, with the signature of the Operator included with the submitted IRI trace and electronic files.

The Department will require that corrective action be taken regardless of final IRI. Re-profile the corrected area to ensure that the corrective action was successful. If the corrective action is not successful, the Department will assess a penalty or require additional corrective action.

$$PA = (165 - LR\#) 5$$

Where:

PA = Pay Adjustment (dollars)

LR# = The Localized Roughness number determined from SAM report for the ride quality threshold

Corrective work for localized roughness shall be approved by the Engineer before performing the work and shall consist of either replacing the area by milling and inlaying or other methods approved by the Engineer. Any corrective action performed shall not reduce the integrity or durability of the pavement that is to remain in place. Milling and inlay or any corrective actions shall meet the specifications requirements for ride quality over the entire length of the correction. Notify the Engineer five days before commencement of the corrective action.

Localized roughness correction work shall be for the entire traffic lane width. Pavement cross slope shall be maintained through corrective areas.

(B) Option 2 - North Carolina Hearne Straightedge

Push the straightedge manually over the pavement at a speed not exceeding 2 miles per hour. For all lanes, take profiles in the right wheel path approximately 3 feet from the right edge of pavement in the same direction as the paving operation, unless otherwise approved by the Engineer due to traffic control or safety considerations. As an exception, lanes adjacent to curb and gutter, expressway gutter, or shoulder berm gutter may be tested in the left wheel path. Make one pass of the straightedge in each full width travel lane. The full lane width should be comparable in ride quality to the area evaluated with the Hearne Straightedge. If deviations exist at other locations across the lane width, use a 10 foot non-mobile straightedge or the Hearne Straightedge to evaluate which areas may require corrective action. Take profiles as soon as practical after the pavement has been rolled and compacted, but no later than 24 hours following placement of the pavement, unless otherwise authorized by the Engineer. Take profiles over the entire length of the final surface travel lane pavement exclusive of structures, approach slabs, paved shoulders, tapers, or other irregular shaped areas of pavement, unless otherwise approved

Section 610

by the Engineer. Test in accordance with this provision all mainline travel lanes, full width acceleration or deceleration lanes, and collector lanes.

At the beginning and end of each day's testing operations, and at such other times as determined by the Engineer, operate the straightedge over a calibration strip so that the Engineer can verify correct operation of the straightedge. The calibration strip shall be a 100 foot section of pavement that is reasonably level and smooth. Submit each day's calibration graphs with that day's test section graphs to the Engineer. Calibrate the straightedge in accordance with the Section 11.1.4 of the *Asphalt QMS Manual*.

Plot the straightedge graph at a horizontal scale of approximately 25 feet per inch with the vertical scale plotted at a true scale. Record station numbers and references (bridges, approach slabs, culverts, etc.) on the graphs. Distances between references/stations shall not exceed 100 feet. Have the operator record the Date, Project No., Lane Location, Wheel Path Location, Type Mix and Operator's Name on the graph.

Upon completion of each day's testing, evaluate the graph, calculate the Cumulative Straightedge Index (CSI) and determine which lots, if any, require corrective action. Document the evaluation of each lot on a *QA/QC-7 form*. Submit the graphs along with the completed *QA/QC-7 forms* to the Engineer, within 24 hours after profiles are completed, for verification of the results. The Engineer will furnish results of their acceptance evaluation to the Contractor within 48 hours of receiving the graphs. In the event of discrepancies, the Engineer's evaluation of the graphs will prevail for acceptance purposes. The Engineer will retain all graphs and forms.

Use blanking bands of 0.2 inch, 0.3 inch and 0.4 inch to evaluate the graph for acceptance. The 0.2 inch and 0.3 inch blanking bands are used to determine the Straightedge Index (SEI), which is a number that indicates the deviations that exceed each of the 0.2 inch and 0.3 inch bands within a 100 foot test section. The Cumulative Straightedge Index (CSI) is a number representing the total of the SEIs for one lot, which consist of not more than 25 consecutive test sections. In addition, the 0.4 inch blanking band is used to further evaluate deviations on an individual basis. The CSI will be determined by the Engineer in accordance with Section 11.1.5 of the *Asphalt QMS Manual*.

The pavement will be accepted for surface smoothness on a lot by lot basis. A test section represents pavement one travel lane wide not more than 100 feet in length. A lot will consist of 25 consecutive test sections, except that separate lots will be established for each travel lane, unless otherwise approved by the Engineer. In addition, full width acceleration or deceleration lanes, ramps, turn lanes and collector lanes will be evaluated as separate lots. For any lot that is less than 2,500 feet in length, the applicable pay adjustment incentive will be prorated on the basis of the actual lot length. For any lot which is less than 2,500 feet in length, the applicable pay adjustment disincentive will be the full amount for a lot, regardless of the lot length.

If during the evaluation of the graphs, five lots require corrective action, then proceed on limited production for unsatisfactory laydown in accordance with Article 610-12. Proceeding on limited production is based upon the Contractor's initial evaluation of the straightedge test results and shall begin immediately upon obtaining those results. Additionally, the Engineer may direct the Contractor to proceed on limited production in accordance with Article 610-12 due to unsatisfactory laydown or workmanship.

Limited production for unsatisfactory laydown is defined as being restricted to the production, placement, compaction and final surface testing of a sufficient quantity of mix necessary to construct only 2,500 feet of pavement at the laydown width. Once this lot is complete, the final surface testing graphs will be evaluated jointly by the Contractor and the Engineer. Remain on limited production until such time as acceptable laydown results are obtained or until three consecutive 2,500 foot sections have been attempted without achieving acceptable laydown results. The Engineer will determine if normal

Section 610

production may resume based upon the CSI for the limited production lot and any adjustments to the equipment, placement methods, and/or personnel performing the work. Once on limited production, the Engineer may require the Contractor to evaluate the smoothness of the previous asphalt layer and take appropriate action to reduce and/or eliminate corrective measures on the final surface course. Additionally, the Contractor may be required to demonstrate acceptable laydown techniques off the project limits before proceeding on the project.

If the Contractor fails to achieve satisfactory laydown results after three consecutive 2,500 foot sections have been attempted, cease production of that mix type until such time as the cause of the unsatisfactory laydown results can be determined.

As an exception, the Engineer may grant approval to produce a different mix design of the same mix type if the cause is related to mix problem(s) rather than laydown procedures. If production of a new mix design is allowed, proceed under the limited production procedures detailed above.

After initially proceeding under limited production, the Contractor shall immediately notify the Engineer if any additional lot on the project requires corrective action. The Engineer will determine if limited production procedures are warranted for continued production.

If the Contractor does not operate by the limited production procedures as specified above, the 5 lots, which require corrective action, will be considered unacceptable and may be subject to removal and replacement. Mix placed under the limited production procedures for unsatisfactory laydown will be evaluated for acceptance in accordance with Article 105-3.

The pay adjustment schedule for the Cumulative Straightedge Index (CSI) test results per lot is in Table 610-9.

TABLE 610-9 PAY ADJUSTMENT SCHEDULE FOR CUMULATIVE STRAIGHTEDGE INDEX (Obtained by adding SE Index of up to 25 consecutive 100 ft test sections)				
CSI ^A	Acceptance Category	Corrective Action	Pay Adjustment Before Corrective	Pay Adjustment After Corrective Action
0-0	Acceptable	None	\$300 Incentive	None
1-0 or 2-0	Acceptable	None	\$100 Incentive	None
3-0 or 4-0	Acceptable	None	No Adjustment	No Adjustment
1-1, 2-1, 5-0 or 6-0	Acceptable	Allowed	\$300 Disincentive	\$300 Disincentive
3-1, 4-1, 5-1 or 6-1			\$600 Disincentive	
Any other Number	Unacceptable	Required	Per CSI after Correction(s) (not to exceed 100% Pay)	

A. Either Before or After Corrective Actions

Correct any deviation that exceeds a 0.4 inch blanking band such that the deviation is reduced to 0.3 inch or less.

Corrective actions shall be performed at the Contractor's expense and shall be presented for evaluation and approval by the Engineer prior to proceeding. Any corrective action performed shall not reduce the integrity or durability of the pavement that is to remain in place. Corrective action for deviation repair may consist of overlaying, removing and replacing, indirect heating and rerolling. Scraping of the pavement with any blade type device will not be allowed as a corrective action. Provide overlays of the same type mix,

Section 610

full roadway width, and to the length and depth established by the Engineer. Tapering of the longitudinal edges of the overlay will not be allowed.

Corrective actions will not be allowed for lots having a CSI of 4-0 or better. If the CSI indicates Allowed corrective action, the Contractor may elect to take necessary measures to reduce the CSI instead of accepting the disincentive. Take corrective actions as specified if the CSI indicates required corrective action. The CSI after corrective action shall meet or exceed Acceptable requirements.

Where corrective action is allowed or required, the test section(s) requiring corrective action will be retested, unless the Engineer directs the retesting of the of the entire lot. No disincentive will apply after corrective action if the CSI is 4-0 or better. If the retested lot after corrective action has a CSI indicating a disincentive, the appropriate disincentive will be applied.

Test sections and/or lots that are initially tested by the Contractor that indicate excessive deviations such that either a disincentive or corrective action is necessary, may be re-rolled with asphalt rollers while the mix is still warm and in a workable condition, to possibly correct the problem. In this instance, reevaluation of the test section(s) shall be completed within 24 hours of pavement placement and these test results will serve as the initial test results.

Incentive pay adjustments will be based only on the initially measured CSI, as determined by the Engineer, before any corrective work. Where corrective actions have been taken, payment will be based on the CSI determined after correction, not to exceed 100% payment.

Areas excluded from testing by the N.C. Hearne Straightedge will be tested by using a non-mobile 10-foot straightedge. Assure that the variation of the surface from the testing edge of the straightedge between any 2 contact points with the surface is not more than 1/8 inch. Correct deviations exceeding the allowable tolerance in accordance with the corrective actions specified above, unless the Engineer permits other corrective actions.

Furnish the North Carolina Hearne Straightedge(s) necessary to perform this work. Maintain responsibility for all costs relating to the procurement, handling, and maintenance of these devices. The Department has entered into a license agreement with a manufacturer to fabricate, sell and distribute the N.C. Hearne Straightedge. The Department's Pavement Construction Section may be contacted for the name of the current manufacturer and the approximate price of the straightedge.

610-14 DENSITY ACCEPTANCE

The Department will evaluate the asphalt pavement for density acceptance after the asphalt mix has been placed and compacted using the Contractor's QC test results, the Department's QA test results (including verification samples) and by observation of the Contractor's density QC process. Minimum density requirements for all mixes will be as specified in Table 610-7. Density acceptance will be as provided in Section 10 of the *Asphalt QMS Manual*.

A failing lot for density acceptance purposes is defined as a lot for which the average of all test sections, and portions thereof, fails to meet the minimum specification requirement. If additional density sampling and testing, beyond the minimum requirement, is performed and additional test sections are thereby created, then all test results shall be included in the lot average. In addition, any lot or portion of a lot that is obviously unacceptable will be rejected for use in the work.

If the Engineer determines that a given lot of mix that falls in the New category does not meet the minimum specification requirements but the work is reasonably acceptable, the lot will be accepted at a reduced pay factor in accordance with the following formula. The reduced pay factor will apply only to the mix unit price.

Section 610

$$\text{Reduced Pay Factor} = 100 + \left[\left(\frac{\text{Actual Density} - \text{Specified Density}}{2} \right) \times 30 \right]$$

Where:

Actual Density = the lot average density, not to exceed 2.0% of the specified density

Specified Density = the density in Table 610-7 or as specified in the contract

1 All failing lots in the Other category will be evaluated for acceptance in accordance with
2 Article 105-3.

3 Any density lot not meeting minimum density requirements detailed in Table 610-7 will be
4 evaluated for acceptance in accordance with Article 105-3. If the lot is determined not to be
5 acceptable, the mix will be removed and replaced with mix meeting and compacted to the
6 requirement of these specifications.

7 **610-15 MAINTENANCE**

8 Maintain the plant mix pavement in an acceptable condition until final acceptance of the
9 project. Immediately repair any defects or damage that may occur. Perform maintenance to
10 damaged or defective pavement and repeat as often as may be necessary to keep the base or
11 pavement in an acceptable condition.

12 **610-16 MEASUREMENT AND PAYMENT**

13 *Hot Mix Asphalt Pavement* will be paid at the contract unit price per ton that will be the actual
14 number of tons of each type of hot mix asphalt pavement incorporated into the completed and
15 accepted work in accordance with Article 106-7.

16 No direct payment will be made for providing and using the materials transfer vehicle or any
17 associated equipment, as the cost of providing same will be included in the contract unit bid
18 price per ton for the mix type to be placed.

19 Any reduction in pay due to failing density will be in addition to any reduction in pay due to
20 failing mix property test results on the same mix.

21 A high frequency of asphalt plant mix or density deficiencies may result in future deficient
22 asphalt being excluded from acceptance at an adjusted contract unit price in accordance with
23 Article 105-3. This acceptance process will apply to all asphalt produced or placed and will
24 continue until the Engineer determines a history of quality asphalt production and placement
25 is reestablished.

26 Furnishing asphalt binder will be paid as provided in Article 620-4 for *Asphalt Binder for*
27 *Plant Mix* for each grade required.

28 Provide the work and materials required in the correction of defective work or sand seal base
29 course as required at no cost to the Department. If the Engineer has such work performed
30 with Department forces and equipment, the cost of such work performed by Department
31 forces will be deducted from monies due or to become due to the Contractor.

32 No direct payment will be made for final surface testing covered by this section. Payment at
33 the contract unit prices for the various items covered by those sections of the specifications
34 directly applicable to the work constructed will be full compensation for all work covered by
35 Article 610-13 including, but not limited to, performing testing in accordance with this
36 specification, any corrective work required as a result of this testing and any additional traffic
37 control as may be necessary.

Section 620

Payment will be made under:

Pay Item	Pay Unit
Asphalt Concrete Base Course, Type B25.0C	Ton
Asphalt Concrete Intermediate Course, Type I19.0C	Ton
Asphalt Concrete Surface Course, Type S4.75A	Ton
Asphalt Concrete Surface Course, Type S9.5B	Ton
Asphalt Concrete Surface Course, Type S9.5C	Ton
Asphalt Concrete Surface Course, Type S9.5D	Ton

SECTION 620 ASPHALT BINDER FOR PLANT MIX

620-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, furnishing of asphalt binder, with anti-strip additive when required, at an asphalt plant and incorporating the asphalt binder and anti-strip additive into the asphalt plant mix.

620-2 MATERIALS

Refer to Division 10.

Item	Section
Anti-strip Additives	1020-8
Asphalt Binder, All Grades	1020-2
Silicone	1020-9

The asphalt binder for the mixture will be accepted at the source subject to Article 1020-1.

Use additives from the NCDOT APL. Submit a sample and manufacturer's data to the Engineer for approval before use, if proposing to use a brand not on the NCDOT APL.

620-3 GENERAL REQUIREMENTS

The requirements of Section 610 that pertain to handling of asphalt binder will be applicable to the work covered by this section.

Add silicone to all asphalt binder used in surface courses and open-graded asphalt friction course, unless otherwise directed by the Engineer. The amount of silicone added will range from one ounce per 2,000 gal of asphalt binder to one ounce per 2,500 gal. Add silicone to the asphalt binder at the plant site unless added at the source and it is so noted on the delivery ticket.

Do not heat the asphalt binder to a temperature in excess of the supplier's recommendation while stored or when being used in production of mix at the asphalt plant.

Introduce the actual quantity of asphalt binder at the established percentage shown on the applicable JMF into the mix by the plant weighing or metering system. No working tolerance for asphalt binder percentage will be allowed during production.

When required, incorporate an anti-strip additive. It may be either chemical additive mixed with the asphalt binder or hydrated lime added to the aggregate or a combination of both. Furnish the brand name of the type (lime or chemical), supplier and shipping point of anti-strip additive. Note on the asphalt binder delivery ticket the rate (or quantity), brand of chemical additive when added at the supplier's terminal. Introduce and mix chemical anti-strip additive into the asphalt binder at either the supplier's terminal or at the asphalt plant site at the dosage required by the JMF. Use in-line blending equipment at either location. When added at the asphalt plant, use equipment that meets Sections 5 and 6 of the *Asphalt QMS Manual*. When added at the supplier's terminal, use equipment that in-line blends with a constant flow of the additive for a minimum of 80% of the asphalt binder loading time. When

hydrated lime is used, use equipment to introduce the lime that meets Sections 5 and 6 of the *Asphalt QMS Manual*. Thoroughly mix chemical anti-strip additive and asphalt binder together before incorporating into the asphalt plant mix.

620-4 MEASUREMENT AND PAYMENT

Asphalt Binder for Plant Mix and *Polymer Modified Asphalt Binder for Plant Mix* will be measured and paid as the theoretical number of tons required by the applicable JMF based on the actual number of tons of plant mix completed and accepted on the job.

Such price and payment will be full compensation for all work covered by this section.

There will be no direct payment for anti-strip additive. Payment at the contract unit prices for the various asphalt plant mix items will be full compensation for the work.

Adjustments will be made to the payments due the Contractor for each grade of asphalt binder when it has been determined that the monthly average terminal F.O.B. Selling Price of asphalt binder, Grade PG 64-22, has fluctuated from the Base Price Index for Asphalt Binder included in the contract. The methods for calculating a base price index, for calculating the monthly average terminal F.O.B. selling price and for determining the terminals used are in accordance with procedures on file with the Construction Unit.

When it is determined that the monthly selling price of asphalt binder on the first business day of the calendar month during which the last day of the partial payment period occurs varies either upward or downward from the base price index, the contract unit price for asphalt binder for plant mix will be adjusted. The adjusted contract unit price will be determined by adding the difference between the selling price and the base price index to the contract unit bid price for asphalt binder.

The adjusted contract unit price will then be applied to the theoretical quantity of asphalt binder authorized for use in the plant mix placed during the partial payment period involved, except that where recycled plant mix is used, the adjusted unit price will be applied only to the theoretical number of tons of additional asphalt binder materials required by the JMF.

Adjusted contract unit prices for all grades of asphalt binder, including additional asphalt binder materials in recycled mixtures, will be based on the average selling price and base price index for asphalt binder, Grade PG 64-22, regardless of the actual grade required by the JMF.

In determining the adjusted contract unit price for any material specified in this section the following formula will be used:

$$A = B + (D - C)$$

Where:

A = Adjusted Contract Unit Price

B = Contract Unit Price

C = Base Price Index

D = Monthly Average Terminal F.O.B. Selling Price

In the event the Department is unable to secure an F.O.B. selling price from at least 4 terminals in a given month, payment will be at the contract unit price for each ton of asphalt binder used in the work during that month.

Payment will be made under:

Pay Item	Pay Unit
Asphalt Binder for Plant Mix	Ton
Polymer Modified Asphalt Binder for Plant Mix	Ton

SECTION 654

ASPHALT PLANT MIX, PAVEMENT REPAIR

654-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, repairing of existing pavement with asphalt plant mix in order to provide a safe, passable and convenient condition for traffic, or to replace pavement removed in order to remove or to place pipe lines.

Section 657

Perform the work by cutting the existing pavement to a neat vertical joint and uniform line; removing and disposing of pavement, base and subgrade material as approved or directed by the Engineer; coating the area to be repaired with a tack coat; furnishing, placing and compacting asphalt plant mix; and replacing of the removed material with asphalt plant mix.

Make the repairs in accordance with the plans, or as approved or directed by the Engineer.

654-2 MATERIALS

Where a pavement repair detail is not shown in the plans, use an approved asphalt plant mix.

Where a pavement repair detail is shown in the plans, the type of plant mix shall be in accordance with the pavement repair detail except where the specifications permit the substitution of another type of plant mix or where approved by the Engineer.

In areas where the existing pavement is not to be resurfaced, the Contractor will not be allowed to substitute a different type of surface course from that shown on the pavement repair detail.

654-3 CONSTRUCTION METHODS

(A) General

Perform repair of existing pavement as approved or directed by the Engineer. Coordinate the work with all other work and operations necessary to maintain traffic.

(B) Pipe Removal or Installation

Where traffic is to be maintained, perform the removal or installation of pipe in sections so that half the width of the roadway will be available to traffic. Immediately upon completion of the entire pipeline removal or installation, repair the pavement.

654-4 MEASUREMENT AND PAYMENT

Asphalt Plant Mix, Pavement Repair will be paid as the actual number of tons of asphalt plant mix, complete in place, used to make completed and accepted repairs, except for those repairs made necessary by the contractor's negligence. The asphalt plant mixed material will be measured by being weighed in trucks on certified platform scales or other certified weighing devices.

Furnishing asphalt binder will be paid as provided in Article 620-4 for *Asphalt Binder for Plant Mix* for each grade required.

Payment will be made under:

Pay Item	Pay Unit
Asphalt Plant Mix, Pavement Repair	Ton

DIVISION 7

CONCRETE PAVEMENTS AND SHOULDERS

SECTION 700

GENERAL REQUIREMENTS FOR

PORTLAND CEMENT CONCRETE PAVEMENT

700-1 DESCRIPTION

Perform the work covered by this section, which includes, but is not limited to, the construction of a single course non-reinforced Portland cement concrete pavement on a prepared base, in accordance with these *Standard Specifications* and with the lines, grades, thicknesses and typical sections shown on the plans or as directed by the Engineer.

The Department accepts concrete pavement with respect to strength, thickness and ride quality on a lot by lot basis subject to adjusted unit prices as provided in Sections 710 and 720.

Use any combination of equipment that shall effectively perform the necessary construction operations. Ensure the equipment is at the job site sufficiently ahead of the start of construction operations for the Engineer to examine thoroughly and approve.

Maintain all equipment in a satisfactory operating condition while in use on the work.

Submit to the Engineer for approval a Process Control Plan addressing all operations necessary in the production and placement of concrete pavement a minimum of 30 calendar days prior to placing concrete pavement.

700-2 CONCRETE PRODUCTION EQUIPMENT

Use batch plants, central mix plants and truck mixers that meet Section 1000.

700-3 CONCRETE HAULING EQUIPMENT

Transport concrete to the point of placement either in a truck agitator, a truck mixer operating at agitating speed or in non-agitating equipment meeting the provisions below. Bottom or belly dump equipment is prohibited. Provide and secure material covers on the equipment bodies for protection against detrimental environmental conditions.

Prevent the accumulation of hardened concrete in the delivery vehicles. Discharge all flushing water before charging with the next concrete load.

When using non-agitating hauling equipment, provide bodies which are smooth, watertight, metal containers with rounded internal corners equipped with vibrators and gates to discharge the concrete without segregation or damage.

For concrete hauled in a transit mix (ready mix) truck, use Table 1000-2 to determine the maximum elapsed time. For concrete hauled in other equipment, the elapsed time shall be 60 minutes or less, unless otherwise approved by the Engineer. Define the "elapsed time" as the period from first contact between mixing water and cement until the completion of the entire operation including placing, finishing, micro-surfacing and any necessary corrective work.

Deliver the concrete to the work site in a thoroughly mixed and uniform mass.

If at discharge, the concrete is not thoroughly mixed and homogeneous, the hauling distance, charging sequence, size of load, mixing time or any combination thereof shall be altered to meet these requirements; otherwise, use other equipment capable of delivering a thoroughly mixed and uniform concrete mass.

Section 700**700-4 PREPARATION OF SUBGRADE AND BASE**

Prepare the subgrade and base beneath Portland cement concrete pavement in accordance with the applicable sections of these specifications and with a grading tolerance of $\pm 1/4$ inch from the established grade on mainline lanes and a grading tolerance of $\pm 1/2$ inch in all other areas. Use approved automatically controlled grading and paving equipment to produce final subgrade and base surfaces meeting the lines, grades and cross sections required by the plans or as directed by the Engineer. When in the judgment of the Engineer the use of such equipment is impractical, this requirement will be waived.

Dampen the surface of the base at the time the concrete is placed. Sprinkle the base when necessary to provide a damp surface. Ensure that no free water or ponding is present at the time of concrete placement. Correct all damaged areas in the subgrade or base before placing concrete.

Do not allow traffic on the underlying asphalt courses other than necessary local traffic and essential construction equipment as authorized by the Engineer.

Unless otherwise approved by the Engineer, use and maintain a braided metal cable stringline reference to control the profile and alignment of the concrete pavement. Monitor the stringline for accuracy and tautness. Set pins at a distance no farther than 50 feet apart. When located on a vertical curve, set pins no farther than 25 feet apart.

700-5 PLACING CONCRETE**(A) General**

Use a slip form paver to place concrete except where impractical due to irregular areas or areas of existing pavement adjacent to the proposed pavement.

Place concrete only in the presence of the Engineer or his authorized representative.

Handle concrete so as to prevent segregation and keep free from mud, soil or any other foreign matter.

Where finishing operations must be completed after dark, provide acceptable artificial light in accordance with Section 1413.

Do not pave when any of the following conditions exist:

(1) A descending air temperature at the location of the concrete paving operation and away from artificial heat reaches 35°F. Paving may resume when the weather forecast is projected to reach a high of 40°F on that day's operation and the morning ambient temperature is above 32°F.

(2) The subgrade or base course is frozen.

(3) Aggregates to be used in the mix contain frozen particles.

(4) Air temperature in the shade is 90°F and rising or the concrete temperature is greater than 95°F.

Where additional pavement, aggregate or soil must be placed adjacent to new pavement by machine methods, do not place it until the concrete has attained a compressive strength of at least 3,000 psi.

Construction equipment or hauling equipment will not be allowed over the pavement until the concrete has attained a compressive strength of 3,000 psi.

Spread the concrete uniformly over the entire area without segregation. Perform the spreading with a mechanical spreader independent of the paver except where hand methods are necessary due to pavement design, equipment breakdown or other emergencies.

Section 700

(B) Slip Form Paver Method

Use a slip form paver that is an approved self-propelled machine designed to spread, consolidate, screed and float finish the concrete in one complete pass of the machine to provide a smooth, dense and homogeneous pavement with minimal hand finishing. Use a slip form paver equipped with forms of sufficient length and rigidity to support the edges of the slab to minimize hand finishing. Use a slip form paver equipped with both horizontal and vertical automatic controls. Operate the paver with continuous forward movement and coordinate all operations of mixing, delivering and spreading the concrete to provide uniform progress and minimize stopping and starting of the paver.

Provide concrete that has sufficient cohesion to prevent appreciable slumping at the edges of each slab. Longitudinal straight edge tolerance of 1/4 inch in 10 feet shall apply to the area within 6 inches of the edge. Edge slump shall be limited to no more than 1/4 inch.

(C) Fixed Form Method

Apply this section to all paving operations where a slip form paver is not being used.

Use forms made of metal and of such section and design that they will adequately support the concrete and the construction equipment.

Use forms that have a depth not less than the edge thickness of the pavement to be constructed and not more than 1 inch greater than the edge thickness of the pavement to be constructed. Use a form which has the base width at least equal to the height of the form.

Use a form in which the top face does not vary from a true plane more than 1/8 inch in 10 feet and the upstanding leg does not vary more than 1/4 inch.

Use straight forms that have at least 3 pin pockets per 10 feet in length and at least 2 pin pockets per 5 feet in length.

Use form pins that are metal and capable of holding the forms rigidly in place during construction operations. The Engineer may require pinholes in the base to be sealed before placing subsequent pavement.

Connect the form sections by a locking joint that will keep the forms free from vertical and horizontal movement.

Use straight forms 10 feet in length on tangents and on curves having a radius of 200 feet or more. For curves having a radius of between 50 feet and 200 feet use either straight forms 5 feet in length or flexible forms. Use flexible forms for curves having a radius of less than 50 feet.

Clean all forms before they are set. Oil all forms before placing concrete. Check the bearing of the forms and correct all areas of inadequate bearing.

Remove all rejected forms immediately from the project.

Set forms a sufficient distance in advance of the point where the concrete is being placed to provide for a continuous operation in placing the concrete and for proper inspection of line and grade.

All forms used for construction joints shall meet this section except provisions shall be made for inserting dowel bars where required.

700-6 VIBRATING CONCRETE

Uniformly vibrate the concrete after it has been spread. Consolidate the full width and depth of the concrete in a single pass.

Section 700

Vibrators for full width vibration of concrete may be either the surface pan type or the internal type with either immersed tube or multiple spuds. Attach the vibrators to the spreader or the finishing machine, or mount the vibrators on a separate carriage.

Furnish an electronic vibrator monitoring device, displaying the operating frequency of each individual vibrator on the paving equipment. Operate the electronic vibrator monitoring device in areas where the mainline, ramp or loop pavement exceeds 600 feet in length. Record the time, station location, paver track speed and operating frequency of each individual vibrator after every 25 feet of paving or after each 5 minute time interval has elapsed. Provide a report of the vibrator data to the Engineer daily for the first 3 days of paving and weekly thereafter. The Engineer may determine that more frequent submissions are necessary, particularly if equipment is malfunctioning.

Set the internal vibrators to approximately mid slab depth and provide a locking device to avoid contact with any joint, load transfer device, tie bar, subgrade or side form. Provide an operating position locking device so that no part of the vibrating unit can be lowered to the extent that it will come in contact with dowel bars, dowel bar assemblies or tie bars while paving.

Set the horizontal spacing of vibrators to the manufacturer's recommendations, but in no case exceed 16 inches from center to center.

Operate internal and spud vibrators within a frequency range of 3,500 to 8,000 vpm and surface vibrators within a frequency range of 3,500 to 6,500 vpm. Operate vibrators to avoid separation of the mix ingredients. A reduction in vibrator frequency may be required when the forward motion of the paver is reduced to avoid separation of the mix. Either discontinue the use or remove from contact with the concrete, the machine mounted vibrators, whenever the forward motion of the machinery is stopped.

Should the electronic monitoring device fail to operate properly, immediately check the vibrators manually in the presence of the Engineer. If the vibrators are functioning properly, paving may continue. Repair the monitoring device within 3 production days or suspend paving.

700-7 FINISHING

Finish concrete pavement or concrete shoulders in accordance with Article 710-6 or 720-7, respectively. Do not use excessive water for finishing.

700-8 PROTECTION OF PORTLAND CEMENT CONCRETE PAVEMENT**(A) General**

Protect the concrete pavement from environmental conditions. Remove and replace concrete pavement damaged as a result of environmental conditions.

Use protective covering that will protect the surface of the freshly placed pavement from rain or cold weather readily available each day at the location of each proposed day's operation before beginning work. Store an adequate quantity of these materials at the paving train.

(B) Cold Weather

When the temperature is projected to drop below 35°F for more than four hours, insulate the concrete pavement to prohibit the concrete surface temperature from dropping below 35°F during the curing period.

(C) Hot Weather

When the anticipated daily high temperature is above 90°F, place the concrete at the coolest temperature practical. Control concrete temperatures to assure proper placing, consolidation, finishing, curing and to prevent plastic shrinkage cracking.

Section 700

(D) Rain

When rain appears imminent, stop all paving operations, and ensure all available personnel protect the surface of the unhardened concrete. Failure to properly protect the concrete pavement may constitute cause for removal and replacement of the damaged pavement.

700-9 CURING**(A) General**

Immediately after finishing operations have been completed and surface water has disappeared, cover all exposed surfaces of the pavement by one of the curing methods herein or as approved by the Engineer.

Apply the selected curing method to the edges of the pavement immediately after the forms are removed.

Curing is required until the concrete compressive strength has exceeded 3,000 psi using the maturity method in accordance with Article 700-13.

(B) Membrane Curing Compound

After final finish and immediately after the free surface moisture has disappeared, use a minimum application rate of 0.0067 gal/sf when the application equipment is mechanically operated. Provide an inline flow-metering device to ensure the proper rate is applied. Apply the curing compound such that puddling or ponding does not occur on the fresh concrete surface.

Use mechanically operated application equipment designed to apply a uniformly agitated continuous flow of the curing compound at the prescribed rate to all concrete surfaces.

Hand spraying shall only be permitted for irregular widths or shapes and surfaces exposed by removal of forms. The rate of application for these areas shall be 0.01 gal/sf.

Do not expose newly placed concrete for more than 30 minutes before being covered with curing compound. Failure to cover the surfaces of the concrete shall be cause for immediate suspension of the paving operation.

Protect the membrane curing compound film at all times during the curing period and repair any damage immediately. Ensure a sufficient amount of polyethylene film, burlap or other approved material is available to provide for protection of the concrete during rain or when the application equipment fails to apply the curing compound uniformly to all surfaces.

Reapply curing compound to any concrete surfaces that received heavy rainfall within 3 hours after initial application.

(C) Polyethylene Film

Spread the sections of the film in a manner that will not damage the finished pavement surface. Securely tape or provide lap joints for the sections that are at least 12 inches wide, and take suitable precautions to prevent the circulation of air beneath the film. Cover all exposed surfaces and beyond the edge of the pavement surface.

Use black or dark plastic sheets when the daily high ambient temperature is between 40°F and 60°F. Use white opaque reflective plastic sheet when the daily ambient temperature is above 60°F. Plastic sheets will meet ASTM C171.

Check the film for damage when it is spread and during the curing period. Repair or replace any damaged sections immediately.

Section 700**(D) Burlap**

Spread the sections of burlap in a manner that will not damage the finished pavement surface. Provide lap joints that are at least 6 inches wide.

Use an amount of burlap that is not less than 12 ounces per running yard based on a 40 inch width. Use either one layer of Class 4 burlap or 2 layers of Class 1, 2 or 3 burlap.

Saturate the burlap thoroughly before placing on the concrete and keep thoroughly wet throughout the curing period.

700-10 REMOVING FORMS

Do not remove forms from freshly placed concrete for at least 12 hours after placement and until the concrete has hardened sufficiently to resist spalling, cracking or any other damage. Repair any honeycombed areas along the sides or edges of the slab by filling with mortar immediately after the forms have been removed. Use mortar consisting of one part cement to 2 parts fine aggregate.

700-11 JOINT CONSTRUCTION**(A) General**

Construct all joints in accordance with these *Standard Specifications* and the details shown on the plans. Saw all transverse joints and seal them with joint sealer in accordance with the dimensions and details shown in the contract. Seal joints in accordance with Article 700-12.

Saw the concrete pavement as soon as it can support the weight of the equipment and operator without disturbing the final finish. Saw joints in a neat, vertical straight line without chipping, spalling, tearing or disturbing the final finish.

Ensure an adequate amount of sawing equipment is available to match the production and concrete paving operations. At least one standby sawing unit is recommended. Construct the joint groove using a 1/8 inch saw blade to a minimum depth of 4 inches or the design thickness divided by 3 whichever is less. Perform sawing as soon as the concrete has hardened sufficiently without undercutting, spalling and raveling to control random cracking. To estimate the time of sawing, it is recommended to use the latest version of FHWA's High Performance Paving software entitled HIPERPAV.

Immediately after sawing the joint to the dimensions shown on the plans, completely remove the resulting slurry from the joint without damaging the adjacent concrete. Immediately reapply curing membrane to areas damaged by the sawing operation.

Deviations from the method of joint construction specified in the contract requires prior approval in writing by the Engineer. Such approval is conditional and is subject to obtaining satisfactory results.

The Engineer may order any concrete pavement or shoulder where uncontrolled cracking has occurred before final acceptance to be removed and replaced at no cost to the Department. Where permitted, the Contractor may be allowed to repair the cracking in a manner acceptable to the Engineer.

Before placing either concrete pavement or concrete shoulders adjacent to a previously placed pavement, cover the transverse joint opening on the edge of the existing slab to prevent intrusion of grout into the opening.

(B) Transverse Contraction Joints

Construct transverse contraction joints in accordance with the details, dimensions and intervals as shown on the plans.

(C) Longitudinal Contraction Joints

Construct longitudinal contraction joints in all pavements wider than 16 feet in accordance with the details and dimensions shown on the plans.

(D) Transverse Construction Joints**(1) General**

Construct transverse construction joints by use of an approved form at the end of each day's operations (planned joint) or whenever the placing of concrete is suspended for more than 30 minutes (emergency joint).

(2) Planned Transverse Construction Joints

Locate this type of joint at the same spacing required for contraction joints. Use dowel bars of the size and spacing shown on the plans.

(3) Emergency Transverse Construction Joints

Use this type of joint when the placing of concrete is suspended for more than 30 minutes. Use tie bars of the size and spacing shown on the plans.

Do not change the spacing of contraction joints due to emergency construction joints. Locate the emergency construction joints at least 6 feet from any contraction joint or planned construction joint.

(E) Longitudinal Construction Joints

Construct longitudinal construction joints using tie bars in accordance with the details shown on the plans.

(F) Transverse Expansion Joints

Construct transverse expansion joints in accordance with the details shown on the plans utilizing an approved joint assembly.

(G) Verification of Dowel Bar Alignment

Use either properly secured dowel baskets or a dowel bar inserter, provided the ability to correctly locate and align the dowels at the joints is demonstrated as described below.

Provide a calibrated magnetic imaging device that will document dowel bar location and alignment. Calibrate the magnetic imaging device to the type and size dowel bar used in the work. Use this device as a process control and make necessary adjustment to ensure the dowels are placed in the correct location.

Scan all of the joints in the initial 500 feet of placement each time the paving train is mobilized, relocated or altered. Scan joints as soon as practical after the pavement has been placed. Submit scanned data to the Engineer within 48 hours following placement of pavement. Mark scanned joints on the pavement.

Continue scanning no less than 25% of the joints after the initial placement until it is established that the dowel bar inserter or secured dowel basket assemblies are consistently placing the dowel bars at the correct location and meeting the tolerances defined in Table 700-1. Scanned data shall include longitudinal translation (side shift), horizontal translation, vertical translation (depth), horizontal skew or vertical tilt.. The contractor may reduce the percentage of scanned joints to no less than 10% by submitting a request to the Engineer for review and approval. Any time inconsistency in the placement of the dowel bars becomes evident, additional scanning may be required up to 100% of the joints. Materials and Tests Unit will provide Quality Assurance and random verification scans during the initial concrete placement to verify the Contractor's scan results. The QA frequency will be at least 10% of the Contractor's scan.

Section 700

If consistency of the proper dowel bar alignment cannot be established within a reasonable time frame, the Engineer will have the option of suspending the paving operation.

Provide a report of the scanned joints within 48 hours of completing the day's production. The report should include the station and lane of the joint scanned, as well as the horizontal location, depth, longitudinal translation (side shift), horizontal skew and vertical tilt, and total misalignment, of each dowel bar in the joint. If a dowel bar inserter is used, the joint score described below should also be provided in the report.

Longitudinal translation (side shift) is defined as the position of the center of the dowel bar in relation to the sawed joint. The maximum allowable longitudinal translation (side shift) is 2 inches.

Horizontal translation is defined as difference in the actual dowel bar location from its theoretical position as detailed in the standard details. The maximum allowable horizontal translation is 2 inches.

Vertical translation (depth) is the difference in the actual dowel bar location from the theoretical midpoint of the slab. The maximum allowable vertical translation is 1/2 inch higher than the theoretical midpoint and 1 inch lower than the theoretical midpoint.

Dowel bar misalignment, either vertical tilt or horizontal skew is defined as the difference in position of the dowel bar ends with respect to each other. Vertical tilt is measured in the vertical axis whereas horizontal skew is measured in the horizontal axis.

If a dowel bar inserter is used, determine a joint score for each joint scanned. The joint score is a measure of the combined effects from the dowel's horizontal skew or vertical tilt. The joint score is determined by summing the product of the weight shown in the Table 700-1 and the number of bars in each misalignment category and adding one. The vertical tilt and horizontal skew should be evaluated and the total misalignment shall be used in determining the joint score.

**TABLE 700-1
TOLERANCE FOR DOWEL BAR ALIGNMENT^A**

Misalignment Category, inches (mm)	Weight
$0 \leq d \leq 0.6$ (15)	0
0.6 (15) $< d \leq 0.8$ (20)	2
0.8 (20) $< d \leq 1.00$ (25)	4
1.00 (25) $< d \leq 1.50$ (38)	5
1.50 (38) $\leq d$	10

A. Where **d** is the individual dowel bar misalignment.

A joint that has a joint score of 12 or greater will be considered locked.

When a locked joint as defined above is discovered, scan the 2 joints immediately adjacent to the locked joint. If either of the adjacent joints are deemed to be locked, provide a written proposal to address the dowel misalignment for each locked joint. No corrective action should be performed without written approval by the Engineer.

700-12 SEALING JOINTS

(A) General

Seal all joints with an approved low modulus silicone sealant in the presence of the Engineer.

Install backer rod and sealant in accordance with the details shown in the plans and the manufacturer's recommendations.

Section 700

Any failure of the joint material will be cause for rejection. Repair the failed joint material as approved by the Engineer.

When requested, have a representative of the silicone sealant manufacturer present on the project during the sealing operation.

(B) Age of Pavement

Do not seal the joints until the concrete is at least 7 calendar days old and concrete is dry based on sealant manufacturer's recommendations.

Do not perform final sawing and sealing of concrete pavement joints until after surface testing, correction of surface deficiencies and all adjacent earth and paved shoulder construction has been completed.

(C) Temperature

Do not place joint sealant when the air temperature near the joint is less than 45°F or is 45°F and falling.

(D) Sealing the Joint

Immediately after sawing the joint to the dimensions as shown on the plans, completely remove the resulting slurry from the joint by flushing with a jet of water under pressure. Use sand blasting to clean joint faces before applying sealant. Make as many passes with a sand blaster as are necessary to provide a clean joint wall.

Blow all joints clear of deleterious materials with air using a nozzle pressure of at least 90 psi before installing the backer rod. Use rotary screw compressors for this purpose that are equipped with traps capable of removing water and oil from the air. Maintain the traps in accordance with manufacturer's instructions.

Apply sealer only on thoroughly clean and dry joints. Place the sealer to closely conform to dimensions shown on the plans. Any unreasonable deviation will be cause for rejection.

(E) Cleaning Pavement

After a joint has been sealed, remove surplus joint sealer on the pavement as soon as possible.

700-13 USE OF NEW PAVEMENT OR SHOULDER

Traffic or other heavy equipment will not be allowed on the concrete pavement or shoulder until the estimated compressive strength of the concrete using the maturity method has exceeded 3,000 psi. Estimate the compressive strength of concrete pavement in accordance with ASTM C1074 unless otherwise specified.

Furnish thermocouples or thermistors and digital data logging maturity meters that automatically compute and display the maturity index in terms of a temperature-time factor (TTF). The maturity meters must be capable of storing at least 28 days worth of data and exporting data into an Excel® spreadsheet. Install loggers in slabs after every 2 lots approximately 4 inches from the concrete surface. Submit the proposed equipment to the Engineer for approval.

When establishing a strength-maturity relationship, perform compressive tests at ages 1, 3, 7, 14 and 28 days in accordance with AASHTO T 22.

Use the TTF maturity function to compute the maturity index from the measured temperature history of the concrete. Set the datum temperature at -10°C to calculate the TTF in Equation 1 of ASTM C1074.

Section 700

Establish and submit a strength-maturity relationship in conjunction with each concrete pavement mix design. Determine the TTF corresponding to the strength-maturity relationship at 3,500 psi, TTF. Any changes to plant operations, material sources or mix proportions will affect the strength-maturity relationship. If any changes occur during production, develop a new strength-maturity relationship unless otherwise directed by the Engineer.

Validate the strength-maturity relationship and the correlation between cylinders and beams during the first day's production by casting cylinders and beams and performing strength tests. Use the TTF developed during the mix design process to verify the strength-maturity relationship.

Validate the strength-maturity relationship and the correlation between cylinders and beams by casting cylinders and beams and performing strength tests at least every 30 calendar days, or when the TTF varies by more than 10% from the latest approved maturity curve or there is a material change from the approved concrete mix design. If the verification sample's compressive strength when tested at TTF is less than 3,000 psi, immediately suspend early opening of traffic on pavement that has not obtained TTF until a new strength-maturity relationship is developed.

No permanent traffic will be allowed on the pavement until construction of the joints, including all sawing, sealing and curing that is required, has been completed.

Take particular care to protect the exposed pavement edges and ends.

700-14 CONTRACTOR'S RESPONSIBILITY FOR PROCESS CONTROL

Perform process control sampling and testing of concrete materials and operations in accordance with Article 1000-4. The Contractor's roadway foreman and all personnel involved in the batching, sampling, testing and acceptance of Portland cement concrete pavement shall be Department certified Portland cement concrete pavement technicians.

700-15 ACCEPTANCE TESTS FOR CONCRETE**(A) Responsibility**

The Engineer will conduct acceptance sampling and testing of concrete. Provide access to all materials to be sampled and tested. The following tests will be performed on both concrete pavement and concrete shoulders to determine acceptance.

(B) Lot Definition

A lot for acceptance purposes is defined and described in Article 710-4.

(C) Air Content

The air content of the concrete will be determined on the roadway at a frequency established by the Engineer and in accordance with Subarticle 1000-4(B). The sample taken for determination of air content will be obtained immediately after the concrete has been discharged on the road.

Concrete failing to meet specification requirements for air content will be subject to rejection.

(D) Slump

The slump of the concrete will be determined in accordance with AASHTO T 119 at a frequency established by the Engineer. The sample taken for determination of slump will be obtained immediately after the concrete has been discharged on the road.

When the slump of the concrete is questionable by visual observation, do not place the concrete on the road until tested for slump by the Engineer.

Concrete failing to meet specification requirements for slump will be subject to rejection.

Section 710**(E) Compressive Strength**

Determine the compressive strength of concrete using one set of two 6 inch x 12 inch cylinders at 28 calendar days. Test samples will be made by the Engineer from the concrete as it comes from the mixer. The samples will be made and cured in accordance with AASHTO R 100. Test specimens will be tested by the Engineer in accordance with AASHTO T 22. Furnish curing facilities for the test samples in accordance with Section 725.

(F) Thickness

The thickness of the pavement will be determined by measurement of cores in accordance with AASHTO T 148.

Take 4 inch diameter cores in the presence of the Engineer. The Engineer will take immediate possession of the cores. Take the cores when the concrete has attained a compressive strength of at least 3,500 psi and at least 72 hours have elapsed since placement of the pavement. If the concrete has not attained a compressive strength of at least 3,500 psi, the gross vehicle weight rating of vehicles supporting the coring operation may not exceed 7,000 lbs. Take cores no later than 30 days after the pavement has been placed. The core locations for each lot will be selected at random by the Engineer.

Patch all core holes within 72 hours of taking the core, using an approved nonshrink grout compatible with the pavement or shoulder concrete.

(G) Surface Smoothness

Perform acceptance testing for surface smoothness on concrete pavements in accordance with Article 710-7. The Engineer will have a representative present during all testing and will take possession of the results at the completion of each day's testing.

700-16 MEASUREMENT AND PAYMENT

Remove and repair defects and damage to underlying asphalt course, Portland cement concrete and joints at no cost to the Department.

SECTION 710 CONCRETE PAVEMENT

710-1 DESCRIPTION

Perform the work covered by this section, including, but not limited to, designing the concrete mix; furnishing and placing concrete; furnishing of all admixtures and additives; constructing all joints and furnishing joint materials; marking the pavement; curing the pavement and furnishing all curing materials; furnishing concrete necessary for making test beams and cylinders; performing maturity testing; coring and patching the pavement; calibrating and checking the operation of batching equipment; taking actions necessary to prevent or to repair cracking; sawing and sealing joints; verifying dowel bar alignment; removing and replacing of defective pavement; and constructing Portland cement concrete pavement in accordance with these *Standard Specifications* and with the lines, grades and dimensions shown on the plans.

Section 710

710-2 MATERIALS

Refer to Division 10.

Item	Section
Curing Materials	1026
Dowels and Tie Bars	1070-6
Joint Filler	1028-1
Low Modulus Silicone Sealant	1028-3
Portland Cement Concrete	1000
Water	1024-4

710-3 COMPOSITION OF CONCRETE

Design the concrete mix in accordance with Section 1000.

Before placement, produce a trial batch through the plant. The Engineer will make compressive and flexural samples from the trial batch for testing at 1, 3, 7, 14 and 28 days of age. Until the trial batch meets 650 psi flexural strength and 4,500 psi compressive strength, the Engineer will make acceptance samples for flexural and compressive tests for mix placed. If the trial batch test results meet strength requirements, flexural samples representing placed concrete will be discarded, and compressive samples will be used for acceptance. If the trial batch does not meet strength requirements, flexural samples will be used for acceptance until plant produced mix meets strength requirements.

If any major change as defined in Article 1000-1 is made to the mix design, this process shall be initiated again.

710-4 ACCEPTANCE OF CONCRETE

The Department will test the concrete pavement for acceptance with respect to compressive strength and thickness on a lot by lot basis in accordance with Article 700-15 and the requirements herein.

For all concrete pavement, including mainline, shoulders, ramps, tapers, intersections, entrances, crossovers and irregular areas not otherwise defined, produce a lot consisting of 1,333.3 sy or fraction thereof placed within 28 calendar days. From each lot, the Engineer will make at least one set of two 6 inch x 12 inch cylinders from a randomly selected batch of concrete. The average compression strength of the 2 cylinders is considered one test. If Department personnel make and test additional sets of cylinders for a lot, all sets will be averaged with the original set to determine the strength. In the case of low strength, the Engineer will perform an investigation.

710-5 CONSTRUCTION METHODS

Construct concrete pavement in accordance with Section 700.

Place concrete in 2 lane minimum widths in a single operation except as follows:

(A) Where the total number of lanes is an odd number, in which case one of the lanes may be placed in a separate operation.

(B) Areas such as ramps or auxiliary lanes where the total width is less than 2 lanes.

710-6 FINISHING

Screed and float finish the concrete to the required cross section that minimizes or eliminates hand finishing. Additional water for finishing will not be allowed. Hand finishing will not be permitted except under the following conditions:

(A) Narrow widths or irregular areas, where operation of mechanical equipment is impractical.

Section 710

(B) If a breakdown of mechanical equipment occurs, hand methods may be used to finish only that concrete deposited on the base before the breakdown.

(C) Abnormal circumstances of short duration subject to approval by the Engineer.

Produce a final finish on the pavement surface true to grade and uniform in appearance and free of irregular, rough or porous areas.

Following the finishing of the pavement by screeding, floating and checking with straightedges, further finish the surface of the pavement by burlap dragging or other acceptable method to produce a uniform surface texture. Pull the burlap drag in a longitudinal direction.

Produce the final surface finish on all mainline pavement, auxiliary lanes, and ramps by mechanical equipment for longitudinally tined grooves while the concrete is plastic. The tining shall be done with a mechanical device such as a wire comb. The comb shall have a single row of tines. Each shall have a nominal width of 5/56 inch to 1/8 inch. The nominal spacing of the tines shall be $3/4 \pm 1/8$ inch center-to-center. The nominal depth of tined groove in the plastic concrete shall be $1/8 \pm 1/32$ inch.

Longitudinal tining shall be accomplished by equipment with automated horizontal and vertical controls to ensure straight, uniform depth tined grooves. The texture geometry shall be the same as imparted throughout the length of the tining comb. A 2 inch to 3 inch wide strip of pavement surface shall be protected from tining for the length of and centered about longitudinal joints.

The tining operation shall be done so that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets. Where abutting pavement is to be placed, the tining shall extend as close to the edge as possible without damaging the edge. If abutting pavement is not to be placed, the 6 inch area nearest the edge or 1 foot from the face of the curb shall not be tined. Hand-operated tining equipment that produces an equivalent texture may be used only on small or irregularly shaped areas. Tines shall be thoroughly cleaned at the end of each day's use and damaged or worn tines replaced.

When surface corrections for pavement smoothness are made in the hardened concrete, no additional texturing is required.

After final finishing, hand finishing may be required on the edges of pavement and joints whenever irregularities in surface texture or alignment occur. Care should be taken in hand finishing pavement edges to avoid ridges or high places that will prevent water from draining out of the transverse grooves.

The use of excessive water during the finishing operations will not be permitted.

Provide a textured surface with an average texture depth of 0.8 mm as tested in accordance with ASTM E965 with no single test having a texture depth of 0.5 mm or less. Perform 4 randomly located tests in accordance with ASTM E965 within the initial pavement lot of each mobilization in the presence of the Engineer. A "lot" is defined in Article 710-4. If the average of the 4 tests does not meet the above criteria, make appropriate changes to the surface texture operations and test the next lot as detailed above. Once the surface texture process is established to meet minimum texture requirements, maintain consistency within the operation to provide the above minimum texture depth. Perform additional sand patch tests in accordance with ASTM E965 when directed by the Engineer.

If the surface texture becomes damaged or reduced by rain or any other action, reestablish or restore surface texture by an approved method.

710-7 FINAL SURFACE TESTING

Use an Inertial Profiler to measure the longitudinal pavement profile for construction quality control and smoothness acceptance. Use a profiler with line laser technology as single-point

Section 710

1 laser technology will not be allowed. Produce International Roughness Index (IRI) and Mean
2 Roughness Index (MRI) values for measuring smoothness.

3 Use testing and recording software to produce electronic inertial road profiles in a format
4 compatible with the latest version of FHWA's ProVAL (Profile Viewing and Analysis)
5 software.

6 The Inertial Profiler shall be calibrated and verified in accordance with the most current
7 version of AASHTO M 328. Provide certification documentation that the profiler meets
8 AASHTO M 328 to the Engineer before the first day the Inertial Profiler is used on the
9 project.

10 Configure the profiler to record the actual elevation of the pavement surface. Do not use the
11 profiler's internal IRI calculation mode. The profile data shall be filtered with a 300 feet
12 Butterworth high-pass filter. The interval at which relative profile elevations are reported
13 shall be a maximum of 1 inch.

14 Provide IRI data in accordance with most current version of ASTM E1926. Use personnel
15 trained to record and evaluate IRI data.

16 Provide an Inertial Profiler Operator that has been certified by the Department's Profiler and
17 Operator Certification Program as administered by the Materials and Tests Unit. Provide the
18 user selected Inertial Profiler settings to the Engineer for the project records.

19 In the presence of the Engineer, at the beginning of each day's data collection, perform a
20 block test to verify the Inertial Profiler's ability to accurately collect elevation data is met and
21 perform bounce test to verify that the Inertial Profiler's accelerometers are performing
22 correctly.

23 Remove all objects and foreign material on the pavement surface prior to longitudinal
24 pavement profile testing.

25 In the presence of the Engineer, operate the profiler at any speed as per the manufacturer's
26 recommendations, however, the speed must be constant to within ± 3 mph of the intended
27 speed and any required acceleration should be as gradual as possible. For example, if the
28 intended speed were 30 mph, the acceptable range of speed for testing would be 27 to 33 mph.

29 Operate the Inertial Profiler in the direction of the final traffic pattern. Collect IRI data from
30 both wheel paths during the same run. It is permissible to collect data one wheel path at a
31 time if each wheel path is tested and evaluated separately. Define a "wheel path" as the 3 feet
32 from the edge of the travel lane. MRI values are the average of the IRI values from both
33 wheel paths. When using an inertial profiler that collects a single trace per pass, take care to
34 ensure that the measurements from each trace in a travel lane start and stop at the same
35 longitudinal locations. Unless otherwise specified, multiple runs are not necessary for data
36 collection.

37 Operate the automatic triggering method at all times unless impractical. A tape stripe or
38 traffic cone wrapped with reflective material may be used to alert the profiler's automatic
39 triggering sensor to begin data collection. The profiler shall reach the intended operating
40 speed before entering the test section. The runup and runout distances should be sufficient to
41 obtain the intended operating speed and to slow down after testing is completed.

42 Divide the pavement surface for the project into sections which represent a continuous
43 placement (i.e. the start of the project to bridge, intersection to intersection). Terminate
44 a section 50 feet before a bridge approach, railroad track, or similar interruption. (Separate
45 into 0.10-mile sections).

46 The evaluation of the profiles will be performed on a section basis. A section is 0.10 mile of
47 a single pavement lane. For any section, which is less than 0.10 mile in length, the applicable
48 pay adjustment incentive will be prorated on the basis of the actual length.

Section 710

1 Mark the limits of structures and other special areas to be excluded from testing using the
2 profiler's event identifier such that the exact locations can be extracted from the profile data
3 file during processing.

4 Unless otherwise authorized by the Engineer, perform all smoothness testing in the presence
5 of the Engineer. Perform smoothness tests on the finished surface of the completed project or
6 at the completion of a major stage of construction as approved by the Engineer. Coordinate
7 with and receive authorization from the Engineer before starting smoothness testing. Perform
8 smoothness tests within 7 days after receiving authorization. Any testing performed without
9 the Engineer's presence, unless otherwise authorized, may be ordered retested at the
10 Contractor's expense.

11 After testing, transfer the profile data from the profiler portable computer's hard drive to a
12 write once storage media (USB flash drive, external hard drive or electronic media method
13 approved by the Engineer). Label the disk or electronic media with the Project number,
14 Route, file number, date, and termini of the profile data. Submit the electronic data on the
15 approved media to the Engineer immediately after testing and this media will not be returned
16 to the Contractor.

17 Submit documentation and electronic data of the evaluation for each section to the Engineer
18 within 10 days after completion of the smoothness testing. Submit the electronic files
19 compatible with ProVAL and the evaluation in tabular form with each 0.10-mile segment
20 occupying a row. Include each row with the beginning and ending station for the section, the
21 length of the section, the original IRI values from each wheel path, and the MRI value for the
22 section. Each continuous run for a section will occupy a separate table and each table will
23 have a header that includes the following: the project contract number, county, the roadway
24 number or designation, a lane designation, the dates of the smoothness runs, and the
25 beginning and ending station of the continuous run. Summarize each table at the bottom.

26 Traffic control and all associated activities included in the pavement smoothness testing of the
27 pavement surface will be the responsibility of the Contractor.

(A) Acceptance for Construction

29 IRI and MRI numbers recorded in inches per mile will be established for each
30 0.10-mile section for each travel lane of the finished pavement surface designated by the
31 Contract.

32 Areas excluded from testing by the profiler will be tested by the Contractor and the
33 Engineer using a 10-foot stationary straightedge furnished by the Contractor. Any
34 location on the pavement selected by the Department shall be tested as well as all
35 transverse joints. Apply the straightedge parallel to the centerline of the surface. Do not
36 exceed 1/8 inch variation of the surface being tested from the edge of the straightedge
37 between any 2 contact points. Correct areas found to exceed this tolerance by removal of
38 the defective work and replacement with new material, unless other corrective measures
39 are permitted by the Engineer. Provide the work and materials required in the correction
40 of defective work.

41 Table 710-1 provides the acceptance quality rating scale of pavement based on the final
42 rideability determination.

Section 710

TABLE 710-1 MRI PRICE ADJUSTMENT PER 0.10-MILE SECTION	
MRI after Completion (Inches Per Mile)	Price Adjustment Per Lane (0.10-Mile Section)
45.0 and Under	\$200.00
45.1-55.0	PA = 600 – (10 * MRI)
55.1-70.0	Acceptable (No Pay Adjustment)
70.1-90.0	PA = 650 – (10 * MRI)
Over 90.1	Corrective Action Required

This price adjustment will apply to each 0.10-mile section based on the Mean Roughness Index (MRI), the average IRI values from both wheel paths.

When corrections to the pavement surface are required, the Engineer shall approve the Contractor's method of correction. Methods of correction shall be diamond grinding, remove and replace, or other methods approved by the Engineer. To produce a uniform cross section, the Engineer may require correction to the adjoining traffic lanes or shoulders. Corrections to the pavement surface, the adjoining traffic lanes and shoulders will be at no cost to the Department.

Where corrections are made after the initial smoothness testing, the pavement will be retested by the Contractor to verify that corrections have produced the acceptable ride surface. No incentives will be provided for sections on which corrective actions have been required. The Contractor will have one opportunity to perform corrective action(s).

(B) Localized Roughness

Areas of localized roughness shall be identified through the "Smoothness Assurance Module" provided in the ProVAL software. Use the "Smoothness Assurance Module" to optimize repair strategies by analyzing the measurements from profiles collected using inertial profilers. The ride quality threshold for localized roughness shall be 165 inches per mile at the continuous short interval of 25 feet. Submit a continuous roughness report to identify sections outside the threshold and identify all localized roughness, with the signature of the Operator included with the submitted IRI trace and electronic files.

The Department will require that corrective action be taken regardless of final IRI. Re-profile the corrected area to ensure that the corrective action was successful. If the corrective action is not successful, the Department will assess a penalty or require additional corrective action.

$$PA = (165 - LR\#) 5$$

Where:

$$PA = \text{Pay Adjustment (dollars)}$$

$$LR\# = \text{The Localized Roughness number determined from SAM report for the ride quality threshold}$$

Corrective work for localized roughness shall be approved by the Engineer before performing the work and shall consist of either diamond grinding or other methods approved by the Engineer. Any corrective action performed shall not reduce the integrity or durability of the pavement that is to remain in place. Notify the Engineer 5 days prior to commencement of the corrective action.

Localized roughness correction work shall be for the entire traffic lane width. Pavement cross slope shall be maintained through corrective areas.

710-8 MARKING FOR STATION NUMBERS AND DRAINAGE OUTLETS

Mark the pavement at locations as shown on the plans with station numbers. Mark the pavement by pressing beveled-face metal dies between 4 inches and 6 inches high into the plastic concrete.

Section 710

At locations where shoulder drain outlets are placed, mark the edge of pavement nearest the outlet with the letters "OL". Use the same marking procedure as for station numbers.

710-9 THICKNESS TOLERANCES

A lot for thickness acceptance testing is defined in Article 710-4.

To establish an adjusted unit price, if appropriate, for mainline pavement, take one 4 inch diameter core from each lot at a random location as directed by the Engineer. Other areas such as intersections, entrances, crossovers and ramps will each be considered as one lot and the thickness of each of these lots will be determined separately. Small irregular areas may be included as part of another lot. Take one core for each 1,333.3 sy of pavement or fraction thereof in the lot.

When the measurement of any core, original core or additional cores taken to calculate the average, is less than the plan thickness by more than 1.0 inch, the extent of the removal area due to thickness deficiency will be determined by taking additional exploratory cores at approximately 10 foot intervals parallel to the center line in each direction from the deficient core until an exploratory core is found in each direction which is within 1.0 inch of the plan thickness. The pavement between these exploratory cores will be removed full lane width wide and replaced with concrete of the thickness shown on the plans. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price.

When the measurement of the core from a lot is deficient by 0.2 inch or less from the plan thickness, no pay reduction will be made for thickness. When such measurement is deficient by more than 0.2 inch from the plan thickness, take 2 additional cores at random locations within the lot and calculate the average thickness of the lot from the 3 cores.

In determining the average thickness of the pavement lot, the Engineer will use all 3 core measurements. Individual core measurements which are greater than the plan thickness + 0.2 inch will be considered as the plan thickness + 0.2 inch. Individual cores which are less than the plan thickness - 1.0 inch will be considered as the plan thickness - 1.0 inch. If the average measurement of the 3 cores is within 0.2 inch from the plan thickness, full payment will be made. If the average measurement of the 3 cores is deficient by more than 0.2 inch from the plan thickness, an adjusted unit price in accordance with Subarticle 710-10(B) will be paid for the lot represented.

Areas found deficient in thickness by more than 1.0 inch shall be removed and replaced with concrete of the thickness shown on the plans. Any full lane or full shoulder width repairs to the concrete pavement shall be performed in accordance with the *North Carolina Department of Transportation Partial and Full Depth Repair Manual* and not be less than 1/2 of the slab length.

Patch all core holes within 72 hours of taking the core, using a Department approved nonshrink grout compatible with the pavement concrete.

710-10 MEASUREMENT AND PAYMENT**(A) General**

The quantity of Portland cement concrete pavement to be paid will be the actual number of square yards of concrete pavement completed and accepted. In measuring this quantity, the width of the pavement will be as called for on the plans or as directed by the Engineer. The length will be the actual length constructed, measured along the centerline of the pavement.

Separate measurement will be made of pavement that is deficient in thickness by more than 0.2 inch and of pavement that is deficient in compressive strength.

The quantities of Portland cement concrete pavement will be paid at the contract unit price per square yard for ____ " *Portland Cement Concrete Pavement, Through Lanes, (with dowels)*, ____ " *Portland Cement Concrete Pavement, Ramps, (with dowels)* or ____ " *Portland*

Section 710

Cement Concrete Pavement, Miscellaneous, (without dowels), or if applicable, at such contract unit prices adjusted in accordance with the requirements shown below. No unit price adjustments on lots will be made until a final determination of the lot strength and depth is made. Pavement will be classified as through lane, ramp or miscellaneous pavement in accordance with the classification shown on the plans.

Payment for all work of surface testing will be incidental to the contract unit price for *Portland Cement Concrete Pavement, Through Lanes, (with dowels)* for *Surface Testing Concrete Pavement*.

(B) Pavement Deficient In Thickness

The quantities of Portland cement concrete pavement which are deficient in thickness by more than 0.2 inch but not deficient by more than 1.0 inch, measured as provided in Article 710-10, will be paid at an adjusted contract unit price per square yard for ___" *Portland Cement Concrete Pavement, Through Lanes, (with dowels)*, ___" *Portland Cement Concrete Pavement, Ramps, (with dowels)* or ___" *Portland Cement Concrete Pavement, Miscellaneous, (without dowels)* completed in place and accepted.

The adjusted contract unit price is determined by the following formula, except no pay over 100% will be allowed:

$$\text{Pay Factor (\%)} = 110 - \left[50 \times (\text{Plan Thickness} - \text{Average Core Thickness}) \right]$$

Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Where pavement deficient by more than 1.0 inch is removed and replaced, the replacement pavement will be paid at the contract unit price per square yard for ___" *Portland Cement Concrete Pavement, Through Lanes, (with dowels)*, ___" *Portland Cement Concrete Pavement, Ramps, (with dowels)* or ___" *Portland Cement Concrete Pavement, Miscellaneous, (without dowels)* which price and payment will be full compensation for all work of placement, removal, restoration of subgrade and base and replacement.

(C) Concrete Pavement Varying In Strength

One of the following formulas will be used to calculate the concrete pavement pay factor.

(1) Compressive Strength

The pay factor for pavement achieving a compressive strength in 28 days of 4,500 psi or greater is 100%. The pay factor for pavement achieving a compressive strength in 28 days between 3,500 psi and 4,500 psi is determined by the following formula:

$$\text{Pay Factor (\%)} = 100.0 - \left[0.05 \times (4,500 - \text{Compressive Strength}) \right]$$

(pay factor rounded to nearest 0.1%)

(2) Flexural Strength

The pay factor for pavement achieving a flexural strength in 28 days of 650 psi or greater is 100%. The pay factor for pavement achieving a flexural strength in 28 days between 600 psi and 650 psi is determined by the following formula:

$$\text{Pay Factor (\%)} = 100.0 - (650 - \text{Flexural Strength})$$

(pay factor rounded to nearest 0.1%)

The quantities of Portland cement concrete pavement that meet these criteria, will be paid at an adjusted unit price per square yard for ___" *Portland Cement Concrete Pavement, Through Lanes, (with dowels)*, ___" *Portland Cement Concrete Pavement, Ramps, (with dowels)* or ___" *Portland Cement Concrete Pavement, Miscellaneous, (without dowels)* completed in place and accepted. The adjusted contract unit price will be determined by

Section 720

1 multiplying the contract unit price by the pay factor level determined for the average
 2 strength of concrete in each lot and will be applicable to the total square yards of concrete
 3 in each lot.

4 Any pavement that fails to attain 3,500 psi in compression is subject to removal. If
 5 allowed to remain in place, the pavement will be accepted at a reduced unit price based
 6 on a pay factor level of 50% as provided in Article 105-3.

7 Where pavement deficient in strength is removed and replaced, the replacement
 8 pavement, if acceptable, will be paid at the contract unit price for ____" *Portland Cement*
 9 *Concrete Pavement, Through Lanes, (with dowels)*, ____" *Portland Cement Concrete*
 10 *Pavement, Ramps, (with dowels)* or ____" *Portland Cement Concrete Pavement,*
 11 *Miscellaneous, (without dowels)* which price and payment will be full compensation for
 12 all work including placement, removal, restoration of subgrade and base and replacement.

(D) Multiple Adjustments in Price

14 Pavement found deficient in both thickness and strength will be evaluated by the
 15 Engineer to determine if it may be permitted to remain in place. Pavement permitted to
 16 remain in place will be paid at a reduced price determined by successively multiplying
 17 the contract price by the appropriate factor indicated for each deficiency.

(E) Compensation

19 Payment at the contract unit prices for ____" *Portland Cement Concrete Pavement,*
 20 *Through Lanes, (with dowels)* and ____" *Portland Cement Concrete Pavement Ramps,*
 21 *(with dowels)* and ____" *Portland Cement Concrete Pavement, Miscellaneous, (without*
 22 *dowels)* will be full compensation for all work covered by this section.

(F) Pay Items

24 Payment will be made under:

Pay Item	Pay Unit
____" Portland Cement Concrete Pavement, Through Lanes (with dowels)	Square Yard
____" Portland Cement Concrete Pavement, Ramps (with dowels)	Square Yard
____" Portland Cement Concrete Pavement, Miscellaneous (without dowels)	Square Yard

DIVISION 8 INCIDENTALS

SECTION 800 MOBILIZATION

800-1 DESCRIPTION

This work consists of preparatory work and operations to mobilize personnel, materials and equipment to the project site.

800-2 MEASUREMENT AND PAYMENT

Mobilization will be paid as contract lump sum price.

Partial payments for *Mobilization* will be made with the first and second partial pay estimates paid on the contract and will be made at the rate of 50% lump sum price 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. Where the amount bid for *Mobilization* exceeds 5% of the total amount bid for the contract, 2.5% of the total amount bid will be paid on each of the first two partial pay estimates. That portion exceeding 5% will be paid 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, payment of the entire lump sum price for *Mobilization* will be made with the first partial pay estimate paid on the contract, provided the amount bid does not exceed 5% of the total amount bid for the contract. Where the amount bid for *Mobilization* exceeds 5% of the total amount bid for the contract, 5% of the total amount bid will be paid on the first partial pay estimate. That portion exceeding 5% will be paid on the last partial pay estimate.

Such price and payment includes, but is not limited to, the movement of personnel, equipment, supplies and incidentals to the project site, for the establishment of offices, buildings and other facilities necessary for work on the project; the removal and disbandment of those personnel, equipment, supplies, incidentals or other facilities that were established for the prosecution of work on the project; and for all other work and operations that shall be performed for costs incurred before beginning work on the various items on the project site.

For projects that have a delayed availability date of 90 calendar days or more after contract execution, the first mobilization payment may be for the verified actual cost of paid bond premiums. This payment will only be made upon request by the contractor with supporting documentation including invoice and proof of payment. This payment will be limited to 1% of the amount bid for the contract and the subsequent mobilization payment will be reduced by an equal amount to follow the payment schedule as shown above. In no case will more than 5% of the amount bid for the contract be paid before the last partial pay estimate.

Payment will be made under:

Pay Item
Mobilization

Pay Unit
Lump Sum

Section 801

**SECTION 801
CONSTRUCTION STAKES, LINES AND GRADE****801-1 DESCRIPTION**

When required by the contract, provide all construction layout, surveying, stakeout, supplemental surveying and engineering necessary for the proper control of construction operations in accordance with this section and the *Manual for Construction Layout*. Provide a stakeout of areas where an environmental permit is required before performing any construction in or adjacent to these areas. Stake out limits of the permitted work areas according to the approved permit drawings. Provide clear delineation by use of highly visible flagging. Ensure construction limits do not exceed approved permitted work areas. Immediately notify the Engineer of any variations of the stakeout limits when compared to the approved permit drawings.

The *Manual for Construction Layout* and the *Guidelines for Drainage Studies and Hydraulic Design* is available on the Department's website.

801-2 CONSTRUCTION METHODS**(A) General**

Furnish personnel who are under the direct supervision of the Contractor's project engineer or a land surveyor licensed by the State of North Carolina in conformance with NCGS § 89C.

Furnish personnel who are experienced in highway construction surveying and are capable of accurately establishing all line and grade points necessary to complete the work in accordance with the plan dimensions within the precision established in the *Manual for Construction Layout*. Consult the Engineer for clarifications of the plans.

Perform work in safe manner and conform to Article 107-21. Perform all flagging operations in accordance with Section 1150.

The Contractor may elect to use global positioning system (GPS) surveying, either static or kinematic. Perform GPS surveys with same or higher order of accuracy as conventional surveys detailed in the *Manual for Construction Layout*. Department projects use a localized coordinate system developed by the Location and Surveys Unit specifically for each individual project. Obtain the control information that the Location and Surveys Unit used in establishing the localized coordinate system, specifically the rotation, scaling, translation and coordinates for the azimuth pairs. Newly developed GPS procedures and techniques that do not conform to this section may be used, if approved.

Investigate the plan horizontal alignment, vertical profile and super elevation of existing facilities that tie to proposed roadways. Investigate 100 feet beyond all paving limits and revise grades as needed to establish smooth transitions to the existing facilities.

Tie existing driveways to proposed facilities within the limits detailed in the plans and within the gradients detailed in the *Roadway Standard Drawings*.

The Engineer reserves the right to check, correct where necessary or require any layout work to be revised. The Engineer will perform checks to ensure the roadway, structure and incidental items are surveyed in accordance with the plans and the *Manual for Construction Layout*.

The Department's review of the Contractor's work in no way relieves the Contractor of responsibility for conformance with the contract. Failure by the Engineer or inspector to point out unsatisfactory work, from lack of discovery or for any other reason, in no way prevents later rejection or corrections to the unsatisfactory work, when discovered. No claims will be allowed for losses suffered due to any necessary removals or repairs resulting from the unsatisfactory work.

Section 801

When requested by the Engineer, check the accuracy of the stakeout. Correct all inaccuracies in the construction stakeout before performing the affected work.

When the Contractor proposes an alteration to the plans to rectify a construction stakeout error, submit alterations to the Engineer for review and approval. Include design calculations and drawings sealed by an engineer licensed by the State of North Carolina along with a narrative describing justification for the alteration.

When surveying is required, which in the Contractor's opinion could not have been reasonably anticipated and is not customary or inherent to the construction industry, notify the Engineer in writing before beginning such surveying. After investigation, the following will occur:

(1) When the Engineer determines that the surveying could not have been anticipated or is not customary or inherent to the construction industry, the Contractor will be notified in writing that the work is considered supplemental and measurement and payment will be made in accordance with Article 801-3.

(2) When the Engineer determines that the surveying could have been anticipated or is customary or inherent to the construction industry, he will notify the Contractor, in writing, of his determination. If the Contractor intends to file a claim for additional compensation by reason of such surveying, notify the Engineer in writing of such intent before beginning any of the alleged supplemental surveying. Strictly adhere to Subarticle 104-8(B).

(B) Records

Submit proposed method for setting up survey books or electronic data files to the Engineer before beginning work to assure clarity and adequacy.

Promptly make available to the Engineer all requested survey records.

Provide updates to the Engineer monthly of the electronic and/or manuscript survey records. Submit remaining records upon completion of the work. Attest the work was performed in accordance with the contract by providing all receivable information signed by an engineer or land surveyor licensed by the State of North Carolina and in responsible charge.

(C) Horizontal and Vertical Control

The Department will provide azimuth pairs to be used as primary horizontal and vertical control at approximately 1 mile intervals along the project corridor, and secondary horizontal baseline control on approximate 1,000 foot intervals and secondary vertical control on approximate 2,500 foot intervals within the project limits. Obtain a copy of the electronic survey control files from the Engineer.

Clearing limits may be established during original traverse of baseline control provided the accuracy ratio does not exceed 1 foot per 5,000 feet of perimeter and all Department established baseline control is protected and preserved during clearing operations. Before performing any additional construction layout, verify the horizontal baseline control by a closed traverse survey or alternate approved method based on the established azimuth pairs. The horizontal accuracy ratio shall not exceed an error of closure of 1 foot per 20,000 feet of perimeter. Verify the vertical control by performing a closed loop survey using differential leveling. For the vertical error of closure, do not exceed 0.05 feet times the square root of the miles:

$$\text{Error of Closure} \leq 0.05 \text{ ft} \sqrt{(x) \text{ miles}} .$$

Notify the Engineer of any discrepancies in either the horizontal or vertical control. Reference, outside of the proposed construction limits and evenly distributed throughout

Section 801

the project limits, a minimum of 50% of the Department's horizontal and vertical control. Provide reference information to the Engineer.

If GPS is used, occupy the azimuth pairs with the base station during verification of baseline control, otherwise, occupy baseline. Verify remaining baseline control using a Rover. Submit coordinate data showing differences between supplied baseline coordinates and field obtained GPS coordinates. Include report detailing the use of preliminary input data, specifically rotation, scaling and translation.

Using the horizontal and vertical control established by the Department, provide surveying necessary to construct all roadway, structure and miscellaneous items as detailed in the plans. Perform staking in accordance with the *Manual for Construction Layout*. Layout the work and provide all measurements that may be required for the execution of the construction in conformity with the contract.

(D) Right of Way, Control of Access and Easements

The Department will establish the location of all proposed right-of-way markers, control-of-access markers and permanent easements. Validate the position of the markers and permanent easement locations with those detailed in the plans. Report any discrepancies to the Engineer.

Reference the location of all proposed markers and permanent easements. Restore right-of-way and control-of-access monument positions after completion of construction. Set a right-of-way or control-of-access monument cap on an 18 inch (minimum) long #5 reinforcing bar and a carsonite witness stake unless concrete right-of-way and control-of-access markers are specified in the contract. The Department will provide the monument cap and witness stake. Re-establish location of permanent easements after completion of construction and install a permanent easement cap on 18 inch (minimum) long #5 reinforcing bar for monumentation.

Re-establishment and verification of existing monuments or the replacement of existing monuments with other material (concrete R/W markers, new iron pins, etc.), shall be performed under the responsible charge of a North Carolina Professional Land Surveyor (PLS). Verify all right of way, permanent easement, and control-of-access monument positions after completion of construction with signed and sealed attestation by PLS of said verification in accordance with the *Manual for Construction Layout*.

(E) Cross sections for Earthwork Quantities

The Engineer may elect to obtain cross sections either by hand or aerial methods. If the Engineer elects to obtain cross sections by aerial methods, furnish materials and install photogrammetric control panels in accordance with the *Manual for Construction Layout* or as otherwise directed by the Engineer.

(1) Borrow Pits

Establish a baseline alignment or establish horizontal and vertical control on approximate 1,000 foot intervals within each borrow pit, as necessary, to allow the Engineer to obtain measurement of quantities for payment. Stake these alignments just before field cross sections are taken by the Engineer for original, intermediate and final cross sections.

(2) Roadway

Unless otherwise directed, stakeout the survey lines for original and final cross sections. The stakeout of the survey lines will consist of surveying and staking all alignments within the plans on 50 foot intervals, including all cardinal points. When the alignments are inaccessible, install offset alignments. Begin the staking of these alignments within 48 hours of the Engineer's notice to proceed. Upon the completion of the entire project, with the exception of the survey line for final cross sections, and

Section 801

upon request by the Contractor, the project may be accepted for maintenance by the Department, excluding the survey line.

(F) Drainage and Utility Construction Systems**(1) General**

Where underground conflicts are suspected, contact utility owners and locate all utilities horizontally and vertically. Consider the utilities' locations and elevations in the layout of the drainage systems and utility construction systems. Utilities may exist that are not depicted in the plans.

Submit an electronic copy of all layout drawings for drainage systems and utility construction systems to the Engineer for his review and approval. The Engineer will note the review and approval by adding an appropriate note to the drawings along with the date and his signature. The Engineer will retain a copy of the drawings and a copy will be returned to the Contractor.

(2) Drainage Systems

Provide construction layout of drainage systems, as depicted in the plans and in accordance with the *Guidelines for Drainage Studies and Hydraulic Design*. Consider the locations and elevations of all existing and proposed utilities, proposed utility construction and existing and proposed drainage systems, in the layout of the drainage system. Modifications of the drainage plan may be necessary to properly collect and transport water. Advise the Engineer if modifications are needed to achieve the original design functionality and the intent of the drainage plans, such as adjusting the location of a drainage structure, adding a drainage structure and increasing or decreasing pipe lengths. The Engineer will review any major modifications.

Provide layout drawing of the drainage system including calculations of flow line elevations for all drainage structures; pipe invert elevations, both inlet and outlet of the drainage structure; grade of each pipe within the drainage system; elevation of any existing facility connection, such as stream or pipe; headwall location, if depicted in the plans; and locations and elevations of any existing or proposed utilities to the Engineer for review and approval at least 7 days before beginning work on the drainage system. Modification of the submitted drainage layout drawing by the Engineer will not eliminate the Contractor's liability for the accuracy of the information submitted. Any restaking or additional staking required to conform to the approved drainage layout drawing is incidental to the work.

(3) Utility Construction

Provide utility construction layout as detailed in the contract. Consider the locations and elevations of all existing and proposed utilities, proposed utility construction and existing and proposed drainage systems in the layout of the utility construction. Advise the Engineer if modifications to the utility construction plans are necessary. The Engineer will review any major modifications.

Provide layout drawing of the utility construction system including elevations of any existing utilities, drainage systems and/or proposed drainage systems to the Engineer for review and approval at least 7 days before beginning work on the utility construction system. Modification of the submitted utility construction layout drawing by the Engineer will not eliminate the Contractor's liability for the accuracy of the information submitted. Any restaking or additional staking required to conform to the approved utility layout drawing is incidental to the work.

(G) Structures

Provide surveying and calculations necessary to construct structures in accordance with the plans. Provide staking in accordance with the *Manual for Construction Layout*. Establish

Section 801

horizontal alignment of entire structure. Set at least one benchmark adjacent to the structure site that will be retained throughout the structure construction. The Engineer will furnish the finished construction elevations for use in determining the required construction elevations for bridges. Provide method for computing buildups over beams, screed grades and overhang form elevations to the Engineer for review before staking these items to assure clarity and adequacy.

Submit an electronic copy of structure layout drawings to the Engineer for his review and approval. The Engineer will independently verify and accept the structure layout before the structure construction may begin. The Engineer will note the review and approval by adding an appropriate note to the drawings along with the date and his signature. The Engineer will retain a copy of the drawings and a copy will be returned to the Contractor.

If structure phasing or damaged stakes require significant resurveying during the life of the structure, provide revised layout drawing for the Engineer's verification and acceptance.

(H) Signs

Stake horizontal locations of all overhead and Type A and B ground-mounted signs for Engineer's verification before obtaining S-dimensions. Measure or calculate overhead and ground-mounted sign S-dimensions in accordance with the plans and the *Manual for Construction Layout*. Perform investigation of proposed sign locations and notify the Engineer of any obstructions, either existing or proposed, that may interfere with the proposed sign installation. Provide an 11 inch x 17 inch drawing depicting the theoretical finished section at each proposed overhead sign assembly location. Include within the submittal the roadway, shoulder and slope gradients. Include the proposed finish elevations of the edges of pavement, each lane line and the ground at each proposed sign footing location. Set a slope stake at each proposed overhead sign location to ensure the slopes are constructed as calculated and detailed in the above submittal. Submit sign information to the Engineer. Stake horizontal locations of all ground mounted and barrier mounted signs.

801-3 MEASUREMENT AND PAYMENT

Construction Surveying will be paid at the contract lump sum price for the work detailed in this section.

Partial payments will be made on each particular payment estimate based upon the percentage complete of *Construction Surveying* as determined by the Engineer. The Contractor shall submit a certified statement each month indicating the percentage of *Construction Surveying* work completed. The Engineer will determine if the amount indicated is reasonably correct and the Engineer will pay accordingly on the next partial pay estimate.

Establishment of baseline alignments within each borrow pit is incidental to *Construction Surveying*.

Supplemental Field Surveying will be measured and paid as the actual number of hours the Contractor's survey crew is actively engaged in performing the following:

- (A) Investigative surveying, in excess of 100 feet of horizontal alignment, vertical profile and superelevation of existing facilities that tie to proposed roadways.
- (B) Surveying specifically for the relocation of utility conflicts.
- (C) Investigation of a previous stakeout when such stakeout is found to be correct.
- (D) Surveying that the Engineer has deemed could not have been anticipated or is not customary or inherent to the construction industry.
- (E) The stakeout of the roadway survey alignments for intermediate cross sections when deemed necessary by the Engineer.

Section 802

If the Engineer determines intermediate cross sections are not necessary for computing partial payments, the intermediate stakeout of the survey line is incidental to the work.

Supplemental Surveying Office Calculations will be measured and paid as the actual number of hours the Contractor's survey personnel is actively engaged in performing office calculations specifically associated with Subarticles 801-3(A) through 801-3(E).

Supplemental Surveying Office Calculations will be paid at the stated price of \$85.00 per hour. *Supplemental Field Surveying* will be paid at the stated price of \$145.00 per hour. The payment includes furnishing personnel, all surveying equipment, stakes, layout drawings, calculations, stakeout records and any materials and equipment necessary to perform the surveying and engineering work.

If the Engineer directs that the accuracy of the original stakeout be checked and the stakeout is found to be in error, perform the work required to check and correct the stakeout at no cost to the Department.

Exploratory Excavation required to locate a utility not identified in the plans will be paid in accordance with Article 104-7.

Work Zone Signs (Portable) will be paid in accordance with Article 1110-4.

Flaggers will be paid by the day in accordance with Article 1150-4.

Any payments for *Supplemental Field Surveying* or *Supplemental Surveying Office Calculations* required by this section will be paid on the appropriate partial payment estimate.

Payment will be made under:

Pay Item	Pay Unit
Construction Surveying	Lump Sum
Supplemental Field Surveying	Hour
Supplemental Surveying Office Calculations	Hour

SECTION 802
DISPOSAL OF WASTE AND DEBRIS

802-1 DESCRIPTION

The work consists of the disposal of waste and debris including, but not limited to, furnishing any waste areas; providing and implementing a Development, Use and Reclamation Plan; any right of access to waste areas; disposing of waste and debris; dressing and shaping of waste areas; furnishing and spreading earth material over debris, rock, broken pavement and masonry; clearing and grubbing of waste areas; hauling waste and debris to waste areas or permitted landfills; assessment for wetlands and endangered species; obtaining required permits or certifications; and any tipping fees required for disposal in permitted landfills.

Define "waste" as all excavated materials that are not used in the construction of the project, including overburden from borrow sources and soil-type base course sources.

Define "debris" as all undesirable material encountered on the project.

802-2 GENERAL REQUIREMENTS

Follow the most recent reclamation procedures found on the Department's website for all waste sites. Before the removal of any waste from any project, obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the deposition of the waste material to the proposed waste area will have no effect on any known district, site building, structure or object, architectural or archaeological, that is included, or eligible for inclusion, in the National Register of Historic Places. Furnish a copy of this certification to the Engineer before performing any work in the proposed waste site.

Section 802

Provide an area and dispose of waste and debris outside of the right of way, unless otherwise allowed by written request. Limit the materials placed in non-permitted disposal areas to clean soil, rock, concrete, brick, other inert materials and bituminous asphalt when placed at least 4 feet above the water table. Mixtures of soil and vegetation, that are primarily soil, may be placed in non-permitted disposal areas. Place all other debris in sites permitted by the Solid Waste Management Division of NCDEQ, unless otherwise approved.

Maintain the earth surfaces at all waste areas in a manner that will effectively control erosion and siltation until final acceptance of the project.

Shape the waste or disposal area to drain such that no water will collect or stand. Provide a functioning drainage system.

Shape rock and earth waste to contour and blend with the adjacent topography. Cover all rock, concrete, broken pavement and masonry with a minimum 6 inch thick layer of earth material from the project or borrow. Earth material should be tested to insure it will support long-term growth of the proposed ground cover and should be amended as necessary to support permanent growth. As an exception, side slopes constructed of all rock material will not require earth covering. Construct all slopes, other than rock, 2:1 or flatter. Construct rock slopes on a stable angle of repose.

Where the Engineer has granted permission to dispose of waste within the right of way, the Engineer will have the authority to establish whatever additional requirements may be necessary to insure the satisfactory appearance and drainage of the completed project.

Where electing to dispose of waste or debris in active public waste or disposal sites, provide evidence satisfactory to the Engineer that the Solid Waste Management Division of NCDEQ has permitted the proposed area or site.

Where electing to dispose of waste in a waste or disposal area, other than active public waste or disposal areas permitted by the Solid Waste Management Division of NCDEQ or on the Department's right of way or an existing borrow pit, submit jointly with the property owner a notarized Development, Use and Reclamation Plan for each waste or disposal area proposed for use.

As part of the Reclamation Plan, perform the following before wasting:

(A) Material Description

Detail the type of waste material proposed in the area. Only material originating from the Department's projects and complying with the Solid Waste Disposal Act will be permitted within the proposed waste or disposal area.

(B) Topography

Detail the existing topography and locations of the proposed access and egress haul roads. Detail the proposed final topography of the waste or disposal area showing any proposed drainage systems. If a pond is to be constructed or remain, the minimum depth shall be at least 4 feet as determined from the water table at the time the reclamation plan is executed. The slope of the soil below the water shall be between 5:1 and 2:1. The slope of the sides above the water line shall be 2:1 or flatter.

(C) Slopes

Rock and earth waste shall be shaped to contours that are compatible to and blend with the adjacent topography. Cover all rock with a minimum 6 inch layer of earth material either from project waste or from borrow. As an exception, side slopes constructed of all rock material will not require earth covering. Construct all slopes at a 2:1 or flatter except rock slopes that shall be on a stable angle of repose.

Section 802

(D) Construction Debris

Cover construction debris and all broken pavement and masonry with a minimum 6 inch thick layer of earth waste material from the project or borrow. Shape the completed waste area as required above for the disposal of earth or rock waste.

(E) Erosion Control

Detail the temporary and permanent erosion control measures, along with design calculations, that are intended during use of the site and as part of the reclamation. Unless considered impractical due to special circumstances, provide in the plan for the use of staged permanent seeding and mulching and appropriate fertilizer topdressing on a continual basis during site use and the immediate total reclamation of the site when the site is no longer needed. Define the seed mixture proposed for establishing temporary and/or permanent vegetation. Establish permanent stand of vegetation before acceptance of project.

(F) Evaluation for Potential Wetlands and Endangered Species

Hire an experienced environmental consultant on the Department's approved list to perform an assessment of the waste site for potential conflicts with wetlands, areas of environmental concern, federally listed threatened or endangered species, and federal species of concern.

Delineate the boundaries of any wetlands or jurisdictional surface waters (streams) encountered. Follow the standard practice for documenting the wetland delineation including completion of the USACE's approved *Wetland Determination Data Form*. Document information including data regarding soil, vegetation and hydrology. Maintain a minimum 25 foot buffer adjacent to all sides of the wetland boundary and a minimum 50 foot buffer adjacent to any stream. Depict the limits of the delineated wetland and surrounding buffer on the Reclamation Plan. Do not dispose of waste and debris in any area under the USACE' or any other environmental agencies' regulatory jurisdiction unless and until the NCDOT permit has been modified to permit such disposal activity in the jurisdictional area.

Perform a site assessment for federally listed threatened or endangered species to include habitats that may support these species. Provide to the Engineer a detailed report on the assessment findings. If federally listed threatened or endangered species, or habitat that may support such species, exist on the proposed waste site, notify the Engineer before continued pursuit of such site.

(G) Buffer Zones

Allocate sufficient area between the nearest property line and the tie-in of the slope to natural ground to allow for the operation of excavation, hauling, and seeding equipment and for the installation of any and all erosion control devices required. Leave additional undisturbed area between the source and any watercourse or body to prevent siltation of the watercourse or body and the movement of the shore line either into the watercourse or body or into the waste areas. Determine if the adjoining property owners or other government agencies require any additional buffer zones and comply with those requirements. [Suggested minimum distances are 10 feet from property lines and 50 feet from water bodies or watercourses.] Do not place waste material within the 100-year floodplain unless superseded by an environmental permit.

(H) Approval

Obtain written approval from the Engineer before wasting within the proposed waste or disposal area.

Section 806

Submit a revised or additional reclamation plan to the Engineer if the non-permitted waste or disposal area is expanded by more than one acre or is significantly changed from the previously approved submittal.

802-3 MEASUREMENT AND PAYMENT

Seeding and mulching, fertilizer topdressing and establishing erosion control measures for waste or disposal areas will be measured and paid at the contract unit prices for the items established in the contract.

When permitted to waste within the right of way and when the waste area requires additional covering material before seeding, provide covering material at no cost to the Department.

When waste areas are located outside the right of way, no payment will be made for any borrow used to cover rock, broken pavement, masonry or other inert materials.

Except as otherwise provided above, no direct payment will be made for the work covered by this section. Payment at the contract prices for the various items in the contract will be full compensation for all work covered by this section.

SECTION 806

RIGHT-OF-WAY AND CONTROL-OF-ACCESS MARKERS

806-1 DESCRIPTION

Furnish and install precast concrete or granite markers to mark the boundaries of the right of way or the control of access in accordance with the contract.

806-2 MATERIALS

Refer to Division 10.

Item	Section
Steel Bar Reinforcement	1070-2
Precast Concrete Units	1077

The Contractor may, at his option, use either granite or concrete markers. Make granite markers from granite that is hard and durable, of a light color, free from seams which impair its structural integrity, and of a good, smooth splitting appearance.

806-3 CONSTRUCTION METHODS

Precast the right-of-way and control-of-access markers in watertight forms of a size and shape that will produce a completed marker of the dimensions shown in the *Roadway Standard Drawings*. Construct the forms so as to impress the concrete with the lettering and markings shown in the contract.

Cure the concrete in accordance with Article 420-15. Give that portion of the marker that will be above the surface of the ground ordinary surface finish in accordance with Subarticle 420-17(B).

If using granite markers, quarry and finish the markers to the dimensions indicated in the contract. Drill holes will be permitted in the sides and bottom.

Install the markers vertically in the ground to the depth and locations specified in the contract. Thoroughly tamp backfill material.

806-4 MEASUREMENT AND PAYMENT

Right-of-Way Markers will be measured and paid in units of each for the actual number of right-of-way markers furnished, installed and accepted.

Control-of-Access Markers will be measured and paid in units of each for the actual number of control-of-access markers furnished, installed and accepted.

Section 808

1 Payment will be made under:

Pay Item

Right-of-Way Markers

Control-of-Access Markers

Pay Unit

Each

Each

Section 828

SECTION 828
TEMPORARY STEEL COVER FOR MASONRY
DRAINAGE STRUCTURES

828-1 DESCRIPTION

Install temporary steel plate covers on masonry drainage structures in accordance with the details shown in the plans and as directed by the Engineer.

828-2 MATERIALS

Provide materials that are Grade A36 steel and the size and thickness shown on the detail in the plans.

828-3 MEASUREMENT AND PAYMENT

Temporary Steel Plate Covers for Masonry Drainage Structures will be measured and paid in units of each for the actual number of these items incorporated into the completed and accepted work.

Payment will be made under:

Pay Item	Pay Unit
Temporary Steel Plate Covers for Masonry Drainage Structures	Each

SECTION 830
BRICK MASONRY CONSTRUCTION

830-1 DESCRIPTION

This work consists of the general requirements for all unreinforced brick masonry construction. The requirements of Sections 838, 840 and 858 will prevail over any conflicting requirements of this section.

830-2 CONSTRUCTION METHODS

Construct all concrete footings and all other concrete elements of the structure in accordance with Section 825.

830-3 MORTAR

Machine mix mortar in accordance with Article 1040-9 for at least 90 seconds. Remove and dispose of any mortar that has developed initial set or lost plasticity.

830-4 LAYING BRICK

Dampen brick when necessary to reduce the rate of absorption. Build brick masonry plumb and true to the required dimensions. Place a header course approximately mid height of the structure in structures less than 9 courses high. Place a header course every third course on structures 9 courses high or higher. Use other types of bonding where indicated in the plans.

Completely fill brick joints and cavities with mortar. Make mortar joint thickness at least 3/8 inch and no more than 5/8 inch. Finish joints that will remain exposed after backfill with a concave jointer. Flush cut all other joints.

Use spalls or bats only when shaping around irregular openings or when unavoidable to finish out a course. Place a full brick at the corner and place the bat in the interior of the course when necessary to finish out the course.

Clean spilled mortar from exposed exterior surfaces not backfilled.

Section 832**830-5 PROTECTION FROM COLD WEATHER**

Do not place masonry when the temperature is below 35°F unless adequate protection is provided by a pre-approved method.

When it is anticipated that the atmospheric temperature will fall below 35°F protect masonry, in accordance with Subarticle 420-7(C), for at least 3 curing days.

Define a “curing day” as any consecutive 24 hour period, beginning when the last masonry unit is placed in the completed structure, during which the air temperature adjacent to the structure does not fall below 40°F.

830-6 MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered by this section.

Payment at the contract prices for the various items covered by those sections of the *Standard Specifications* directly applicable to the work being constructed will be full compensation for all work covered by this section.

SECTION 832

REINFORCED BRICK MASONRY CONSTRUCTION

832-1 DESCRIPTION

This work shall consist of the general requirements for all reinforced brick masonry construction. The requirements of Section 838 will prevail over any conflicting requirements of this section.

832-2 CONCRETE CONSTRUCTION

Construct concrete footings and all other concrete elements of the structure in accordance with Section 825. Furnish and place reinforcement as shown in the plans and in accordance with Section 425. Use Class A concrete for footings unless otherwise indicated in the plans. Use Class B concrete in reinforcement cavities. Rod Class B concrete in reinforcement cavities to provide a dense, homogeneous concrete. Do not vibrate.

832-3 MORTAR

Machine mix mortar that meets Article 1040-9 for at least 90 seconds. Remove and dispose of any mortar that has developed initial set or lost plasticity.

832-4 LAYING BRICK

Dampen brick when necessary to reduce the rate of absorption. Construct the type of bond called for in the plans. Build reinforced brick masonry plumb and true to the required dimensions.

Lay brick with completely filled mortar joints. Make mortar joint thickness at least 3/8 inch and no more than 5/8 inch. Finish joints that will remain exposed after backfill, with a concave jointer. Flush cut all other joints.

Use spalls or bats only when shaping around irregular openings. Place a full brick at the corner and place the bat in the interior of the course when necessary to finish out a course.

Clean spilled mortar from exposed exterior surfaces not backfilled.

832-5 PROTECTION FROM COLD WEATHER

Refer to Article 830-5.

832-6 MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered by this section.

Section 834

Payment at the contract unit prices for the various items covered by those sections of the Specifications directly applicable to the work being constructed will be full compensation for all work covered by this section.

**SECTION 834
BLOCK MASONRY CONSTRUCTION**

834-1 DESCRIPTION

This work consists of constructing concrete block masonry. The requirements of Sections 840, 858 and 859 will prevail over any conflicting requirements of this section.

834-2 CONCRETE CONSTRUCTION

Construct concrete footings and all other concrete elements of the structure in accordance with Section 825.

834-3 MORTAR

Machine mix mortar in accordance with Article 1040-9 for at least 90 seconds. Remove and dispose of any mortar that has developed initial set or has lost plasticity.

834-4 LAYING CONCRETE BLOCK

Build block masonry plumb and true to the required dimensions. Stagger vertical joints. Set the block with the cells vertical. Spread mortar on the bearing members and fill the vertical joints with mortar. Dampen block when necessary to reduce the rate of absorption.

Make joints straight, level, plumb, and neat at intersection. Make mortar joint thickness at least 3/8 inch and no more than 5/8 inch. Finish joints that will remain exposed after backfill, with a concave jointer. Flush cut all other joints. Clean exposed exterior surfaces of spilled mortar that are not backfilled.

834-5 PROTECTION FROM COLD WEATHER

Refer to Article 830-5.

834-6 MEASUREMENT AND PAYMENT

There will be no direct payment for the work covered by this section.

Payment at the contract prices for the various items covered by those sections of the *Standard Specifications* directly applicable to the work being constructed will be full compensation for all work covered by this section.

SECTION 838 ENDWALLS

838-1 DESCRIPTION

Perform the work covered by this section including but not limited to excavation, hauling, disposal of materials, furnishing and placing backfill materials, subsurface drainage, concrete, brick masonry, mortar, grout, and furnishing and placing reinforcing steel to construct Portland cement concrete or brick masonry endwalls, either plain or reinforced, in accordance with the contract.

838-2 MATERIALS

Refer to Division 10:

Item	Section
Brick	1040-1
Curing Materials	1026
Mortar	1040-9
Precast Concrete Units	1077
Portland Cement Concrete, Class A	1000
Steel Bar Reinforcement	1070-2
Select Materials	1016
Subsurface Drainage Materials	1044

Use Portland cement concrete, brick masonry or precast concrete for the endwall unless otherwise specified in the plans.

If precast sections are proposed, submit in writing for approval.

838-3 CONSTRUCTION METHODS

(A) Foundation

Do not place concrete or masonry until the foundation is approved by the Engineer.

Excavate foundation to a firm surface, make level or stepped and clean surfaces of loose material. Make excavation true to lines and dimensions shown on plans.

Where the foundation material is found to be of poor supporting value or of rock, the Engineer may make minor adjustments in the location of the structure to provide a more suitable foundation. Where this is not practical, undercut the foundation and condition by backfilling with an approved select material.

(B) Concrete and Masonry

Construct concrete in accordance with Section 825 and give an ordinary surface finish.
Construct brick masonry in accordance with Sections 830 and 832. Furnish and place reinforcing steel in accordance with Section 425.

Section 840

Provide the class of concrete indicated in the plans.

Obtain approval if field conditions necessitate a variance from the plan dimensions of the structure and footings.

Construct endwalls on the end of a full joint of pipe and in accordance with the details in the plans.

Any endwall that incorporates an opening for circular pipe 54 inches or greater shall be reinforced.

(C) Backfill

Complete endwall construction, and remove all forms. Backfill with approved material after the concrete or brick masonry has cured for at least 7 curing days unless otherwise permitted. A “curing day” is defined in Article 830-5. Within 4 calendar days after the completion of the 7 day curing period, shape, compact and complete backfill in accordance with the contract.

838-4 MEASUREMENT AND PAYMENT

Endwalls will be measured and paid in cubic yards of concrete or brick completed and accepted. This quantity will be computed from the dimensions shown in the plans or from revised authorized dimensions. Where precast concrete units have been approved and are used instead of cast-in-place units the quantity to be paid will be computed the same as if cast-in-place units were used, as no reduction in pay quantity will be made due to the use of precast instead of cast-in-place endwalls.

Reinforced Endwalls will be measured and paid in cubic yards of concrete or brick completed and accepted. This quantity will be computed from the dimensions shown in the plans or from revised authorized dimensions. Where precast concrete units have been approved and are used instead of cast-in-place units the quantity to be paid will be computed the same as if cast-in-place units were used, as no reduction in pay quantity will be made due to the use of precast instead of reinforced cast-in-place endwalls.

Payment will be made under:

Pay Item	Pay Unit
Endwalls	Cubic Yard
Reinforced Endwalls	Cubic Yard

**SECTION 840
MINOR DRAINAGE STRUCTURES**

840-1 DESCRIPTION

Perform the work covered by this section including, but not limited to, excavation; providing protection of employees in excavation; hauling; disposal of materials; removing existing pipe and drainage structures at the site of the work; furnishing, transporting and placing foundation conditioning material, backfill material, subsurface drainage, concrete, brick masonry, block masonry, precast units, mortar, grout, reinforcing steel, hardware, castings and miscellaneous metal; fabrication; welding; and galvanizing to construct cast-in-place concrete, brick masonry, block masonry or precast concrete inlets, catch basins, junction boxes, spring boxes, manholes, concrete aprons and other minor drainage structures excluding endwalls, with all necessary metal grates, covers, frames, steps and other hardware, in accordance with the contract.

Use cast-in place concrete, brick masonry, block masonry or precast concrete construction as shown on approved plans.

Section 840

840-2 MATERIALS

Refer to Division 10.

Item	Section
Brick	1040-1
Concrete Block	1040-2
Curing Materials	1026
Fabricated Steel Grates	1074-9
Gray Iron Castings	1074-7
Joint Filler	1028-1
Joint Sealers	1028-2, 1028-3
Mortar	1040-9
Precast Drainage Structure Units	1077
Portland Cement Concrete, Class B	1000
Reinforcing Steel	1070
Select Materials	1016
Steps	1074-8
Structural Steel	1072

Use grout in precast structures consisting of one part Portland cement to two parts of mortar sand.

Use foundation conditioning material meeting Article 1016-3 for Class V or VI select material as shown in the contract or as directed.

840-3 CONSTRUCTION METHODS

(A) Excavation

Perform excavation with equipment of adequate weight, size and capability. Where necessary, provide a competent person and protection of personnel in excavation by sloping, shoring or bracing in accordance with Federal, State or local standards and Article 107-1.

(B) Foundation

Do not place masonry drainage structure until the foundation has achieved adequate strength.

Where the foundation material is found to be of poor supporting value or of rock, minor adjustments in the location of the structure may be approved to provide a more suitable foundation. Where this is not practical, undercut the foundation and condition by backfilling with an approved select material.

Set precast structure foundations to within $\pm 1/2$ inch of grade on a 2 inch to 3 inch thick bed of compacted foundation conditioning material.

(C) Cast-In-Place Concrete, Brick and Block Masonry

Install drainage structures to plan line and grade or approved to meet drainage conditions. Do not modify the drainage structure by corbeling or use of concrete slabs unless otherwise directed by the Engineer.

Construct concrete in accordance with Section 825 and give an ordinary surface finish. Construct brick masonry in accordance with Section 830. Construct block masonry in accordance with Section 834. Furnish and place reinforcing steel in accordance with Section 425.

Obtain approval if field conditions necessitate a variance from the plan dimensions of the structure or footings.

Section 840

(D) Installation of Precast Units

Install drainage structures to plan line and grade or approved to meet drainage conditions. Do not modify the drainage structure by corbeling or use of concrete slabs unless otherwise directed by the Engineer.

Assemble the precast drainage structure units in accordance with the manufacturer's instructions. Subarticle 840-3(C) applies where it is necessary to use cast-in-place concrete, brick masonry or block masonry construction as part of the structure. Fill any void greater than 1 inch with a brick or block bat fully encased in mortar.

Obtain approval if field conditions necessitate a variance from the plan dimensions of the structure or footings.

(E) Fittings and Connections

As the work is built up, accurately space, align and thoroughly bond fittings that enter the structure.

Make pipe connections so the pipe does not project beyond the inside wall of the drainage structure and grout as necessary to make smooth and uniform surfaces on the inside of the structure.

Set metal frames for grates and covers in full mortar beds or secure by approved methods.

(F) Backfill

Complete drainage structure and remove all forms and falsework. Backfill with approved material, compacted to the density required by Subarticle 235-3(C), after the drainage structure has cured for at least 7 curing days, unless otherwise permitted. Define a "curing day" in accordance with Article 825-9 for concrete or Article 830-5 for brick or block masonry.

(G) Pipe Collars and Pipe Plugs

Construct pipe collars and pipe plugs in accordance with the details shown in the plans or as directed by the Engineer.

Use any class of Portland cement concrete contained within Section 1000 for pipe collars.

Construct pipe plugs with either brick masonry or any class of Portland cement concrete contained within Section 1000.

(H) Concrete Aprons

Construct concrete aprons in accordance with the details in the plans. Use Class B or higher compressive strength concrete.

840-4 MEASUREMENT AND PAYMENT

Masonry Drainage Structure that incorporate an opening for circular pipe not exceeding 48 inches in diameter will be measured and paid in units of each for the actual number completed and accepted.

Masonry Drainage Structure exceeding a height of 5.0 feet will be measured and paid in linear feet for the portion of the drainage structure exceeding a height of 5.0 feet. The height will be measured vertically to the nearest 0.1 feet from the top of the bottom slab to the top of the wall. For that portion of *Masonry Drainage Structure* measured above a height of 10.0 feet, payment will be made at 1.3 times the contract unit price per linear foot for *Masonry Drainage Structure*.

Masonry Drainage Structures that incorporate an opening for circular pipe exceeding 48 inches in diameter, or for pipe arch of any size, will be measured and paid on a volume basis as provided below.

Section 840

Masonry to be paid will be the number of cubic yards of cast-in-place concrete brick or block that has been incorporated into the completed and accepted structure. This quantity will be computed from the dimensions shown in the plans or from revised dimensions authorized by the Engineer. Where the wall thickness is greater than the wall thickness shown in the plans due to the use of oversize brick or for any other reason, the wall thickness shown in the plans will be used to compute quantities except where an increase in wall thickness has been authorized by the Engineer.

Pipe Collars will be measured and paid in cubic yards of concrete or brick that has been incorporated into the completed work. The cubic yards of pipe collars will be computed from the dimensions shown in the plans or from revised dimensions authorized by the Engineer.

Pipe Plugs will be measured and paid in cubic yards of concrete or brick that has been incorporated into the completed and accepted pipe plug. The cubic yards of pipe plugs will be computed from the dimensions shown in the plans or from revised dimensions authorized by the Engineer.

Frame with Grate and Hood, Std. ____ will be measured and paid in units of each for actual number of assemblies incorporated into the completed work. No separate measurement will be made of grates, hoods, and covers that are part of the assembly, as the grates, hoods and covers will be considered to be part of the complete assembly.

Frame with Grate, Std. ____ will be measured and paid in units of each for actual number of assemblies incorporated into the completed work. No separate measurement will be made of grates, hoods, and covers that are part of the assembly, as the grates, hoods and covers will be considered to be part of the complete assembly.

Frame with Two Grates, Std. ____ will be measured and paid in units of each for actual number of assemblies incorporated into the completed work. No separate measurement will be made of grates, hoods, and covers that are part of the assembly, as the grates, hoods and covers will be considered to be part of the complete assembly.

Frame with Cover, Std. ____ will be measured and paid in units of each for actual number of assemblies incorporated into the completed work. No separate measurement will be made of grates, hoods, and covers that are part of the assembly, as the grates, hoods and covers will be considered to be part of the complete assembly.

Steel Frame with Two Grates, Std. ____ will be measured and paid in units of each for the actual number of fabricated steel grates incorporated into the completed work.

No separate payment will be made for concrete aprons shown in *Roadway Standard Drawings* No. 840.17, 840.18, 840.19, 840.26, 840.27 and 840.28, as this work will be incidental to the other work in this section.

Foundation Conditioning Material, Minor Structures will be paid as provided in Article 300-9.

The above prices and payments will be full compensation for all work covered by this section.

Section 846

1 Payment will be made under:

Pay Item	Pay Unit
Masonry Drainage Structures	Each
Masonry Drainage Structures	Linear Foot
Masonry Drainage Structures	Cubic Yard
Pipe Collars	Cubic Yard
Pipe Plugs	Cubic Yard
Frame with Grate and Hood, Std. _____	Each
Frame with Grate, Std. _____	Each
Frame with Two Grates, Std. _____	Each
Frame with Cover, Std. _____	Each
Steel Frame with Two Grates, Std. _____	Each

2 **SECTION 846**
3 **CONCRETE CURB, CURB AND GUTTER, CONCRETE**
4 **GUTTER, SHOULDER BERM GUTTER, CONCRETE EXPRESSWAY**
5 **GUTTER AND CONCRETE VALLEY GUTTER**

6 **846-1 DESCRIPTION**

7 Construct Portland cement concrete curb, concrete curb and gutter, concrete gutter, shoulder
8 berm gutter, concrete expressway gutter and 4 inch concrete valley gutter as shown in the
9 contract.

10 **846-2 MATERIALS**

11 Refer to Division 10.

Item	Section
Curing Materials	1026
Joint Filler	1028-1
Joint Sealers	1028-2, 1028-3
Portland Cement Concrete, Class B	1000

12 **846-3 CONSTRUCTION METHODS**

13 **(A) General**

- 14 Construct concrete in accordance with Section 825, except as provided herein.
- 15 Give surface a light broom finish with brush marks parallel to the curb line or gutter line.
- 16 Prepare foundation and compact base or subgrade to the degree required by the applicable
17 section of the *Standard Specifications* before placing forms.

18 **(B) Forms**

- 19 Use forms that have no more than 1/8 inch in 10 feet deflection from true line horizontally
20 and vertically to adequately support the concrete and construction equipment.
- 21 Obtain approval before placing concrete.

22 **(C) Joints**

- 23 Locate joints as shown in the plans except as provided herein.
- 24 Space joints no closer than 5 feet.
- 25 Locate joints to line up with the joints in concrete pavement when placed adjacent to
26 concrete pavement.
- 27 Form grooved contraction joints as required by Subarticle 825-10(B).

Section 846

Construct grooved butt joint between the work and adjacent pavement except where expansion joints are required by the plans. Form butt joints as required by Subarticle 825-10(B) for grooved contraction joints and seal.

Seal all joints except for joints in curb sections not having an integral gutter.

Fill joints in gutter with joint sealer to the top surface of the gutter.

Seal joints before backfilling or performing adjacent operations.

(D) Surface Tolerances

Finish surface within 1/4 inch when checked longitudinally with a 10 foot straightedge.

(E) Backfilling

Do not place backfill or pavement adjacent to the curb, curb and gutter, gutter, shoulder berm gutter, expressway gutter or concrete valley gutter until at least 3 curing days, as defined in Article 825-9, have elapsed.

Complete backfill within 4 calendar days after the completion of the 3 day curing period unless otherwise approved.

Compact backfill to an approved density.

(F) Opening to Traffic

Vehicles may be permitted on the completed work after the following curing days, as defined in Article 825-9, have elapsed. For regular strength concrete, cure for at least 7 curing days. For high early strength concrete, cure for at least 3 curing days.

846-4 MEASUREMENT AND PAYMENT

" x " Concrete Curb will be measured and paid in linear feet, accepted in place, along the surface of the top of the curb.

' " Concrete Curb and Gutter will be measured and paid in linear feet, accepted in place, along the surface of the top of the curb.

' Concrete Gutter will be measured and paid in linear feet accepted in place, along the surface of the top of the gutter.

Shoulder Berm Gutter will be measured and paid in linear feet, accepted in place, along the surface of the top of the gutter.

Concrete Expressway Gutter will be measured and paid in linear feet, accepted in place, along the surface of the top of the gutter.

Concrete Valley Gutter will be measured and paid in linear feet, accepted in place, along the surface of the top of the gutter.

Work includes providing all materials, placing all concrete, excavating and backfilling, forming, finishing, constructing and sealing joints, and all incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
<i>" x " Concrete Curb</i>	Linear Foot
<i>' " Concrete Curb and Gutter</i>	Linear Foot
<i>' Concrete Gutter</i>	Linear Foot
<i>Shoulder Berm Gutter</i>	Linear Foot
<i>Concrete Expressway Gutter</i>	Linear Foot
<i>Concrete Valley Gutter</i>	Linear Foot

SECTION 848

CONCRETE SIDEWALKS, DRIVEWAYS AND CURB RAMPS

848-1 DESCRIPTION

Construct Portland cement concrete sidewalks, driveways and curb ramps in accordance with the contract.

848-2 MATERIALS

Refer to Division 10.

Item	Section
Curing Materials	1026
Joint Filler	1028-1
Joint Sealers	1028-2, 1028-3
Portland Cement Concrete, Class B	1000

Detectable warning for curb ramps shall consist of raised truncated domes. Use material for detectable warning systems as shown herein. Material and coating specifications must be stated in the Manufacturers Type 3 Certification and all Detectable Warning systems must be on the NCDOT APL.

Install detectable warnings created from one of the following materials: precast concrete blocks or bricks, clay paving brick, gray or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile. Only one material type for detectable warning will be permitted per project, unless otherwise approved by the Engineer.

Detectable Warnings shall consist of a base with integrated raised truncated domes, and when constructed of precast concrete they shall conform to the material requirements.

Detectable Warnings shall consist of a base with integrated raised truncated domes, and may be comprised of other materials including, but not limited to, clay paving brick, gray iron or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile, which are applied directly to the curb ramps by incorporating into or attaching to the existing ramp floor. The material shall have an integral color throughout the thickness of the material. The detectable warning shall include fasteners, anchors, or adhesives for attachment in the existing ramp and shall be furnished as a system from the manufacturer.

Prior to installation, the Contractor shall submit to the Engineer assembling instructions from the manufacturer for each type of system used. The system shall be furnished as a kit containing all consumable materials and consumable tools, required for the application. They shall be capable of being affixed to or anchored in the concrete curb ramp, including green concrete (concrete that has set but not appreciably hardened). The system shall be solvent free and contain no volatile organic compounds (VOC). The system shall be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to degradation by motor fuels, lubricants and antifreeze.

When steel or gray iron or ductile iron casting products are provided, only products that meet the requirements of Subarticle 106-1(B) may be used. Submit to the Engineer a Type 6 Certification, catalog cuts and installation procedures at least 30 days prior to installation for all.

848-3 CONSTRUCTION METHODS

Where it is necessary to remove a portion of existing sidewalks or driveways, saw a neat edge along the pavement to be retained approximately 2 inches deep with a concrete saw before breaking the adjacent pavement away.

Construct concrete in accordance with Section 825 and give a sidewalk finish, except as otherwise provided herein.

Section 848

Broom the concrete surface in a transverse direction to traffic. Make joint spacing no less than 5 feet. Where existing sidewalks are being widened, line up new transverse joints with existing joints in the adjacent sidewalk. Seal expansion joints where sidewalk and curb ramps are placed adjacent to concrete curb and/or gutter. Do not seal grooved joints.

Do not place backfill adjacent to the sidewalk, driveway or curb ramp until at least 3 curing days, as defined in Article 825-9, have elapsed unless otherwise approved by the Engineer. Compact backfill to a degree comparable to the adjacent undisturbed material.

Do not place vehicles on the completed work until 7 curing days, as defined in Article 825-9, have elapsed. When high early strength concrete is used, vehicles will be permitted on the completed work after 3 curing days have elapsed.

Install detectable warnings for proposed curb ramps in accordance with the contract.

Prior to placing detectable warnings in existing concrete curb ramps, saw cut to the full depth of the concrete, for other material remove as necessary, and adjust the existing subgrade to the proper grade.

Place all detectable warnings in accordance to manufacturer's recommendations.

848-4 MEASUREMENT AND PAYMENT

" *Concrete Sidewalk* will be measured and paid in square yards, measured along the surface of the completed and accepted work. Such price includes, but is not limited to, excavating and backfilling, sawing the existing sidewalk, furnishing and placing concrete, and constructing and sealing joints.

" *Concrete Driveway* will be measured and paid in square yards, measured along the surface of the completed and accepted work. Such price includes, but is not limited to, excavating and backfilling, sawing the existing driveway, furnishing and placing concrete, and constructing and sealing joints.

Concrete Curb Ramps will be measured and paid in units of each. Such price includes, but is not limited to, excavating and backfilling, sawing the existing sidewalk or driveway, furnishing and placing concrete, curb and gutter, constructing and sealing joints and furnishing and installing truncated domes shown in the *Roadway Standard Drawings*.

Retrofit Existing Concrete Curb Ramps with detectable warnings constructed of any type material will be paid as the actual number of retrofitted curb ramps, completed and accepted. Such price and payment will be full compensation for excavating and backfilling; sawing, repairing and replacing portions of the existing curb ramp within the pay limits for retrofit shown on the detail; pavement repairs; furnishing and placing detectable warnings, construction joints and removing and disposing of portions of the existing curb ramp when required and for all materials, labor, equipment, tools and incidentals necessary to complete the work.

Remove and Replace Concrete Curb Ramps will be measured and paid in units of each. Such price includes, but is not limited to, excavating, removing and backfilling, sawing the existing sidewalk or driveway and furnishing and installing truncated domes and constructing the new curb ramp. Removal and disposal of existing curb ramps will be incidental to the work performed.

Payment will be made under:

Pay Item	Pay Unit
" Concrete Sidewalk	Square Yard
" Concrete Driveway	Square Yard
Concrete Curb Ramps	Each
Retrofit Existing Concrete Curb Ramps	Each
Remove and Replace Concrete Curb Ramps	Each

Section 876

SECTION 876
RIP RAP

876-1 DESCRIPTION

Supply and place rip rap and, if necessary, filtration geotextiles in accordance with the contract and as directed by the Engineer.

876-2 MATERIALS

Refer to Division 10.

Item	Section
Geotextile for Drainage, Type 2	1056
Plain Rip Rap	1042

Provide Type 2 geotextile for filtration geotextiles and plain rip rap classes in accordance with the contract.

876-3 PLAIN RIP RAP

Grade locations for rip rap as shown in the plans. Use filtration geotextiles under rip rap when shown in the plans and as directed by the Engineer. Do not leave geotextiles exposed for more than 7 days before covering with rip rap. Place filtration geotextiles on surfaces free of obstructions, debris and soft pockets.

Overlap adjacent geotextiles at least 18 inches in the downhill and downstream direction to prevent flow from lifting the edge of the top geotextile. Pull filtration geotextiles taut so they are in tension and free of kinks, folds, wrinkles or creases. Hold geotextiles in place as needed with wire staples or anchor pins. Do not displace or damage filtration geotextiles while placing rip rap. Replace any damaged geotextiles to the satisfaction of the Engineer.

For rip rap at pipe outlets, place rip rap immediately after installing pipes. When rip rap is required for channel changes and drainage ditches, place rip rap before diverting water into channels and ditches.

Place rip rap such that the smaller stones are uniformly distributed throughout rip rap. Install rip rap with mechanical methods and if necessary, by hand to form a well-graded, dense and neat layer of rip rap.

876-4 MEASUREMENT AND PAYMENT

Rip Rap, Class ____ will be measured and paid in tons. Plain rip rap will be measured by weighing rip rap in trucks in accordance with Article 106-7.

Geotextile for Drainage will be measured and paid in square yards. Filtration geotextiles will be measured along the ground surface as the square yards of exposed geotextiles before placing rip rap. No measurement will be made for overlapping geotextiles.

The contract unit prices for *Rip Rap, Class ____* and *Geotextile for Drainage* will be full compensation for providing, transporting and placing rip rap, filtration geotextiles, wire staples and anchor pins.

Payment will be made under:

Pay Item	Pay Unit
Rip Rap, Class ____	Ton
Geotextile for Drainage	Square Yard

DIVISION 10 MATERIALS

SECTION 1000

PORTLAND CEMENT CONCRETE PRODUCTION AND DELIVERY

1000-1 DESCRIPTION

This section addresses Portland cement concrete to be used for pavement, structures and precast and incidental construction. Produce Portland cement concrete composed of Portland cement, fine and coarse aggregates, and water. Include supplementary cementitious material (SCM) and chemical admixtures as required or needed. SCMs consist of ground granulated blast furnace slag, fly ash or silica fume and may be substituted for a portion of the Portland cement. Type (Portland-Limestone Cement) IL, (Portland-Pozzolan Cement) IP, (Portland-Slag Cement) IS or (Ternary Blended Cement) IT blended cement may be used instead of Portland cement (see Section 1024 for details). Cement, fine and coarse aggregate, and SCMs shall be approved by the Department prior to use. Only use admixtures that are currently on the NCDOT APL.

All Portland cement concrete mixtures shall be designed by a NCDOT Certified Concrete Mix Design Technician or an engineer licensed by the State of North Carolina.

For approved mixture designs requiring a major change, submit a new mix design accompanied by the applicable test results indicating the mix conforms to the design requirements for the indicated class of concrete. Define a major change as:

(A) A source change in coarse aggregate or fine aggregate.

(B) A change in cement type (e.g. from Type I/II to Type IL).

(C) A change in SCM class or type change (e.g. Class F fly ash to Class C fly ash)

(D) A quantitative change in coarse aggregate, fine aggregate, or pozzolan greater than 5% (by weight).

(E) A quantitative change in water (applies to increase only) or cement (applies to decrease only).

For approved mix designs requiring a minor change, submit a Materials and Tests Form 312M. Define a minor change as:

(A) A change in source of the same type of cement or SCM.

(B) A change in source or brand of admixtures.

When concrete for any one pour is furnished by multiple concrete plants, use the same mix design for all concrete, including sources and quantities of ingredients.

Use materials which do not produce a mottled appearance through rusting or other staining of the finished concrete surface.

Section 1000

1000-2 MATERIALS

Refer to Division 10.

Item	Section
Air Entraining Agent	1024-3
Calcium Nitrite Corrosion Inhibitor	1024-3
Chemical Admixtures	1024-3
Coarse Aggregate	1014-2
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Portland Cement	1024-1
Silica Fume	1024-7
Type IL Blended Cement	1024-1
Type IP Blended Cement	1024-1
Type IS Blended Cement	1024-1
Type IT Blended Cement	1024-1
Water	1024-4

1000-3 PORTLAND CEMENT CONCRETE FOR STRUCTURES AND INCIDENTAL CONSTRUCTION

(A) Composition and Design

Provide the class of concrete required by the contract. Higher strength classes of concrete may be permissible as approved by the Engineer.

Submit proposed concrete mix designs for each class of concrete to be used in the work. Mix proportions shall meet the design requirements provided in Table 1000-1 and the applicable portions of this section. Laboratory trial batches shall be created to confirm the proposed mix design meets the requirements of the plastic and hardened concrete.

Submit mix designs in terms of saturated surface dry weights on *Materials and Tests Form 312U* at least 35 days before proposed use. Adjust batch proportions to compensate for surface moisture contained in the aggregates at the time of batching. Changes in the saturated surface dry mix proportions will not be permitted unless revised mix designs have been submitted to the Engineer and approved.

Accompany *Materials and Tests Form 312U* with a listing of laboratory test results of aggregate gradation, air content, slump and compressive strength from a certified laboratory. List the compressive strength of at least three 6 inch x 12 inch or 4 inch x 8 inch cylinders at the age of 7 and 28 days.

Perform laboratory tests in accordance with the following test procedures:

Property	Test Method
Aggregate Gradation	AASHTO T 27
Air Content	AASHTO T 152
Slump	AASHTO T 119
Compressive Strength	AASHTO T 22 and R100

The Engineer will review the mix design for compliance with the specifications and notify the Contractor as to its acceptability. Do not use a mix until written notice has been received. Acceptance of the mix design does not relieve the Contractor of his responsibility to furnish a product that meets the contract.

Section 1000**(B) Air Entrainment**

Entrain air in the concrete unless otherwise indicated in the plans or in the Specifications. Add an air entraining agent at the time of mixing to produce an air content in the freshly mixed concrete of $6.0\% \pm 1.5\%$ when tested at the job site. Determine the air content in accordance with AASHTO T 121, T152 or T196. Measurement of air content may also be performed by the Chace Indicator, in which case sufficient tests will be made in accordance with AASHTO T 121, T152 or T196 to establish correlation with the Chace Indicator. Concrete for structures will not be rejected based on tests made with the Chace Indicator. Concrete for incidental construction may be rejected based on an average of 3 or more tests made with the Chace Indicator.

Air entraining agent may be added at the job site when permitted by the Engineer.

(C) Strength of Concrete

The compressive strength of the concrete will be considered the average compressive strength test results of two 6 inch x 12 inch cylinders, or two 4 inch x 8 inch cylinders if the aggregate size is not larger than size 57 or 57M. Make cylinders in accordance with AASHTO R 100 from the concrete delivered to the work. Make cylinders at such frequencies as the Engineer may determine and cure them in accordance with AASHTO R 100 as modified by the Department. Copies of these modified test procedures are available upon request from the Materials and Tests Unit.

When the average compressive strength of the concrete test cylinders is less than the minimum strength specified for the class of concrete and the Engineer determines it is within reasonably close conformity with strength requirements, concrete strength will be considered acceptable. When the Engineer determines average cylinder strength is below the specification, the in-place concrete will be investigated. Based on these investigation results, the concrete will be accepted with no reduction in payment, accepted at a reduced unit price or rejected as set forth in Article 105-3.

(D) Temperature Requirements

The concrete temperature at the time of placement shall be not less than 50°F and no more than 95°F except where other temperatures are required by Articles 420-4, 420-7, 420-14 and 420-15.

Do not place concrete without permission when the air temperature measured at the location of the concrete operation in the shade away from artificial heat is below 35°F.

When such permission is granted, uniformly heat the aggregates and/or water to a temperature not higher than 150°F. Heated concrete shall be between 55°F and 80°F at the time of placement.

Section 1000

**TABLE 1000-1
DESIGN REQUIREMENTS FOR CONCRETE**

Class of Concrete	Min. Compressive Strength at 28 days	Maximum Water-Cementitious Ratio	Maximum Slump		Min. Cementitious Content	Coarse Aggregate Sizes
			Vibrated	Non-Vibrated		
<i>Units</i>	<i>psi</i>		<i>inch</i>	<i>inch</i>	<i>lb/cy</i>	
AA	4500	0.426	1.5 slip form 3.5 ^A	---	639	57, 67, or 78M
Drilled Pier ^B	4500	0.450	---	5 – 7 dry 7 - 9 wet	640	78M
Sand Light-weight	4500	0.420	4.0 ^A	---	715	Lightweight (see Table 1014-1)
A ^{B,C}	3000	0.532	3.5 ^A	4.0	564	57, 67, or 78M
B ^B	2500	0.567	1.5 machine placed 2.5 ^A hand placed	4.0	508	57, 67, or 78M

- A.** A slump of 6 inches is allowed only by use of an approved admixture meeting Article 1024-3. In no case shall the water-cement ratio on the approved design be exceeded.
- B.** Drilled Pier mixes are non-air entrained. Class A and Class B mixes may be non-air entrained if specified by the contract or special provision.
- C.** Per Article 450-2, Class A concrete used for drilled-in piles shall have a slump of 6-8 inches and is achieved using an approved water reducer. Do not exceed the water-cement ratio on the approved design.

(E) Elapsed Time for Placing Concrete

Regulate the delivery so the maximum interval between the placing of batches at the work site does not exceed 20 minutes. Place concrete before exceeding the times in Table 1000-2. Measure the elapsed time as the time between adding the mixing water to the mix and placing the concrete.

Section 1000

**TABLE 1000-2
ELAPSED TIME FOR PLACING CONCRETE**

Air or Concrete Temperature Whichever is Higher	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below ^A	60 minutes	1 hr. 45 minutes
70°F through 79°F ^B	60 minutes	1 hr. 45 minutes
69°F or below ^B	1 hr. 30 minutes	2 hr. 15 minutes

A. Applicable to Class AA, A and Drilled Pier concrete.

B. Applicable to Class B concrete.

(F) Use of Set Retarding Admixtures

Use an approved set retarding admixture in all concrete placed in the superstructure of bridges such that the concrete will remain workable until the entire operation of placing and finishing, including corrective measures, if necessary, has been completed. The Engineer may waive the use of set retarding admixture when conditions clearly indicate that it is not needed.

Other structural concrete may contain an approved set retarding admixture when permitted by the Engineer.

Use a set retarding admixture on the NCDOT APL following the manufacturer's recommended dosage rate.

(G) Use of Water Reducing Admixtures

By permission of the Engineer, the Contractor may use an approved water reducing admixture to facilitate placing and finishing.

Use a water reducing admixture on the NCDOT APL following the manufacturer's recommended dosage rate. Concrete containing water reducing admixtures that exhibits segregation and/or excessive bleeding will be rejected. Utilizing an admixture to modify slump does not relinquish the contractor's responsibility to ensure the final product quality and overall configuration meets design specifications. Caution should be taken when placing these mixes on steep grades to prevent unintended changes to the set slope.

(H) Use of Calcium Chloride

Calcium chloride may be used as a set accelerating agent where permitted by the Engineer. Use one lb. of calcium chloride per 100 lbs. of cement except where lesser amounts are directed by the Engineer. Do not use calcium chloride where steel reinforcement, metal conduit or other metals will be in contact with the concrete. Do not use calcium chloride in concrete that has a temperature higher than 70°F, or when the air temperature is greater than 70°F. Provide cold weather protection for concrete containing calcium chloride in the same manner as is provided for concrete without calcium chloride.

Use calcium chloride in liquid form. Dissolve solid calcium chloride using one lb. or less of calcium chloride per one quart of water and mix well to form a liquid solution. To avoid incompatibility with other additives, add the calcium chloride to the batch after all other ingredients have been put into the mixer.

(I) Use of Supplementary Cementitious Materials (SCMs)

SCMs may be substituted for cement in the mix design at a rate of 1.0 lb. of SCM to each pound of cement replaced, up to the maximum amount shown in Table 1024-1. Concrete mixes using SCMs shall not exceed the maximum allowable water/cementitious material

Section 1000

ratio for the designated concrete class. Use Table 1000-1 to determine the maximum allowable water-cementitious material ratio for the classes of concrete listed.

(J) Use of Calcium Nitrite Corrosion Inhibitor

Units with calcium nitrite in a quantity less than specified are subject to rejection. Furnish concrete powder drilled from representative cylinders to the Engineer, in a quantity to be specified, to verify the concentrations of calcium nitrite in hardened concrete. Concrete that fails to contain calcium nitrite at the required concentrations as tested is subject to rejection. Use air-entraining, water-reducing and/or set-controlling admixtures compatible with calcium nitrite solutions. Strictly adhere to the manufacturer's written recommendations regarding the use of admixtures, including storage, transportation and method of mixing. If preferred, use calcium nitrite, which acts as an accelerator, in conjunction with a retarder to control the set of concrete, as per the manufacturer's recommendation. Add an approved calcium nitrite corrosion inhibitor (30% solids) to the concrete mix at the batch plant for the bridge elements identified by the plan notes. Use the inhibitor at a minimum rate of 3.0 gal/cy. Ensure that the hardened concrete contains at least 5.8 lbs/cy nitrite (NO₂) when tested in accordance with Materials and Tests Method Chem. C-20.0. The preceding paragraph does not apply to concrete used in prestressed concrete members. Concrete used in prestressed concrete members shall be tested in accordance with Subarticle 1078-4(G).

1000-4 PORTLAND CEMENT CONCRETE FOR PAVEMENT

(A) Composition and Design

Submit a concrete paving mix design in terms of saturated surface dry weights on *Materials and Tests Form 312U* to the Engineer for approval at least 35 days before proposed use. Mix proportions shall meet the design requirements provided in Table 1000-3 and the applicable portions of this section.

TABLE 1000-3 DESIGN REQUIREMENTS FOR CONCRETE PAVEMENT							
Class of Concrete	Min. Compressive Strength at 28 days	Min. Flexural Strength at 28 days	Maximum Water/Cementitious Ratio	Max. Slump	Min. Cementitious Content	Air Content	Coarse Aggregate Sizes
<i>Units</i>	<i>psi</i>	<i>psi</i>	<i>lb/lb</i>	<i>inch</i>	<i>lb/cy</i>	%	
Pavement	4500	650	0.559	1.5 slip form 3.0 hand placed	526	5.0% ± 1.5%	57, 67, or 78M
Very High Early Strength for Pavement Repair	4500	650 400 at 4 hours ^A	0.500	1.5 slip form 3.0 hand placed	600	5.0% ± 1.5%	57, 67, or 78M

A. Use of a high alkali cement or reactive aggregate is prohibited unless the supplier can achieve the required flexural strength in 4 hours while substituting the minimum supplementary cementitious material (SCM) amount specified in Section 1024-1 for mitigating ASR.

Include in the mix design the source of aggregates, cement, SCM, water and admixtures; the gradation and specific gravity of the aggregates; the fineness modulus of the fine aggregate; and the dry rodded unit weight and size of the coarse aggregate. Submit test

Section 1000

results showing that the mix design conforms to the criteria, including the 1, 3, 7, 14 and 28-day strengths of the average of two 6 inch x 6 inch x 20 inch beams and the average of two 6 inch x 12 inch cylinders for each age made and tested in accordance with AASHTO R 39, T22 and T97 from a certified laboratory. Design the mix to produce an average strength sufficient to indicate that a minimum strength of 650 psi in flexure and 4,500 psi in compression will be achieved in the field within 28 days.

Where concrete with a higher slump for hand methods of placing and finishing is necessary, submit an adjusted mix design for approval to provide a maximum slump of 3 inches and to maintain the water/cementitious material ratio established by the original mix design. The water/cementitious ratio refers to the ratio of the weight of water (lb) in concrete to the combined weight of cement and SCMs in the concrete. For mixes that use only cement (e.g. no SCMs), the water/cementitious ratio refers to the ratio of the weight of water (lb) to the weight of cement (lb) in the concrete.

(B) Air Entrainment

Entrain air in the concrete by the use of an approved air entraining agent dispensed with the mixing water, unless prohibited.

Provide an air content of $5.0\% \pm 1.5\%$ in the freshly mixed concrete. The air content will be determined in accordance with AASHTO T 121, T152 or T196. At the option of the Engineer, the air content may be measured by the Chace Indicator, in which case sufficient tests will be made to establish correlation with the test methods of AASHTO T 121, T152 or T196. Concrete will not be rejected based on tests from the Chace Indicator.

(C) Slump

Provide concrete with a maximum slump of 1.5 inches where placed by a fully mechanized paving train and no more than 3 inches where placed by hand methods.

The sample taken for determination of slump will be obtained immediately after the concrete has been discharged onto the road.

(D) Set Retarding Admixture and Water Reducing Admixture

With permission, the Contractor may use an approved set retarding admixture, an approved water reducing admixture or both to facilitate placing and finishing. Use a quantity of set retarding admixture or water reducing admixture within the range shown on the current list of approved admixtures maintained by the Materials and Tests Unit.

(E) Use of Supplementary Cementitious Materials (SCMs)

SCMs may be substituted for cement in the mix design at a rate of 1.0 lb. of SCM to each pound of cement replaced, up to the maximum amount shown in Table 1024-1. Concrete mixes using SCMs shall not exceed the maximum allowable water-cementitious material ratio for the designated concrete class. Use Table 1000-3 to determine the maximum allowable water-cementitious material ratio for the classes of concrete listed.

(F) Contractor's Responsibility for Process Control

Before or at the preconstruction conference, submit a plan detailing the process control and the type and frequency of testing and inspection necessary to produce concrete that meets the specifications. During all batching and delivery operations assign a Certified Concrete Batch Technician on site whose sole duty is to supervise the production and control of the concrete. This duty includes the following:

- (1) Tests and inspections necessary to maintain the stockpiles of aggregates in an unsegregated and uncontaminated condition.
- (2) Calibration of admixture dispensing systems, weighing systems and water gauges.
- (3) Tests and adjustments of mix proportions for moisture content of aggregates.

Section 1000

- (4) Mixer performance tests before reducing mixing time of central mix plant to less than 90 seconds and at other times when deemed necessary by the Engineer.
- (5) Verifying the actual mixing time of the concrete after all materials are introduced into the mixer at the beginning of paving operations and at least once each month.
- (6) Testing all vibrators.
- (7) Tests necessary to document the slump and air content of the mix produced. Determine air content at least twice each day.
- (8) Tests for depth of the pavement in the plastic state.
- (9) Furnishing data to verify that the approved theoretical cement content has been met at intervals not to exceed 50,000 sy of pavement.
- (10) Signing all plant reports, batch tickets and delivery tickets.

The Department certifies technicians who satisfactorily complete examinations prepared and administered by the Department.

Perform all test procedures in compliance with the appropriate articles of Section 1000.

Tests may be witnessed by the Engineer. Document the results of all tests and inspections and make a copy available to the Engineer upon request. Take prompt action to correct conditions that have resulted in or could result in the submission of materials, products, or completed construction that do not conform to the specifications.

(G) Contractor Not Relieved of Responsibility for End Result

The Contractor will not be relieved of his obligation to produce a uniform pavement meeting specifications by reason of:

- (1) The acceptance or approval by the Engineer of the concrete mix design or any adjustments;
- (2) Compliance with the concrete mix design and compliance with the testing requirements and other process control requirements by the Contractor; or
- (3) The failure of the Engineer to perform any tests in the process control, nor the performance of any tests in the process control that indicate compliance with the specifications.

1000-5 VERY HIGH EARLY STRENGTH CONCRETE FOR CONCRETE PAVEMENT REPAIR

Mix proportions shall meet the design requirements provided in Table 1000-3 and the applicable portions of this section. Use cement, fine aggregate, coarse aggregate, admixtures and SCMs that have been approved by the Department. SCMs shall be used according to Section 1024.

Accompany *Materials and Tests Form 312U* with 4 hour flexural strength results of at least 6 beams made and tested in accordance with AASHTO R 39 and T97. In addition, submit 4 hour compressive strength results of at least six 4 inch by 8 inch or 6 inch by 12 inch cylinders and maturity test results of the mix. With permission of the Engineer, compressive strength testing and maturity testing may be used in lieu of or concurrent with flexural strength testing to determine the acceptability of the concrete in the field.

1000-6 HIGH EARLY STRENGTH PORTLAND CEMENT CONCRETE

Use high early strength Portland cement concrete when required by contract. When not required, it may be used at the Contractor's option with approval of the Engineer.

Section 1000

1 For all classes of concrete, high early strength concrete may be produced by using
 2 Type III Portland cement. To produce high early strength concrete with regular cement, use
 3 a higher class of concrete as follows:

4 For Class A and Class B, use Class AA with a cement content of at least 677 lbs/cy. Other
 5 classes that lend themselves to high early strength with regular cement will be reviewed by the
 6 Engineer on a case-by-case basis.

7 **1000-7 FLOWABLE FILL**

8 Flowable fill consists of Portland cement, water, supplementary cementitious materials and/or
 9 fine aggregate and, optionally, concrete admixtures.

10 Submit the proposed mix design on *Materials and Tests Form 312U* at least 35 days before use.

11 State on *Materials and Tests Form 312U* the intended use of the material (excavatable or non-
 12 excavatable). Excavatable flowable fill shall have a maximum strength of 150 psi at 56 days
 13 of age. Non-excavatable flowable fill shall have a minimum strength of 125 psi at 28 days of
 14 age. Accompany *Materials and Tests Form 312U* with a listing of compressive strength of at
 15 least three 4 inch x 8 inch cylinders at the age of 28 or 56 days, depending on whether the mix
 16 is to be excavated or not. Air cure the cylinders during the entire period before testing. The
 17 Engineer will advise the Contractor in writing of the acceptability of the mix design.

18 **1000-8 LATEX MODIFIED CONCRETE (LMC)**

19 **(A) Materials**

20 Refer to Division 10.

Item	Section
Coarse Aggregate, standard size No. 78M	1014-2
Fine Aggregate	1014-1
Portland Cement	1024-1
Type IL Blended Cement	1024-1
Type IP Blended Cement	1024-1
Type IS Blended Cement	1024-1
Type IT Blended Cement	1024-1
Water	1024-4

21 Use a formulated latex admixture that is a non-hazardous, film forming and polymeric
 22 emulsion in water and is homogeneous and uniform in composition. Add all stabilizers at
 23 the point of manufacture. The use of Type III high early strength cement in LMC is only
 24 permitted as allowed by the contract.

25 Use a latex modifier conforming to Table 1000-4.

Section 1000

TABLE 1000-4 PROPERTIES OF LATEX MODIFIER FOR CONCRETE	
Property	Requirement
Polymer Type	Styrene Butadiene: 68 ± 4% Styrene 32 ± 4% Butadiene
Average Polymer Particle Size	1500 to 2500 Angstroms
Emulsion Stabilizers	Anionic and non-ionic surfactants
Percent Solids	46.5% to 49.0%
Weight per gallon at 75°F	8.40 to 8.60 lb
pH	9.5 to 11.0
Shelf Life	2 Years
Color	White

Provide a Type 5 material certification for each load of latex emulsion admixture in accordance with Article 106-3. Test admixture samples to verify compliance with the requirements before use. Allow 7 days for sampling and testing after delivery to the project.

Do not allow the temperature of latex emulsion admixture to fall below 35°F at any time or exceed 85°F after delivery to the project.

For latex emulsion that has been in storage, use a transfer pump and lines to recirculate it before using and sampling.

For LMC, use a workable mixture that meets Table 1000-5.

Measure the slump 4 to 5 minutes after discharge from the mixer.

Submit the LMC mix design, including laboratory compressive strength data for a minimum of six (6) 4-inch by 8-inch cylinders at seven (7) days for normal setting concrete to the Engineer for review. Include test results for the slump and air content of the laboratory mix. Perform tests in accordance with AASHTO T 22, T119 and T152.

TABLE 1000-5 PROPERTIES OF LATEX MODIFIED CONCRETE	
Property	Requirement
Cement Content, lb/cy	658 min.
Latex Emulsion Admixture, gal/cy	24.5 min.
Air Content of Plastic Mix, %	3.5 - 6.5
Slump, inches	3 - 6
% Fine Aggregate as percent of total aggregate by weight	50 - 55
7 day Compressive Strength, psi	3,000 min.
Water-Cement Ratio by weight	0.40 max.

(B) Equipment

Before beginning any work, obtain approval for all equipment to be used for deck preparation, mixing, placing, finishing and curing the latex modified concrete.

Use sandblasting equipment capable of removing all clay, salt deposits, oil and grease deposits and all other foreign matter. Provide traps or separators to remove oil and water from the compressed air. Use traps or separators of adequate size and drain them periodically during operations. For proportioning and mixing, use self-contained, mobile and continuously mixing equipment that meets the following requirements:

- (1) Use a self-propelled mixer that is capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, latex modifier and water to produce at least 6 cy of concrete on site.

Section 1000

- (2) Use a mixer that is capable of positive measurement of cement introduced into the mix. Use a recording meter that is visible at all times and equipped with a ticket printout to indicate the quantity of cement.
- (3) Calibrate the mixers to accurately proportion the specified mix. Before placing latex modified concrete, perform calibration and yield tests under the Engineer's supervision in accordance with the Department's written instructions. Copies of these written instructions are available from the Materials and Tests Unit. Perform the calibration and yield tests using the material to be used on the project. Recalibrate the mixer after any major maintenance operation on the mixer, anytime the source of materials changes or as directed by the Engineer. Furnish all materials and equipment necessary to perform the calibrations and yield tests.
- (4) Use a mixer that controls the flow of water and latex emulsion into the mix. Measure the flow rate of water and the latex emulsion with a calibrated flowmeter coordinated with both the cement and aggregate feeding mechanisms and the mixer. Adjust the flow rate, as necessary, to control the slump and ensure that the water-cement ratios are met. In addition to flowmeters, use mixers with accumulative water and latex meters capable of indicating the number of gallons, to the nearest 0.1 gallon, introduced into the mixer. Filter water and latex with a suitable mesh filter before it flows through the accumulative water and latex meters.
- (5) Calibrate the mixer to automatically proportion and blend all components of the indicated composition on a continuous or intermittent basis as the finishing operation requires. Provide a mixer that discharges mixed material through a conventional chute and is capable of spraying water over the placement width as it moves ahead to ensure that the surface to be overlaid is wet before receiving the modified material.
- (6) Mount a tachometer on the unit to indicate the drive shaft speed.
- (7) Use adequate hand tools for placing and leveling concrete down to approximately the correct level for striking off with the screed.
- (8) Use a finishing machine that meets the approval of the Engineer and the requirements of the contract. Use a self-propelled finishing machine capable of forward and reverse movement under positive control. Use a machine with at least 2 finishing devices, one that is a vibrating screed and the other either a vibrating screed, oscillating screed, or one or more rotating cylindrical drums 48 inches long or less and operating between 1,500 and 2,500 vpm. Make certain the finishing machine can finish the surface to within 1 foot of the edges of the area being placed. Raise all screeds when the finishing machine is moving backwards over the screeded surface.
- (9) Use screeds with a vibration frequency that is variable between 3,000 and 6,000 vpm with positive controls. Use screeds with a metal covered bottom face not less than 4 inches wide. Provide screeds with positive control of the vertical position.
- (10) Use supporting rails for travelling of the finishing machine rigid enough to eliminate deflection from the weight of the machine.

(C) Proportioning and Mixing of Modified Compositions

Use mobile continuous mixers that accurately proportion all materials for the specified mixture. Operate the proportioning equipment at the manufacturer's recommended speed verified with the tachometer during calibration and normal operations.

Yield checks and other checks are permitted.

(D) Contractor's Responsibility for Process Control

Before or at the preconstruction conference, submit a plan detailing the process control and the type and frequency of testing and inspection necessary to produce concrete that meets the specifications. During all batching and delivery operations assign a Certified Concrete

Section 1000

Batch Technician on site whose sole duty is to supervise the production and control of the concrete. This duty includes the following:

- (1) Tests and inspections necessary to maintain the stockpiles of aggregates in an unsegregated and uncontaminated condition.
- (2) Calibration of admixture dispensing systems, weighing systems and water gauges.
- (3) Tests and adjustments of mix proportions for moisture content of aggregates.
- (4) Mixer performance tests before reducing mixing time of central mix plant to less than 90 seconds and at other times when deemed necessary by the Engineer.
- (5) Verifying the actual mixing time of the concrete after all materials are introduced into the mixer at the beginning of paving operations and at least once each month.
- (6) Testing all vibrators.
- (7) Tests necessary to document the slump and air content of the mix produced. Determine air content at least twice each day.
- (8) Tests for depth of the pavement in the plastic state.
- (9) Furnishing data to verify that the approved theoretical cement content has been met at intervals not to exceed 50,000 sy of pavement.
- (10) Signing all plant reports, batch tickets and delivery tickets.

The Department certifies technicians who satisfactorily complete examinations prepared and administered by the Division of Highways.

Perform all test procedures in compliance with the appropriate articles of Section 1000.

Tests may be witnessed by the Engineer. Document the results of all tests and inspections and make a copy available to the Engineer upon request. Take prompt action to correct conditions that have resulted in or could result in the submission of materials, products, or completed construction that do not conform to these specifications.

1000-9 MEASURING MATERIALS**(A) Weighing Cement**

Measure cement by weight on scales separate from those used for other materials and in a hopper that is entirely free and independent of the hoppers used for weighing the aggregates. When the quantity of cement in a batch exceeds 30% of the full capacity of the scale, ensure the quantity of cement as indicated by the scale is within $\pm 1\%$ of the required weight. For smaller batches, ensure the quantity of cement as indicated by the scale be not less than the required amount or more than 4% in excess. Equip all beam type scales with a tare beam.

(B) Weighing Aggregates

Measure aggregates by weight. Base batch weights on saturated surface dry materials which is the required weight plus the total weight of surface moisture contained in the aggregate. Ensure the individual aggregates, as weighed, are within $\pm 2\%$ of the required weights.

(C) Water

Measure water by volume or by weight. Ensure the quantity of water measured is within $\pm 1\%$ of the required amount.

(D) Admixture Dispensing Systems

Provide a separate dispensing system with separate fill and discharge lines for each type of admixture to be used, except that admixtures may be measured and introduced into the mix

Section 1000

manually if approval has been obtained. Ensure each system is capable of measuring, displaying and discharging the required amount of admixture into the mix. Keep dispensing systems clean and in good operating condition. Use a dispensing system that is either:

- (1) Manually operated, self-contained; or
- (2) Semi-automatic or automatic, self-contained; or
- (3) Interfaced to operate automatically with the concrete batching control panel.

Have the admixture dispenser dispense the required quantity of admixture for each concrete batch within an accuracy of $\pm 3\%$. Check the accuracy of the dispenser as provided below. Check the accuracy at the point of discharge, or through a bypass valve suitable for obtaining a calibrated sample of admixture and at the volumes normally used for one half mixer capacity and for full mixer capacity. Determine the accuracy at the time of installation and check daily during the early part of each day's operation.

Include in each system a graduated measuring unit into which the admixture is batched to permit a quick visual check of accuracy before its discharge. Ensure the measuring unit is clearly graduated and be of sufficient size to hold the maximum anticipated dose for one batch. Clearly mark the measuring unit for the type of admixture to be used.

Control the discharge sequence so an admixture will not be brought into contact with raw cement or another admixture before being diluted through contact with the mixing water in the mixer. Where 2 types of admixtures are being used, do not discharge them into the mix simultaneously. Add the air entraining agent with the first addition of water and add any other chemical admixture with the final addition of water, unless otherwise permitted.

Construct the discharge lines to completely empty after each cycle. Locate the admixture dispensing systems so the batching plant operator will have a visual verification of the actual quantity of admixture batched.

Use air entraining admixtures in accordance with the manufacturer's recommendations and in such quantity to provide the specified air content in freshly mixed concrete. Use a quantity of set retarding admixture and of water reducing admixture per 100 lbs. of cement that is within the range recommended on the current list of approved admixtures issued by the Materials and Tests Unit.

1000-10 BATCHING PLANT**(A) General**

Plants located on the Department rights of way shall conform to Article 107-3.

Have ready mixed concrete plants inspected and approved by the Department before they are used to produce concrete, either paving, structural or incidental, for the project. Plants shall meet all the applicable requirements of these *Standard Specifications*, and in addition, ensure each ready mix plant provides at least three acceptable truck mixers or truck agitators available for use. Use trucks that have an identifying number. Plants approved by the Department will be placed on a list of approved plants available to the Contractor. All plants will be subject to reinspection at intervals selected by the Engineer. Reapproval after each inspection will be contingent on continuing compliance with the *Standard Specifications*.

(B) Bins and Hoppers

Provide bins with separate compartments for fine aggregates and for each required size of coarse aggregate in the batching plant. Design each compartment to discharge efficiently and freely into the weighing hopper. Provide control so, as the quantity desired is being approached, the material may be added slowly and shut off with precision. Construct weighing hoppers to eliminate accumulation of tare materials and to discharge fully unless

Section 1000

otherwise permitted. Provide a port or other opening for removing an overload of any one of the several materials from the hopper.

(C) Scales

Use either the beam type, load cell type or the springless dial type scales for weighing aggregates and cement. Ensure the minimum graduation on beam or dial is not more than 0.1% of the total capacity of the scale. Methods of weighing, other than beam or springless dial scales, may be approved by the Engineer provided they meet the required weighing tolerances. Ensure the scales are accurate within 0.5% under operating conditions. Make available ten 50 lb. test weights at the plant for checking accuracy. Use test weights which meet the U.S. Bureau of Standards requirements for calibrating and testing equipment. Keep all exposed fulcrums, clevises and similar working parts of scales clean. When beam type scales are used, make provisions for indicating to the operator that the required load in the weighing hopper is being approached. Ensure the device indicates at least the last 50 lbs. of load and design it to give a positive indication of overload of the scales. During charging of the hopper, have all indicating devices in full view of the operator and provide convenient access to all controls. Ensure the indicating devices are in the immediate vicinity of the operator and easily readable by the operator.

(D) Water Measuring Devices

Use devices for measurement of the water which are readily adjustable and are capable of being set to deliver the required amount and cut off the flow automatically when this amount has been discharged. Under all operating conditions the device shall have accuracy within 1% of the quantity of water required for the batch. Arrange the device so variable pressures in the water supply line will not affect the measurements. Use measuring tanks of adequate capacity to furnish the maximum mixing water required and equip them with outside taps and valves to provide for checking their calibration unless other means are provided for readily and accurately determining the amounts in the tank.

1000-11 MIXERS AND AGITATORS**(A) General**

Mixers are defined as equipment to mix concrete and may be stationary or truck mounted. Agitators are defined as equipment used to haul central mixed concrete and may be truck mixers or truck agitators. Provide a metal plate or plates attached to each mixer and agitator in a prominent place on which the manufacturer has plainly marked the mixing speed of the drum or paddles and the maximum capacity of the drum or container in terms of volume of mixed concrete. On truck mixers and agitators, show the manufacturer's recommended agitating and mixing speed of rotation of the mixing drum or blades. Equip stationary mixers with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed. Equip truck mixers with counters to verify the number of revolutions of the drum or blades. Actuate the counters at the initial time the drums have reached mixing speed.

Examine mixers and agitators periodically for changes in condition due to accumulation of hard concrete or mortar, wear of blades or any other condition which decreases mixing efficiency. Mixers are unacceptable when the radial height or other dimension of the blade has worn below 90% of the original dimension. This radial height excludes any lips on the blade and is the height of the blade running perpendicular to the shell of the drum. Where such conditions are found, do not use the units until they are corrected.

Also examine mixers and agitators periodically for general mechanical condition, including water measuring and discharge apparatus, identifying number on trucks, condition of the blades, speed of rotation of the drum and condition of the drum.

Section 1000

(B) Mixer Capacity

Do not load truck mixers with concrete with more than 63% of the gross volume of the drum. Use mixers capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity. Use stationary mixers, when loaded at the manufacturers guaranteed mixing capacity and the concrete mixed for the prescribed mixing time, capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and discharging the concrete with satisfactory uniformity.

Use at least 20% of the rated mixing capacity as the minimum quantity of concrete permitted to be mixed or agitated in any mixer.

(C) Agitator Capacity

Load the agitator to not exceed 80% of the gross drum volume and have it be capable of maintaining the concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

(D) Consistency Tests

The Engineer may, from time to time, make slump tests to measure consistency of the concrete. Take individual samples at approximately the 1/5th point, the midpoint and the 4/5th point of the load, using AASHTO T 119. Such tests will be made within 20 minutes of discharge of that portion of the load. If the results vary by more than 1 inch in slump, do not use the mixer or agitator unless the condition is corrected.

1000-12 MIXING AND DELIVERY**(A) General**

Mix and deliver concrete to the site of the work by one of the following methods, except where other methods are approved by the Engineer. Maintain responsibility for controlling the materials and operations as to produce uniform concrete meeting specifications requirements.

When concrete is being produced for structures and incidental construction in accordance with Article 1000-3, have present during all batching operations a Certified Concrete Batch Technician employed by the Contractor or concrete supplier. During batching and delivery, the sole duty of this employee is to supervise the production and control of the concrete. Perform moisture tests, adjust mix proportions of aggregates for free moisture, complete and sign Batch Tickets (*Materials and Tests Form 903*) or approved delivery tickets and assure quality control of the batching. Delivery tickets will be permitted instead of batch tickets (*Materials and Tests Form 903*) provided they have been reviewed and approved by the Materials and Tests Unit. The Department certifies technicians who satisfactorily complete examinations prepared and administered by the Department.

(1) Central Mixed Concrete

Concrete that is mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in a truck agitator or in a truck mixer operating at agitating speed or in non-agitating equipment approved by the Engineer. Perform mixing within the capacity and at the mixing speeds recommended by the manufacturer.

(2) Transit Mixed Concrete

Concrete that is mixed completely in a truck mixer while at the batching plant, in transit, or at the work site.

(3) Shrink Mixed Concrete

Section 1000

Concrete that is mixed partially in a stationary mixer at a central mixing plant and completed as transit mixed concrete. Place all ingredients for a batch in the stationary mixer, partially mix before any concrete is discharged to the truck mixer and do not exceed the rated capacity of the equipment for the batch size. The mixing time at the stationary mixer may be reduced to the minimum necessary to intermingle the ingredients, and the mixing may be completed in the truck mixer. Use the number of mixing revolutions in the truck mixer as specified for transit mixed concrete or reduce as indicated by mixer performance tests.

(B) Mixing Time for Central Mixed Concrete

Mixing time begins when all solid materials are in the mixing compartment and ends when any part of the concrete begins to discharge. In charging the mixer, water will enter in advance of cement and aggregate. Ensure all the water is substantially in the drum before 1/3 of the specified mixing time has elapsed. Count transfer time in multiple drum mixers as part of the mixing time.

Where mixer performance tests are not made, use a minimum mixing time of 90 seconds, providing that blending of materials during charging is achieved to the satisfaction of the Engineer. The minimum mixing time for an individual mixer is that which, as shown by mixer performance tests, will produce concrete in accordance with Table 1000-6, except that the mixing time shall not be less than 50 seconds under any circumstances. Maximum mixing time excluding discharge time is 150 seconds.

Sampling and testing for mixer performance tests will be done as provided below. Charge the mixer to its rated capacity with the materials and proportions to be used in the work and mixed at the recommended mixing speed to the target time. Stop mixing and begin discharging. Two samples of sufficient size to make the required tests will be taken after discharge of approximately 15% and 85% of the load.

TABLE 1000-6 REQUIREMENTS FOR UNIFORMITY OF CONCRETE		
Property	Requirement	Test Method
Difference in Test Samples Air Content, percent by volume of concrete	1.0%	AASHTO T 152
Slump	1.0"	AASHTO T 119
Coarse aggregate content, portion by weight of each sample retained on the No. 4 sieve	6.0%	AASHTO M 157
Weight	1.0 lb	AASHTO T 121
Average Compressive Strength at 7 days, percent of average	10.0% ^A	AASHTO T 22 AASHTO R 100

A. Tentative approval may be granted pending 7 day compressive strength tests.

Each of the two samples of concrete will be separately tested for the properties listed in Table 1000-6. Tests will be conducted in accordance with the test procedures specified in Table 1000-6 or procedures established by the Materials and Tests Unit.

The mixer performance test described above will be performed on at least two batches of concrete. For the performance test to be acceptable, have all tests in each batch tested meet the requirements listed above.

The Engineer may recheck mixer performance at any time when, in his opinion, satisfactory mixing is not being accomplished.

Where satisfactory mixing cannot be accomplished in 90 seconds, the Engineer may increase the mixing time or require that the mixer be repaired or replaced before any further mixing can be done.

Section 1000**(C) Truck Mixers and Truck Agitators**

When a truck mixer is used for complete mixing, mix each batch of concrete for at least 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment as mixing speed, unless otherwise directed by the Engineer. Unless the mixer is equipped with a counter which will distinguish between mixing and agitating speeds, perform the minimum required number of revolutions of the drum at mixing speed as directed by the Engineer, either at the batching plant before the mixer leaves for the work site and/or at the work site before the concrete is discharged. Perform any additional mixing at the speed designated by the manufacturer of the equipment as agitating speed. Put all materials including mixing water in the drum before actuating the revolution counter for determining the number of revolutions of the drum.

When a truck mixer or truck agitator is used to transport concrete that has been completely mixed in a stationary mixer, perform mixing during transport at agitating speed.

Provide concrete, when discharged from truck mixers or truck agitators, of the consistency and workability required for the work. Control the rate of discharge of the plastic concrete from the mixer drum by the speed or rotation of the drum in the discharge direction with the discharge gate fully open. If additional mixing water is necessary to produce the slump necessary for proper placement, add it only with permission and rotate the truck mixer drum at least 25 revolutions at mixing speed before discharge of any concrete. Additional mixing water will be allowed only if the maximum specified water content per cubic yard is not exceeded.

(D) Delivery

Use a ticket system for recording the transportation of batches from the proportioning plant to the site of the work. Use tickets furnished by the Engineer and fill it out in accordance with instructions issued by the Engineer. Issue the tickets to the truck operator at the proportioning plant for each load and have them signed by the plant inspector, which will signify that the concrete in the truck has been inspected before departure. Ensure each ticket shows the time batching was completed and if transit mixed, the number of revolutions at mixing speed, if any, at the plant. Deliver the tickets to the inspector at the site of the work. Do not use loads which do not carry such tickets and loads which do not arrive in satisfactory condition within the time limits specified in the work.

1000-13 VOLUMETRIC MIXED CONCRETE

Upon written request by the contractor, the Department may approve the use of concrete proportioned by volume. The volumetric producer must submit and have approved a process control plan and product quality control plan by the Materials and Tests Unit. If concrete is proportioned by volume, the other requirements of these specifications with the following modifications will apply. Unless otherwise approved by the Department, use of concrete proportioned by volume shall be limited to Class B concrete and no more than 30 cy per unit per day.

(A) Materials

Use materials that meet the requirements for the respective items except that they will be measured by a calibrated volume-weight relationship.

Storage facilities for all material shall be designed to permit the Department to make necessary inspections before the batching operations. The facilities shall permit identification of approved material at all times and shall be designed to avoid mixing with, or contaminating by, unapproved material. Coarse and fine aggregate shall be furnished and handled so variations in the moisture content affecting the uniform consistency of the concrete is avoided.

Moisture content of the coarse and fine aggregate will be made available onsite for the Engineer's review for each load. The frequency of moisture testing will be dependent on

Section 1000

certain variables such as weather, season and source; however, moisture tests should be performed at least once at the beginning of the work day for each source material. Additional daily moisture tests for the coarse and fine aggregate shall be performed if requested by the Engineer.

Unused materials should be emptied from hopper daily. Concrete should not be mixed with materials left in the hopper overnight.

(B) Equipment

Provide volumetric mixers with rating plates indicating that the performance of the mixer is in accordance with the Volumetric Mixer Manufacturer Bureau or equivalent. Mixers must comply with ASTM C685. Unless otherwise specified, all mixing operations must be in strict accordance with the manufacturer's recommended procedures. Such procedures shall be provided to the Department for review upon request.

The volumetric mixer shall be capable of carrying sufficient unmixed dry bulk cement, supplementary cementitious material (if required), fine aggregate, coarse aggregate, admixtures and water, in separate compartments and accurately proportioning the specified mix. Each batching or mixing unit (or both) shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator.

The concrete mixing device shall be an auger-type continuous mixer used in conjunction with volumetric proportioning. The mixer shall produce concrete, uniform in color and appearance, with homogeneous distribution of the material throughout the mixture. Mixing time necessary to produce uniform concrete shall be established by the contractor and shall comply with other requirements of these specifications. Only equipment found acceptable in every respect and capable of producing uniform results will be permitted.

Each volumetric mixer shall be equipped with an onboard ticketing system that will electronically produce a record of all material used and their respective weights and the total volume of concrete placed. Alternate methods of recordation may be used if approved by the Engineer. Tickets shall identify at least the following information:

- (1) Contractor Name
- (2) Contractor Phone Number
- (3) NCDOT Project No. and TIP No.
- (4) Date
- (5) Truck No.
- (6) Ticket No.
- (7) Time Start/End of Pour
- (8) Mix ID and Description (Strength)
- (9) Aggregate Moisture Before Mixing

(C) Proportioning Devices

Volume proportioning devices, such as counters, calibrated gate openings or flow meters, shall be easily accessible for controlling and determining the quantities of the ingredients discharged. All indicating devices that affect the accuracy of proportioning and mixing of concrete shall be in full view of and near enough to be read by the operator and Engineer while concrete is being produced. In operation, the entire measuring and dispensing mechanism shall produce the specified proportions of each ingredient.

Provide positive control of the flow of water and admixtures into the mixing chamber with a volumetric mixer. Indicate water flow by a flow meter and be readily adjustable to provide for slump control and/or minor variations in aggregate moisture. Provide a mixer capable of continuously circulating or mechanically agitating the admixtures.

Section 1000

Dispense liquid admixtures through a controlled, calibrated flow meter. A positive means to observe the continuous flow of material shall be provided. If an admixture requires diluting, the admixture shall be diluted and thoroughly mixed before introducing the admixture into the dispenser. When admixtures are diluted, the ratio of dilution and the mixing shall be approved by and performed in the presence of the Department.

The volumetric mixer shall be capable of measurement of cement, supplementary cementitious material (if required), liquids and aggregate being introduced into the mix.

(D) Calibration

Volume-weight relationships will be based on calibration. The proportioning devices shall be calibrated by the contractor before the start of each NCDOT job and subsequently at intervals recommended by the equipment manufacturer. Calibrations will be performed in the presence of the Department and subject to approval from the Department. Calibration of the cement and aggregate proportioning devices shall be accomplished by weighing (determining the mass of) each component. Calibration of the admixture and water proportioning devices shall be accomplished by weight (mass) or volume. Tolerances in proportioning the individual components will be as follows:

TABLE 1000-7 VOLUMETRIC MIXED CONCRETE CALIBRATION TOLERANCES	
Item	Tolerance
Cement, Weight (Mass) percent	0 to +4
Fine Aggregate, Weight (Mass) percent	± 2
Coarse Aggregate, Weight (Mass) percent	± 2
Admixtures, Weight (Mass) or Volume percent	± 3
Water, Weight (Mass) or Volume percent	± 1

Each volumetric mixer must be accompanied at all times by completed calibration worksheets and they shall be made available to the Department upon request.

(E) Verification of Yield

Verification of the proportioning devices may be required at any time by the Department. Verification shall be accomplished by proportioning the rock and sand based on the cement meter count for each concrete mobile mixer. Once the count (revolutions) for 94 lbs. of cement has been determined then delivery of the correct amount of rock and sand can be verified.

(F) Uniformity

When concrete is produced, have present during all batching operations a Certified Concrete Batch Technician. During batching and placement, the sole duty of this employee is to supervise the production and control of the concrete, perform moisture tests, adjust mix proportions of aggregates for free moisture, complete and sign approved delivery tickets and assure quality control of the batching.

Two samples of sufficient size to make the required tests will be taken after discharge of approximately 15% and 85% of the load. Each of the two samples of concrete will be separately tested for the properties listed in Table 1000-7. Tests will be conducted in accordance with the test procedures specified in Table 1000-7 or procedures established by the Materials and Tests Unit. The Engineer may recheck mixer performance at any time when, in his opinion, satisfactory mixing is not being accomplished.

Section 1003

**SECTION 1003
GROUT PRODUCTION AND DELIVERY**

1003-1 DESCRIPTION

This section addresses cement grout to be used for structures, foundations, retaining walls, concrete barriers, embankments, pavements and other applications in accordance with the contract. Produce non-metallic grout composed of Portland cement and water and at the Contractor's option or as required, aggregate and supplementary cementitious materials. Include chemical admixtures as required or needed. Provide sand cement or neat cement grout as required. Define "neat cement grout" as grout without aggregate.

The types of grout with their typical uses are as shown below:

Type 1 – A cement grout with only a 3 day strength requirement and a fluid consistency that is typically used for filling subsurface voids.

Type 2 – A nonshrink grout with strength, height change and flow conforming to ASTM C1107 that is typically used for foundations and rock anchors.

Type 3 – A nonshrink grout with high early strength and freeze-thaw durability requirements that is typically used in pile blockouts, grout pockets, shear keys, dowel holes and recesses for concrete barriers and structures.

Type 4 – A neat cement grout with low strength, a fluid consistency and high fly ash content that is typically used for slab jacking.

Type 5 – A neat cement grout that is typically used for soil nails and ground anchors.

Type 6 – A low slump, low mobility cement grout with minimal strength that is typically used for compaction grouting.

1003-2 MATERIALS

Refer to Division 10.

Item	Section
Chemical Admixtures	1024-3
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Portland Cement	1024-1
Silica Fume	1024-7
Water	1024-4

Do not use grout that contains soluble chlorides or more than 1% soluble sulfate.

At the Contractor's option, use an approved packaged grout instead of the materials above except for water. Use packaged grouts that are on the NCDOT APL.

Use admixtures for grout that are on the NCDOT APL or other admixtures in accordance with Subarticle 1024-3(E) except do not use concrete additives or unclassified or other admixtures in Type 4 or 6 grout. Use Class F fly ash for Type 4 grout and Type II Portland cement for Type 6 grout.

Use well graded rounded aggregate with a gradation, liquid limit (LL) and plasticity index (PI) that meet Table 1003-1 for Type 6 grout. Fly ash may be substituted for a portion of the fines in the aggregate. Do not use any other supplementary cementitious materials in Type 6 grout.

Section 1003

TABLE 1003-1 AGGREGATE REQUIREMENTS FOR TYPE 6 GROUT			
Gradation		Maximum Liquid Limit	Maximum Plasticity Index
Sieve Designation per AASHTO M 92	Percentage Passing (% by weight)		
3/8"	100	N/A	N/A
No. 4	70 – 95		
No. 8	50 – 90		
No. 16	30 – 80		
No. 30	25 – 70		
No. 50	20 – 50		
No. 100	15 – 40		
No. 200	10 – 30	25	10

1003-3 COMPOSITION AND DESIGN

When using approved packaged grout, a grout mix design submittal is not required. Otherwise, submit proposed grout mix designs for each grout mix to be used in the work, except for Type 5 grout, which has a prescribed mix design specified in Article 1003-4. Mixes for all grout shall be designed by a Certified Concrete Mix Design Technician or an engineer licensed by the State of North Carolina. Mix proportions shall be determined by a testing laboratory approved by the Department. Base grout mix designs on laboratory trial batches that meet Table 1003-2 and this section. With permission, the Contractor may use a quantity of chemical admixture within the range shown on the current list of approved admixtures maintained by the Materials and Tests Unit.

Submit grout mix designs in terms of saturated surface dry weights on *Materials and Tests Form 312U* at least 35 days before proposed use. Adjust batch proportions to compensate for surface moisture contained in the aggregates at the time of batching. Changes in the saturated surface dry mix proportions will not be permitted unless revised grout mix designs have been submitted to the Engineer and approved.

Accompany *Materials and Tests Form 312U* with a listing of laboratory test results of compressive strength, density and flow or slump and if applicable, aggregate gradation, height change and durability from a certified laboratory. List the compressive strength of at least three 2 inch cubes at the age of 3 and 14 or 28 days per Table 1003-2 for Type 1 through 4 grouts. List the compressive strength of at least three 6 inch x 12 inch cylinders at the age of 3 and 28 days for Type 6 grout.

The Engineer will review the grout mix design for compliance with the contract and notify the Contractor as to its acceptability. Do not use a grout mix until written notice has been received. Acceptance of the grout mix design or use of approved packaged grouts does not relieve the Contractor of his responsibility to furnish a product that meets the contract.

Section 1003

- 1 Perform laboratory tests in accordance with the following test procedures:

Property	Test Method
Aggregate Gradation ^A	AASHTO T 27
Compressive Strength	AASHTO T 106
Density (Unit Weight)	AASHTO T 121, AASHTO T 133 ^B , ANSI/API RPC 13B-1 ^B (Section 4, Mud Balance)
Durability	AASHTO T 161 ^D
Flow	ASTM C939 (Flow Cone)
Height Change	ASTM C1090 ^E
Slump	AASHTO T 119 (Except do not rod grout)

- 2 **A.** Applicable to grout with aggregate.
3 **B.** Applicable to Neat Cement Grout.
4 **C.** American National Standards Institute/American Petroleum Institute Recommended
5 Practice.
6 **D.** Procedure A (Rapid Freezing and Thawing in Water) required
7 **E.** Moist room storage required.

8 1003-4 GROUT REQUIREMENTS

9 Provide grout types in accordance with the contract. Use grouts with properties that meet Table
10 1003-2. For Type 1 through 5 grouts, the compressive strength of the grout will be considered
11 the average compressive strength test results of three 2 inch cubes at the oldest age per Table
12 1003-2. Make cubes that meet AASHTO T 106 from the grout delivered for the work or mixed
13 on-site. Make cubes at such frequencies as the Engineer may determine and cure them in
14 accordance with AASHTO T 106.

15
16 For Type 5 grout, use neat cement grout that only contains cement and water with a water
17 cement ratio of 0.4 to 0.5, which is approximately 5.5 gallons of water per 94 lbs. of Portland
18 cement.

19
20 For Type 6 grout, the compressive strength of the grout will be considered the average
21 compressive strength test results of three 6 inch x 12 inch cylinders at the age of 28 days. Make
22 cylinders in accordance with AASHTO R 100 except do not rod grout. Make cylinders at such
23 frequencies as the Engineer may determine and cure them in accordance with AASHTO R 100.

Section 1003

**TABLE 1003-2
GROUT REQUIREMENTS**

Type of Grout	Minimum Compressive Strength at			Height Change at 28 days	Flow ^A /Slump ^B	Minimum Durability Factor
	3 days	14 days ^C	28 days			
1	3,000 psi	-	-	-	10 – 30 sec	-
2	Table 1 ^D				Fluid Consistency ^D	-
3	5,000 psi ^E	5,000 psi	-	0 – 0.2%	Per Accepted Grout Mix Design or Approved Packaged Grout ^F	80
4 ^G	600 psi	-	1,500 psi	-	10 – 26 sec	-
5	1,500 psi	-	4,000 psi	-	Per Standard Mix Design specified in Article 1003-4	-
6	100 psi	-	250 psi	-	< 2"	-

A. Applicable to Type 1 through 4 grouts.

B. Applicable to Type 6 grout.

C. Not applicable to Type 2 grout

D. ASTM C1107.

E. Minimum compressive strength at 3 days is only required to approve Type 3 grout mix designs or evaluate Type 3 packaged grouts for the NCDOT APL.

F. Add mixing water to Type 3 packaged grout at the manufacturer's recommended rate to produce grout with the designed consistency and required 3 day strength.

G. Use Type 4 grout with proportions by volume of 1 part cement and 3 parts fly ash.

1003-5 TEMPERATURE REQUIREMENTS

When using an approved packaged grout, follow the manufacturer's instructions for grout and air temperature at the time of placement. Otherwise, the grout temperature at the time of placement shall be not less than 50°F nor more than 90°F. Do not place grout when the air temperature measured at the location of the grouting operation in the shade away from artificial heat is below 40°F.

1003-6 ELAPSED TIME FOR PLACING GROUT

Agitate grout continuously before placement. Regulate the delivery so the maximum interval between the placing of batches at the work site does not exceed 20 minutes. Place grout before exceeding the times in Table 1003-3. Measure the elapsed time as the time between adding the mixing water to the grout mix and placing the grout.

**TABLE 1003-3
ELAPSED TIME FOR PLACING GROUT
(with continuous agitation)**

Air or Grout Temperature, Whichever is Higher	Maximum Elapsed Time	
	No Retarding Admixture Used	Retarding Admixture Used
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below	60 minutes	1 hr. 45 minutes

Section 1005**1003-7 MIXING AND DELIVERY**

Use grout free of any lumps and undispersed cement. When using an approved packaged grout, mix grout in accordance with the manufacturer's instructions. Otherwise, comply with Articles 1000-9 through 1000-13 to the extent applicable for grout instead of concrete.

SECTION 1005**GENERAL REQUIREMENTS FOR AGGREGATE****1005-1 GENERAL**

Obtain aggregates from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. Obtain aggregates from pre-approved sources, or have the source approved through the Department's Aggregate QC/QA Program before use. Approval of such sources is based not only on the quality of the aggregate, but also on satisfactory production facilities and procedures. A list of approved aggregate sources participating in the Department's Aggregate QC/QA Program in North Carolina and adjoining states is available from the Materials and Tests Unit. Use of aggregates is allowed in the work provided they have been properly stockpiled in units of not less than 300 tons, tests of representative samples of these aggregates indicate satisfactory compliance with the specifications and the source meets all the requirements of the Aggregate QC/QA Program.

Separate aggregate containing rock of more than one identifiable rock type or particles of visibly different degrees of weathering in amounts of 10% or more into each individual type. Aggregate is acceptable only if each type does not exceed the percentage of wear specified for a particular use.

Blended aggregates from different sources are allowed if all aggregates meet the Specifications for soundness or resistance to abrasion.

1005-2 HANDLING AND STORING AGGREGATES

Handle and stockpile aggregates in such a manner to minimize segregation.

Provide sites for aggregate stockpiles that are cleared, grubbed and cleaned with a firm, smooth and well drained ground surface. Maintain a cover of at least 3 inches of aggregate over the ground surface to avoid the inclusion of soil or foreign material. Operate trucks or other equipment on a stockpile in an acceptable manner.

Space, or separate with suitable walls or partitions, stockpiles of different types or sizes of aggregates to prevent the mixing of the aggregates. Do not allow the stockpile to become contaminated with foreign matter or degrade excessively. Failure of aggregate samples to meet all gradation requirements due to excessive degradation will be determined by sieve tests of samples taken from any portion of the stockpile and is cause for discontinuance of such stockpiling procedure.

Stockpiled aggregates should be essentially free of clay or shale particles, and should contain dust that is primarily rock dust produced through normal handling of the aggregate.

Sampling stockpiles for conformance shall be conducted as described in the Aggregate QC/QA Program manual.

1005-3 GRADATION

Grade all standard sizes of aggregate to meet Tables 1005-1 or 1005-2.

1005-4 TESTING

Aggregates will be tested in accordance with the test methods below except where other test procedures are required by other articles covering a particular application.

Section 1005

Property	Test Method
Gradation	AASHTO T 27 and T11, AASHTO T 88 as Modified for Base Course and Stabilizer
Liquid Limit	AASHTO T 89 as Modified
Plasticity Index	AASHTO T 90
Resistance to Abrasion (Percentage of Wear)	AASHTO T 96
Soundness	AASHTO T 104 Using Sodium Sulfate

- 1 Copies of modified test procedures are available from the Materials and Tests Unit.

TABLE 1005-1
AGGREGATE GRADATION - COARSE AGGREGATE

Std. Size #	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#10	#16	#40	#200	Remarks
4	100	90-100	20-55	0-15	-	0-5	-	-	-	-	-	A	Asphalt Plant Mix
46/7M	100	95-100	-	35-70	-	0-30	0-5	-	-	-	-	A	Asphalt Plant Mix
5	-	100	90-100	20-55	0-10	0-5	-	-	-	-	-	A	AST, Sediment Control Stone
57	-	100	95-100	-	25-60	-	0-10	0-5	-	-	-	A	AST, Str. Conc., Shoulder Drain, Sediment Control Stone
57M	-	100	95-100	-	25-45	-	0-10	0-5	-	-	-	A	AST, Concrete Pavement
6M	-	-	100	90-100	20-55	0-20	0-8	-	-	-	-	A	AST
67	-	-	100	90-100	-	20-55	0-10	0-5	-	-	-	A	AST, Str. Concrete, Asphalt Plant Mix
78M	-	-	-	100	98-100	75-100	20-45	0-15	-	-	-	A	AST, Str. Conc., Weep Hole Drains., Asphalt Plant Mix
14M	-	-	-	-	100	98-100	35-70	5-20	-	0-8	-	A	Asphalt Plant Mix, AST, Weep Hole Drains, Str. Concrete
9M	-	-	-	-	100	98-100	85-100	10-40	-	0-10	-	A	AST
ABC	-	100	75-97	-	55-80	-	35-55	-	25-45	-	14-30	4-12 ^B	Aggregate Base Course, Aggregate Stabilization
ABC(M)	-	100	75-100	-	45-79	-	20-40	-	0-25	-	-	0-12 ^B	Maintenance Stabilization
Light-weight ^C	-	-	-	-	100	80-100	5-40	0-20	-	0-10	-	0-2.5	AST

A. See Subarticle 1005-4(A). B. See Subarticle 1005-4(B). C. For Lightweight Aggregate used in Structural Concrete, see Subarticle 1014-2(E)(6)

Section 1005

- (A) When aggregates are used for Portland cement concrete, asphalt treatment and asphalt plant mix, the requirements pertaining to material passing the No. 200 sieve are as follows:
- (1) When tested in a stockpile at the quarry site, the amount of material passing the No. 200 sieve shall be no greater than 1.0%.
 - (2) When tested at the job site before use, the amount of material passing the No. 200 sieve shall:
 - (a) Be no greater than 1.5% for aggregate used in Portland cement concrete or asphalt surface treatment.
 - (b) Be no greater than 2.0% for aggregate used in asphalt plant mix.
 - (3) If a stockpile at the job site is found to contain in excess of the specified amount of material passing the No. 200 sieve before use, the Engineer may approve its use provided:
 - (a) For aggregate used in Portland cement concrete, the total percentage by weight passing the No. 200 sieve in the combined coarse and fine aggregate in the mix does not exceed 3.5%, and provided no increase in water-cement ratio is required by the use of this aggregate.
 - (b) For aggregate used in asphalt plant mix, the total percentage by weight of minus No. 200 material in the plant mix being produced, as determined by the extraction test, can be maintained within the limits allowed by the job mix formula.
- (B) For ABC and ABC(M), in addition to the gradation requirements, the material passing the No. 40 sieve shall not have a LL in excess of 30 nor a PI in excess of 4. If PI exceeds 4 and is no more than 6, soil mortar limits apply. If PI exceeds 6, material shall be rejected. The gradation requirements for material passing the No. 10 sieve (soil mortar) will be as required in Section 1010.

TABLE 1005-2 AGGREGATE GRADATION FINE AGGREGATE									
Std. Size #	Percentage of Total by Weight Passing								Remarks
	3/8"	#4	#8	#16	#30	#50	#100	#200	
1S	100	90-100		40-85		0-20		0-3	Blotting Sand, Asphalt Retreatment
2S	100	95-100	80-100	45-95	25-75	5-30	0-10	0-3	Concrete, Shotcrete, Grout, Subsurface Drainage, Blotting Sand
2MS		95-100	80-100	45-95	25-75	5-35	0-20	0-8 ^A	Concrete, Shotcrete, Grout, Subsurface Drainage
4S		100	95-100			15-45	0-10	0-5	Mortar

- A. When tested at the job site before use, the amount of material passing the No. 200 sieve shall not be greater than 10%.

Section 1006**SECTION 1006****AGGREGATE QUALITY CONTROL/QUALITY ASSURANCE**

The Aggregate QC/QA Program is designed to allow aggregate producers the responsibility for controlling the quality of material they produce and to utilize the quality control information they provide in the acceptance process by the Department. It requires aggregate producers to perform quality control sampling, testing and record keeping on aggregates they ship for use by the Department. It requires the Department to perform quality assurance sampling, testing and record keeping confirming the performance of the producers' control plan. The program and participation requirements are described in the *Aggregate QC/QA Program Manual*.

Participation in this program does not relieve the producer of the responsibility of complying with all requirements of the *Standard Specifications*.

Section 1012

1010-2 AGGREGATE FOR PLANT MIXED CEMENT TREATED BASE COURSE

Provide aggregate meeting Article 1010-1, except as modified herein. Sources of aggregate will not be approved unless the material has a percentage of wear of not greater than 65%.

**SECTION 1012
AGGREGATE FOR ASPHALT PAVEMENTS
AND SURFACE TREATMENTS**

1012-1 AGGREGATE FOR ASPHALT PLANT MIXES**(A) General**

Design the asphalt plant mix with coarse and fine aggregate that meet Section 1005, except as noted herein. Size, uniformly grade and combine the aggregate fractions in such proportions that the resulting mixture meets the grading and physical requirements of these specifications for the specified mix type. Materials that will not produce a mixture within the design criteria required by these specifications will be rejected, unless otherwise approved by the Engineer.

The consensus property criteria in Table 1012-1 apply to the design aggregate blend. Source property criteria apply to individual aggregate sources.

For all dense-graded surface course mixes, that are the top or final layer, limit the amount of coarse aggregate or fine aggregate produced from crystalline limestone, crystalline-dolomitic limestone or marble to no more than 50% of the total amount of coarse aggregate or fine aggregate in the asphalt mixture. For open-graded asphalt friction course and ultra-thin bonded wearing course, do not use aggregates produced from crystalline limestone, crystalline-dolomitic limestone or marble.

(B) Coarse Aggregate**(1) General**

Use coarse aggregate consisting of crushed stone, crushed gravel, a mixture of uncrushed gravel with either crushed stone or crushed gravel or other inert material having similar characteristics. Provide coarse aggregate composed of clean, tough, durable fragments free from an excess of flat or elongated pieces and free of organic matter and deleterious substances.

Use coarse aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. A list of sources participating in the Department's Aggregate QC/QA Program in North Carolina and adjoining states is available from the Materials and Tests Unit in Raleigh.

(2) Gradation

Use standard size coarse aggregate meeting Table 1005-1 and these *Standard Specifications* unless otherwise approved by the Engineer.

(3) Coarse Aggregate Angularity (Fractured Faces)

Use coarse aggregate meeting Table 1012-1 for coarse aggregate angularity (fractured faces) when tested in accordance with ASTM D5821.

(4) Flat and Elongated Pieces

Use coarse aggregate meeting Table 1012-1 for flat and elongated pieces when tested in accordance with ASTM D4791 on the No. 4 sieve and larger with a 5:1 aspect ratio (maximum to minimum) for all pavement types, except there is no requirement for Types S4.75A and S9.5B.

Section 1012

(5) Soundness

The maximum weighted average soundness loss of individual coarse aggregate sources when subjected to 5 cycles using sodium sulfate when tested in accordance with AASHTO T 104 is 15%.

**TABLE 1012-1
AGGREGATE CONSENSUS PROPERTIES^A**

Mix Type	Coarse Aggregate Angularity ^B	Fine Aggregate Angularity % Minimum	Sand Equivalent % Minimum	Flat and Elongated 5 : 1 Ratio % Maximum
<i>Test Method</i>	<i>ASTM D5821</i>	<i>AASHTO T 304</i>	<i>AASHTO T 176</i>	<i>ASTM D4791</i>
S4.75A; S9.5B	75 / -	40	40	-
S9.5C; I19.0C; B25.0C	95 / 90	45	45	10
S9.5D	100 / 100	45	50	10
OGFC	100 / 100	45	45	10
UBWC	100 / 85	45	45	10

A. Requirements apply to the design aggregate blend.

B. 95/90 denotes that 95% of the coarse aggregate has one fractured face and 90% has 2 or more fractured faces.

(6) Toughness (Resistance to Abrasion)

The maximum allowable percentage of loss of each individual coarse aggregate source for all plant mix types except open-graded asphalt friction course, shall be 55% when tested in accordance with AASHTO T 96. The maximum percentage loss for aggregate used in OGFC shall be 45%. The percentage loss for aggregate used in UBWC shall be no more than 35%.

(7) Deleterious Materials

The maximum allowable percentage by weight of clay lumps and friable particles in individual aggregate sources shall be 1% when tested in accordance with AASHTO T 112.

(8) Durability (Micro-Deval test)

The maximum allowable abrasion loss for aggregate used in UBWC shall be 18% when tested in accordance with AASHTO T 327.

(C) Fine Aggregate

(1) General

Use fine aggregate that is consistently graded from coarse to fine and consists of natural sand, stone screenings, or a blend of natural sand and stone screenings. Use aggregate composed of rough surfaced and angular grains of quartz or other hard durable rock.

Use fine aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. A list of sources participating in the Department's QC/QA Program in North Carolina and adjoining states is available from the Department's Materials and Tests Unit in Raleigh. If a natural sand source is owned by the same owner as the asphalt plant where the material is used, participation in the Aggregate QC/QA Program is not required.

Section 1012

Furnish sand from approved sources. Do not use sources contaminated by industrial waste. A sufficient number of samples of fine aggregate, but in no case less than three, will be taken to indicate any variation within any stockpile or source of supply.

Do not use fine aggregate containing sticks, roots, trash, visible lumps of clay, or other unsatisfactory material unless all undesirable material is removed to the satisfaction of the Engineer before the aggregate is used in the asphalt mixture.

Use natural sand that is non-plastic when tested in accordance with AASHTO T 90.

Produce stone screenings from stone that has a maximum percentage of wear of 55% when tested in accordance with AASHTO T 96 using test grading A.

(2) Gradation

Use stone screenings that are consistently graded with not more than 20% by weight passing the No. 200 sieve when tested by dry sieving in accordance with AASHTO T 27. Use natural sand that is consistently graded.

(3) Clay Content (Sand Equivalent)

Use a fine aggregate blend that has a minimum sand equivalent percentage as indicated in Table 1012-1 when tested in accordance with AASHTO T 176.

(4) Soundness

The maximum weighted average soundness loss of individual fine aggregate sources when subjected to 5 cycles using sodium sulfate shall be 15% when tested in accordance with AASHTO T 104.

Natural sand that contains grains of questionable hardness will be subjected to 5 cycles of the soundness test. The weighted average loss shall be not more than 15%. The soundness test will be performed before establishing the mix design.

(5) Deleterious Materials

The maximum percentage by weight of clay lumps and friable particles in individual fine aggregate sources shall be 1% when tested in accordance with AASHTO T 112.

(6) Fine Aggregate Angularity

Use a fine aggregate blend that has a minimum fine aggregate angularity as indicated in Table 1012-1 when tested in accordance with AASHTO T 304, Method A.

(D) Mineral Filler

Use mineral filler consisting of limestone dust, dolomite dust, Portland cement, or other inert mineral matter that conforms to AASHTO M 17.

(E) Reclaimed Asphalt Shingles (RAS)

For use in asphalt mix, Reclaimed Asphalt Shingles (RAS) can be either manufacturer-waste shingles or post-consumer shingles that have been processed into a product that meets the requirements of this section.

Manufacturer-waste RAS (MRAS) are processed shingle materials discarded from the manufacturing of new asphalt shingles. It may include asphalt shingles or shingle tabs that have been rejected by the shingle manufacturer.

Post-consumer RAS (PRAS) are processed shingle materials recovered from mixed roofing material scrap removed from existing structures. Tear-off shingle scrap must be sorted and other roofing debris, including nails, plastic, metal, wood, coal tar epoxy, rubber materials, or other undesirable components, shall be removed. This sorting of the scrap must be done prior to grinding of the PRAS for use in asphalt production.

Section 1012

Sample and test PRAS for asbestos and provide results demonstrating that the bulk samples contain less than one percent of asbestos containing material in accordance with Federal, State of North Carolina, and Local regulations. Use NC-accredited Asbestos Inspectors or Roofing Supervisors to sample the PRAS to meet the above criteria. Maintain records on-site indicating shingle source(s), asbestos operation plan approved by Division of Public Health's Health Hazards Control Unit, and all asbestos analytical reports. All documentation will be subject to review by the Department.

Process RAS by ambient grinding or granulating methods such that 100% of the particles will pass the 9.50 mm (3/8 inch) sieve when tested in accordance with AASHTO T27. Perform sieve analysis on processed asphalt shingles prior to ignition or solvent extraction testing.

RAS shall contain no more than 0.5% by total cumulative weight of deleterious materials. These materials include, but are not limited to, excessive dirt, debris, concrete, metals, glass, paper, rubber, wood, plastic, soil, brick, tars, or other contaminating substances.

Blend RAS with fine aggregate, meeting the requirements of this Section, if needed to keep the processed material workable. Any stockpile containing RAS will be considered a RAS stockpile and will be limited in mixtures as prescribed in Article 610-3.

MRAS and PRAS shall not be blended together for the production of hot mix asphalt.

(1) Mix Design RAS

Incorporate RAS from stockpiles that have been tested for uniformity of gradation and binder content prior to use in an asphalt mix design.

(2) Mix Production RAS

New Source RAS is defined as acceptable material which was not included in the stockpile when samples were taken for mix design purposes. Process new source RAS so that all materials will meet the gradation requirements prior to introduction into the plant mixer unit.

After a stockpile of processed RAS has been sampled and mix designs made from these samples, do not add new source RAS to the original stockpile without prior field testing to ensure gradation and binder uniformity. Sample and test new source RAS before blending with the existing stockpile.

Store new source RAS in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAS may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity prior to its use in the recycled mix. Store RAS materials in such a manner as to prevent contamination.

Field approval of new source RAS will be based on Table 1012-2 and volumetric mix properties on the mix with the new source RAS included. Provided these tolerances are met, volumetric properties of the new mix will then be performed. If all volumetric mix properties meet the mix design criteria for that mix type, the new source RAS may continue to be used.

If the gradation, binder content, or any of the volumetric mix properties are not within the allowable tolerances of Table 1012-2, do not use the new source RAS unless approved by the Engineer. The Contractor may elect to either not use the stockpile, to request an adjustment to the JMF, or to redesign the mix.

TABLE 1012-2
NEW SOURCE RAS BINDER AND GRADATION TOLERANCES
(Apply Tolerances to Mix Design Data)

P_b %	± 2.5
<i>Sieve Size, mm</i>	<i>Tolerance</i>
4.75	± 5
2.36	± 4
1.18	± 4
0.300	± 4
0.150	± 4
0.075	± 2.0

(F) Reclaimed Asphalt Pavement (RAP)

(1) RAP Classifications

During production incorporate RAP from stockpiles or other sources tested for uniformity of gradation and binder content before use in an asphalt mix. Ensure that no deleterious material is allowed in any stockpile. When multiple stockpiles of recycled material are used during production, erect and maintain signs satisfactory to the Engineer properly identifying each stockpile. Use RAP that meets all requirements specified for the following classifications.

(a) Millings

Existing RAP that is removed from its original location by a milling process as specified in Section 607. Millings shall have a uniform gradation and binder content and all materials must pass a 1 1/2 inch sieve before introduction into the plant mixer unit.

(b) Processed RAP

RAP that is processed by crushing, screening and/or blending to produce a uniform gradation and binder content. Processed RAP shall have a uniform gradation and binder content and will pass a 1 inch sieve before introduction into the plant mixer unit.

(c) Fractionated RAP

RAP that is processed by crushing, screening and/or blending into one or two stockpiles. When only one fractionated RAP stockpile is used, the stockpile shall only contain material passing the 5/8 inch sieve. If a second coarse fraction is used, the coarse stockpile shall only contain material passing the 1 inch sieve and retained on the 5/8 inch sieve. The Engineer may allow the Contractor to use an alternate screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse, fine, or the combination of both. Use a separate cold feed bin for each stockpile of fractionated RAP introduced into the plant mixer unit.

Perform gradation and asphalt content tests at a rate of one per 1,000 tons of RAP, with at least five tests per stockpile to determine the asphalt content and gradation. Assure that no deleterious material is allowed to contaminate any stockpile. The Engineer may reject by visual inspection any stockpiles that are not kept clean, separated and free of foreign materials.

For the Fractionated RAP to be considered for approval, the gradation and asphalt content shall be uniform. Individual test results, when compared to the target, will be accepted if within the tolerances listed in Table 1012-3.

Section 1012

TABLE 1012-3
FRACTIONATED RAP GRADATION AND BINDER TOLERANCES^A
(Apply Tolerances to Mix Design Data)

P_b %	± 0.3%
<i>Sieve Size, mm</i>	<i>Tolerance</i>
25.0	± 5%
19.0	± 5%
12.5	± 5%
9.50	± 5%
4.75	± 5%
2.36	± 4%
1.18	± 4%
0.300	± 4%
0.150	± 4%
0.075	± 1.5%

A. If more than 20% of the individual sieves are out of the gradation tolerances, or if more than 20% of the asphalt binder content test results fall outside the appropriate tolerances, the RAP shall not be used in asphalt mix unless the RAP representing the failing tests is removed from the stockpile.

Do not add additional material to any fractionated RAP stockpile, unless otherwise approved by the Engineer.

Maintain a record system for all fractionated RAP stockpiles at the plant site. Include at a minimum the following: Stockpile identification and a sketch of all stockpile areas at the plant site; all RAP test results (including asphalt content, gradation and asphalt binder characteristics).

(2) RAP Management During Production

New source RAP is any acceptable material that was not included in the stockpile or other source when samples were taken for mix design purposes.

After a stockpile of millings, processed RAP or fractionated RAP has been sampled and mix designs made from these samples, do not add new source RAP to the original stockpile without prior field testing to insure gradation and binder uniformity. Sample and test new source RAP to ensure it meets one of the RAP Classifications in Subarticle 1012-1(F)(1) before blending with the existing stockpile.

Store new source RAP in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAP may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity before its use in the recycled mix.

Unprocessed RAP is asphalt material that was not milled and/or has not been processed to obtain a uniform gradation and binder content and is not representative of the RAP used during the applicable mix design. Unprocessed RAP shall not be incorporated into any JMFs before processing. Different sources of unprocessed RAP may be stockpiled together provided it is generally free of contamination and will be processed before use in a recycled mix. RAP contamination in the form of excessive dirt, debris, clean stone, concrete, etc. will not be allowed. Incidental amounts of dirt, concrete and clean stone may be acceptable. Unprocessed RAP may be processed and then classified as a new source RAP as described above.

Field approval of new source RAP will be based on Table 1012-4 and volumetric mix properties in the mix with the new source RAP included. Provided the Table 1012-3 tolerances are met, volumetric properties of the new mix will then be performed. If all volumetric mix properties meet the mix design criteria for that mix type, the new source RAP may continue to be used.

Section 1012

If the gradation, binder content, or any of the volumetric mix properties are not within the allowable tolerances of Table 1012-4, do not use the new source RAP unless approved by the Engineer. The Contractor may elect to either not use the stockpile, to request an adjustment to the JMF, or to redesign the mix.

TABLE 1012-4 NEW SOURCE RAP GRADATION AND BINDER TOLERANCES (Apply Tolerances To Mix Design Data)									
	0 - 20% RAP			20 - 30 % RAP			> 30 % RAP		
Pb, %	± 0.7%			± 0.4%			± 0.3%		
Sieve Size, mm	Mix Type			Mix Type			Mix Type		
	Base	Inter.	Surf.	Base	Inter.	Surf.	Base	Inter.	Surf.
25.0	±10	-	-	±7	-	-	±5	-	-
19.0	±10	±10	-	±7	±7	-	±5	±5	-
12.5	-	±10	±6	-	±7	±3	-	±5	±2
9.50	-	-	±8	-	-	±5	-	-	±4
4.75	±10	-	±10	±7	-	±7	±5	-	±5
2.36	±8	±8	±8	±5	±5	±5	±4	±4	±4
1.18	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.300	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.150	-	-	±8	-	-	±5	-	-	±4
0.075	±4	±4	±4	±2	±2	±2	±1.5	±1.5	±1.5

1012-2 AGGREGATES FOR ASPHALT SURFACE TREATMENT

(A) General

Use coarse aggregate consisting of crushed stone, crushed gravel, or other inert material having similar characteristics. Adequately wash coarse aggregate so it is free from clay, loam, dust and other adherent materials.

Adequately clean all fine aggregate so it is free from sticks, roots, visible lumps of clay or other unsatisfactory material before use.

(B) Gradation

Use coarse aggregate for mat and seal coat and AST as required by Section 660, unless otherwise required by the contract. Use aggregate meeting the applicable gradation requirements of Table 1005-1.

Remix aggregate that has become segregated until it meets the applicable gradation requirements.

(C) Fractured Faces

Use coarse aggregate that contains at least 75% by weight of crushed pieces having 2 or more fractured faces and at least 90% by weight of crushed pieces having one or more fractured faces on that portion retained on the No. 4 sieve.

(D) Soundness

The maximum weighted average loss of either coarse or fine aggregate when subjected to 5 cycles using sodium sulfate when tested in accordance with AASHTO T 104 is 15%.

(E) Toughness (Resistance to Abrasion)

The maximum percentage loss of coarse aggregate for asphalt surface treatment when tested in accordance with AASHTO T 96 is 55%.

Section 1014

(F) Blending of Aggregates

Blending of two or more aggregates will not be permitted regardless of the origin of the aggregates if any one of the aggregates fails to meet the requirements for soundness or resistance to abrasion.

1012-3 BLOTTING SAND

Blotting sand is fine aggregate consisting of natural sand, commercial sand, manufactured sand, coarse screenings, or other inert material having similar characteristics. Subarticles 1012-2(D) and 1012-2(F) will be applicable to blotting sand. Adequately clean the fine aggregate so it is free from sticks, roots, visible lumps of clay or other unsatisfactory material before use.

1012-4 LIGHTWEIGHT AGGREGATE

Lightweight aggregates used in asphalt surface treatments shall be produced by the rotary kiln process and shall come from an approved Department source meeting applicable requirements of Section 1005 and 1006. The aggregate shall meet Table 1012-5 and AASHTO M 195 with the exception of any other references to concrete samples or concrete strength.

TABLE 1012-5 LIGHTWEIGHT AGGREGATE PHYSICAL PROPERTIES		
Property	Specification (maximum limit)	Test Method
Sodium Sulfate Soundness	5%	AASHTO T 104
Los Angeles Abrasion	45%	AASHTO T 96 (B grading)
Percent Absorption	10%	AASHTO T 19
Micro-Deval	18%	AASHTO T 327

**SECTION 1014
AGGREGATE FOR PORTLAND CEMENT CONCRETE**

1014-1 FINE AGGREGATE

(A) General

Use fine aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. A list of sources participating in the Department's QC/QA Program in North Carolina and adjoining states is available from the Materials and Tests Unit.

Use fine aggregate consisting of natural sand or manufactured sand having clean, durable, hard, uncoated particles, or other inert materials having similar characteristics. Produce manufactured sand from fractured stone material. Use fine aggregate free from dirt, wood, paper, burlap and all other foreign material.

To permit excess water to drain and the moisture content to become uniform, stockpile the aggregates either at the producer's plant or at the batch plant site for at least 24 hours before use in the concrete. Build open stockpiles of fine aggregate at the batch plant on concrete surfaces. Do not add new material to the stockpile during the 24 hour period. When the aggregates have a low and uniform moisture content and the consistency of the concrete can be satisfactorily controlled without stockpiling the aggregates for 24 hours, the minimum stockpiling period may be reduced or waived entirely by the Engineer.

The Department's list of approved sources of fine aggregate shows the target fineness modulus of each aggregate as established by the producer. Do not use fine aggregate with a fineness modulus that varies more than 0.2 from the target value until the concrete mix proportions are adjusted.

Section 1014

(B) Soundness

When subjected to 5 cycles of the soundness test, the weighted average loss shall not be more than 15%.

(C) Deleterious Substances

Determine the percentage of deleterious substances (clay lumps and friable particles) in accordance with AASHTO T 112. The amount of deleterious substances shall not exceed 2.0% by weight for natural sand or 1.0% by weight for manufactured sand.

(D) Organic Impurities

The color of each source of fine aggregate will be determined annually in accordance with AASHTO T 21. Should the fine aggregate show a darker color than samples previously approved from the same source, withhold its use until tests have been made to determine the quality of the sand.

(E) Mortar Strength

Mortar made with the fine aggregate shall have a compressive strength at the age of 3 and 7 days using Type III Portland cement, or 7 and 28 days using Type I or II Portland cement, of not less than 95% of that developed by a comparison mortar. Make the comparison mortar with the same cement, graded Ottawa sand with a fineness modulus of 2.40 ± 0.05 , and the same water-cement ratio and consistency as the test mortar. Test the mortar strength in accordance with AASHTO T 106.

Fine aggregate that fails the mortar strength may be used with the approval of the Engineer, provided that when it is tested in concrete cylinders the compressive strength of the concrete at 14 days is equal to or greater than the strength of cylinders made with an identical mix using an acceptable sand.

(F) Gradation

Natural sand shall meet the gradation for standard size No. 2S fine aggregate. Manufactured sand shall meet the gradation for standard size No. 2MS fine aggregate.

(G) Blending Fine Aggregate

Blending fine aggregates to obtain the required gradation will be permitted if test results of each aggregate meet the durability requirements and test results of the combination indicate acceptable quality. Blend aggregates by weighing them separately at the time of batching or by other means acceptable to the Engineer.

When natural sand is blended with natural sand, the blend shall meet the gradation for No. 2S fine aggregate. When manufactured sand is blended with natural sand or with manufactured sand, the blend shall meet the gradation for No. 2MS fine aggregate and neither component shall exceed the gradation limits on the No. 200 sieve shown in Table 1005-2.

1014-2 COARSE AGGREGATE**(A) General**

Use coarse aggregate from sources participating in the Department's Aggregate QC/QA Program as described in Section 1006. A list of these sources in North Carolina and adjoining states is available from the Materials and Tests Unit in Raleigh.

Use coarse aggregate that consists of crushed stone, crushed or uncrushed gravel, crushed air-cooled blast furnace slag or other inert materials that have similar characteristics. Wash all coarse aggregate for Portland cement concrete to remove clay, loam, dust and similar adherent materials unless otherwise permitted by the Engineer in writing. Keep coarse aggregate free from dirt, wood, paper, burlap and all other foreign material.

Section 1014

To permit excess water to drain and the moisture content to become uniform, stockpile the aggregates either at the producer's plant or at the batch plant site for at least 24 hours before use in the concrete. Build open stockpiles of coarse aggregate at the batch plant on concrete surfaces. Do not add new material to the stockpile during the 24 hour period. Where the aggregates have low and uniform moisture content and the consistency of the concrete can be satisfactorily controlled without stockpiling the aggregates for 24 hours, the minimum stockpiling period may be reduced or waived entirely by the Engineer.

Do not mix coarse aggregate from different sources or use it in alternate batches except where permitted by the Engineer in writing. Blending of coarse aggregates to obtain the required gradation will be permitted if the different sizes are from the same source. Blend coarse aggregates by weighing them separately at the time of batching or by other means acceptable to the Engineer.

(B) Soundness

When subjected to 5 cycles of the soundness test, the weighted average loss shall not exceed 15%. For concrete with a 28 day design compressive strength greater than 6,000 psi, the loss shall not exceed 8%.

(C) Deleterious Substances

Determine the percentage of deleterious substances (clay lumps and friable particles) in accordance with AASHTO T 112. The amount of deleterious substances shall not exceed 3% by weight.

(D) Resistance to Abrasion

The percentage of wear of crushed stone or gravel shall not exceed 55%. For concrete with a 28 day design strength greater than 6,000 psi, the wear shall not exceed 40%.

(E) Aggregate Sizes**(1) General**

Use standard size No. 57, No. 67, or No. 78M coarse aggregate in Portland cement concrete unless otherwise indicated.

(2) Latex Modified Concrete

Use standard size No. 78M coarse aggregate in latex modified concrete.

(3) Prestressed and Precast Concrete

Use standard size No. 67 or No. 78M coarse aggregate in prestressed and precast concrete.

(4) Use of More Than One Size

All concrete used in a single component of any structure shall be made with the same size aggregate.

(5) Portland Cement Concrete Pavement

Use standard size No. 57, No. 57M, No. 67 or No. 78M coarse aggregate in concrete for Portland cement concrete pavement unless otherwise specified by the Engineer.

(6) Sand Lightweight Concrete

Use the following gradation for the lightweight coarse aggregate.

Section 1016

TABLE 1014-1 GRADATION FOR LIGHTWEIGHT COARSE AGGREGATE	
Sieve Size	Passing Square Opening Sieves (Percent by Weight)
1"	100
3/4"	90 - 100
3/8"	10 - 50
No. 4	0 - 15

(7) Drilled Pier Concrete

Use standard size No. 78M coarse aggregate in Drilled Pier concrete.

SECTION 1016

SELECT MATERIALS

1016-1 DESCRIPTION

Select material is suitable material classified by gradation and performance characteristics as shown in this section.

1016-2 USES

Use select material called for in the contract. With written approval and without additional compensation, a higher class of material may be substituted than stated in the contract.

1016-3 CLASSIFICATIONS

CLASS I

Class I select material is silty or clayey soil material meeting AASHTO M 145 for soil classification A-4. Soil materials which meet AASHTO M 145 for soil classifications A-2, A-5, A-6 and A-7 are acceptable provided such materials do not have a LL greater than 50, nor a PI of less than 7 or greater than 20.

CLASS II

Type 1 Select Material

Type 1 select material is a fine aggregate material consisting of crushed stone screenings (washed or unwashed) meeting the gradation in Table 1016-1.

TABLE 1016-1 GRADATION FOR CLASS II, TYPE 1 SELECT MATERIAL	
Sieve	Percent Passing
3/8"	100
No. 4	80 - 100
No. 10	65 - 95
No. 40	25 - 55
No. 200	0 - 20
LL	≤ 30
PI	≤ 6

Type 2 Select Material

Type 2 select material is a granular soil material meeting AASHTO M 145 for soil classifications A-2-4 with a maximum PI of 6 and A-4 soil containing 45% maximum passing a No. 200 sieve and a maximum PI of 6.

When a type is not specified, either type may be used, but no additional compensation will be made.

Section 1016

CLASS III

Type 1 Select Material

Type 1 select material is a natural or manufactured fine aggregate material meeting the requirements of standard size 2S or 2MS as described in Sections 1005 and 1006.

Type 2 Select Material

Type 2 select material is a granular soil material meeting AASHTO M 145 for soil classification A-1 or A-3.

Type 3 Select Material

Type 3 select material is a natural or manufactured fine aggregate material meeting the gradation in Table 1016-2.

TABLE 1016-2 GRADATION FOR CLASS III, TYPE 3 SELECT MATERIAL	
Sieve	Percent Passing
3/8"	100
No. 4	95 - 100
No. 8	65 - 100
No. 16	35 - 95
No. 30	15 - 75
No. 50	5 - 50
No. 100	0 - 25
No. 200	0 - 8

Type 3 select material shall meet the requirements described in Sections 1005 and 1006. When a type is not specified, Type 1, Type 2 or Type 3 may be used, but no additional compensation will be made.

CLASS IV

Select material is a coarse aggregate material meeting the requirements of standard size ABC as described in Sections 1005, 1006 and 1010. When material is produced from aggregates from crushed concrete, Section 1043 requirements shall be applied.

CLASS V

Select material is a coarse aggregate material meeting the requirements of standard size 78M as described in Sections 1005 and 1006.

CLASS VI

Select material is a coarse aggregate material meeting the requirements of standard size 57 as described in Sections 1005 and 1006.

CLASS VII

Select material is clean, unweathered durable, blasted rock material. While no specific gradation is required, the below criteria will be used to evaluate the materials for visual acceptance by the Engineer.

(A) At least 50% of the rock has a diameter of from 1.5 feet to 3 feet,

(B) 30% of the rock ranges in size from 2 inches to 1.5 feet in diameter, and

(C) Not more than 20% of the rock is less than 2 inches in diameter. No ripplable rock will be permitted.

SECTION 1018 **BORROW MATERIAL**

1018-1 GENERAL

Borrow material is used for embankments, backfill or other intended uses. Material that contains roots, root mats, stumps or other unsatisfactory material will not be acceptable.

1018-2 APPROVAL OF BORROW MATERIAL

The approval of borrow material is subject to Section 230.

(A) Statewide Criteria for Acceptance of Borrow Material

- See exceptions in Subarticle 1018-2(B).
- Use only natural earth materials as borrow material. Any other materials are subject to rejection.

TABLE 1018-1 PIEDMONT AND WESTERN AREA CRITERIA FOR ACCEPTANCE OF BORROW MATERIAL	
Soil with PI of 25 or less	Acceptable
Soil with PI of 26 through 35	Acceptable, but not to be used in top 3 ft of embankment or backfill
Soil with PI of more than 35	Not Acceptable

(B) Exceptions to Statewide Criteria for Acceptance of Borrow Material

- (1) Soils in the Coastal Plain (area described below) will be accepted by the Engineer in accordance with the Table 1018-2.

TABLE 1018-2 COASTAL AREA CRITERIA FOR ACCEPTANCE OF BORROW MATERIAL	
Soil with PI of 15 or less	Acceptable
Soil with PI of 16 through 20	Acceptable, but not to be used in top 3 ft of embankment or backfill
Soil with PI of more than 20	Not Acceptable

Areas where Table 1018-2 is applicable are as follows:

- Division 1 Entire Division except Northampton (West of I-95)
- Division 2 Entire Division
- Division 3 Entire Division
- Division 4 Edgecombe, Wayne, Johnston (East of US 301), Wilson (East of I-95), Nash (East of I-95), Halifax (East of I-95)
- Division 6 Bladen, Columbus, Robeson, Cumberland, Harnett (South of NC 27)
- Division 8 Scotland, Hoke, Moore (Southeast of US 15-501, NC 73, NC 211), Richmond (East of US 220 North and US 1 South)

Table 1018-2 shall be applicable to the flood plains of the Roanoke, Tar, Neuse, Cape Fear and Lumber Rivers and their tributaries that are outside the above described areas.

- (2) Waste or by-products from industrial processes or mining operations are not acceptable except by specific written approval.
- (3) When tested, soils having a pH of less than 5.5 or an organic content more than 4.0% may be rejected by the Engineer.
- (4) When material is to be used for placing embankments or backfilling of undercut areas that are excessively wet, the material shall consist of Class II, III or IV select material.

SECTION 1020
ASPHALT MATERIALS AND ADDITIVES

1020-1 DELIVERY AND ACCEPTANCE OF ASPHALT MATERIALS

Asphalt materials are accepted at the source of shipment subject to the conditions herein.

All asphalt transport tankers, including rail and truck tankers, shall have a sampling valve in accordance with *Asphalt QMS Manual*, AASHTO R66, ASTM D140 or a comparable device acceptable to the Engineer.

Each transport tanker delivering asphalt materials to the project or rail siding shall keep a running log showing the date, destination and type and grade of material hauled on each trip. Print, stamp, or write in ink information appearing in the log and have available for examination upon request.

Section 1020

Furnish with each shipment 2 copies of a delivery ticket. Ensure both copies accompany the shipment and are delivered to the Engineer or his representative at the destination. The delivery ticket must contain all necessary information to identify the material and meet the state requirements of the Department of Agriculture and Consumer Services or other appropriate state agency that the asphalt terminal is in, the Department's *Performance Graded Asphalt Binder QC/QA Program* and the Department's *Asphalt Emulsion QC/QA Program*.

When anti-strip additive is introduced into the asphalt binder, ensure the delivery ticket notes the brand, grade and percentage or quantity at which the additive was introduced.

Furnish a statement of certification from the supplier and a separate statement of certification from the transporter. Sign each certification by an authorized representative of the supplier or transporter. Stamp, write or print these certifications on the delivery ticket in accordance with the appropriate QC/QA Program (Department's *Performance Graded Asphalt Binder QC/QA Program* or the Department's *Asphalt Emulsion QC/QA Program*), or attach to the delivery ticket.

Failure to sign the certifications by either the supplier or transporter will be cause to withhold use of the material until a sample can be taken and tested, except where an alternative testing and invoicing procedure has been pre-approved by the Engineer.

The Engineer reserves the right to sample and test any shipment regardless of whether the above conditions have been met and to reject any material not meeting the specifications.

1020-2 ASPHALT BINDER

Use performance graded asphalt binder meeting AASHTO M 320 Table 1 and the Department's *Performance Graded Asphalt Binder QC/QA Program*. See Article 610-3 for the specified grades.

Submit a Quality Control Plan for asphalt binder production in conformance with AASHTO R 26 and the Department's *Performance Graded Asphalt Binder QC/QA Program* to the Asphalt Workgroup in the Materials and Tests Unit. The Department's *Performance Graded Asphalt Binder QC/QA Program* shall be implemented in accordance with Article 1020-6.

Where modification of the asphalt binder is required to meet the specified grade, accomplish the modification using a styrene butadiene styrene (SBS), styrene butadiene rubber (SBR), styrene butadiene (SB) polymer or other modifiers approved by the Engineer to modify asphalt to meet the grade specified before delivery to the asphalt plant. Other polymers shall be pre-approved and listed by the Materials and Tests Unit. Air blown asphalt will not be permitted.

1020-3 ASPHALT EMULSION

Use asphalt emulsion that meets the requirements in the Department's *Asphalt Emulsion QC/QA Program*. The program includes requirements for latex modified, polymer modified, and non-tracking tack emulsified asphalt products and producers. New emulsified asphalt products will need to go through the new products approval process.

Submit a QC Plan for asphalt emulsion that meets the Department's *Asphalt Emulsion QC/QA Program* to the Materials and Tests Unit.

1020-4 POLYMER MODIFIED EMULSION MEMBRANE

Use polymer modified emulsion membrane consisting of styrene butadiene block copolymer modified asphalt emulsion to form a water impermeable seal and bond the new hot mix to the existing surface. Complete polymer modification of base asphalt before emulsification. Conform to Table 1020-1.

Section 1020

**TABLE 1020-1
EMULSION AND RESIDUE TESTING**

Property	Requirement		Test Method
	Min.	Max.	
EMULSION:			
Saybolt Viscosity @ 77°F, SFS	20	100	AASHTO T 59
Sieve Test, %		0.1	AASHTO T 59
24-Hour Storage Stability, % ^A		1	AASHTO T 59
Residue from Distillation, % ^B	63		AASHTO T 59
Oil portion from distillation ml of oil per 100 g emulsion		2.0	
Demulsibility	60		AASHTO T 59
RESIDUE:			
Solubility in TCE, %	97.5		AASHTO T 44
Elastic Recovery	60		AASHTO T 301
Penetration @ 77°F, 100 g, 5 sec, d _{mm}	60	150	AASHTO T 49

A. After standing undisturbed for 24 hours, the surface shall show no white, milky colored substance, but shall be a smooth homogeneous color throughout.

B. AASHTO T-59 with modifications to include a 400°F ± 10°F maximum temperature to be held for 15 minutes.

1020-5 PRIME COAT MATERIALS

Supply prime coat materials from pre-approved sources that are on the NCDOT APL. Verification samples taken at the point of application (destination) are subject to the following conditions:

(A) All prime coat materials shall be delivered to the project ready for use.

(B) Sampling will be made at the point of application as directed by the Engineer. The Department reserves the right to sample all materials used for prime coat applications, either at the destination or at the point of origin, and to withhold acceptance of material until analysis of such samples have been made. When a material meets specification requirements, but has a history of unsatisfactory service performance, its use for construction or maintenance purposes may be restricted by the Engineer.

(C) The sand penetration results for a material used as a prime coat are penetration depth of at least 12 mm and penetration time of not more than 90 seconds. Copies of the *Sand Penetration Test Procedure* are available upon request from the Materials and Tests Unit.

(D) Materials used as a prime coat shall have a minimum rating of fair on the coating ability and water resistance test in accordance with AASHTO T 59.

(E) For materials stored longer than one day at the destination point (Contractors'/Divisions' tanks), submit to the Engineer a certified laboratory report on the performance of the material for storage stability test in accordance with AASHTO T 59.

(F) The diluted materials shall be tested for asphalt residue percent in accordance with AASHTO T 59, and shall have a minimum asphalt residue percent of 15%.

1020-6 PERFORMANCE GRADED ASPHALT BINDER AND ASPHALT EMULSION QUALITY CONTROL/QUALITY ASSURANCE

The *Performance Graded Asphalt Binder and Asphalt Emulsion QC/QA Programs* are designed to give asphalt binder and asphalt emulsion producers/suppliers (henceforth Producer

Section 1020

designates producer/supplier) more responsibility for controlling the quality of material they produce and to use the quality control information they provide in the acceptance process by the Department. It requires asphalt binder and asphalt emulsion producers to perform quality control sampling, testing and record keeping on materials they ship for use by the Department. It documents that the Department will perform quality assurance sampling, testing and record keeping confirming the performance of the producers' control plan. In addition, the producer is required to participate in independent assurance comparative sample activities. The program is described in the *Performance Graded Asphalt Binder and Asphalt Emulsion QC/QA Program Manuals*. An electronic copy of the program manuals may be obtained by accessing the Materials and Tests website.

The types of samples and the lot sizes required by the Producers and the Department are described in detail in the *Performance Graded Asphalt Binder and Asphalt Emulsion QC/QA Program Manuals*.

Acceptance or rejection of material will be based on the total program. Therefore, a comparison of the quality control, quality assurance and other sample data may be used by the Department for acceptance or rejection of a lot of material.

Participation in this program does not relieve the producer of the responsibility of complying with all requirements of the specifications.

1020-7 WATERPROOFING AND DAMPPROOFING MATERIALS**(A) Asphalt Primer**

Asphalt primer shall meet ASTM D41.

(B) Asphalt Binder

Asphalt Binder shall meet Article 1020-2, Grade PG 64-22.

(C) Tar

Tar shall meet ASTM D490.

(D) Woven Cotton Fabric

Bitumen-saturated woven cotton fabric for waterproofing shall meet ASTM D173.

1020-8 ANTI-STRIP ADDITIVES

Anti-strip additives may either be hydrated lime or a chemical additive or a combination of both and must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan. Use an anti-strip additive capable of preventing the separation of the asphalt binder from the aggregate and achieving the required tensile strength ratio (TSR) on the asphalt mix when tested in accordance with AASHTO T 283 as modified by the Department.

Use hydrated lime conforming to AASHTO M 303. Add hydrated lime used of anti-strip purposes at a rate of not less than 1.0% by weight of the total dry aggregate.

Add chemical anti-strip additives to the asphalt binder before introduction into the mix. Do not use any chemical additive or particular concentration of chemical additive found to be harmful to the asphalt material or which causes the performance grading of the original asphalt binder to be out of specifications for the grade required.

1020-9 SILICONE

Silicone additives shall be pre-approved by the Materials and Tests Unit.

1020-10 FIBER STABILIZING ADDITIVES

Use fiber stabilizing additives that are capable of stabilizing the asphalt film surrounding the aggregate particles to reduce drain-down of the asphalt binder. A fiber stabilizer such as mineral fiber or cellulose may be used. The selected fiber shall meet the properties described

Section 1020

below. Dosage rates given are typical ranges but the actual dosage rate used will be approved by the Engineer.

(A) Mineral Fibers

Mineral fibers shall be made from virgin basalt, diabase or slag treated with a cationic sizing agent to enhance disbursement of the fiber as well as increase adhesion of the fiber surface to the asphalt binder. Mineral fibers shall be in accordance with Table 1020-2. Add the fiber at a dosage rate between 0.2% and 0.4% by weight of total mix, as approved by the Engineer.

TABLE 1020-2 MINERAL FIBER PROPERTIES		
Property	Requirement	Test Method
Average Fiber length	0.25" maximum	-
Average Fiber thickness	0.0002" maximum	-
Shot Content Passing No. 60 sieve	90 - 100%	ASTM C612
Shot Content Passing No. 230 sieve	65 - 100%	ASTM C612
Degradation	30% maximum	GDT-124/McNett Fractionation

(B) Cellulose Fibers

Add cellulose fibers at a dosage rate between 0.2% and 0.4% by weight of total mix as approved by the Engineer. Fiber properties shall be in accordance with the following table.

TABLE 1020-3 CELLULOSE FIBER PROPERTIES	
Property	Requirement
Average Fiber Length	0.25" maximum
Alpine Sieve Method Passing No. 100 Sieve	60 - 80%
Ro-Tap Sieve Method Passing No. 20 Sieve	80 - 95%
Ro-Tap Sieve Method Passing No. 40 Sieve	45 - 85%
Ro-Tap Sieve Method Passing No. 100 Sieve	5 - 40%
Ash Content	18% ± 5% non-volatiles
pH	7.5 ± 1
Oil Absorption	5.0 ± 1 (times fiber weight)
Moisture Content	5.0 maximum

(C) Cellulose Pellets

Cellulose pellets consist of a 50/50 blend of cellulose fiber and asphalt binder. Use cellulose that complies with Subarticle 1020-10(B) and the following table. Add the cellulose pellets at a dosage rate between 0.4% and 0.8% by weight of total mix, as approved by the Engineer.

TABLE 1020-4 CELLULOSE PELLET PROPERTIES	
Property	Requirement
Pellet Size	1/4 cu.in. maximum
Asphalt	25 - 80 pen.

SECTION 1024

MATERIALS FOR PORTLAND CEMENT CONCRETE

1024-1 PORTLAND CEMENT

Supply Portland cement that meets AASHTO M 85 for Type I, II or III except that the maximum fineness requirements of AASHTO M 85 do not apply to cement used in precast concrete products. Throughout these specifications Types I and II cement are referred to as regular Portland cement and Type III as high early strength Portland cement.

Certain combinations of cement and aggregate exhibit an adverse alkali-silica reaction. The alkalinity of any cement, expressed as sodium-oxide equivalent, shall not exceed 1.0%. For mix designs that contain non-reactive aggregates and cement with an alkali content less than 0.6%, straight cement or a combination of cement and SCM may be used. The SCM quantity shall not exceed the amount shown in Table 1024-1. For mixes that contain cement with an alkali content between 0.6% and 1.0% and for mixes that contain a reactive aggregate documented by the Department, use a SCM in the amount shown in Table 1024-1.

Obtain the list of reactive aggregates documented by the Department at the Materials and Tests Unit website.

TABLE 1024-1 SUPPLEMENTARY CEMENTITIOUS MATERIAL FOR USE IN PORTLAND CEMENT CONCRETE	
SCM	Substitution Rate (1 lb. SCM per 1 lb. Cement)
Class F Fly Ash	20% - 30%
Ground Granulated Blast Furnace Slag	35%-50%
Microsilica	4%-8%

Blended cements meeting AASHTO M 240 may be used with permission of the Engineer. Blended cements consist of either binary blends (e.g. a mixture of hydraulic cement with one other component) or ternary blends (e.g. a mixture of hydraulic cement and two other components). The components permitted for blending with cement are slag, pozzolans, or limestone. The term pozzolan can reference natural pozzolans (e.g. metakaolins), fly ash, or silica fume. The binary blended cements are Type IS (Portland-slag cement), Type IP (Portland-pozzolan cement), and Type IL (Portland-limestone cement). The ternary blended cement is Type IT and represents blends of Portland cement with varying amounts of any two different additives, which are pozzolans, slags or limestone. See AASHTO M 240 for details on the various blend ratios for Type IT blended cement.

Type IP or IS blended cement is allowed for the cement-and-fly-ash or cement-and-slag portion of the mix. Type IT may be allowed for the cement-and- supplementary cementitious portion of the mix with the permission of the Engineer. Do not substitute fly ash or slag for a portion of Type IP, IS or IT cement.

Use white cement that meets ASTM C150, except that the ferric oxide content is limited to 0.5%.

Use Type IP blended cement that meets AASHTO M 240, except that the pozzolanic content is limited to between 20 and 30% by weight and the constituents shall be interground.

Use Type IS blended cement that meets AASHTO M 240 except that the slag content is limited to between 35% and 50% by weight and the constituents are interground.

Use Type IT blended cement that meets AASHTO M 240. The Engineer will evaluate the blend of constituents for acceptance in Department work.

Section 1024

Use Type IL blended cement that meets AASHTO M 240, except the constituents shall be interground. SCMs can replace a portion of Type IL blended cement and shall be replaced as outlined in Subarticle 1000-3(I) for Portland cement.

Do not use air-entraining Portland cement. Do not mix different types of cement, different brands of cement, or the same brand from different mills nor use them alternately except when authorized in writing by the Engineer.

Protect cement from contamination or damage during handling and storage. Do not use cement that is damaged, partially set, lumpy or caked.

All cement is sampled and tested by the Department as it arrives on the project or at the batching plant at such frequency as established by the Department.

1024-2 AGGREGATE

Provide aggregate that meets Section 1014.

1024-3 ADMIXTURES**(A) Basis of Acceptance**

Admixtures from an approved source are accepted without further testing. Only use admixtures that are on the NCDOT APL. Products must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT APL.

(B) Approved Admixture

An approved admixture complies with this subarticle in order to be added to the NCDOT APL.

The manufacturer shall submit to the Product Evaluation Program an application and certified reports of tests that show that the admixture meets the applicable specifications. Tests shall be performed by AASHTO's designated AASHTO Product Evaluation & Audit Solutions laboratory for concrete admixture testing. Admixtures that contain chloride other than calcium chloride as provided herein are not permitted. The manufacturer is required to state in writing that no chloride was added during the manufacture of the admixture.

After an admixture is accepted, the manufacturer is required to submit to the Product Evaluation Program on or before February 1 of each year a notarized certification that shows that the material is of the same composition as originally accepted and has not been changed or altered. If an admixture is changed or altered, approval of the source in accordance with the above requirements is necessary before using the admixture.

The Engineer has the option to perform tests deemed desirable to verify the manufacturer's certification. Failure of the admixture in such tests is cause for discontinuation of its use. Failure of an admixture to perform satisfactorily under job conditions is cause for rejection of the admixture.

(C) Air Entraining Agent

Provide air entraining agents that meet AASHTO M 154.

(D) Chemical Admixtures**(1) Set Retarding Admixtures**

Use set retarding admixtures that meet AASHTO M 194 for Type D, water reducing and retarding admixtures.

(2) Water Reducing Admixtures

Use water reducing admixtures that meet AASHTO M 194 for Type A admixtures. Mid-range water reducing admixtures will be considered as high range water reducing admixtures if they meet the requirements for Type F water reducing admixtures.

Section 1024**(3) Calcium Chloride**

Provide calcium chloride that meets AASHTO M 144 for Type 2, concentrated flake, pellet or other granular calcium chloride. The Engineer may waive the gradation requirement.

(4) High-Range Water Reducing Admixtures

Use high-range water reducing admixtures that meet AASHTO M 194 for Type F or Type G.

(5) Calcium Nitrite Corrosion Inhibitor

Use an approved calcium nitrite corrosion inhibitor that contains 30% solids.

(E) Other Admixtures

Admixtures not otherwise classified will be reviewed on a case-by-case basis by the Materials and Tests Unit.

1024-4 WATER

Ensure that water used to condition, wash, or as an integral part of materials is clear and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substance. It shall not be salty or brackish. Water used in the production of concrete or grout shall be from wells or public water systems which are suitable for drinking and must meet the criteria listed in Table 1024-2.

Test water from wells at all locations. Test public water supplies from all out of state locations and in the following counties: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrell and Washington unless the Engineer waives the testing requirements. Water from a municipal water supply in all other NC counties may be accepted by the Engineer without testing.

Section 1026

TABLE 1024-2 PHYSICAL PROPERTIES OF WATER		
Property	Requirement	Test Method
Compressive Strength, minimum percent of control at 3 and 7 days	90%	ASTM C1602
Time of set, deviation from control	From 1:00 hr. earlier to 1:30 hr. later	ASTM C1602
Chloride Ion Content, Max.	250 ppm	ASTM D512 *
Total Solids Content (Residue), Max.	1,000 ppm	SM 2540B *
Resistivity, Min.	0.500 kohm-cm	ASTM D1125 *

* Denotes an alternate method is acceptable. Test method used shall be referenced in the test report.

1024-5 FLY ASH

Provide fly ash that meets ASTM C618 for Class F or Class C, except ensure that the loss on ignition does not exceed 4%. Use fly ash that meets the optional physical requirements for uniformity shown in Table 3 of ASTM C618.

Do not use Class C fly ash in Portland cement concrete if the alkali content of the cement exceeds 0.4%.

All fly ash is sampled and tested by the Department as it arrives on the project at such frequency as established by the Department.

1024-6 GROUND GRANULATED BLAST FURNACE SLAG

Use blast furnace slag that meets AASHTO M 302, Grade 100. All slag is sampled and tested by the Department as it arrives on the project at such frequency as established by the Department.

1024-7 SILICA FUME

Provide silica fume (microsilica) that meets Tables 1, 2 and 3 of ASTM C1240. All silica fume is sampled and tested by the Department as it arrives on the project at such frequency as established by the Department.

1024-8 NATURAL POZZOLANS

Provide natural pozzolans that meet ASTM C618 for Class N pozzolans, except ensure that the loss on ignition does not exceed 4%. Use natural pozzolans that meet the optional physical requirements for uniformity shown in Table 2 of ASTM C618.

All natural pozzolan is sampled and tested by the Department as it arrives on the project at such frequency as established by the Department.

SECTION 1026
CONCRETE CURING MATERIALS

1026-1 GENERAL

All curing materials shall be free from impurities that may be detrimental to the concrete.

1026-2 LIQUID MEMBRANE CURING COMPOUNDS

(A) General

Liquid membrane curing compounds shall meet ASTM C309, except that when tested in the water retention test described in AASHTO T 155 the curing compound shall restrict the loss of water in the test specimen at the time of application of the compound to not

Section 1028

more than 0.007 ounces per square inch. Do not use curing compound until the applicable tests have been performed for each batch and has been approved by the Engineer.

The curing compound shall be Type 2, white pigmented, except where clear type is required for a particular application, the curing compound shall be Type 1D, clear or translucent with fugitive dye.

Deliver curing compound in the manufacturer's original clean, sealed containers. Legibly mark each container with the name of the manufacturer, the name of the compound, the type of compound, the manufacturer's batch number, the date of manufacture and the manufacturer's recommended shelf life.

Do not use curing compound that has been in storage for more than one year from the date of manufacture or more than the manufacturer's recommended shelf life, whichever is less.

(B) Test Procedures

Curing compound will be tested in accordance with ASTM C309, except the size of molds for making test specimens will be approximately 5.5 inches in diameter by approximately 1 inch deep, or any other size selected by the Engineer.

1026-3 POLYETHYLENE FILM

Polyethylene film shall meet ASTM C171 for white opaque polyethylene film, except that when tested for moisture retention efficiency the loss shall not be more than 0.007 oz./sq.in of surface area.

1026-4 WATER

All water used for curing concrete shall meet Article 1024-4 and Table 1024-2. Water from wells, streams, ponds or public water systems may be used.

1026-5 BURLAP

Burlap shall meet AASHTO M 182. Any class of burlap will be acceptable.

Use new burlap or burlap that has been used for no purpose other than curing concrete. New burlap shall be free from starch, filler or other substances added during manufacture, or shall be washed to remove such substances before use.

**SECTION 1028
JOINT MATERIALS****1028-1 JOINT FILLER**

Provide a nonbituminous type joint filler that meets AASHTO M 153 for Types I, II or III, or a bituminous type that meets AASHTO M 213. Furnish a Type 3 material certification in accordance with Article 106-3 with each lot of the joint material supplied to each project.

1028-2 HOT APPLIED JOINT SEALER

Provide a hot applied joint sealer listed on the NCDOT APL, that conforms to ASTM D6690. Products must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT APL. Furnish a Type 3 material certification in accordance with Article 106-3 for each lot of the joint sealer supplied to each project.

1028-3 LOW MODULUS SILICONE SEALANT

Provide a cold applied, single component, chemically curing low modulus silicone sealant from the NCDOT APL. Products must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT APL. Acid cure sealants are not acceptable for use on Portland cement concrete. Bond breakers shall meet Article 1028-4.

Section 1028

(A) Silicone Sealant Types

(1) Type NS

A non-sag silicone for use in sealing horizontal and vertical joints in Portland cement concrete pavements and bridges. Tooling is required.

(2) Type SL

A self-leveling silicone used to seal horizontal joints in Portland cement concrete pavements and bridges. Tooling is not normally required.

(B) Requirements

TABLE 1028-1 PHYSICAL PROPERTIES OF SEALANT		
Property	Requirement	Test Method
Peel	Minimum of 20 lb/in of width with at least 75% cohesive failure	ASTM D903 bonded on concrete block
Movement Capability and Adhesion	No adhesive or cohesive failure after 10 cycles of test movements of +100% (extension) and -50% (compression)	ASTM C719

Silicone sealant shall meet the Table 1028-1, ASTM D5893.

Furnish a Type 3 material certification in accordance with Article 106-3 for each lot of joint sealer material supplied to each project. Deliver each lot of sealant in containers plainly marked with the manufacturer's name or trademark, lot number and date of manufacture.

1028-4 BOND BREAKER

Install silicone sealant over a bond breaker to prevent the sealant from bonding to the bottom of the joint. Use bond breakers that do not stain or adhere to the sealant and are chemically inert and resistant to oils. Furnish a Type 3 material certification in accordance with Article 106-3 for each lot of bond breaker material supplied to each project.

(A) Type L

Type L backer rod is a closed-cell expanded polyethylene foam backer rod. Use this backer rod in roadway and bridge joints and with Type NS silicone only. Use Type L backer rod that complies with Table 1028-2.

(B) Type M

Type M backer rod is a closed-cell polyolefin foam backer rod which has a closed-cell skin over an open cell core. Use this backer rod in roadway and bridge joints with both silicone sealant types. Use Type M backer rod that complies with Table 1028-2.

Section 1030

TABLE 1028-2 PHYSICAL PROPERTIES OF TYPE L AND TYPE M BACKER ROD		
Property	Requirement	Test Method
Min. Density	2.0 lb/cf	ASTM D 1622
Min. Tensile Strength	25 psi	ASTM D 1623
Max. Water Absorption	0.5% by volume	ASTM C 509

(C) Type N

Provide bond breaking tape made from extruded polyethylene that has a pressure sensitive adhesive on one side. Bond breaking tape may be used with both types of silicone but is suitable for bridge joints only. Bond breaking tapes shall be at least 0.005 inch in thickness.

SECTION 1030

RFID TRACKING PROGRAM FOR MANUFACTURED PRODUCTS

1030-1 DESCRIPTION

Radio Frequency Identification (RFID) tracking and tagging is used for manufactured products which includes but is not limited to Prestressed Concrete Products, Precast Concrete Products, Plastic Pipe, Reinforced Concrete Pipe, Steel Products and Metal Pipe. The RFID tag/label is used for identification of manufactured products by visually reading the 24-digit code, scanning the RFID embedded chip, or scanning the printed QR/barcode. It is the responsibility of the producer to supply RFID tags approved by the Department following the requirements of Section 1030 and place them on the products that are being manufactured. The producer manages the quality control and initial production information and assigns an RFID alternate ID. It is the producer's responsibility to manage tags placed on products and upload test results once complete.

1030-2 MANUFACTURED PRODUCTS

Place the RFID tag/label on manufactured products. When accepted, the RFID tag/label item record will be updated. RFID tags/labels are identifiers for all manufactured products that must be scanned to find the approval status on the Field Inspection Report (FIR) or NCDOT vendor alternate ID found on the NCDOT APL prior to use.

RFID tag/label parameters for use on all manufactured products are as follows:

(A) Tag/Label Copy

The tag/label copy shall be block type lettering with the company name, NCDOT Facility Plant ID Number and company logo. All information shall be subsurface printed.

(B) Colors

Color of ink must be black on white background.

(C) Serialization

The bar code and human-readable equivalent shall be subsurface printed. Code 128 in 24-character hexadecimal format shall be utilized. A QR/barcode linking to the NCDOT vendor alternate ID found on the NCDOT APL shall also be subsurface printed on the label.

(D) Adhesion

Adhesives shall be non-proprietary and have a minimum 2 year above ground life span.

Section 1030**(E) Tag Proof**

The Materials and Tests Unit must approve the tag/label. The Producer will provide an image of the tag/label and a copy of the tag/label specification to the Manufactured Products Engineer for approval.

(F) Tag Location

The location of the RFID tag/label for all manufactured products can be found in the *Guide to Placement of RFID Tags/Labels* found on Materials and Tests Unit website.

1030-3 PLASTIC PIPE

The RFID tag/label shall be placed on Plastic Pipe Products in accordance with Subarticle 1030-2(F).

RFID tag/label parameters for use on plastic pipes are as follows:

(A) Dimensions

Shall be a minimum size of 4.5 inches x 1 inch x 0.017 inches.

(B) Material

Use 0.002 inch thick Polyester; total tag thickness to be 0.017 inches.

(C) Numbering Scheme

The 24-character numbering scheme will be utilized as follows. AA00xx000000002000000000 where the first six digits identify the material and NCDOT Facility Plant ID Number replaces the xx and AA will identify polyethylene pipe while AB will identify polypropylene pipe. Numbering will start with a 2 in the billions position to prevent duplication of numbers across products. Numbering scheme must be approved by the Materials and Tests Unit.

(D) RFID inlay

The inlay shall be Alien Squiggle or comparable UHF passive inlay with a frequency range of 860-960 MHz.

(E) Read Range

The RFID tag/label shall have a minimum read range of 18 feet with a reader at 24 dBm (1/4 of maximum reader power).

1030-4 REINFORCED CONCRETE PIPE

The RFID tag/label shall be placed on Reinforced Concrete Pipe Products in accordance with Subarticle 1030-2(F).

RFID tag/label parameters for use on reinforced concrete pipes are as follows:

(A) Dimensions

Shall be a minimum size of 4 inches x 0.75 inches x 0.02 inches, with the option of being larger as approved by the Department.

(B) Material

Use 0.003 inch thick Polyester for subsurface printing. Additional polyester layers total 0.2 inch tag must be slotted on either end and contain a textured base layer.

(C) Numbering Scheme

The 24-character numbering scheme will be utilized as follows. AC00xx000000002000000000 where the first six digits identify the material and NCDOT Facility Plant ID Number replaces the xx and AC will identify concrete pipe. Numbering

Section 1030

will start with a 2 in the billions position to prevent duplication of numbers across products. Numbering scheme must be approved by the Materials and Tests Unit.

(D) RFID inlay

The inlay shall be Alien Higgs 3 Squiggle or comparable UHF passive inlay optional Smartrac Short Dipole R6 with a frequency range of 860-960 MHz.

(E) Read Range

The RFID tag/label shall have a minimum read range of 18 feet with a reader at 30 dBm.

1030-5 CORRUGATED METAL PIPE PRODUCTS

The RFID tag/label shall be placed on Corrugated Metal Pipe Products in accordance with Subarticle 1030-2(F).

RFID tag/label parameters for use on metal pipes are as follows:

(A) Dimensions

Shall be a minimum size of 2.875 inches x 1.375 inches x 0.085 inches, with the option of being larger as approved by the Department.

(B) Material

Use 0.002 inch thick Polyester label adhered to a non-proprietary inlay wrapped around 1/16 inch foam.

(C) Numbering Scheme

The 24-character numbering scheme will be utilized as follows. AD00xx000000002000000000 where the first six digits identify the material and NCDOT Facility Plant ID Number replaces the xx and AD will identify metal pipe. Numbering will start with a 2 in the billions position to prevent duplication of numbers across products. Numbering scheme must be approved by the Materials and Tests Unit.

(D) RFID inlay

The inlay shall be Alien Higgs 3 or comparable UHF passive inlay with a frequency range of 860-960 MHz.

(E) Read Range

The RFID tag/label shall have a minimum read range of 18 feet with a reader at 30 dBm.

1030-6 PRESTRESSED CONCRETE PRODUCTS

The RFID tag/label shall be placed on Prestressed Concrete Products in accordance with Subarticle 1030-2(F).

RFID tag/label parameters for use on prestressed concrete products are as follows:

(A) Dimensions

Shall be a minimum size of 2.75 inches x 1 inch x 0.02 inches, with the option of being larger as approved by the Department.

(B) Material

Use 0.003 inch thick Polyester for subsurface printing. Additional polyester layers total 0.2 inch tag must be slotted on either end and contain a textured base layer. Alternatively, the proprietary Cast-A-Tag can be utilized.

(C) Numbering Scheme

The 24-character numbering scheme will be utilized as follows. 000xxx00000000000000000000 where the first six digits identify the material and NCDOT

Section 1030

Facility Plant ID Number replaces the xx. Numbering scheme must be approved by the Materials and Tests Unit.

(D) RFID inlay

The inlay shall be Alien Higgs 3 Squiggle or comparable UHF passive inlay, optional Smartrac Short Dipole R6 with a frequency range of 860-960 MHz.

(E) Read Range

The RFID tag/label shall have a minimum read range of 18 feet with a reader at 30 dBm.

1030-7 PRECAST CONCRETE PRODUCTS

The RFID tag/label shall be placed on Precast Concrete Products in accordance with Subarticle 1030-2(F).

RFID tag/label parameters for use on precast concrete products are as follows:

(A) Dimensions

Shall be a minimum size of 2.75 inches x 1 inch x 0.02 inches, with the option of being larger as approved by the Department.

(B) Material

Use 0.003 inch thick Polyester for subsurface printing. Additional polyester layers total 0.2 inch tag must be slotted on either end and contain a textured base layer. Alternatively, the proprietary Cast-A-Tag can be utilized.

(C) Numbering Scheme

The 24-character numbering scheme will be utilized as follows. 000xxx000000002000000000 where the first six digits identify the material and NCDOT Facility Plant ID Number replaces the xx. Numbering scheme must be approved by the Materials and Tests Unit.

(D) RFID inlay

The inlay shall be Alien Higgs 3 Squiggle or comparable UHF passive inlay, optional Smartrac Short Dipole R6 with a frequency range of 860-960 MHz.

(E) Read Range

The RFID tag/label shall have a minimum read range of 18 feet with a reader at 30 dBm.

1030-8 SIGN PRODUCTS

The RFID tag/label shall be placed on Sign Products in accordance with Subarticle 1030-2(F).

RFID tag/label parameters for use on signs products found on Article 901-2 and Subarticle 901-3(A) are as follows:

(A) Dimensions

Shall be a minimum size of 5 inches x 3 inch x 0.085 inches, with the option of being larger as approved by the Department.

(B) Material

Use 0.002 inch thick Polyester label adhered to a non-proprietary inlay wrapped around a 1/16 inch foam.

(C) Numbering Scheme

The 24-character numbering scheme will be utilized as follows. 000xxx000000002000000000 where the first six digits identify the material and NCDOT

Section 1032

Facility Plant ID Number replaces the xx. Numbering scheme must be approved by the Materials and Tests Unit.

(D) RFID inlay

The inlay shall be Alien Higgs 3 or comparable UHF passive inlay with a frequency range of 860-960 MHz.

(E) Read Range

The RFID tag/label shall have a minimum read range of 18 feet with a reader at 30 dBm.

SECTION 1032 CULVERT PIPE

1032-1 CORRUGATED METAL CULVERT PIPE

Use corrugated metal culvert pipe that is NCDOT approved, found on the Department's producer/supplier list that participate in the Department's Brand Registration program for metal culvert pipe. The producer/supplier must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT producer/supplier list. The Department will remove a manufacturer of metal culvert pipe from this program if the monitoring efforts indicated that non-specification material is being provided or test procedures are not being followed.

The following types of steel and aluminum alloy pipe and all associated accessories may be accepted under this program.

(A) Coated corrugated metal culvert pipe and pipe arches,

(B) Coated corrugated metal end sections, coupling band and other accessories,

(C) Corrugated aluminum alloy structural plate pipe and pipe arches,

(D) Corrugated aluminum alloy end sections, coupling band and other accessories, and

Field joints for each type of corrugated steel pipe or corrugated aluminum pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installation. Coupling bands may be of the following types: bands with annular corrugations; bands with helical corrugations; bands with projections (dimples); channel bands for upturned flanges, with or without annular corrugations; flat bands; and smooth sleeve-type couplers. Coupling bands shall be installed in accordance with details in plans and/or in accordance with manufacturer's recommendations.

Corrugated metal pipe, pipe arches and coupling bands shall conform to AASHTO M 196 for Corrugated Aluminum Pipe, AASHTO M 36 for Galvanized Corrugated Steel Pipe, AASHTO M 36 for Aluminized Coated Corrugated Steel Pipe.

Aluminum and aluminized pipe shall have a barrier coat applied to the faying surfaces and edges of those components coming into contact with concrete. Surface preparation and barrier coat paint systems are found in the *Thermal Spray Coatings (Metallization) Program*.

1032-2 CORRUGATED ALUMINUM ALLOY CULVERT PIPE**(A) Corrugated Aluminum Alloy Culvert Pipe and Pipe Arch**

Corrugated aluminum alloy culvert pipe and corrugated aluminum alloy pipe arch culvert shall meet AASHTO M 196, except that Type IA and Type IIA pipe will not be permitted.

When elongated pipe is called for by the contract, use pipe that is shop formed to provide for a 5% vertical elongation.

(1) Coupling Bands

(a) Use corrugated coupling bands except as otherwise provided below.

Section 1032

- (b) A hugger type corrugated band having one annular corrugation at each outside edge of the band will be acceptable.
- (c) Coupling bands with projections (dimples) may be used where it is necessary to join new pipe to existing pipe having helical corrugations at the joint locations. The bands shall be formed with projections in annular rows with one projection for each corrugation of helical pipe. Use an approved sealer with this type of coupling band. Coupling bands with projections (dimples) may be used for circumferential pipe, heliacal pipe, or a combination of both.
- (d) Fasten coupling bands on the ends with at least two 1/2 inch bolts.
- (e) Annular corrugated bands shall have a minimum width of 10 1/2 inches where 2 2/3 inches x 1/2 inch corrugations are used.

(B) Corrugated Aluminum Alloy Pipe Tees and Elbows

Corrugated aluminum alloy pipe and corrugated aluminum alloy pipe arch tees and elbows shall meet all applicable requirements of AASHTO M 196.

(C) Acceptance

Acceptance by the Engineer of corrugated aluminum alloy culvert pipe and corrugated aluminum alloy pipe arch culvert and its accessories will be based on, but not limited to, visual inspections, classification requirements and check samples taken from material delivered to the project and conformance to the annual Brand Registration.

1032-3 CORRUGATED STEEL CULVERT PIPE**(A) Corrugated Steel Culvert Pipe and Pipe Arch**

Corrugated steel culvert pipe and pipe arch shall meet AASHTO M 36 with the following exceptions:

(1) Coupling Bands

- (a) Use corrugated coupling bands except as otherwise provided below.
- (b) A hugger type corrugated band having one annular corrugation at each outside edge of the band will be acceptable.
- (c) Coupling bands with projections (dimples) may be used where it is necessary to join new pipe to existing pipe having helical corrugations at the joint locations. The bands shall be formed with projections in annular rows with one projection for each corrugation of helical pipe. Use an approved sealer with this type of coupling band. Coupling bands with projections may be used for circumferential pipe, heliacal pipe, or a combination of both.
- (d) Fasten coupling bands on the ends with at least two 1/2 inch bolts.
- (e) Annular corrugated bands shall have a minimum width of 10 1/2 inches where 2 2/3 inches x 1/2 inch corrugations are used.

(2) Corrugations

Where 1/4 inch deep corrugations are permitted by AASHTO M 36, the maximum pitch of the corrugations shall be 1 7/8 inches.

Where 3 inches x 1 inch corrugations are required, the Contractor will be permitted to use 5 inches x 1 inch corrugations.

Pipe with helical corrugations shall have rerolled ends with at least 2 annual corrugations at each end.

Section 1032**(3) Elongated Pipe**

When elongated pipe is called for by the contract, use pipe that is shop formed to provide for a 5% vertical elongation.

(4) Lifting Straps

The pipe may be furnished either with or without lifting straps for handling. Attach the lifting straps by bolting or by welding. Bolt holes for attaching the straps shall be a smooth hole that is either punched or drilled. No burning of holes will be permitted. Design the lifting straps so the holes can be plugged to prevent infiltration of backfill material.

Design the placement of lifting straps to ensure the pipe is equally supported along its axis.

(5) Coating Repair

Repair shall be in accordance with Section 1076-7.

(6) Type IA and Type IIA Pipe

Type IA and Type IIA pipe will not be permitted.

(7) Aluminized Pipe

Aluminized pipe shall meet all requirements herein except that the pipe and coupling bands shall be fabricated from aluminum coated steel sheet meeting AASHTO M 274.

(8) Marking Requirements

Pipe sections and special attachments for pipe 60 inches or larger diameter pipe shall be alphanumerically match-marked at the plant site before shipping. There may be additional markings as required by the Department's Brand Certification Program.

(B) Prefabricated Corrugated Steel Pipe End Sections

Corrugated steel end sections shall be in accordance with the details shown in the plans and Subarticle 1032-3(A). Repair end sections on which the spelter coating has been bruised or broken either in the shop or in shipping in accordance with AASHTO M 36.

(C) Corrugated Steel Pipe Tees and Elbows

Corrugated steel tees and elbows shall be in accordance with Subarticle 1032-3(A).

(D) Corrugated Steel Eccentric Reducers

Corrugated steel eccentric reducers shall be in accordance with Subarticle 1032-3(A) and the additional requirements shown below.

Construct the eccentric reducer so the invert or flow line from the large pipe through the reducer and into the small pipe is a continuous straight line.

Make the reducer from the same thickness corrugated metals as the large diameter pipe. The reducing section may be riveted or welded.

(E) Acceptance

Acceptance by the Engineer of corrugated steel culvert pipe and its accessories will be based on, but not limited to, visual inspections, classification requirements and check samples taken from material delivered to the project and conformance to the annual Brand Registration.

The reducing section shall reduce in diameter no more than 3 inches in 24 inches of length. Rivet or weld a 24 inches long constant diameter stub to each end of the reducing section to form the complete reducer.

Section 1032

Have the completed reducer show careful, finished workmanship in all particulars. Repair reducers on which the spelter coating has been bruised or broken either in the shop or in shipping in accordance with AASHTO M 36. Reducers that show defective workmanship will be rejected by the Engineer. The following defects are evidence of poor workmanship, and the presence of any of them in any individual reducer will constitute sufficient cause for rejection:

- (1) Not meeting required dimensions,
- (2) Not of the specified shape,
- (3) Uneven laps,
- (4) Ragged or diagonal sheared edges,
- (5) Loose, unevenly lined or spaced rivets,
- (6) Poorly formed rivet heads,
- (7) Lack of rigidity,
- (8) Dents or bends in the metal itself,
- (9) Uneven welds, or
- (10) Gaps in welds.

1032-4 POLYPROPYLENE CULVERT PIPE**(A) General**

Use polypropylene pipe that is NCDOT approved as found on the Departments producer/supplier list and participating in the Department's *Polypropylene Pipe QA/QC Program*. The producer/supplier must be current with the applicable Product Evaluation & Audit Solutions workplan to remain on the NCDOT producer/supplier list. The Department will remove a manufacturer of polypropylene pipe from this program if the monitoring efforts indicated that non-specification material is being provided or test procedures are not being followed.

Use polypropylene culvert pipe that meets AASHTO M 330 for Type S or Type D, or ASTM F2881 or ASTM F2764 Double or Triple wall; and has been evaluated by AASHTO Product Evaluation & Audit Solutions. Bell and spigot joint seals shall meet ASTM F477.

(B) End Treatments, Pipe Tees, Elbows, and Couplers

End treatments, pipe tees and elbows shall meet AASHTO M 330, Section 7.7, ASTM F2881, Section 7.11, or ASTM F2764, Section 6.6. Couplers, where indicated on the plans, shall meet AASHTO M 330, Section 7.7, ASTM F2881, Section 7.11, or ASTM F2764, Section 6.6.

(C) Marking

Clearly mark each section of pipe, end section, tee and elbow and other accessories according to the Department's *Polypropylene Pipe QC/QA Program*:

- (1) AASHTO or ASTM Designation
- (2) The date of manufacture
- (3) Name or trademark of the manufacturer

Clearly apply a Department approved self-adhesive RFID tag/label tagged in accordance with Section 1030 applied in accordance with Subarticle 1030-2(F). When polypropylene pipe, end sections, tees, elbows and couplers have been inspected the Department will update the RFID tag/label item record as found in the Field Inspection Report (FIR) or NCDOT alternate ID.

1032-5 WELDED STEEL PIPE FOR DRAINAGE

Welded steel pipe shall meet ASTM A139 for the grade of pipe called for in the plans.

Section 1032

Acceptance of welded steel culvert pipe and its accessories will be based on, but not limited to, visual inspections, classification requirements and check samples taken from material delivered to the project and conformance to the Department's welded steel pipe program.

1032-6 CONCRETE CULVERT PIPE**(A) General**

Use concrete pipe from sources participating in the Department's *Concrete Pipe QC/QA Program*. A list of participating sources is available on the Department's producer/supplier approved list. The producer/supplier must be current with American Concrete Pipe Association (ACPA) or National Precast Concrete Association (NPCA) audit program to remain on the NCDOT producer/supplier list. The Department will remove a manufacturer of concrete pipe from this program if the monitoring efforts indicated that non-specification material is being provided or testing procedures are not being followed.

(B) Reinforced Concrete Culvert Pipe

Reinforced concrete culvert pipe shall meet AASHTO M 170 for the class of pipe called for in the plans except as follows:

- (1) The permissible wall thickness outside of the joint configuration shall not be more than that shown in the design by more than 5% or 3/16 inch, whichever is greater.
- (2) The maximum weighted average loss for both fine and coarse aggregates shall be 15% when subjected to 5 cycles of the soundness test.
- (3) The maximum percentage of wear for coarse aggregates is 55%.

The design wall thickness shall be either the wall thickness shown in AASHTO M 170 for the applicable class and wall or the wall thickness shown in a modified design that has been approved by the Engineer. A wall thickness greater than permitted by the above tolerance will be cause for rejection of the pipe. The circumferential steel in single cage pipe shall not be more than 3 inches from either end of the pipe section excluding the tongue and groove. On double cage pipe, extend one cage into the tongue or groove. Place the other cage so a circumferential wire shall be not less than 2 inches from the other end of the barrel of the pipe.

(C) Precast Concrete Pipe End Sections

Precast concrete pipe end sections shall meet AASHTO M 170 and Section 1077 except those requirements pertaining to design.

Design concrete pipe end sections in accordance with the plans or with plans prepared by the manufacturer which have been approved by the Engineer. Reinforce all concrete pipe end sections. Use air entrained concrete in pipe end sections with a strength of 3,500 psi when tested in accordance with AASHTO T 22.

(D) Concrete Pipe Tees and Elbows

Concrete pipe tees and elbows shall meet AASHTO M 170 for the class of pipe tee or elbow called for in the plans.

(E) Marking

- (1) Clearly etchmark the following information on the outside of each section of pipe, pipe end section, tee and elbow:
 - (a) Pipe class and type of wall if reinforced,
 - (b) The date of manufacture, and
 - (c) Name or trademark of the manufacturer.

Section 1032

Clearly apply a Department approved self-adhesive RFID tag/label tagged in accordance with Section 1030 applied in accordance with Subarticle 1030-2(F). When concrete pipe and pipe end sections have been inspected the Department will update the RFID tag/label item record as found in the Field Inspection Report (FIR) or NCDOT alternate ID. Failure of as much as 20% of any lot of pipe due to cracks, fractures, variation in alignment or other manufacturing defects will be cause for the rejection of the entire lot. The lots shall be as designated by the manufacturer before inspection. Individual lengths of pipe within the lot which were not specifically rejected but which are considered acceptable by the manufacturer may be removed from the rejected lot and resubmitted for inspection as a separate lot.

(F) Joint Materials

For connections to precast structures using grout, cement shall meet Article 1024-1, sand shall meet Article 1014-1 for fine aggregate or Article 1040-7 for mortar sand. Hydrated lime shall meet Article 1040-6.

Flexible plastic joint material shall meet ASTM C990 for flexible plastic gaskets, except as follows:

(1) The flash point, Cleveland Open Cup (C.O.C.) shall be at least 325°F.

(2) The fire point, C.O.C. shall be at least 350°F.

1032-7 CORRUGATED POLYETHYLENE (HDPE) CULVERT PIPE**(A) General**

Use corrugated polyethylene pipe that is NCDOT approved as found on the Department's producer/supplier list and participating in the Department's *HDPE Pipe QC/QA Program*. The producer/supplier must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT producer/supplier list. A list of participating sources is available from the Materials and Tests Unit. The Department will remove a manufacturer of polyethylene pipe from this program if the monitoring efforts indicated that non-specification material is being provided or test procedures are not being followed.

Use corrugated polyethylene culvert pipe that meets AASHTO M 294 for Type S or Type D and has been evaluated by AASHTO Product Evaluation & Audit Solutions. Bell and spigot joint seals shall meet ASTM F477.

(B) End Treatments, Pipe Tees, Elbows and Couplers

End treatments, pipe tees and elbows shall meet AASHTO M 294, Section 7.8. Couplers, where indicated on the plans, shall meet AASHTO M 294, Section 7.8.

(C) Marking

Clearly mark each section of pipe, end section, tee and elbow and other accessories according to the Department's HDPE Pipe QC/QA Program:

(1) AASHTO Designation

(2) The date of manufacture

(3) Name or trademark of the manufacturer

Clearly apply a self-adhesive Department approved RFID tag/label tagged in accordance with Section 1030 applied in accordance with Subarticle 1030-2(F). After polyethylene pipe, end sections, tees, elbows and couplers have been inspected the Department will update the RFID tag/label item record as found in the Field Inspection Report (FIR) or NCDOT alternate ID.

Section 1034**1 1032-8 PVC PROFILE WALL DRAIN PIPE**

2 PVC pipe shall conform to AASHTO M 304. Bell and spigot joint seals shall meet ASTM
3 F477. The gasket shall be the sole element relied on to maintain a tight joint. Watertight joints
4 shall be watertight in accordance with AASHTO M 304, unless a higher pressure rating is
5 specified in the plans.

Section 1040**SECTION 1040
MASONRY****1040-1 BRICK**

Use clay or shale brick that meets ASTM C62 or ASTM C216 for Grade SW, except as otherwise provided herein.

Use brick of uniform standard commercial size, with straight and parallel edges and square corners that are burned hard and entirely true, free from injurious cracks and flaws, tough, strong and have a clear ring when struck together. The sides, ends and faces of all brick shall be plane surfaces at right angles and parallel to each other.

Brick of the same manufacturer shall not vary more than $\pm 1/16$ inch in thickness, $\pm 1/8$ inch in width and $\pm 1/4$ inch in length.

Concrete brick may be used instead of clay or shale brick when designated in the plans or in the specifications. Concrete brick shall meet ASTM C55 for Grade S-II except that the absorption of brick used in minor drainage structures shall not exceed 10 pcf.

Section 1040

1040-2 CONCRETE BUILDING BLOCK

Use concrete building block from sources that participate in the Department's *Solid Concrete Masonry Brick/Unit QC/QA Program*. A list of these sources in North Carolina and adjoining states is available from the Materials and Tests Unit in Raleigh.

Use concrete building block that meets ASTM C90. Block shall be pink in color and substantially free from chips and cracks.

Use solid concrete block instead of clay brick for minor drainage structures that meet ASTM C139 except that the nominal dimensions shall be 4 inches x 8 inches x 16 inches.

Concrete block for block manholes shall meet ASTM C139.

1040-3 CONCRETE PAVING BLOCK

Use concrete paving block from sources that participate in the Department's Solid Concrete Masonry Brick/Unit QC/QA Program. A list of these sources in North Carolina and adjoining states is available from the Materials and Tests Unit in Raleigh.

Use concrete paving block that meet ASTM C139, except that the nominal dimensions shall be 4 inches x 8 inches x 16 inches. The block shall have a uniform surface color and texture.

1040-4 SEGMENTAL RETAINING WALL UNITS

Use segmental retaining wall (SRW) units from sources that participate in the Department's *Solid Concrete Masonry Segmental Retaining Wall Units QC/QA Program*. A list of these sources in North Carolina and adjoining states is available from the Materials and Tests Unit in Raleigh.

Use freeze-thaw durable SRW units when noted in the contract. Unless required otherwise in the contract, provide SRW units with a vertical straight face and a concrete gray color with no tints, dyes or pigments. Do not begin unit production until sample SRW units of the type, face and color proposed for the project are approved by the Engineer.

Use SRW units that meet ASTM C1372 except for Table 1040-1 requirements.

**TABLE 1040-1
SRW UNIT REQUIREMENTS**

Property	Requirement	Test Method
Compressive Strength for SRW Units	4,000 psi min	ASTM C140
Compressive Strength for Freeze-Thaw Durable SRW Units	5,500 psi min	ASTM C140
Absorption	5% max	ASTM C140
Durability for Freeze-Thaw Durable SRW Units	1% max ^A	ASTM C1262

A. Weight loss for 4 of 5 specimens after 150 cycles in water.

1040-5 CEMENT

Portland cement shall meet Article 1024-1.

Masonry cement shall meet ASTM C91.

1040-6 HYDRATED LIME

Hydrated lime shall meet ASTM C207 for Type N.

1040-7 MORTAR SAND

Mortar sand shall meet Article 1014-1, except it shall meet the gradation requirements for No. 4S sand shown in Table 1005-2.

1040-8 WATER

Water shall meet Article 1024-4.

Section 1042

1040-9 MORTAR

Proportion mortar used in all brick and block masonry by volume as shown below. Do not add any more water than is necessary to make a workable mixture.

Mix No. 1: 1 part Portland cement
1/4 part hydrated lime
3 3/4 parts mortar sand (maximum)

Mix No. 2: 1 part Portland cement
1 part masonry cement
6 parts mortar sand (maximum)

Apply Articles 1040-5, 1040-6, 1040-7 and 1040-8 to all cement, hydrated lime, mortar sand and water.

For the hydrated lime and cement portion of Mix No. 1, the Contractor may substitute Type M or Type S masonry cement that meets ASTM C270 for Type S masonry cement the minimum compressive strength of the test specimens shall be 2,500 psi at 28 days and the test specimens shall be composed of one part Type S masonry cement and 3 parts sand. Furnish a Type 3 certification for the Type M or Type S masonry cement in accordance with Article 106-3.

1040-10 ADMIXTURES

Use admixtures that are on the NCDOT APL.

**SECTION 1042
RIP RAP MATERIALS**

Use field stone or rough unhewn quarry stone for plain rip rap. Use stone that is sound, tough, dense, resistant to the action of air and water and suitable in all other respects for the purpose intended. Where broken concrete from demolished structures or pavement is available, it may be used in place of stone provided that such use meets with the approval of the Engineer. However, the use of broken concrete that contains reinforcing steel will not be permitted.

All stone shall meet the approval of the Engineer. While no specific gradation is required, there shall be equal distribution of the various sizes of the stone within the required size range. The size of an individual stone particle will be determined by measuring its long dimension.

Stone or broken concrete for rip rap shall meet Table 1042-1 for the class and size distribution.

TABLE 1042-1 ACCEPTANCE CRITERIA FOR RIP RAP AND STONE FOR EROSION CONTROL			
Class	Required Stone Sizes, inches		
	Minimum	Midrange	Maximum
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

No more than 5.0% of the material furnished can be less than the minimum size specified nor no more than 10.0% of the material can exceed the maximum size specified.

SECTION 1060
LANDSCAPE DEVELOPMENT MATERIALS

1060-1 GENERAL

Supply certifications for all landscape development materials as required below. If no certification is required, supply the Department with a statement certifying that all materials conform to these specifications and those of the NC Department of Agriculture and Consumer Services (NCDA&CS) or both. All landscape development materials shall comply with all applicable Federal and State domestic plant quarantines.

1060-2 FERTILIZER

The quality of all fertilizer and all operations in connection with the furnishing of this material shall comply with the North Carolina Commercial Fertilizer Law and with the rules and regulations, adopted by the North Carolina Board of Agriculture in accordance with said law, in effect at the time of sampling. All fertilizer will be subject to sampling and testing by the Engineer, or by an authorized representative of the North Carolina Department of Agriculture and Consumer Services, or both.

Dry fertilizer shall be manufactured from cured stock. Care for the fertilizer during handling and storing in such a manner that it will be protected against hardening, caking or loss of plant food values. Pulverize any hardened or caked fertilizer to its original condition before using.

1060-3 LIMESTONE

The quality of all limestone and all operations in connection with the furnishing of this material shall comply with the North Carolina Agricultural Liming Materials and Landplaster Act, and with the rules and regulations, adopted by the North Carolina Board of Agriculture and Consumer Services in accordance with said law, in effect at the time of sampling. All limestone will be subject to sampling and testing by the Engineer, or by an authorized representative of the North Carolina Department of Agriculture, or both.

Section 1060

Limestone shall be agricultural grade ground limestone. Either dolomitic or calcitic limestone may be used.

All limestone shall contain not less than 90% calcium carbonate equivalents. Dolomitic limestone shall contain not less than 10% of magnesium. Grade dolomitic limestone so at least 90% will pass through a U.S. Standard 20 mesh screen and at least 35% will pass through a U.S. Standard 100 mesh screen. Grade calcitic limestone so at least 90% will pass through a U.S. Standard 20 mesh screen and at least 25% will pass through a U.S. Standard 100 mesh screen. Where the current grading requirements of the North Carolina Board of Agriculture are different from the above, the requirements of the Board of Agriculture will apply.

During handling and storing, care for the limestone in such manner that it will be protected against hardening or caking. Pulverize any hardened or caked limestone to its original condition before using.

1060-4 SEED

The quality of all seed and all operations in connection with the furnishing of this material shall comply with the North Carolina Seed Law and with the rules and regulations, adopted by the North Carolina Board of Agriculture and Consumer Services in accordance with said law, in effect at the time of sampling, and with the quality requirements of the specifications. All seed will be subject to sampling by the Engineer, or by an authorized representative of the North Carolina Department of Agriculture and Consumer Services, or both; and will be tested by the North Carolina Department of Agriculture. Supplementary testing for seed germination may be performed by the Engineer.

The quality of all seed will be based on the percentage of pure live seed, which will be computed by multiplying the percentage of purity by the percentage of germination and dividing the result by 100.

Seed shall have been approved by the North Carolina Department of Agriculture and Consumer Services before being sown. No seed will be accepted with a date of test more than 8 months before the date of sowing, excluding the month in which the test was completed. Such testing, however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. The Engineer may retest seed for germination after 5 months of storage; at the beginning of each normal seeding season for the particular kind of seed involved or at any time that the condition of the seed appears to have deteriorated.

When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of application sufficiently to obtain the minimum pure live seed content specified, provided that such an increase in the rate of application does not cause the quantity of noxious weed seed per acre or square yard, as the case may be, to exceed the quantity that would be allowable at the regular rate of application.

Furnish and deliver each of the species or varieties of seed in separate bags. If seed is to be mixed before sowing, perform such mixing in a commercial seed mixing machine, or by an equally thorough means, after sampling and testing have been completed.

During handling and storing, care for the seed in such a manner that it will be protected from damage by heat, moisture, rodents or other causes.

1060-5 MULCH FOR EROSION CONTROL

Mulch for erosion control shall consist of grain straw, or other acceptable material, and be approved by the Engineer before being used. All mulch shall be reasonably free from mature seedbearing stalks, roots or bulblets of Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Crotalaria, Witchweed and an excessive amount of restricted noxious weeds as defined by the North Carolina Board of Agriculture at the time of use of the mulch. Loose and separate straw mulch that is matted or lumpy before being used.

Section 1060

Tacking material shall be one of the following:

(A) Emulsified Asphalt

Asphalt emulsion tack shall conform to the requirements of AASHTO M 140. The emulsified asphalt may be rapid setting, medium setting or slow setting.

(B) Cellulose Hydromulch

Cellulose hydromulch products shall be non-toxic, weed-free, prepackaged cellulose fiber (pulp) material containing no more than 3% ash or other inert materials. Cellulose hydromulches may contain dyes or binders specifically formulated to enhance the adhesive qualities of the hydromulch.

Wood fiber or wood fiber blend hydromulches may be substituted for cellulose hydromulch at the same application rate.

(C) Other Tackifiers

Other approved materials, specifically designed and manufactured for application as a straw mulch tacking agent, may be used at the manufacturer's recommended rate.

1060-6 SPRIGS

Sprigs shall consist of freshly dug live stolons or rhizomes of perennial grasses, at least 2 inches in length, and be first class representatives of the required species or varieties specified in the specifications. The areas from which sprigs are to be obtained shall be free from Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Crotalaria, Witchweed and an excessive amount of restricted noxious weeds as defined by the North Carolina Board of Agriculture at the time of digging the sprigs. The areas shall have been mowed and raked, burned off, or otherwise prepared in a manner acceptable to the engineer before digging of sprigs begins.

1060-7 SOD

Sod shall consist of a live, dense, well-rooted growth of permanent grasses, free from Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Crotalaria, Witchweed and an excessive amount of restricted noxious weeds as defined by the North Carolina Board of Agriculture and Consumer Services at the time of cutting the sod. Mow the area from which sod is to be obtained to a height of not more than 2 inches. Rake free of grass clippings and debris and otherwise prepared in a manner satisfactory to the Engineer before cutting of sod begins.

Cut the sod into rectangular sections of sizes convenient for handling without breaking or loss of soil. Cut it with a sod cutter or other acceptable means to a depth that will retain in the sod practically all of the dense root system of the grass.

During wet weather, allow the sod to dry sufficiently before lifting to prevent tearing during handling and placing. During extremely dry weather, water it before lifting if such watering is necessary to ensure its vitality and to prevent loss of soil during handling.

1060-8 MATTING FOR EROSION CONTROL**(A) General**

Matting for erosion control shall be excelsior matting or straw matting. Furnish a Type 3 material certification in accordance with Article 106-3 certifying that the matting meets this article. Other acceptable material manufactured especially for erosion control may be used when approved by the Engineer in writing before being used. Matting for erosion control shall not be dyed, bleached or otherwise treated in a manner that will result in toxicity to vegetation.

(B) Excelsior Matting

Excelsior matting shall consist of a machine produced mat of curled wood excelsior at least 47 inches in width and weigh 0.975 lb/sy with a tolerance of $\pm 10\%$. At least 80% of the

Section 1060

individual excelsior fibers shall be 6 inches or more in length. Evenly distribute the excelsior fibers over the entire area of the blanket. Cover one side of the excelsior matting with an extruded plastic mesh. The mesh size for the plastic mesh shall be no more than 1 inch x 1 inch.

(C) Straw Matting

Straw matting shall consist of a machine produced mat of 100% grain straw. The straw matting shall have a width of at least 48 inches and no more than 90 inches and weighing at least 0.50 lb/sy and no more than 0.75 lb/sy. Evenly distribute the straw over the entire area of the blanket. Cover one side of the blanket with photodegradable netting with a maximum mesh (netting) size of 0.75 inch x 0.75 inch sewn together with a degradable thread. The grain straw shall contain no weed seeds. Package each roll separately.

(D) Wire Staples

Staples shall be machine made of No. 11 gauge new steel wire formed into a U-shape. The size when formed shall be not less than 6 inches in length with a throat of not less than 1 inch in width.

1060-9 WATER

Water used in the planting or care of vegetation shall meet Class C freshwaters as defined in 15A NCAC 02B.0200.

1060-10 NURSERY GROWN PLANT MATERIALS

(A) General

Use all plants as called for by the contract.

Container grown plants may be used instead of balled and burlapped plants or bare rooted plants provided written approval for such use has been obtained from Engineer.

Grading of plants, size of root balls and type and minimum dimensions of containers shall conform to the *American Standard for Nursery Stock*. Do not cut back plants from larger sizes to meet the sizes called for in the contract.

Botanical names referred to in the contract are taken from *Hortus Third, the Bailey Hortorium* (MacMillan Publishing Co., Inc.). All plants delivered shall be true to name. Each plant, or group of the same species, variety and size of plant, shall be legibly tagged with the name and size of the plant.

All plants shall be first-class representatives of their species or varieties. The root system shall be vigorous and well developed. The branch systems shall be of normal development and free from disfiguring knots, sun scald injuries, abrasions of the bark, dead or dry wood, broken terminal growth or other objectionable disfigurements. Trees shall have reasonably straight stems and be well branched and symmetrical in accordance with their natural habits of growth.

All plants shall be free from plant diseases and insect pests. All shipments of plants shall comply with all nursery inspection and plant quarantine regulations of the states of origin and destination, as well as with Federal regulations governing interstate movement of nursery stock. Any nursery stock used on highway landscape projects shall be accompanied by a valid copy of a certificate of inspection, which has been granted by the North Carolina Department of Agriculture and Consumer Services, Entomology Division. Fire ant treatment certification, where applicable, is required.

Section 1060

When nursery stock from other states is used on projects in North Carolina, this stock shall be accompanied by a tag or certificate stating that the nursery stock has been inspected and certified by an authorized official of the state of origin as apparently free from injurious plant pests.

All plant materials are subject to inspection at any time by the Engineer. Any such inspection before or during planting operations, however, will not be construed as final acceptance of the plants involved.

All geophytes; bulbs, corms and tuberous plants; shall be synonymous to the term “plant” within the contract. Examples include, but are not limited to, Narcissi (Daffodil), Tulipa (Tulip), Iris and Canna; the terms “bulb”, “corm”, “tuber”; and specific plant names such as “Daffodil”, “Tulip”, “Canna lily”, etc.

(B) Balled and Burlapped Plants

Dig plants to be balled and burlapped so as to retain a firm ball of soil and the plant’s fibrous root system. The soil in the ball shall be the original and undisturbed soil in which the plant has been grown. Dig, wrap, transport and handle the plant so the soil in the ball shall not become frozen, loosened, cause stripping of the small feeding roots nor movements of the soil away from contact with such roots.

(C) Container Grown Plants

Container grown plants shall be healthy, vigorous, well-rooted and established in the container in which they are delivered. These plants shall be in the container long enough for the fibrous roots to have developed so the root mass will retain its shape and hold together when removed from the container. The container shall be sufficiently rigid to firmly hold the soil protecting the root mass during transporting, handling and planting. The soil shall not be allowed to become frozen.

(D) Bare Root Plants

Bare root plants shall have a heavy fibrous root system that has been developed by proper cultural treatment. Dig, package, transport and handle bare root plants in a manner that will prevent injury to or drying out of the trunks, branches or roots, or freezing of the roots. Bare root plants damaged through improper handling, freezing, drying out, etc. will result in rejection of material.

(E) Plant Substitution

No change in the specifications (species, variety, size, caliper, furnish) will be made without written approval of the Engineer. Present all requests for substitutions in writing and include a listing of the sources contacted in an attempt to secure specified plant material. Requests for substitutions shall include the botanical name, common name, cultivar, where applicable, size, caliper and furnish description of the proposed substitute. No increase in compensation will be made to the Contractor as a result of the use of approved substitute plants. The Department reserves the right to locate specified plant material for the project when it has knowledge that specified material is available.

(F) Geophytes

Geophytes; bulbs, corms and tuberous plants; shall be healthy and free of disease caused by fungi, nematodes, bacteria and wilt. Plants that are lightweight and lacking adequate mass will result in rejection. Plants shall be firm and absent of discolored patches with soft or spongy areas or signs of rot, slime or mold. Plants with new root growth will result in rejection.

Dig, package, transport and handle these plants as to prevent injury, drying out, excessive wetness or freezing. Damaged plants through improper handling, freezing, drying out or excessive moisture will result in rejection.

Section 1060

All geophytes, bulbs, corms and tuberous plants shall be inspected for size and condition and plants rejected by the Engineer shall be removed from the supply before planting.

1060-11 MULCH FOR PLANTING

Use mulch for planting as specified in the specifications, shown in the plans, or approved by the Engineer. Mulch for planting shall not contain substances injurious to plants or which will inhibit normal development and growth of plants. Mulch for a project shall come from a single source, as approved by the Engineer, unless an additional source is submitted and approved before use.

1060-12 MATERIALS FOR STAKING OR GUYING**(A) Stakes**

Use stakes made of cypress, cedar, oak, locust or other acceptable wood free from defects that would compromise the strength of the stake. Stakes shall be at least 2 inches x 2 inches (nominal). Use stakes of the size and length as shown in the plans.

(B) Wire

Wire shall be new soft No. 14 gauge steel wire or as shown in the plans.

(C) Hose

Hose to be used with wire shall have a minimum inside diameter of 1/2 inch. All hose shall be garden type hose composed of rubber and fabric, or as shown in the plans.

(D) Other

Other staking and guying materials may be used if a sample is submitted and approved by the Engineer before use.

1060-13 HERBICIDES

The herbicide to be used for a particular application shall be as specified or approved by the Engineer prior to their application.

Herbicides shall be properly labeled and registered with the United States Department of Agriculture and the North Carolina Department of Agriculture and Consumer Services. A container shall contain only the herbicide that meets the analysis guaranteed on the label. Keep all herbicides in such original labeled containers until used.

Herbicide application shall only be conducted by individuals who possess a pesticide license from the NC Department of Agriculture and Consumer Services or individuals under their direction and who has read, understands, and follows the herbicide labeling before applying the product.

1060-14 COIR FIBER MAT

Coir fiber mat shall consist of 100% coconut fiber (coir) twine woven into high strength matrix. The coir fiber mat shall have a thickness of at least 0.30 inch and weigh at least 20 ounces per square yard. The coir fiber mat shall have a dry tensile strength of at least 1,348 x 626 lbs/ft. The coir fiber mat shall have an observed flow velocity of 11 feet per second. The coir fiber mat shall have a C-Factor of 0.002. The minimum width of the coir fiber mat shall be 6.5 feet and the measured open area shall be 50%.

1060-15 COMPOST

Test methods for the compost should follow USCC TMECC guidelines for laboratory procedures. A sample shall be submitted to the Engineer for approval prior to being used and must comply with all local, state and federal regulations.

Section 1070**(A) Chemical Requirements**

pH between 5.0-8.0 in accordance with TMECC 04.11-A, "Electrometric pH Determinations for Compost".

(B) Physical Requirements

- (1) Weed free.
- (2) Derived from a well-decomposed source of organic matter.
- (3) Produced using an aerobic composting process meeting CFR 503 regulations including time and temperature data indicating effective weed seed, pathogen and insect larvae kill.
- (4) Free of any refuse, contaminants or other materials toxic to plant growth.
- (5) Non-composted products will not be accepted by the Engineer.
- (6) For seeded Compost Blankets, seed should be incorporated at the time of application in the entire depth of the compost blanket, at rates per foot, per square yard, or per acre, as acceptable to the Engineer. The following particle sizes shall also be followed: 100% passing a 2 inch sieve; 99% passing a 1 inch sieve; minimum of 60% passing a 1/2 inch sieve. All other testing parameters remain the same. The seeding rates are generally similar or slightly higher than those used when considering application of seed via hydroseeding or other seeding methods.
- (7) Moisture content of less than 60% in accordance with standardized test methods for moisture determination.
- (8) Material shall be relatively free (<1% by dry weight) of inert or foreign man-made materials.

SECTION 1070 REINFORCING STEEL

1070-1 GENERAL

All reinforcing steel and welded wire reinforcement must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan. Standard drawing details for reinforcement products are found in the *Roadway Standard Drawings*.

Steel reinforcement shall be stored above the surface of the ground on platforms, skids, or other supports and shall be protected from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, loose rust or scale, mortar, paint, grease, oil, or other nonmetallic coatings which could reduce bond as determined by the Engineer. Reinforcing steel placement and fastening shall conform to the requirements of AASHTO LRFD Bridge Construction Specifications, Section 9 and these specifications of which the more stringent shall apply.

When approved by the Engineer, field welding of reinforcing steel materials shall be performed in accordance with Section 1072 and at a minimum, comply with the current edition of AWS D1.4.

1070-2 STEEL BAR REINFORCEMENT FOR ROADS AND STRUCTURES

Use reinforcing steel provided by a NCDOT approved facility as found on the Department's producer/supplier list. All producer/suppliers must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT producer/supplier list. Supply deformed steel bar reinforcement conforming to ASTM A615 for Grade 60. For uncoated deformed and/or plain reinforcing, furnish the Engineer a Type 1 certification in accordance with Article 106-3 and attach it to *Materials and Tests Form 913* for each shipment of reinforcing material. Bend and cut during fabrication with tolerances in accordance with the AASHTO LRFD Bridge Construction Specifications, Section 9. Bend the bars cold to the details shown in the plans.

Section 1070

Weld steel bar reinforcement only where shown in the plans or approved by the Engineer. When welding steel bar reinforcement use bars conforming to ASTM A706.

1070-3 COLD DRAWN STEEL WIRE AND WIRE REINFORCEMENT

Provide cold drawn steel wire for use as spirals or in fabricated form for the reinforcement of concrete meeting AASHTO M 336. When required by the plans, apply epoxy coating by a NCDOT approved facility.

Use steel welded wire reinforcement, plain or deformed, conforming to AASHTO M 336.

1070-4 REINFORCING STEEL BAR SUPPORTS

Provide all wire bar supports of smooth cold drawn industrial quality basic wire having a minimum tensile strength of 65,000 psi. When the legs of the bar supports are in contact with the forms, ensure that the entire leg of the bar support is stainless steel wire or a minimum thickness of 1/4 inch stainless steel at points of contact with the forms. Use stainless steel wire meeting ASTM A493 except having a minimum chromium content of 16% and a minimum tensile strength of 95,000 psi. Ensure that wire sizes, height tolerance, and leg spacing for wire bar supports are in accordance with the *Manual of Standard Practice* published by the Concrete Reinforcing Steel Institute.

As an option to the stainless steel wire for the legs of bar supports at points of contact with the forms, provide legs of cold drawn steel wire plastic protected in accordance with the *Manual of Standard Practice* published by the Concrete Reinforcing Steel Institute, except provide plastic protection by dipping or by premolded plastic tips in accordance with ANSI/CRSI-RB4. Do not use plastic legs molded to the top wire.

Use plastic bar supports meeting the requirements listed in ANSI/CRSI-RB4 published by the Concrete Reinforcing Steel Institute only when approved by the Engineer.

1070-5 PRESTRESSING STRAND

Use prestressing strands for use in prestressed concrete consisting of seven wire strands, stress relieved after manufacture to remove internal stresses. Use the size and the grade of the strand as shown in the plans. Use strands conforming to AASHTO M 203 except provide a specimen for test purposes, if required, from each reel of cable instead of each 20 ton production lot.

For precast prestressed deck panels, use 3/8 inch round seven-wire stress-relieved Grades 250 or 270 prestressing strands meeting AASHTO M 203.

Mark the outer layer of each reel pack of strand with a wide color band as follows: white for Grade 270 stress relieved strand, green for low relaxation strand, and a double marking of green and red for special low relaxation strand. In addition, attach a metal tag to each reel pack labeled in accordance with AASHTO M 203.

1070-6 DOWELS AND TIE BARS FOR PORTLAND CEMENT CONCRETE PAVEMENT

Use dowel and tie bars from the Department's approved producer/supplier list. Use smooth plain round steel dowel bars conforming to AASHTO M 31 Grade 60 conforming to the *Roadway Standard Drawings*. Do not use dowel bars with burred ends. A tolerance of $\pm 1/4$ inch is permitted from the dowel length required by the plans. A straightness tolerance of 0.075 inch from a straight line is permitted.

Epoxy coat and fabricate all dowel bars/baskets by a NCDOT approved facility as found on the Department's producer/supplier list.

Use dowel assemblies for supporting dowel bars of rigid construction capable of holding the dowel bars in proper position during placing of concrete, and of such design to permit unrestricted movement of the pavement slab. Use wire for dowel assemblies meeting AASHTO M 336. Use a dowel assembly that holds the dowels in the required position within a tolerance

Section 1070

of $\pm 1/4$ inch in vertical and horizontal planes. Obtain written approval from the Engineer for the dowel assembly before use.

Coat dowel bars and the entire dowel assembly with an approved wax base coating. Apply the coating by dipping or spraying such that the wax coating on the dowel bars is of uniform thickness sufficient to allow pulling of the dowel from the concrete as provided in AASHTO T 253 Type B coated dowel.

When required by the Department's Minimum Sampling Guide, furnish for testing one dowel basket assembly for each 200 assemblies incorporated into the project. Each Department approved producer/supplier, coater and fabricator shall provide the Department a Type 1 material certification in accordance with Article 106-3, M&T DB-06 Dowel Basket Fabrication Report and when required by the Engineer the *Materials and Tests Form 913* for all coated dowel baskets and loose dowels with each shipment.

Use deformed tie bars conforming to AASHTO M 31 for Grade 40 or Grade 60.

Storage, handling and transportation of epoxy coated dowel and/or tie bars shall be in accordance with Section 1070-7(D).

1070-7 EPOXY COATED REINFORCING STEEL**(A) General**

Use reinforcing steel from the Department's approved producer/supplier list. All producer/suppliers must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT producer/supplier list. Facilities coating and fabricating epoxy coated reinforcing steel shall establish proof of their competency and responsibility in accordance with the Concrete Reinforcing Steel Institute's Fusion Bonded Epoxy Coating Applicator Plant Certification Program. Registration and certification of the plant or shop under the CRSI Program and submission of the valid annual certificate to the State Materials Engineer is required before beginning any coating. The same requirement applies to coaters subcontracting work from the coater directly employed by the contractor.

Obtain approval of each coater and/or fabricator of epoxy coated reinforcing steel before coating or fabrication of bars. The coating applicator and/or fabricator is responsible for establishing and maintaining an effective quality control program, and employ equipment for cleaning, coating and/or fabricating that produces coated material conforming to the *Standard Specifications*.

Include in requests for approval a well-defined quality control program and direct the requests to the State Materials Engineer. Before Department approval is issued, the condition of equipment for blast cleaning, coating and/or fabricating material is evaluated by the Engineer for determining the equipment capability of producing a coated product conforming to the *Standard Specifications*. Use Department approved epoxy coating and fabricating companies as found on the Department's approved producer/supplier list.

(B) Coating Materials

Obtain approval for the epoxy resin powder before use. A list of prequalified powder sources is available from the State Materials Engineer.

(C) Coated Reinforcing Steel

Use coated steel reinforcing bars meeting AASHTO M 31, Grade 60 and free of contaminants such as oil, grease and paint. Use bars free of surface irregularities as defined in ASTM A775 and/or that produce holidays in the coating.

(D) Handling, Storage and Transportation

When handling, storing and transporting coated steel reinforcing bars, all contact areas shall be padded.

Section 1070

All bundling bands shall be padded or suitable banding shall be used to prevent damage to the coating. All bundles of coated steel reinforcing bars shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge to prevent bar-to-bar abrasion from sags in the bundles of coated steel reinforcing bars. Packaging of uncoated and coated bars is strictly prohibited. When loading/unloading coated bars; pallets, bags or bundles shall not be dropped or dragged.

During storage, protect steel reinforcement at all times from damage and make sure it is free from dirt, dust, loose mill scale, loose rust, paint, oil or other foreign materials until the time of placement. For storage outside at the fabrication shop and project site, store epoxy coated reinforcing steel bars at least 1 foot above the ground on wooden or padded supports placed 10 feet apart, and completely cover with an opaque cloth, canvas or woven fiber reinforced polyethylene white tarp. Storage of uncoated and coated material shall not be mixed or in direct contact. Do not use solid plastic sheeting. Cover the bars such that adequate ventilation is provided to prevent condensation from forming on the material during storage, and completely protect the bars from direct sunlight. Do not allow water to pond under the epoxy coated reinforcing steel. Do not expose epoxy coated reinforcing steel to outdoor weather for more than 30 days. If the coated steel reinforcing bars are stored outdoors without cover, the date on which the coated bars are placed outdoors shall be recorded on the identification tag for the bundled steel.

Transport the bundled bars from the producer/supplier to the project site with padding, such as carpet padding, placed over each bundle of steel upon which another bundle of steel is placed unless wooden spacers are placed between each bundle to prevent contact. Load all bundles of bars horizontally for transporting. Transport the bars on a flatbed trailer. Do not allow the length of bars to exceed 8 feet beyond the trailer bed. Repair coating damage associated with handling and transporting or other causes in accordance to Subarticle 1070-7(E). Coated steel reinforcing bars should be off-loaded as close as possible to their points of placement or under the crane so that the bars can be hoisted to the area of placement to minimize re-handling. If the material is being transported in adverse weather conditions the producer/supplier, coater, fabricator and/or Contractor shall co-coordinate a material protection plan, test for the presence of chlorides, and, if necessary, clean the material as directed by the Engineer.

(E) Field Coating Repair

The maximum amount of repaired damaged coating shall not exceed 1% of the total surface area in each 0.3 m [1 foot] of the bar. This limit on repaired damaged coating shall not include sheared or cut ends that are coated with patching material. When degraded coating is observed additional inspection or non-destructive testing may be required by the Engineer at no additional cost to the Department.

Ensure the Contractor uses a Department approved patching or repair material that is compatible with the coating and inert in concrete. When repair is required, clean the areas in accordance to SSPC-SP 1 prior to performing additional surface preparation. Surface preparation shall be in accordance with SSPC-SP 11 (Power Tool Cleaning to Bare Metal) and/or in accordance with the manufacturers recommendations. The more stringent of the two shall apply. Ensure that the material is suitable for making repairs with a minimum dry film thickness of 7 mils. Ensure that the Contractor has a copy of the manufacturer's written instructions for application of the patching material and the instructions are closely followed during any coating damage repair. Do not apply any patch material when the surface temperature of the steel or the air temperature is below 40°F. Do not ship or place steel until the patch material is dry to the touch.

1070-8 SPIRAL COLUMN REINFORCING STEEL

Furnish spiral column reinforcing steel with the following areas and weights as required in Table 1070-1 and in the plans.

Section 1070

TABLE 1070-1 SPIRAL COLUMN REINFORCEMENT STEEL PROPERTIES			
Material	Size	Area, sq.in.	Weight, lb/ft
Plain Cold Drawn Wire	W 20	0.20	0.668
	W 31	0.31	1.043
Deformed Cold Drawn Wire	D-20	0.20	0.680
	D-31	0.31	1.054
Plain or Deformed Bar	#4	0.20	0.668
	#5	0.31	1.043

Use cold drawn wire conforming to AASHTO M 336. Use plain or deformed bars conforming to AASHTO M 31 for Grade 60. Use deformed cold drawn wire conforming to AASHTO M 225.

The diameter of the spiral reinforcing steel is the outside to outside measurement of the bars or wire, with an allowance of 1/2 inch more or 1/2 inch less than the specified diameter as shown in the plans.

Furnish spirals with 1.5 extra turns at top and at bottom of the completed spiral cage. Where splicing of the spirals is necessary other than those shown in the plans, provide a minimum lap splice of 3 feet.

Do not weld on the spiral reinforcing steel.

When required by the plans, use epoxy coated spiral column reinforcing steel and spacers provided by a NCDOT approved supplier available on the Department's approved producer/supplier list.

Use the minimum number of spiral spacers as shown in the plans. Ensure a minimum section modulus per spiral spacer of 0.030 cu. in.

1070-9 MECHANICAL BUTT SPLICES

When called for by the contract or when approved by the Engineer, use a mechanical butt reinforcing steel splice from an approved source that is found on the Department's producer/supplier list. Use a standard metal filled sleeve, cement mortar filled sleeve, threaded steel couplings, forged steel sleeve or cold-forged sleeve. An exothermic process whereby molten filler metal, contained by a high strength steel sleeve of larger inside diameter than the bars, is introduced into the annular space between the bars and the sleeve and between the ends of the bars may be used. Provide a splice that is capable of transferring at least 125% of the yield strength of the bars from one bar to the other by the mechanical strength of the splice components.

For splices not on the approved list, before use and as a condition of approval, assemble three test splices in the presence of the Engineer for each size of bar which is proposed for use on the project. Forward the test splices to the Materials and Tests Unit in Raleigh, NC for testing and approval.

1070-10 REJECTION

Reinforcing material that does not meet the *Standard Specifications* is rejected by the Engineer. When required by the Engineer, replace reinforcing material that is bent, deformed, exhibits cracked material or welds, contaminated and when the maximum amount of coating damage exceeds the limits herein or degraded coating is observed and as determined by the Engineer.

SECTION 1074**MISCELLANEOUS METALS AND HARDWARE****1074-1 WELDING**

Any facility performing welding operations shall be approved by NCDOT Materials and Tests Unit. Weld other steel items not covered under the Bridge Welding Code in accordance with the applicable AWS Welding Code. Some examples may include but not limited to; Structural Welding Code-Steel (AWS D1.1), Structural Welding Code-Aluminum (AWS D1.2), Structural Welding Code-Sheet Steel (AWS D1.3), Structural Welding Code- Steel Reinforcing Bars (AWS D1.4) and Structural Welding Code-Stainless Steel (AWS D1.6). Certify all welders performing any welding on any metals in accordance with the applicable AWS welding code in the position and process required as approved by the Engineer.

1074-2 EXPANSION ANCHORS

Unless otherwise shown in the plans, provide expansion anchors consisting of two or more units with a minimum of two hard metal conical ring wedges and two expandable lead sleeves of an equally effective design that is approved by the Engineer. Use anchors providing a minimum safe holding power of 3,000 lbs. for 3/4 inch bolts and 2,000 lbs. for 5/8 inch bolts, based upon

Section 1074

1 1/4 of the actual holding power of the anchor in 3,000 psi concrete. Furnish satisfactory
 2 evidence, based upon actual tests performed by a commercial testing laboratory, which indicate
 3 that the anchors develop the minimum required safe holding power.

4 When it is proposed to use anchors that are previously accepted as meeting the above
 5 requirements, the anchors are accepted on the basis of a certified statement indicating the prior
 6 acceptance of the furnished anchors.

1074-3 PLAIN STEEL BARS WITH THREADED ENDS

7 Provide plain steel bars with threaded ends meeting ASTM A307, Grade A.

1074-4 HARDWARE FOR TIMBER STRUCTURES

8 Use machine bolts, drift-bolts and dowels that are either wrought iron or medium steel. Use
 9 washers that are cast iron ogee, malleable iron castings or cut from medium steel or wrought
 10 iron plate.

11 Use machine bolts with square heads and nuts. Use nails that are cut or round wire of standard
 12 form. Use spikes that are cut, wire spikes or boat spikes.

13 Use black or galvanized nails, spikes, bolts, dowels, washers and lag screws for untreated
 14 timber.

15 Galvanize or cadmium plate all hardware for treated timber bridges, except malleable iron
 16 connectors.

1074-5 METAL BRIDGE RAILING**(A) General**

17 As an option, use either aluminum or galvanized steel metal rail, provided that the same
 18 material is used on all structures on the project.

19 Certified Mill Test Reports are required for rails and posts.

20 Place a permanent identifying mark that identifies the fabricator on each post. Use
 21 a method and location of the identifying mark such that it does not detract from the
 22 appearance of the post.

23 Where it is necessary for rails to be curved, form the curvature in the shop or in the field.
 24 Uniformly curve the rail without buckling or kinking. Perform all welding in accordance
 25 with AWS D1.1 for steel railing and AWS D1.2 for aluminum railing.

26 Provide an anchor unit of sufficient strength to ensure load anchoring capacity as specified
 27 for rail loading in the *AASHTO LRFD Bridge Design Specifications*.

(B) Aluminum Rail

28 Supply material for posts, post bases, rails, expansion bars and clamp bars meeting ASTM
 29 B221 for Alloy 6061 T6, materials will be mill finished.

30 Use material for rivets meeting ASTM B316 for Alloy 6061 T6. Use rivets that are
 31 standard button head and cone point cold driven.

32 Use material for nuts meeting ASTM B211 for Alloy 6061 T6.

33 Provide material for washers meeting ASTM B209 for Alloy Alclad 2024 T3.

34 Supply material for shims meeting ASTM B209 for Alloy 6061 T6.

35 Ensure that the handrails meet the dimensional tolerance requirements of ANSI H35.2.

(C) Galvanized Steel Rail

36 Use posts, post bases, rails, expansion bars and clamp bars meeting ASTM A36 and
 37 galvanize in accordance with ASTM A123. Grind the cut ends of rail smooth and give

Section 1074

them 2 coats of organic zinc repair paint. Galvanize the posts and post bases after they are riveted together.

Use rivets meeting ASTM A502 for Grade 1 rivets.

Use bolts meeting ASTM F593 Alloy 304.

Use nuts meeting ASTM F594 Alloy 304.

Use washers meeting ASTM F844 except made from Alloy 304 stainless steel.

Use materials for shims meeting ASTM A1011 for Grades 36, 40 or 45, or ASTM A1008 for Grade C, and galvanized in accordance with ASTM A123.

1074-6 STEEL PIPE

Steel pipe bent or welded in fabricating shall meet ASTM A53 for standard weight pipe. Use galvanized pipe unless otherwise shown in the plans.

1074-7 IRON CASTINGS**(A) General**

Comply with the Department's Iron Casting QA/QC program. Producers and suppliers furnishing iron castings for Department projects shall comply with this program. The program details are available on the Materials and Tests website.

Boldly fillet castings at angles, and provide arises that are sharp and precise. No sharp, unfilleted angles or corners are permitted. Provide castings that are true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects affecting their strength and value for the service intended. Sand blast or otherwise effectively clean of scale and sand all castings to present a smooth, clean, and uniform surface. Welding is not allowed for the purpose of making a casting structurally sound. Welding for cosmetic or other purposes is not allowed without approval of the Engineer.

(B) Gray Iron Castings

Supply gray iron castings meeting all facets of AASHTO M 306 excluding proof load. Proof load testing will only be required for new casting designs during the design process, and conformance to AASHTO M 306 loading (40,000 lbs.) will be required only when noted on the design documents. Acceptance of production castings will be based on test bars. Cast test bars, of size "B", attached to an integral with the castings. Instead of this, cast test bars separate from the castings when approved in writing by the Engineer. The Engineer reserves the right to require that a test bar be machined from an actual casting if deemed necessary. Unless otherwise specified, do not coat gray iron castings. Do not perform any welding on castings for any reason without prior approval from the Engineer. Mark castings with the NCDOT Standard Number of the casting design, the fabricator's ID and the day, month and year of production.

1074-8 STEPS

Fabricate steps for minor drainage structures from deformed reinforcing bars, use gray iron castings meeting Subarticle 1074-7(B) or use composite plastic-steel construction as shown in the plans.

The use of steps differing in dimension, configuration or materials from those shown in the plans is allowed by furnishing the Engineer with details of the proposed steps and obtaining written approval for the use of such steps.

1074-9 FABRICATED STEEL GRATES

Use fabricated steel grates made from bars that meet ASTM A36. Galvanize the grates after fabrication in accordance with AASHTO M 111. Mark items with fabricators ID, month and year of production.

Section 1076**1074-10 PINS**

Supply pins for bearing assemblies meeting either ASTM A36 or ASTM A108 for Grades 1016 through 1030, unless otherwise required by the plans or specifications.

1074-11 WASHERS

Provide washers for use with fasteners meeting ASTM F436. Provide washers for high strength bolts meeting Article 1072-5.

Ensure that the size and finish (plain, weathering or galvanized) of washers is compatible with the fastener.

1074-12 METAL STAY-IN-PLACE FORMS

Provide metal stay-in-place forms for concrete floor slabs of zinc-coated (galvanized) steel sheet conforming to ASTM A653, Structural Steel (SS) Grades 33 through 80 and Coating Class G165 meeting all requirements relevant to steel stay-in-place forms as noted on the contract plans. Do not use material thinner than 20 gauge.

1074-13 STEEL GRID FLOORING

Steel grid flooring shall conform to the requirements of *AASHTO LRFD Bridge Construction Specifications*, Section 12 and these *Standard Specifications*.

SECTION 1077
PRECAST CONCRETE UNITS

1077-1 GENERAL

Use precast concrete units that is NCDOT approved as found on the Department's approved producer/supplier list. The Department will remove a manufacturer of precast concrete units from this producer/supplier list if the monitoring efforts indicated that non-specification material is being provided or test procedures are not being followed.

This section covers the materials for and the production of precast reinforced concrete units produced in accordance with the contract. Where precast reinforced concrete circular manhole sections are used, they shall meet AASHTO M 199.

(A) Producer Qualification

Producers of precast concrete members are required to establish proof of their competency and responsibility in accordance with the National Precast Concrete Association (NPCA) or American Concrete Pipe Association (ACPA) Certification Programs to perform work for the NCDOT. Certification of the manufacturing plant under either NPCA or ACPA program and submission of proof of certification to the State Materials Engineer is required before beginning fabrication. Maintain certification at all times while work is being performed for the Department. Submit proof of certification following each NCPA or

Section 1077

ACPA audit to the State Materials Engineer for continued qualification. These same requirements apply to producers subcontracting work from the producer directly employed by the Contractor. All producers shall be listed as an approved producer/supplier before beginning any work for the Department.

1077-2 PLAN REQUIREMENTS

The plans for precast units will be furnished by the Department in the *Roadway Standard Drawings* or details shown in the project plans.

When the Department does not make precast plans available and the Contractor chooses to precast, submit drawings to the Engineer for the items proposed to precast. Submit one complete set of drawings for review, at least 40 calendar days before beginning production. After acceptance, submit a complete set of drawings. Acceptance by the Engineer of contractor drawings will not be considered as relieving the Contractor of any responsibility for precast units. When precast units are load bearing and require structure design, have the plans prepared and certified by an engineer licensed by the State of North Carolina. Contractor furnished drawings shall show complete design, installation and construction information in such detail as to enable the Engineer to determine the adequacy of the proposed units for the intended use. Contractor drawings shall include details of steel reinforcement size, weight and placement and a schedule that lists the size and type of precast units at each location where the precast units are to be used. Produce precast units in accordance with the approved drawings.

1077-3 MATERIALS

Refer to Division 10.

Item	Section
Air Entraining Agent	1024-3
Chemical Admixtures	1024-3
Coarse Aggregate	1014-2
Curing Materials	1026
Fine Aggregate	1014-1
Fly Ash	1024-5
Ground Granulated Blast Furnace Slag	1024-6
Miscellaneous Metals	1074
Portland Cement	1024-1
Reinforcing Steel	1070
Silica Fume	1024-7
Blended Cement	1024-1
Water	1024-4

1077-4 INSPECTION

The Department reserves the right to place a duly authorized inspector in the plant at any time work related to the production of units for the Department is being performed. Notify the Engineer at least 15 business days in advance when such work is scheduled to begin.

Provide an office area for the inspector of at least 50 sf with desk, chair, telephone, facilities for proper heating and cooling, adequate lightning, electrical outlets and internet access.

Acceptance of precast units will be on the basis of tests of materials, compression tests on concrete cylinders and inspection of the finished units, including amount and placement of steel reinforcement, to determine their conformance with the approved dimensions and design and their freedom from defect. The inspector will have the authority to reject any or all units not manufactured in accordance with these specifications. Any unit found to be defective in any manner at any time will be rejected and replaced by an acceptable unit or repaired in a manner approved by the Engineer.

Section 1077

(A) Storage

Store all Department units in a separate area on the yard. Store all units on a solid, unyielding foundation free of standing water or in a manner directed by the Engineer. Do not stack units before inspection. Provide access to all surfaces of units so the plant inspector has the opportunity to properly inspect the units before approval. The provided access should allow room for inspection personnel to safely and freely move between and around units. Do not stack above 6 feet off the ground.

(B) Transporting

Do not transport units away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days elapses after casting, unless otherwise permitted by the Engineer.

Do not transport any unit from the plant to the job site before the approval of that unit by the plant inspector. Such approval will be indicated by the compliance with the Department's RFID tag/label tagging policy in accordance with Section 1030 and verified product approval as noted by an authorized Field Inspection Report (FIR) or NCDOT alternate ID.

1077-5 PORTLAND CEMENT CONCRETE**(A) Composition and Design**

Portland cement concrete is composed of Portland cement, coarse aggregate (#67 or 78M), fine aggregate, water and unless otherwise permitted by the Engineer, an air entraining agent. If other cementitious materials and/or chemical admixtures are used, use these materials in the proper proportions to obtain the optimum effect. Do not use calcium chloride or other admixtures containing calcium chloride.

Supply concrete that develops a minimum compressive strength as shown in Table 1077-1 unless other strengths are designated on the approved drawings. When required, air entrain concrete to provide an air content of $5\% \pm 2\%$. Supply concrete with a maximum slump of 3.5 inches unless a high range water reducer (super plasticizer) is approved by the Engineer. Supply concrete with a maximum slump of 3.5 inches. A slump of 8 inches is permitted only when obtained with the use of an approved high range water reducer. As an option, reduce the cement content of the mix design by up to 30% and replace with fly ash at a rate of 1 lb. of fly ash for each pound of cement replaced or reduce the cement content up to 50% and replace with blast furnace slag on a pound for pound basis.

Submit proposed concrete mix designs in terms of saturated surface dry weights on *Materials and Tests Form 312U* at least 35 days before proposed use. Adjust batch proportions to compensate for surface moisture contained in the aggregates at the time of batching. Changes in the saturated surface dry mix proportions will not be permitted unless revised mix designs have been submitted to the Engineer and approved. Laboratory trial batches shall be created to confirm the proposed mix design meets the requirements of the plastic and hardened concrete.

Accompany *Materials and Tests Form 312U* with a listing of laboratory test results of aggregate gradation, air content, slump and compressive strength from a certified laboratory. List the compressive strength of at least three 6 inch x 12 inch or 4 inch x 8 inch cylinders at the age of 7 and 28 days.

Section 1077

Perform laboratory tests in accordance with the following test procedures:

Property	Test Method
Aggregate Gradation	AASHTO T 27
Air Content	AASHTO T 152
Slump	AASHTO T 119
Compressive Strength	AASHTO T 22 and R100

The Engineer will review the mix design for compliance with the Specifications and notify the Contractor as to its acceptability. Do not use a mix until written notice has been received. Acceptance of the mix design does not relieve the Contractor of his responsibility to furnish a product that meets the contract.

(B) Self-Consolidating Concrete (SCC) and Intermediate Flow Concrete

When a flowable concrete consistency is required, the use of an SCC or Intermediate Flow concrete is permitted with an approved concrete mix design.

SCC is a specialized concrete mix that utilizes various admixtures to obtain a fluid consistency without negatively impacting the strength or homogeneity of the mix. SCC is designed to flow under its own weight and completely fill the formwork completely, even in the presence of dense reinforcement and without the need for consolidation. SCC is characterized by a plastic concrete mixture with a flow that achieves a spread of 22-30 inches, when tested in accordance with ASTM C1611.

Intermediate Flow Concrete is a concrete mix that exceeds the slump of standard concrete but does not have the same high flow characteristics of an SCC concrete mix.. Intermediate Flow Concrete is characterized by a plastic concrete mixture with a flow that achieves a spread of 16-22 inches, when tested in accordance with ASTM C1611.

When submitting a proposed SCC or Intermediate Flow concrete mix design on a *Materials and Tests Form 312U*, include the test results obtained using the following test procedures:

Property	Test Method
Aggregate Gradation	AASHTO T 27
Air Content	AASHTO T 152
Slump Flow	ASTM C1611
Visual Stability Index (VSI)	ASTM C1611
Passing Ability	ASTMC1621 (Filling Procedure B)
Segregation	ASTM C1610
Compressive Strength	AASHTO T 22 and R100

Supply concrete that develops a minimum compressive strength as shown in Table 1077-1 unless other strengths are designated on the approved drawings. When required, air entrain concrete to provide an air content of $5 \pm 2\%$. SCC and Intermediate Flow mixes shall have a difference in slump flow and passing ability not to exceed 2 inches, a Visual Stability Index no greater than 1, and a static segregation limit of 15%.

Section 1077

TABLE 1077-1 PRECAST CONCRETE STRENGTH REQUIREMENTS AT AN AGE OF 28 DAYS		
Precast Units	Requirement	Specification Reference
<u>BARRIER:</u>		
Portable	4,500 psi	Section 854, 1090 and 1170
Permanent	4,500 psi	Section 854, 857 and 1090
<u>CULVERTS:</u>		
Circular Pipe	4,000 psi	Section 310, 1032, 1034, 1520 and AASHTO M 170
Single Cell Box Sections	5,000 psi	Contract and AASHTO M 259
Pipe Tees	4,000 psi	Section 310, 1032 and AASHTO M 170
Pipe Elbows	4,000 psi	Section 310, 1032 and AASHTO M 170
Cross & Parallel Special End Sections	3,500 psi	Section 310 and 1032
<u>DRAINAGE STRUCTURES:</u>		
Boxes (Solid & Waffle)	4,000 psi	Section 840 and ASTM C913
<u>CIRCULAR MANHOLES:</u>		
Base	4,000 psi	Section 1525 and AASHTO M 199
Riser Section	4,000 psi	Section 1525 and AASHTO M 199
Top Section	4,000 psi	Section 1525 and AASHTO M 199
Grade Ring	4,000 psi	Section 858 and AASHTO M 199
<u>WALLS AND PANELS:</u>		
Wing, Head & End Walls	4,000 psi	AASHTO T 23
Precast Retaining Wall (PRW) Units	4,000 psi	Section 455
Precast Coping	3,000 psi	Contract
Retaining Wall Panels	4,000 psi	Contract
Sound Barrier Wall Panels	4,500 psi	Contract
<u>INCIDENTAL PRECAST ITEMS:</u>		
Concrete Pads For Outlet Pipe, Controller Base Cabinets	2,500 psi	Section 815, 816 and 825
Right-of-Way Markers	2,500 psi	Section 806 and 1054
Concrete Anchor For Cable Guardrail	3,000 psi	Section 1046
Picnic Tables	2,500 psi	Contract
Waste Containers	2,500 psi	Contract

Submit a proposed concrete mix design for the precast units to the Engineer. Determine quantities of fine and coarse aggregates necessary to provide concrete in accordance with this section by the method described in ACI 211 using the absolute volume method.

The Engineer will review the mix design only to ascertain general compliance with the *Standard Specifications*. Do not use a mix until notified that the mix is acceptable.

Section 1077

Acceptance of the mix design does not relieve the Contractor of his responsibility to furnish an end product meeting the *Standard Specifications*.

(C) Testing

Make all representative concrete test cylinders and all testing required herein in the presence of the plant inspector for items with strength requirements greater than 2,500 psi in Table 1077-1, unless otherwise approved by the Engineer. For incidental precast items listed in Table 1077-1, furnish a Type 3 material certification in accordance with Article 106-3 certifying that the item meets this Specification.

Before the first load is placed, determine the air content by AASHTO T 152, T196 or T121. If the air content does not meet the *Standard Specifications*, a second test on the same load is conducted using AASHTO T 152, T196 or T121. Acceptance or rejection of the load is based on the results of this test.

Perform temperature, air, and slump or spread tests whenever cylinders are cast.

Determine slump in accordance with AASHTO T 119 and ensure that slump meets the specifications as stated on Materials and Tests Form 312U approved mix design.

For the purpose of testing for the required 28 day compressive strength, furnish, at no cost to the Department, at least four concrete cylinders for each class of concrete, each structure and each day that precast units are produced for the Department. If the contractor anticipates an early break request, furnish the Department with two concrete cylinders for each early break request. These cylinders are in addition to the four concrete cylinders required for each day of production. Make and cure cylinders in accordance with AASHTO R 100 unless, by permission of the Engineer, the units are cured by one of the methods in Article 1077-9 for the full time required to meet the specified compressive strength requirements. In such case, cure the cylinders with the members and in the same manner as the members. Test cylinders in accordance with AASHTO T 22. If the average of two cylinders tested to determine compressive strength at the age of 28 days fails to indicate a compressive strength as shown in Table 1077-1, or such compressive strength as is required by the approved drawings, such failure is cause for the rejection of the members represented.

(D) Temperature Requirements

Maintain the concrete temperature at the time of placing in the forms not less than 50°F nor more than 95°F unless otherwise directed by the Engineer.

Place concrete in cold weather in accordance with Article 420-7.

(E) Use of Water Reducing Admixtures

Use water reducing admixtures in accordance with Subarticle 1000-3(G). Use high range water reducers (super plasticizers), if approved by the Engineer.

1077-6 FORMS

Use forms of sturdy construction and in good working order which are capable of consistently providing straight lines and uniform dimensions in the finished product. Use metal forms except where other materials are approved by the Engineer. Provide an identifying number on each form, and mark each precast unit with the same identifying number as the form used to cast unit. Forms not meeting these requirements are subject to rejection by the Engineer. Provide joints in forms that are smooth and tight enough to prevent leakage of mortar. Provide inside surfaces of forms that are accessible for cleaning. After each use, clean the forms thoroughly and inspect for damage. Repair or replace damaged forms that will not allow for proper casting or cause defects in the finished product. Before casting, free the inside surfaces of the forms from rust, grease or other foreign matter. Do not allow coatings used for release of members to build up and in no case allow liquid or powder from coating materials to come in contact with the reinforcement steel.

Section 1077

1077-7 REINFORCEMENT

(A) Steel Reinforcement

Furnish steel reinforcement and place as shown in the plans and in accordance with Section 1070.

(B) Macro Synthetic Fiber Reinforcement

Substitute as an option, macro-synthetic fibers instead of 4 inches x 4 inches W1.4 x W1.4 welded wire reinforcement for selected precast concrete products in accordance with the following requirements.

(1) Materials

Refer to Division 10.

Item	Section
Portland Cement Concrete	1077-5

Substitute macro-synthetic fibers only for steel reinforcement with an area of steel of 0.12 sq.in./ft or less in the following items:

(a) Precast drainage structure units in accordance with *Roadway Standard Drawings* No. 840.45.

(b) Precast manhole 4.0 feet riser sections in accordance with *Roadway Standard Drawings* No. 840.52.

All other requirements, including reinforcement for these precast concrete items will remain the same.

(2) Submittal

Submit to the Department for approval by the precast producer and fiber manufacturer, independently performed test results certifying the macro-synthetic fibers and the precast concrete products meet the requirements listed herein.

(3) Macro-Synthetic Fibers

Manufacture from virgin polyolefins (polypropylene and polyethylene) and comply with ASTM D7508. When using fibers manufactured from materials other than polyolefins, submit test results complying with ASTM D7508 certifying resistance to long-term deterioration when in contact with the moisture and alkalies present in cement paste and/or the substances present in air-entraining and chemical admixtures.

Fiber length shall be no less than 1.5 inches. Use macro-synthetic fibers with an aspect ratio (length divided by the equivalent diameter of the fiber) between 45 and 150, a minimum tensile strength of 40 ksi when tested in accordance with ASTM D3822 and a minimum modulus of elasticity of 400 ksi when tested in accordance with ASTM D3822.

(4) Fiber Reinforced Concrete

Approved structural fibers may be used as a replacement of steel reinforcement in allowable structures of *Roadway Standard Drawings* Nos. 840.45 and 840.52. The dosage rate, in pounds of fibers per cubic yard, shall be as recommended by the fiber manufacturer to provide a minimum average residual strength of concrete, tested in accordance with ASTM C1399, of no less than that of the concrete with the steel reinforcement that is being replaced and no less than 5 lb/cy. Submit the recommendations of the manufacturer that correlate the toughness of steel-reinforced concrete with that of the recommended dosage rate for the fiber-reinforced concrete.

Section 1077

Use fiber reinforced concrete with a $5\% \pm 2\%$ air content and a compressive strength of at least 4,000 psi in 28 days.

Assure the fibers are well dispersed and prevent fiber balling during production. After introduction of all other ingredients, add the plastic concrete and mix the plastic concrete for at least 4 minutes or for 50 revolutions at standard mixing speed.

1077-8 PLACING CONCRETE

Use the procedures and equipment for handling, placing and consolidating the concrete such that a uniformly dense and high grade concrete is obtained in all parts of the unit under all working and weather conditions. Do not mix, handle, deliver, place or finish concrete using devices made of aluminum or containing aluminum.

Placing concrete for precast members in cold weather shall be in accordance with Article 1078-10.

Internal, external or a combination of internal and external vibration is required as necessary to produce uniformly dense concrete without honeycomb.

1077-9 CURING CONCRETE**(A) General**

Precast units are subjected to one of the methods of curing described below or to other methods or combinations of methods approved by the Engineer. Cure the precast units for a sufficient length of time so the concrete develops the specified compressive strength at 28 days or less. Do not strip forms until at least 24 hours after the concrete attains initial set. For this purpose, initial set is defined as at least 500 psi resistance to a standard penetrometer. The option to strip forms earlier is available provided concrete cylinders indicate a strength of at least 75% of the 28 day compressive strength is attained before release for each day's production. Do not deface or injure the units.

(B) Curing at Elevated Temperatures

Cure at elevated temperatures in accordance with Subarticle 1078-11(B). The temperature within the curing enclosure shall not exceed 160°F. Place recording thermometers within each enclosure. Calibrate recording thermometers at intervals not to exceed 6 months. Submit complete temperature records to the Engineer for all cures before final approval of the members.

(C) Water Curing

Water curing of precast units is allowed as described in Subarticle 420-15(B), by covering with water saturated material, or by a system of perforated pipes, mechanical sprinklers, porous hoses or by any other method that keeps the units moist during the specified curing period. Do not use methods that deface or injure the precast units.

(D) Curing Compound

Application of a curing compound is allowed provided it is left intact until the specified compressive strength is met. Keep all surfaces moist before the application of the compound and damp when the compound is applied. Seal the surface with a single uniform coating at the rate of coverage recommended by the curing compound manufacturer, or as directed by the Engineer, but not less than 1 gal per 150 sf of area.

1077-10 LIFT HOLES, HANDLING

Do not cast or drill more than 4 holes in each unit for the purpose of handling or placing unless otherwise approved by the Engineer. Locate all lift holes and handling devices in accordance with plan and design requirements. Units damaged while being handled or transported are rejected or require repair in a manner approved by the Engineer.

Section 1077**1077-11 FINAL FINISH**

Unless otherwise required by the contract, finish all concrete in accordance with Subarticle 420-17(B) except as noted within Article 1077-16.

Do not repair units with honeycomb, cracks, or spalls until inspected by the Engineer. Use repair methods that are approved by the Engineer before their use. Any appreciable impairment of structural adequacy is cause for rejection.

1077-12 EXPOSED AGGREGATE FINISH FOR PRECAST CONCRETE PANELS

When required, provide an exposed aggregate finish for front faces of panels with a depth of exposure ranging from 0 to 1/4 inch. Before beginning production, furnish three 12 inch x 12 inch sample panels to establish acceptable variations in color, texture and uniformity of the finish. After the sample panels are accepted by the Engineer and within 30 days of beginning production, produce a reinforced test panel of the largest size that will be used for the project with the accepted exposed aggregate finish. Acceptance of the appearance of panels during production will be based on the test panel and accepted sample panels.

Use aggregate and cement from the same source as was used for the test panel and accepted sample panels to produce panels with an exposed aggregate finish. Provide access to visually inspect the entire finish of each completed panel and compare it to the test panel appearance before stacking panels. Replace the test panel with a new test panel every three months during production or when fly ash or cement source changes.

1077-13 STEPS FOR PRECAST DRAINAGE STRUCTURES

Supply steps meeting AASHTO M 199 for design, materials and dimensions. Incorporate steps in all drainage structures 3.5 feet or greater in height. Do not detail the lowest step more than 16 inches from the bottom.

1077-14 MARKING

Clearly mark the following information on each precast member:

(A) Date of manufacture,

(B) Name of the manufacturer,

(C) Piece mark designations where such designations are shown in the plans, and

Clearly apply a Department approved self-adhesive RFID tag/label tagged in accordance with Section 1030 applied in accordance with Subarticle 1030-2(F). When precast products have been inspected the Department will update the RFID tag/label record as found in the Field Inspection Report (FIR) or NCDOT alternate ID. RFID tag/labels are allowed but not required for incidental precast items.

1077-15 DIMENSIONS

Ensure that all dimensions allow assembly of the units in place without objectionable deviation from the lines shown in the plans. If requested by the Engineer, assemble the precast members to ensure a quality fit before shipment of the precast members.

1077-16 INCIDENTAL PRECAST ITEMS

Furnish a Type 3 materials certification in accordance with Article 106-3 for incidental precast items in Table 1077-1.

1077-17 SOUND AND NOISE WALL PANELS AND NOISE WALL POSTS

Wall panels will be required to be placed in a rack system for inspection. Double faced wall panels will require access to both faces for proper inspection. After sound wall panels have been inspected and approved they shall be stored in a manner that will not cause damage prior to delivery to the project.

Section 1078

- 1 Manufacture sound wall post within the tolerances indicated in Table 1078-2 and Figure 1078-
- 2 1.

Section 1089

SECTION 1089 TRAFFIC CONTROL

1089-1 WORK ZONE SIGNS

(A) General

Use Grade B fluorescent orange retroreflective sheeting on rigid work zone sign substrates. All sheeting shall conform to Article 1092-2. Cover the entire sign face of the sign substrate with Department approved sheeting as found on the NCDOT APL. No bubbles or wrinkles will be permitted in the material. Products manufactured prior to December 31, 2019 shall meet NCHRP 350 or MASH crash requirements for Category II work zone devices.

(1) Work Zones Signs (Stationary)

Use approved composite or aluminum substrate for sign backing. For aluminum substrate sign thickness, refer to Table 901-2.

Use work zone signs (stationary) and sign supports as found on the NCDOT APL.

(2) Work Zones Signs (Barricade Mounted)

Use approved composite or roll-up signs for barricade mounted sign substrates. No other type of sign substrate is allowed on barricades. Approved composite barricade mounted warning signs (black on orange) shall be Grade B retroreflective sheeting that meets the requirements of Article 1092-2.

Section 1089

- (3) Use work zone signs (barricade mounted) and barricade assemblies as found on the NCDOT APL. Work Zones Signs (Portable)

Use approved composite or roll-up sign substrates on portable sign stands. No other type of sign substrate is allowed on portable sign stands.

Use work zone signs (portable) and sign supports as found on the NCDOT.

(a) Composite

Use Grade B fluorescent orange retroreflective sheeting that meets the requirements of Article 1092-2.

(b) Roll-up Signs

Use Grade B fluorescent orange retroreflective sheeting for roll-up signs that meet the requirements of Article 1092-2.

Use roll up signs that have a minimum 3/16 inch x 1 1/4 inches horizontal rib and 3/8 inch x 1 1/4 inches vertical rib.

(B) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new reflective sheeting used on work zone signs meeting the retroreflective requirements of Article 1092-2. Furnish a Type 7 material certification for all used signs meeting the minimum retroreflective requirements of Article 1092-2.

(C) Approval

All materials are subject to the approval of the Engineer.

(D) Warranty

Refer to Subarticle 1092-2(B) for warranty requirements of rigid sign retroreflective sheeting.

Roll-up fluorescent orange retroreflective signs will maintain 80% of its retroreflectivity as described in Article 1092-2 for years 1 and 2 and 50% for year 3.

Rigid and rollup fluorescent orange signs shall maintain a fluorescence luminance factor of 13% for 3 years and conform to Article 1092-2.

Rigid and roll up fluorescent orange signs shall maintain a total luminance factor of 25 for 3 years and conform to Article 1092-2.

1089-2 WORK ZONE SIGNS SUPPORTS

(A) General

Products manufactured prior to December 31, 2019 shall meet NCHRP 350 or MASH crash requirements for Category II work zone devices.

(1) Work Zone Signs (Stationary)

Provide work zone sign supports for work zone signs (stationary) that are sturdy, durable and crashworthy. Use work zone signs (stationary) and sign supports as found on the NCDOT APL.

Use 3 lb U-channel steel posts, 4 inches x 4 inches wood posts or perforated square steel tubing posts for all work zone signs. Dual mount signs with surface areas greater than 10 sf on either 3 lb U-channel steel posts, 4 inches x 4 inches wood posts or perforated square steel tubing posts having the equivalent or greater strength of 3 lb U-Channel Steel posts. Perforated square steel tubing breakaway posts certified by the manufacturer for single mounting purposes may be used for the single mounting of stationary work zone signs for signs greater than 10 sf.

Section 1089

3 lb. steel U-channel posts shall comply with Subarticle 1094-1(B) and may be galvanized steel or painted green by the post manufacturer.

(2) Work Zone Signs (Portable)

Use work zone signs and portable work zone sign stands that are sturdy, durable and crashworthy. Use work zone signs (portable) and sign supports as found on the NCDOT APL.

(B) Material Certification

Provide portable work zone signs and stands that are listed on the NCDOT Approved Product List. Furnish a Type 3 material certification in accordance with Article 106-3 for all new work zone sign (stationary) posts and a Type 7 material certification for all used work zone sign (stationary) posts before use.

Furnish a Type 3 material certification in accordance with Article 106-3 for all new portable work zone sign stand assemblies and a Type 7 material certification for all used portable work zone sign stand assemblies before use.

(C) Approval

All materials are subject to the approval of the Engineer.

1089-3 BARRICADES**(A) General**

Construct barricades out of perforated square steel tubing, angle iron or other Department approved materials.

Use barricade rails constructed of approved composite, hollow/corrugated extruded rigid polyolefin, HDPE or other Department approved material that have a smooth face and alternating orange and white retroreflective stripes that slope at an angle of 45°.

Use barricades as found on the NCDOT APL. Products manufactured prior to December 31, 2019 shall meet NCHRP 350 or MASH crash requirements for Category II work zone devices.

(B) Supports

Support barricade rails in a manner that shall be visible to the motorist and provide a stable support not easily blown over by wind or traffic.

(C) Retroreflective Sheeting

Use Grade B retroreflective sheeting that meets Article 1092-2. Flame treat rails before applying the sheeting if required by the sign sheeting manufacturer. Apply the reflective sheeting with a pressure sensitive adhesive to both sides of the rails.

Use the same color sheeting on each rail of any individual barricade.

(D) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new barricades and a Type 7 material certification for all used barricades before use.

(E) Approval

All materials are subject to the approval of the Engineer.

1089-4 SEQUENTIAL FLASHING WARNING LIGHTS**(A) General**

Provide sequential flashing warning lights that meet all of the requirements for Type A warning lights in accordance with the MUTCD.

Section 1089**(B) Power System**

Each light unit shall be capable of operating fully and continuously for a minimum of 200 hours when equipped with a standard battery set.

(C) Light Display

Each light in the sequence shall be yellow and flashed at a rate of not less than 55 times per minute and not more than 75 times per minute. The flash rate and flash duration shall be consistent throughout the sequence.

(D) Reliability

The lights shall be weather independent and visual obstructions shall not interfere with the operation of the lights.

(E) Material Certification

Furnish a Type 3 material certification in accordance with article 106-3 for all new Sequential Flashing Warning Lights and a Type 7 material certification for all used Sequential Flashing Warning Lights.

(F) Approval

Use sequential flashing warning lights listed on the NCDOT APL.

1089-5 CHANNELIZING DEVICES**(A) Drums****(1) General**

Provide drums composed of a body, alternating orange and white 4-band pattern of Type III-High Intensity or higher prismatic retroreflective sheeting and ballasts.

(2) Body

Provide a drum made of orange, impact resistant, ultraviolet plastic material capable of maintaining its integrity upon impact throughout a temperature range of -20°F to 125°F. When struck, the drum shall not permanently distort to a degree that would prevent reuse, nor roll excessively after impact. Design the drum to prevent water from accumulating and freezing in the top or bottom.

Provide a drum that is cylindrical in shape with the following dimensions; a minimum height of 36 inches, a minimum top outer diameter of 18 inches, a bottom outer diameter of 21 inches to 24 inches, and a minimum weight of 7 lbs. The top outer diameter shall not exceed the bottom outside diameter. Provide closed tops on drums to prevent accumulation of debris.

(3) Retroreflective Stripes

Provide at least four retroreflective bands with two orange and two white alternating horizontal circumferential bands. The top band shall always be orange. Use a 6 inch to 8 inch wide band Type III-High Intensity or higher prismatic retroreflective sheeting meeting the requirements of Article 1092-2 for each band. Do not exceed 2 inches for any non-retroreflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 6 inch band. Apply the retroreflective sheeting directly to the drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugations areas. No damage to the retroreflective sheeting should result from stacking and unstacking the drums, or vehicle impact.

Section 1089**(4) Ballast**

Ballast drums using the sandbag ballast method, the tire sidewall ballast method or the preformed weighted base ballast method. When properly ballasted, the drums shall be wind resistant to the extent of withstanding wind created by traffic under normal roadway conditions, including high speed truck traffic in close proximity to the drums. Do not place ballast on top of the drum.

(a) Sandbag Ballast Method

Supply a sandbag with 50 lb. of sand with each drum. Place the sandbag inside the body on top of the detachable base. Upon impact the main body of the drum shall deform and become detached from the base, allowing vehicles to easily pass over the remaining base.

(b) Tire Sidewall Ballast Method

Design the base of the drums to accommodate no more than two tire sidewalls that when combined will have a weight of at least 30 lb and no more than 50 lb. Use the manufacturer's required tire sidewall ballast. Upon impact the main body of the drum shall deform and become detached from the tire sidewalls, allowing vehicles to easily pass over the tire sidewall ballasts.

(c) Preformed Weighted Base Ballast Method

Supply a preformed base specifically designed for the model drum. The weight of each drum's preformed base will be self-certified by the manufacturers. Each drum with preformed bases shall be approved by the Work Zone Traffic Control Unit. Upon impact, the main body of the drum shall deform and become detached from the base allowing vehicles to easily pass over the remaining base.

(5) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new drums and a Type 7 material certification for all used drums before use.

(6) Approval

All materials are subject to the approval of the Engineer.

(B) Skinny Drums**(1) General**

Provide skinny drums composed of a body, alternating orange and white stripes of Type III-High Intensity or higher prismatic retroreflective sheeting and ballasts

(2) Body

Provide a skinny drum made of orange, impact resistant, ultraviolet plastic material capable of maintaining its integrity upon impact throughout a temperature range of - 20°F to 125°F. When struck, the skinny drum shall not permanently distort to a degree that would prevent reuse, nor roll excessively after impact. Design the skinny drum to prevent water from accumulating and freezing in the top or bottom.

Provide a skinny drum that is cylindrical in shape with the following dimensions; a minimum height of 42 inches, a minimum top outer diameter of 4 inches and a bottom outer diameter of 7.5 inches. The top outer diameter shall not exceed the bottom outside diameter. Provide closed tops on drums to prevent accumulation of debris.

(3) Retroreflective Stripes

Provide at least four retroreflective bands with two orange and two white alternating horizontal circumferential bands for each skinny drum. The top band shall always be

Section 1089

orange. Use a 6 inch to 8 inch wide band Type III–High Intensity or higher prismatic retroreflective sheeting that meets Article 1092-2 for each band. Do not exceed 2 inches for any non-retroreflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 6 inch band. Apply the retroreflective sheeting directly to the skinny drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugation areas. No damage to the reflective sheeting should result from stacking and unstacking the skinny drums, or vehicle impact.

(4) Ballast

Ballast skinny drums using a preformed base specifically designed for the model skinny drum. Each base shall be at least 15 lb and circular or polygonal with equal sides. When properly ballasted, the skinny drums shall be wind resistant to the extent of withstanding wind created by traffic under normal roadway conditions, including high speed truck traffic in close proximity to the skinny drums. Do not place ballast on top of the drum. Upon impact, the main body of the drum shall deform and become detached from the base allowing vehicles to easily pass over the remaining base.

(5) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new skinny drums and a Type 7 material certification for all used skinny drums before use.

(6) Approval

All materials are subject to the approval of the Engineer.

(C) Cones

(1) General

Use cones made of ultraviolet stabilized plastic impact resistant material meeting MUTCD and this article. Orange will be the predominant color on cones.

Use cones conical in shape with a minimum height of 28 inches or 36 inches. The 28 inch cones shall have a minimum base dimension of 13.75 inches, and the 36 inch cones shall have a minimum base dimension of 14.5 inches as shown in the *Roadway Standard Drawings*. The 28 inch and 36 inch cones (excluding ballast) shall have a minimum weight of 7 lbs. and 10 lbs. respectively. When in an upright position, have the cones display the same dimensions regardless of their orientation to oncoming traffic.

(2) Ballasts

Provide wind resistant cones that do not blow over under normal roadway conditions, including high speed truck traffic in close proximity to the cones when properly ballasted. Provide cones that do not permanently distort to a degree that would prevent reuse when struck.

Achieve ballasting of the cones by using any of the following methods:

(a) Cones with bases that may be filled with ballast,

(b) Doubling the cones or using heavier weighted cones, or

(c) Cones with special weighted bases or weights such as rubber rings that can be dropped over the cones and onto the base to provide increased stability.

(3) Retroreflective Sheeting

Where retroreflective cones are required, provide a cone with flexible, prismatic cone sheeting having impact resistance and attached with precoated pressure sensitive adhesive. The retroreflective sheeting shall meet or exceed the retroreflectivity

Section 1089

requirements of Grade B sheeting in Article 1092-2. Use two retroreflective bands, the top one is 6 inches wide and the bottom one is 4 inches wide; see *Roadway Standard Drawings*.

(4) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new cones with or without retroreflective sheeting and a Type 7 material certification for all used cones with or without retroreflective sheeting before use.

(5) Approval

All materials are subject to the approval of the Engineer.

1089-6 FLASHING ARROW BOARDS**(A) General**

Provide a trailer mounted arrow board that meets or exceeds the physical and operational requirements of the MUTCD and found on the NCDOT APL. Products must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT APL.

The following specifications supplement those basic requirements. Provide a totally mobile complete unit capable of being located as traffic conditions demand.

The display housing shall meet the minimum size requirements of a Type C panel with a 15 or 25 lamp configuration.

The display housing shall have a hand-crank mechanism to allow raising and lowering the display with a locking device to ensure the display housing will remain secured in either position

The display housing will have a minimum height of 7 feet from the bottom of the sign to the ground when raised in the upright position.

The display housing assembly shall be of weather resistant construction.

The lamps shall be controlled to provide the following modes as a minimum: Flashing Right or Left Arrow, Flashing Double Arrow and Caution Mode (four outermost corner lamps).

(B) Power System

Provide a unit that is solar powered and supplemented with a battery backup system that includes a 110/120 VAC powered on-board charging system.

The unit shall also be capable of being powered by standard 110/120 VAC power source.

The batteries, when fully charged, shall be capable of powering the display for 20 continuous days with no solar power.

Store the battery bank and charging system in a lockable, weather and vandal resistant box.

(C) Controller

Provide automatic brightness/dimming of the display and a manual override dimming switch.

The controller shall provide a battery-charge status indicator.

Mobile radio or any other radio transmissions shall not affect the controller.

Store the controller in a lockable, weather and vandal resistant box.

Section 1089**(D) Trailer**

Finish all exterior metal surfaces with Federal orange enamel per AMS-STD-595, color chip ID# 13538 or 12473 respectively. The trailer shall be able to support a 100 mph wind load with the display fully extended.

The trailer shall be equipped with leveling jacks capable of stabilizing the unit in a horizontal position when located on slopes 6:1 or flatter.

The trailer shall be properly equipped in compliance with North Carolina Law governing motor vehicles.

Provide a minimum 4 inch wide strip of fluorescent orange retroreflective sheeting to the frame of the trailer. Apply the sheeting to all sides of the trailer. The retroreflective sheeting shall be Grade C that conforms to Article 1092-2. Drums may be supplemented around the unit in place of the sheeting.

(E) Reliability

Provide a sign unit that all components are rated to operate at temperatures ranging from -30°F to 165°F.

The sign manufacturer shall notify the Work Zone Traffic Control Unit whenever modifications are made to a prequalified sign on the NCDOT APL.

The Work Zone Traffic Control Unit will review changes and per its discretion either make no change to the sign's status or remove it from the list until the sign can be reevaluated.

(F) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new flashing arrow boards, a Type 7 material certification for all used flashing arrow boards, and wind load certifications required in Subarticle 1089-6(D) for all new and used flashing arrow boards before use.

(G) Approval

The sign shall be on the NCDOT APL before use on construction projects in North Carolina. A sign may be removed from the NCDOT APL due to unsatisfactory field performance and shall not return to the list until the manufacturer identifies the reason for the failure and the problem has been corrected to the satisfaction of the Department.

The sign manufacturer shall notify the Department whenever modifications are made to their sign that was prequalified on the NCDOT APL. The Department will review changes and per its discretion, either make no change to the sign's status on the NCDOT APL or remove the sign from the list until the sign can be reevaluated.

1089-7 PORTABLE CHANGEABLE MESSAGE SIGNS**(A) General**

Provide trailer or truck mounted portable changeable message signs that meet MUTCD and found on the NCDOT APL. Products must be current with the applicable AASHTO Product Evaluation & Audit Solutions workplan to remain on the NCDOT APL.

A trailer mounted portable changeable message sign shall be a totally mobile complete sign unit capable of being located as traffic conditions demand.

(B) Display Panel

Provide sign capable of sequentially displaying at least 2 phases of 3 lines of a programmable message with at least 8 characters per line and a character height of at least 18 inches.

Section 1089

The display characters will be composed of LED elements. The display panel may be of the following types- Full Matrix, Continuous Line Matrix, and Character Matrix.

Messages are to be automatically centered and proportionally spaced on each line of a Full Matrix and Continuous Line Matrix displays. Character Matrix displays shall display odd number character messages one character left of the centerline.

The display characters shall be protected with a polycarbonate lens that shall not decrease the daytime visibility of the sign.

The display panel shall have an electro-hydraulic system to allow raising and lowering the display with 360° rotation capability. The distance from the bottom of the sign to the ground shall be at least 7 feet. A locking device(s) shall be provided to ensure the display will remain secure in the raised, lowered and rotated positions. The sign shall have the capability to be raised and rotated to its operating position by one person.

A manual backup mechanism for the raising and lowering the display panel shall be provided in the event the electro-hydraulic system fails.

The display panel assembly shall be of weather resistant construction

(C) Power System

The unit shall be Solar powered and supplemented with a battery backup system which includes a 110/120 VAC powered on-board charging system.

The batteries, when fully charged, shall be capable of powering the display for 20 continuous days with no solar power. The unit shall be capable of being powered by standard 110/120 VAC power source.

Store the battery bank and charging system in a lockable, weather and vandal resistant box.

(D) Controller

The controller shall be capable of being equipped with the necessary hardware and software to allow wireless communication with other portable changeable message signs or other components of an intelligent transportation system. The controller shall also provide at a minimum; a keyboard, a display for message review and editing, a light source for nighttime operations, an event time clock and all other required controls for the operation of the display. Program each controller with password protection that will deter unauthorized programming of the controller. Change the controller password from the factory default and periodically change the controller password to deter unauthorized programming of the controller. The password system is recommended to include at least two levels of security such that operators at one level may only change message sequences displayed using preprogrammed sequences and operators at a higher level may create and store messages or message sequences.

The controller shall include the following capabilities; manually dimming the display, storing at least 99 user generated messages, adjusting the flash rate of display and display phasing and monitoring battery-charge status.

Mobile radio or any other radio transmissions shall not affect the controller.

The controller shall be stored in a locked, weather and vandal resistant box when not in use and after changes to the messages are made.

Section 1089

The controller shall be pre-programmed with messages shown below and stored in memory:

MAX SAFE SPEED 25 MPH	MAX SAFE SPEED 30 MPH
STOP AHEAD	YIELD AHEAD
MAX SAFE SPEED 35 MPH	MAX SAFE SPEED 40 MPH
MAX SAFE SPEED 45 MPH	MAX SAFE SPEED 50 MPH
ONE LANE BRIDGE	SURVEY CREW
MAX SAFE SPEED 55 MPH	DETOUR AHEAD
CAUTION DETOUR AHEAD	LANE CLOSED AHEAD
RIGHT LANE CLOSED	LEFT LANE CLOSED
CENTER LANE CLOSED	SINGLE LANE AHEAD
MERGE LEFT	MERGE RIGHT
KEEP LEFT	KEEP RIGHT
PASS LEFT	PASS RIGHT
USE LEFT LANE	USE RIGHT LANE
MERGE AHEAD	ROAD MACHINES AHEAD
ROAD WORK AHEAD	FLAGGER AHEAD
BUMP	DIP
STOP AHEAD	YIELD AHEAD
BE PREPARED TO STOP	SIGNAL AHEAD
SIGNAL NOT WORKING	DO NOT PASS
ONE LANE BRIDGE	SURVEY CREW
SHOULDER WORK	SOFT SHOULDER
PAVEMENT ENDS	LANE ENDS
ROAD CLOSED 1/4 MILE	ROAD CLOSED 1/2 MILE
ALL TRAFFIC EXIT LEFT	ALL TRAFFIC EXIT RIGHT
ROAD NARROWS	ROAD CLOSED AHEAD
RAMP CLOSED	REDUCE SPEED
ROAD PAVING AHEAD	ALL TRAFFIC MUST STOP
SLOW MOVING TRAFFIC	NIGHT WORK AHEAD
CAUTION FLAGGER AHEAD	RUNAWAY TRUCK RAMP
MEDIAN WORK AHEAD	
LEFT LANE NARROWS	RIGHT LANE NARROWS
TEST PATTERN A ^A	TEST PATTERN B ^B

A. Test Pattern A is 1/2 of the LEDs on at a time.

B. Test Pattern B is for the remaining 1/2 of the LEDs on at a time.

(E) Trailer

Finish all exterior metal surfaces with Federal orange enamel per AMS-STD-595; color chip ID# 13538 or 12473 respectively except for the sign face assembly that shall be flat black.

Provide a minimum 4 inches wide strip of fluorescent orange retroreflective sheeting to the frame of the trailer. Apply the sheeting to all sides of the trailer. The retroreflective sheeting shall be Grade C that conforms to Article 1092-2. Drums may be supplemented around the unit in place of the sheeting.

The trailer shall be able to support a 100 mph wind load with the display fully extended.

The trailer shall be equipped with leveling jacks capable of stabilizing the unit in a horizontal position when located on slopes 6:1 or flatter.

The trailer shall be properly equipped in compliance with North Carolina Law governing motor vehicles.

Section 1089**(F) Reliability**

Provide a sign unit that all components are rated to operate at temperatures ranging from -30°F to 165°F.

(G) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new changeable message signs, a Type 7 material certification for all used changeable message signs and wind load certifications required in Subarticle 1089-7(E) for all new and used changeable message signs before use.

(H) Approval

The sign shall be listed on the NCDOT APL before use on construction projects in North Carolina. A sign may be removed from the NCDOT APL due to unsatisfactory field performance and shall not return to the list until the manufacturer identifies the reason for the failure and the problem has been corrected to the satisfaction of the NCDOT.

The sign manufacturer shall notify NCDOT whenever modifications are made to their sign that was prequalified on the NCDOT APL. The Department will review changes and per its discretion will either make no change to the sign's status on the NCDOT APL or remove the sign from the list until the sign can be reevaluated.

1089-8 TEMPORARY CRASH CUSHIONS**(A) General**

Provide temporary crash cushions that meet Test Level II for work zones that have a posted speed limit of 45 mph or less. Provide temporary crash cushions that meet Test Level III devices for work zones that have a posted speed limit of 50 mph or greater.

Use temporary crash cushions as found on the NCDOT APL. Products manufactured prior to December 31, 2018 shall meet NCHRP 350 or MASH crash requirements for Category III work zone devices.

Provide redirective temporary crash cushions or non-directive temporary crash cushions that capture errant vehicles without complete penetration through the device.

The temporary crash cushion shall contain the debris resulting from impact within the structure of the temporary crash cushion.

Include in the temporary crash cushion package any required rear transition panels to connect the back of the temporary crash cushion to rigid or flexible barrier systems. Include any required portable base, as recommended by the manufacturer of the temporary crash cushion, to connect the bottom of the temporary crash cushion to a paved surface. Temporary crash cushion shall not be placed on an unpaved surface.

(B) Retroreflective End Treatments

Provide a yellow nose wrap that visually matches the color chip that corresponds to the AMS-STD-595 for Yellow (Color No. 13538) for all temporary crash cushions.

The retroreflective end treatment shall meet the requirement for retroreflectivity in Article 1088-1 and *Roadway Standard Drawings*.

(C) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new temporary crash cushions and a Type 7 material certification for all used temporary crash cushions before use.

(D) Approval

Use temporary crash cushions listed on the NCDOT APL.

Section 1089

1089-9 ATTENUATORS**(A) General**

Provide truck mounted attenuators that meet Test Level II for work zones that have a posted speed limit of 45 mph or less. Provide truck mounted attenuators that meet Test Level III for work zones that have a posted speed limit of 50 mph or greater.

Use attenuators as found on the NCDOT APL. Products manufactured prior to December 31, 2018 shall meet NCHRP 350 or MASH crash requirements for Category III work zone devices.

Use trucks with gross vehicle tare weight as described in the NCHRP 350 crash test for the impact attenuator provided. Provide truck in accordance with the manufacturer's specifications. Ballasting methods are not permitted.

Use the attenuator in accordance with the manufacturer's specifications. Provide truck mounted attenuators with standard trailer lighting systems, including brake lights, tail lights and turn signals.

(B) Retroreflective End Treatment

The retroreflective end treatment shall meet Article 1088-1 and *Roadway Standard Drawings*.

(C) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new truck mounted attenuators and a Type 7 material certification for all used truck mounted attenuators before use.

(D) Approval

Use truck mounted attenuators listed on the NCDOT APL.

1089-10 FLAGGER**(A) 24 Inch Stop and Slow Paddle****(1) Retroreflective Sheeting**

Use retroreflective sheeting with a smooth, sealed outer surface that will display the same color both day and night. Cover the entire sign face with Grade B retroreflective sheeting. Retroreflective sheeting shall meet Article 1092-2. The distance from the bottom of the sign to the ground shall be at least 6 feet.

(2) Material Certification

Furnish a Type 3 material certification in accordance with Article 106-3 for all new reflective sheeting used on flagger paddles and a Type 7 material certification for all used sheeting before use.

(3) Approval

All materials are subject to the approval of the Engineer.

(B) Vest**(1) Apparel Materials**

Use highly-visibility safety apparel that meets the Performance Class 2 or higher requirements of the ANSI/ISEA 107-2010 or the equivalent revision. For nighttime flagging operations, Performance Class 3 safety apparel is required.

Section 1090

- 1 (2) Apparel Verification
- 2 All safety apparel shall have the original tag or label indicating that it meets the
- 3 requirements of the ANSI/ISEA 107-2010 or the equivalent revision. Approval
- 4 All safety apparel is subject to the approval of the Engineer.

DIVISION 11

WORK ZONE TRAFFIC CONTROL

SECTION 1101

WORK ZONE TRAFFIC CONTROL GENERAL REQUIREMENTS

1101-1 TRANSPORTATION MANAGEMENT PLAN (TMP)

Maintain traffic through work zones in accordance with these Specifications, the MUTCD, *Roadway Standard Drawings*, 23 CFR 630 Subparts J and K and the Transportation Management Plan (TMP).

Below is a list of the possible TMP components:

- (A) Temporary Traffic Control Plan (TTC),
- (B) Transportation Operations Plan (TO), and
- (C) Public Information Plan (PI).

A TMP will always have a TTC component. The TTC will contain the project notes, phasing, detail sheets and other supporting information.

1101-2 TEMPORARY TRAFFIC CONTROL PLAN (TTC)

(A) General

Typically, phasing and drawings govern over project notes, and local notes govern over general notes. If a conflict arises in the TTC, refer to Article 105-4.

(B) Phasing

Complete the requirements of each phase before proceeding to the next phase and the requirements of each step before proceeding to the next step unless the plans permit work to be performed concurrently.

If a TTC phasing is broken into areas, work may be performed in more than one area simultaneously as described in the plan.

(C) Project Notes

Two types of project notes may be included in the TTC:

- (1) General Notes apply at all times during the project, and
- (2) Local Notes apply only for the specific times and locations that they are referred to in the phasing and detail sheets.

(D) Alternate to Transportation Management Plan

If desired, submit an alternate TMP a minimum of 30 calendar days in advance of the anticipated implementation to allow for adequate review time. Do not implement alternate plans for traffic control until approved in writing and properly sealed. No adjustment in compensation or extension of the completion date(s) will be allowed due to the review time of the alternate. If an alternate TMP is implemented, the Contractor shall be responsible for any unanticipated changes to subsequent phases and steps.

Section 1101**(E) Temporary Traffic Control Plan Not Fully Covered in the Contract**

When the TTC does not cover a particular work function, notify the Engineer to allow for the development or modification of a sealed set of the Temporary Traffic Control Plans.

1101-3 BLASTING ZONE

When blasting operations are within 1,000 feet of a travelway, provide the appropriate traffic control as shown in the plans and/or the *Roadway Standard Drawings*.

1101-4 CONSTRUCTION VEHICLE CROSSINGS

Do not cross the median, ramps or loops with vehicles or equipment unless a specific location for crossing is approved and required traffic control devices are used as shown in the *Roadway Standard Drawings*.

1101-5 ON-ROAD CONSTRUCTION VEHICLES

When operating outside of a closed lane or haul road crossing in a work zone, on-road construction vehicles are subject to the Department's Division of Motor Vehicle weight and safety regulations as commercial vehicles. Work vehicles must always use warning lights with at least 50% being amber in color attached to the vehicle as high as possible and in a manner such that they are not obscured by equipment or supplies. Vehicle hazard signals or lights may be used to supplement this requirement. This requirement applies to all work vehicles and equipment not inside lane closures or behind barriers. This requirement does not apply to dump trucks but it is encouraged.

1101-6 EXCAVATIONS WITHIN TRAVELWAY

During the process of excavating in a travelway where traffic is to be later maintained, make provisions to backfill and repair any excavated or damaged pavement before allowing traffic to proceed over the affected lanes. In low speed areas (35 mph or less), metal plates may be used to cover excavated areas.

1101-7 HAULING OPERATIONS

Comply with the multiple and single vehicle hauling restrictions as shown in the TMP when performing hauling of equipment or materials to or from the project.

Define "Multiple Vehicle Hauling" as the hauling of equipment or materials to or from the project with delivery at intervals of less than 5 minutes or results in more than one vehicle at a particular work site at a time.

Define "Single Vehicle Hauling" as the hauling of equipment or materials to or from the project with delivery at intervals of more than 5 minutes and results in no more than one vehicle at a particular work site at a time.

Do not conduct any hauling operations against the flow of traffic of an open travelway unless an approved temporary barrier or guardrail separates the traffic from the hauling operation.

On multi-lane, controlled access roadways, haul vehicles shall not enter/exit an open travel lane at speeds more than 10 mph below the posted speed limit. Haul vehicle acceleration to within 10 mph of the posted speed limit shall only occur on paved surfaces.

1101-8 MATERIAL AND EQUIPMENT STORAGE

When work is not in progress, keep all personnel, equipment, machinery, tools, construction debris, materials and supplies away from active travel lanes that meets Table 1101-1.

Section 1101

TABLE 1101-1 MATERIAL AND EQUIPMENT STORAGE FROM ACTIVE TRAVEL LANES	
Posted Speed Limit (mph)	Distance (ft)
40 or less	≥ 18
45-50	≥ 28
55	≥ 32
60 or higher	≥ 40

When vehicles, equipment and materials are protected by concrete barrier or guardrail, they shall be offset at least 5 feet from the barrier or guardrail.

1101-9 PARKING OF PERSONAL VEHICLES

Provide staging areas for personal vehicle parking in accordance with Article 1101-8 or as directed by the Engineer before use.

1101-10 PROTECTION OF HAZARDS

Mark all hazards with signs, barricades, drums or other warning devices.

At each location where work is started which creates a safety hazard, continue the work until completed to the extent that the safety hazard is eliminated. If the work is not pursued in a continuous manner the Engineer will not allow any other work on the project to be performed until the existing safety hazard is eliminated.

1101-11 TEMPORARY LANE CLOSURES

(A) General

Operate all equipment and personnel within the designated work area during lane closures. Do not impede or stop traffic for the purpose of performing construction related work on the traffic side of the lane closure, except when called for in the TMP.

Install lane closures with the traffic flow, beginning with devices on the upstream side of traffic. Remove lane closures against the traffic flow, beginning with devices on the downstream side of traffic.

Vehicles used to install or remove lane closures shall have vehicle warning lights as described in Article 1101-5.

(B) Intersections

When construction proceeds through an intersection, provide flaggers and all other necessary traffic control as required by the TMP to direct the traffic through the intersection. When an intersection is signalized, place the signal in flash mode and provide law enforcement or other adequate traffic control measure to direct traffic through the intersection before beginning work in the intersection.

1101-12 TEMPORARY ROAD CLOSURES

(A) Traffic Pattern Alterations

Notify the Engineer 30 calendar days before altering the existing traffic pattern, unless otherwise stated in the TMP.

Plan all traffic pattern alterations and meet with the Engineer to discuss the implementation strategy before altering traffic. The Engineer will notify the proper authorities and other affected parties as necessary.

(B) Detour

Ensure that all required detour signing and delineation, including work done by others, are in place before placing traffic onto a detour.

Section 1101**(C) Traffic Stoppage**

Limit the stoppage of traffic to times specified in the TMP. Provide time between consecutive stoppages to allow the traffic queue to deplete.

1101-13 TRAFFIC CONTROL SUPERVISION

Provide the service of at least one qualified work zone supervisor. The work zone supervisor shall have the overall responsibility for the proper implementation of the TMP and ensure all employees working inside the NCDOT right of way have received the proper training appropriate to the job decisions each individual is required to make.

The work zone supervisor is not required to be on site at all times but shall be available to address concerns of the Engineer. The name and contact information of the work zone supervisor shall be provided to the Engineer prior to or at the preconstruction conference.

Qualification of work zone supervisors shall be done by an NCDOT approved training agency or other approved training provider. For a complete listing of approved training agencies, see the Work Zone Safety Training webpage.

Coordinate with and cooperate with work zone supervisors of adjacent or overlapping construction projects to ensure safe and adequate traffic control is maintained throughout the projects at all times including periods of construction inactivity in accordance with Article 105-7.

All certification records for qualified work zone supervisors shall be uploaded by the approved training agency or other approved training provider to the Department's Work Zone Education Verification App (WZ-EVA) prior to the qualified work zone supervisor performing any work zone supervisor duties on the project. For more information about WZ-EVA, see the Work Zone Safety Training webpage.

1101-14 WORK ZONE INSTALLER

Provide the service of at least one qualified work zone installer during the setup, installation, and removal of temporary traffic control within the highway right of way. The qualified work zone installer shall serve as crew leader and shall be on site and directing the installation and removal of temporary traffic control. If multiple temporary traffic control installations or removals are occurring simultaneously, then each shall have a qualified work zone installer.

The work zone installer shall be qualified by an NCDOT approved training agency or other NCDOT approved training provider in the safe and competent set up of temporary traffic control. For a complete listing of approved training agencies, see the Work Zone Safety Training webpage.

A work zone supervisor, in accordance with Article 1101-13 of the Standard Specifications, may fulfill the role of the work zone installer during the setup, installation, and removal of temporary traffic control within the highway right of way provided they are on site and directing the installation and removal of temporary traffic control.

All other individuals participating in the setup, installation, and removal of temporary traffic control within the highway right of way shall be certified as a qualified flagger in accordance with Article 1150-3 of the Standard Specifications, even if flagging is not being performed as part of the traffic control.

Provide the name and contact information of all qualified work zone installers to the Engineer prior to or at the preconstruction conference. Additionally, provide a qualification statement that all other individuals participating in the setup, installation, and removal of temporary traffic control are qualified flaggers that have been properly trained through an NCDOT approved training agency or other NCDOT approved training provider.

All certification records for qualified work zone installers and flaggers shall be uploaded by the approved training agency or other NCDOT approved training provider to the

Section 1105

Department's Work Zone Education Verification App (WZ-EVA) prior to the qualified work zone installer or flagger performing any traffic control duties on the project. For more information about WZ-EVA, see the Work Zone Safety Training webpage.

1101-15 VEHICULAR ACCESS

Maintain continuous and safe vehicular access, including but not limited to, all residences, businesses, schools, police and fire stations, hydrants, other emergency services, hospitals and mailboxes. Conduct operations so as to limit the inconvenience to property owners.

1101-16 PEDESTRIAN ACCESS

Maintain pedestrian access at all times as shown in the TMP. When existing continuous pedestrian facilities are disrupted, closed or relocated, provide temporary facilities that are detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Temporary pedestrian facilities constructed for maintaining pedestrian access during construction shall be made of concrete, asphalt or other suitable material as approved by the Engineer. If establishing or maintaining a temporary pedestrian facility is not feasible, alternate methods for providing pedestrian accommodations may be used, such as a pedestrian transport service or a dedicated traffic control employee to assist and direct pedestrians around the work area for short duration disruptions. The work zone supervisor is responsible for the implementation of the TMP, and installation and maintenance of the ADA compliant pedestrian traffic control devices. The work zone shall be inspected weekly or as directed by the Engineer. Do not have any abrupt changes in grade or terrain that could cause a tripping hazard or could be a barrier to wheelchair use. Provide ADA compliant channelizing devices that are detectable to pedestrians who have visual disabilities.

Do not sever or move pedestrian facilities for non-construction activities such as parking for vehicles and equipment. Separate pedestrian movements from both work zone activity and vehicular traffic.

SECTION 1105 TEMPORARY TRAFFIC CONTROL DEVICES

1105-1 DESCRIPTION

Furnish, install, maintain, relocate and remove temporary traffic control devices. All temporary traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise specified in the contract.

1105-2 MATERIALS

Refer to Division 10.

Provide temporary traffic control devices that are listed on the NCDOT Approved Product List.

1105-3 CONSTRUCTION METHODS

Ensure all temporary traffic control devices are inspected and approved before using them on the project. Install temporary traffic control devices before construction operations begin and during the proper phase of construction. Maintain and relocate temporary traffic control devices during the time they are in use. Keep these devices in place as long as they are needed and immediately remove thereafter. When operations are performed in stages, install only those devices that apply to the present conditions.

Section 1110

1105-4 MAINTENANCE AND INSPECTION

Submit a proposed traffic control device maintenance schedule and checklist for approval before construction. Perform continuous maintenance and daily scheduled inspections of temporary traffic control devices. Review and maintain all traffic handling measures to ensure that adequate provisions are in place for public and workers' safety.

Maintenance activities include cleaning, repair, or replacement, and prompt disposal of temporary traffic control devices that are damaged, torn, crushed, discolored, displaced or deteriorated beyond effectiveness.

Replace work zone traffic control devices deemed unacceptable according to the guidelines set forth in the American Traffic Safety Service Association's (ATSSA) Quality Guidelines for Work Zone Traffic Control Devices.

If the name and telephone number of the agency, Contractor or supplier is shown on the non-retroreflective surface of all channelizing devices, use letters and numbers that are non-reflective and not over 2 inches in height.

1105-5 FAILURE TO MAINTAIN TRAFFIC CONTROL

Failure to maintain acceptable traffic control measures or temporary traffic control devices may result in formal notification of noncompliance. Implement remedial action immediately for imminent danger situations as directed by the Engineer. Implement remedial action within 48 hours after notification of a safety issue that is not an imminent danger. See Articles 107-21 and 108-7.

Failure to comply may result in having the work performed with available forces and equipment. In cases of willful disregard for the safety of the public, the Engineer may proceed immediately to implement the measures necessary to provide the appropriate level of traffic control to ensure that the safety of all concerned parties is maintained.

1105-6 MEASUREMENT AND PAYMENT

Payment at the contract unit prices for the various items in the contract will be full compensation for all work covered by this specification.

If the Contractor fails to maintain acceptable traffic control measures or temporary traffic control devices and the Engineer implements measures necessary to provide the appropriate level of traffic control, the actual cost of performing said work will be deducted from the monies due the Contractor on the contract.

**SECTION 1110
WORK ZONE SIGNS**

1110-1 DESCRIPTION

Furnish, install, maintain, temporarily cover and uncover, relocate and remove stationary and barricade mounted work zone signs in accordance with the contract.

Furnish, install, maintain and relocate portable work zone signs and portable work zone sign stands in accordance with the plans and the *Standard Specifications*. When portable work zone signs and portable work zone sign stands are not in use for periods longer than 30 minutes, collapse or remove sign stands and reinstall once work begins again.

1110-2 MATERIALS

Refer to Division 10.

Item	Section
Work Zone Signs	1089-1
Work Zone Sign Supports	1089-2

Section 1110

Use portable work zone signs only with portable work zone sign stands specifically designed for one another.

Provide portable work zone sign stands, portable signs and sheeting that are listed on the NCDOT APL.

Provide portable work zone signs and stands that are crash tested together as a system by the manufacturer. Poor performance of portable work zone signs or portable work zone sign stands at any site, whether or not related to a specific contract, will be grounds for non-acceptance of a product on any project under contract.

1110-3 CONSTRUCTION METHODS**(A) Work Zone Signs (Stationary)**

All stationary Advance/General warning work zone signs require notification to existing utility owners per Article 105-8 within 3 to 12 working days prior to installation.

Install work zone signs (stationary) to stand within 2° of plumb in all directions and under all conditions. Erect signs per *Roadway Standard Drawings*.

Splicing of work zone sign (stationary) posts is acceptable. Splice work zone sign (stationary) posts according to *Roadway Standard Drawings*. Remove entire post when removing signs with spliced posts.

When required, cover work zone signs with an opaque material that prevents reading of the sign at night by a driver using high beam headlights. Use material that does not damage the sign sheeting.

Any damage incurred from the covering of work zone signs will be determined using Article 901-5. Replace or repair any damaged signs due to the covering.

(B) Work Zone Signs (Barricade Mounted)

Mount approved composite or roll up signs to barricade rails so the signs do not cover more than 50% of the top 2 rails or 33% of the total area of the 3 rails. Mount signs at least one foot from the ground to the bottom of the sign.

(C) Work Zone Signs (Portable)

Install the work zone sign (portable) and sign stand to stand plumb within 10° left and right, within 20° front and back and be capable of standing erect in windy conditions.

Install roll up or approved composite signs at least one foot from the bottom of the sign to the edge of pavement elevation on two-lane two-way roadways. Install roll up or approved composite signs at least 5 feet from the bottom of the sign to the edge of pavement elevation on multi-lane roadways.

Clean the sign face before use.

When not in use for periods longer than 30 minutes, lay the work zone sign (portable) flat on the ground and collapse the sign stand and lay it flat on the ground.

1110-4 MEASUREMENT AND PAYMENT

Nominal dimensions will be used to compute the sign panel areas.

Work Zone Signs (Stationary) will be measured and paid as the actual number of square feet satisfactorily installed at each location and accepted by the Engineer. Where a particular sign is used at more than one location, measurement will be made at each location. Payment for *Work Zone Signs (Stationary)* will be limited to a maximum of 90% of the total installed quantity. The remaining 10% will be paid once all signs have been removed.

Work Zone Signs (Barricade Mounted) will be measured and paid as the actual number of square feet satisfactorily installed on barricades and accepted by the Engineer. Payment will

Section 1115

- 1

2
- be made for the initial installation only. Relocation of signs will be incidental to the measurement of the quantity of signs.
- 3

4

5

6
- Work Zone Signs (Portable)* will be measured and paid as the actual number of square feet satisfactorily installed and accepted by the Engineer. Payment will be made for the initial installation only. Relocation of signs will be incidental to the measurement of the quantity of signs.
- 7

8

9
- No direct payment will be made for stationary work zone sign supports or portable work zone sign stands. All stationary work zone sign supports or portable work zone sign stands will be incidental to the work of providing work zone signs.
- 10
- Payment will be made under:

Pay Item	Pay Unit
Work Zones Signs (Stationary)	Square Foot
Work Zones Signs (Barricade Mounted)	Square Foot
Work Zones Signs (Portable)	Square Foot

SECTION 1135 CONES

1135-1 DESCRIPTION

Furnish, install, relocate, maintain and remove cones and reflective cone collars.

1135-2 MATERIALS

Refer to Division 10.

Item

Cones

Section

1089-5

Provide cones listed on the NCDOT APL.

1135-3 CONSTRUCTION METHODS

Use retroreflective adhesive sheeting on all cones used between dusk and dawn. Use the same type of retroreflective sheeting on all cone collars installed at any one time during the life of the project. Do not use cones in the upstream taper of lane or shoulder closures for multi-lane roadways. Do not use cones for longer than 3 consecutive days.

Use ballasting methods in accordance with manufacturer's specification.

Cones may be used on all facilities using the following requirements:

(A) For facilities with speed limits below 45 mph cones shall be spaced at 20 feet in the taper and 40 feet in tangent sections.

(B) For facilities with speed limits of 45 mph or higher, drums shall be used in the taper spaced in accordance with Article 1130-3 and cones shall be spaced at 80 feet in the tangent sections.

Do not intermix with drums or skinny drums in either the taper or the tangent sections.

Immediately replace and dispose of any cone that is torn, crushed, discolored or otherwise damaged.

1135-4 MEASUREMENT AND PAYMENT

Cones will be measured and paid as the maximum number of cones acceptably placed and in use at any one time during the life of the project.

Relocation, replacement, repair, maintenance or disposal of cones will be incidental to the work of this section.

Payment will be made under:

DIVISION 16

EROSION CONTROL AND ROADSIDE DEVELOPMENT

SECTION 1605 TEMPORARY SILT FENCE

1605-1 DESCRIPTION

Furnish material, construct, maintain and remove temporary silt fence in locations shown in the plans or in locations that require surface drainage to be filtered.

1605-2 MATERIALS

Refer to Division 10.

Item	Section
Geotextile, Type 3	1056

(A) Posts

Provide steel posts with at least 5 feet long, 1 3/8 inch wide measured parallel to the fence and 1.25 lbs. per foot in weight per length. Equip with an anchor plate with an area of at least 14.0 square inches. Ensure a means of retaining fencing material in the desired position without displacement.

(B) Woven Wire Fence

Provide woven wire fence at least 32 inches high with 5 horizontal wires, vertical wires spaced 12 inches apart, 10 gauge top and bottom wires and 12 1/2 gauge for all other wires.

(C) Attachment Device

Provide plastic ties, wire fasteners or other approved attachment device.

1605-3 CONSTRUCTION METHODS

Install in locations as shown in the plans or as directed by the Engineer.

Install wire and geotextile as shown in *Roadway Standard Drawings*.

Geotextile may be used without the woven wire fence backing with a post spacing of not more than 6 feet.

Install post inclined toward runoff source, at an angle of not more than 20° from vertical.

Attach geotextile to the post with acceptable methods.

Overlap geotextile at least 18 inches at splice joints.

1605-4 MAINTENANCE AND REMOVAL

Maintain the silt fence until the project is accepted by the Engineer or until the fence is removed. Remove and replace deteriorated or ineffective geotextile. Remove and dispose of silt accumulations in accordance with Section 1630 when necessary or as directed by the Engineer.

Leave silt fence in place until site stabilization and remove at project completion. Removed silt fence becomes the property of the Contractor. Dress and seed and mulch all areas where silt fence is removed in accordance with Section 1660.

Section 1606

1605-5 MEASUREMENT AND PAYMENT

Temporary Silt Fence will be measured and paid in linear feet, accepted in place, along the ground line of the fence. Temporary Silt Fence that requires removal and replacement due to general deterioration or ineffective geotextile will be paid at contract unit prices. Repairs to the fence due to carelessness or neglect on the part of the Contractor will be at no cost to the Department.

Silt Excavation will be measured and paid in accordance with Article 1630-3.

Seeding and Mulching will be measured and paid in accordance with Article 1660-8.

Article 104-5, pertaining to revised contract prices, will not apply to *Temporary Silt Fence*.

No revision in the contract unit price will be allowed because of any overrun or underrun.

Payment will be made under:

Pay Item

Temporary Silt Fence

Pay Unit

Linear Foot

SECTION 1610
STONE FOR EROSION CONTROL

1610-1 DESCRIPTION

Furnish, stockpile if directed by the Engineer, place and maintain an approved stone for construction of erosion control devices at ditches, diversions, swales, pipe inlets, pipe outlets, drainage turnouts and at other locations designated in the plans or as directed by the Engineer. The work includes, but is not limited to, furnishing, weighing, stockpiling, re-handling, placing and maintaining stone; and disposal of any stone not incorporated into the project when necessary.

1610-2 MATERIALS

Refer to Division 10.

Item	Section
Sediment Control Stone	1005
Stone for Erosion Control	1042

Use the class or standard size of stone specified in the contract.

1610-3 CONSTRUCTION METHODS

Place stone, in locations and to the thickness, widths and lengths as shown in the plans or as directed by the Engineer. Construct erosion control devices in accordance with the plans neatly and uniformly with an even surface and meeting the plans.

1610-4 MEASUREMENT AND PAYMENT

Stone For Erosion Control, Class __ will be measured and paid in tons of each class of stone incorporated into the work, or has been delivered to and stockpiled on the project as directed by the Engineer. Stone placed in the stockpile will not be measured a second time. Measure stone by weighing in trucks on certified platform scales or other certified weighing devices.

Sediment Control Stone will be measured and paid in tons of stone incorporated into the work, or has been delivered to and stockpiled on the project as directed by the Engineer. Stone placed in the stockpile will not be measured a second time. Measure stone by weighing in trucks on certified platform scales or other certified weighing devices.

Payment will be made under:

Pay Item	Pay Unit
Stone For Erosion Control, Class __	Ton
Sediment Control Stone	Ton

Section 1615

**SECTION 1615
TEMPORARY MULCHING**

1615-1 DESCRIPTION

Furnish, place and secure mulch material to prevent excessive soil erosion during construction operations where it is impossible or impractical to perform permanent seeding and mulching.

The actual conditions which occur during the construction of the project will determine the quantity of mulching. The quantity of mulching may be increased, decreased or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of work.

1615-2 MATERIALS

Refer to Division 10.

Item	Section
Mulch for Erosion Control	1060-5
Tacking Material	1060-5

1615-3 CONSTRUCTION METHODS

Place temporary mulch promptly at locations on temporarily seeded or non-seeded areas when so directed by the Engineer.

Spread mulch uniformly over the area by hand or by means of appropriate mechanical spreaders or blowers to obtain a satisfactory uniform cover. A satisfactory application of temporary mulch on non-seeded areas consists of a sufficient amount to completely and uniformly cover the ground. Apply tack within 24 hours after temporary mulch application.

When temporary mulching is performed in conjunction with temporary seeding, apply mulch in accordance with Article 1660-6. Complete mulching and tacking within 24 hours of temporary seeding work. Exercise care to prevent displacement of soil and seed or other damage to areas where temporary seeding is done.

Apply tack meeting the requirements of Article 1060-5 when using grain straw to assure that the temporary mulch is properly held in place. Take adequate precautions to prevent damage to traffic, structures, guardrails, traffic control devices or any other appurtenances during the application of tacking material. Provide adequate covering or change methods of application as required to prevent such damage. Repair any damage that occurs, including any necessary cleaning.

Apply emulsified asphalt tackifier at a rate of 0.10 gallons per square yard (approximately 484 gallons per acre). Apply cellulose hydromulches at a rate of 1000 pounds (dry weight) per acre. Apply other approved tackifiers at manufacturer's recommended application rate.

Take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes and promptly remove any blockage to drainage facilities.

1615-4 MEASUREMENT AND PAYMENT

Temporary Mulching will be measured and paid in acres, measured along the surface of the ground over which temporary mulch has been placed as directed and accepted by the Engineer.

Tacking material is incidental to the application of *Temporary Mulching* and no additional payment will be made.

Payment will be made under:

Section 1620

Pay Item
Temporary Mulching

Pay Unit
Acre

SECTION 1620
TEMPORARY SEEDING

1620-1 DESCRIPTION

Seed and mulch selected areas in advance of the permanent seeding and mulching operations to minimize erosion of graded areas during construction operations. The work includes preparing seedbeds; furnishing, placing and covering fertilizer and seed; furnishing and placing mulch; and other operations necessary for seeding the required areas.

Perform temporary seeding promptly at the locations and under any of the following conditions when directed by the Engineer:

(A) When it is impossible or impractical to bring an area to the final line, grade and finish so that permanent seeding and mulching operations can be performed without subsequent serious disturbance by additional grading;

(B) When erosion occurs or is considered to be potentially substantial on areas of graded roadbed where construction operations are temporarily suspended or where the grading of the roadbed has been completed substantially in advance of the paving construction;

(C) During seasons of the year when permanent seeding and mulching is prohibited by the contract;

(D) When an immediate cover would be desirable to minimize erosion, siltation or pollution on any area.

The actual conditions that occur during the construction of the project will determine the quantity of seed or fertilizer to be used. The quantity of seed or fertilizer may be increased, decreased or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

1620-2 MATERIALS

Refer to Division 10.

Item	Section
Fertilizer	1060-2
Mulch for erosion control	1060-5
Seed	1060-4

See the contract for analysis of fertilizer and the kinds of seed.

1620-3 CONSTRUCTION METHODS

(A) Seedbed Preparation

Scarify areas to be seeded to a depth of not less than 5 inches unless directed by the Engineer otherwise. The soil conditions and topography will determine the required depth of the seedbed.

Prepare the surface to be seeded with adequate furrows, ridges, terraces, trenches or other irregularities in which seeding materials can lodge with reasonable assurance that the materials will not be easily displaced by wind, rain or surface runoff.

(B) Applying and Covering Fertilizer and Seed

The analysis of fertilizer, the kinds of seed and the rates of application of fertilizer and seed shall be as stated in the contract.

Apply no fertilizer or seed when the Engineer determines that conditions are unfavorable

Section 1622

for such operations.

Distribute the fertilizer or seed uniformly over the seedbed at the required rates of applications.

Cover fertilizer and seed unless otherwise directed by the Engineer. If covering is required, provide it to the depth acceptable to the Engineer for the prevention of displacement by wind, rain or surface runoff.

Mulch all areas temporarily seeded, in accordance with Section 1615, unless otherwise indicated in the contract or as directed by the Engineer.

Article 1660-5 will be applicable to the approval of equipment and the protection of traffic, structures, guardrails, traffic control devices and other appurtenances.

(C) Mowing and Repair of Temporary Seeding

Maintain areas where temporary seeding is performed in a satisfactory condition, including mowing at the locations and times as directed by the Engineer.

Repair areas of temporary seeding which have been damaged or have failed. Repair includes reshaping or the placing of additional earth material and repeating the seeding process.

1620-4 MEASUREMENT AND PAYMENT

Seed for Temporary Seeding will be measured and paid in pounds. The weight of seed will be determined by bag count of standard weight bags or by weighing the seed.

Fertilizer for Temporary Seeding will be measured and paid in tons. The weight of dry fertilizer will be determined by bag count of standard weight bags or by weighing the fertilizer in trucks on certified platform scales or other certified weighing devices.

Temporary Mulching will be measured and paid in accordance with Article 1615-4.

Mowing will be measured and paid in accordance with Article 1660-8.

Where earthwork and temporary seeding have been adequately constructed, completely drained and properly maintained, and damage occurs due to natural causes, the Contractor will be paid at the contract unit price for the excavated material required for repairs to the damaged earthwork and the contract unit prices for *Seed For Temporary Seeding* and *Fertilizer for Temporary Seeding* for correcting the damaged temporary seeding.

Repair, at no cost to the Department, any damage to earthwork or temporary seeding which is due to carelessness or neglect on the part of the Contractor.

Payment will be made under:

Pay Item

Seed For Temporary Seeding

Fertilizer For Temporary Seeding

Pay Unit

Pound

Ton

SECTION 1632
ROCK INLET SEDIMENT TRAP

1632-1 DESCRIPTION

Construct, maintain and remove devices around catch basins and/or drop inlets to reduce water velocity and contain sediment. Work includes furnishing all fence posts, hardware cloth, hardware, stone and other materials, installing and maintaining the 1/4 inch hardware cloth.

The actual conditions which occur during the construction of the project will determine the quantity of rock inlet sediment traps constructed. The quantity of inlet sediment traps may be increased, decreased or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

1632-2 MATERIALS

Refer to Division 10.

Item	Section
Sediment Control Stone, Standard Size No. 5 or 57	1005
Stone for Erosion Control, Class A or Class B	1042

(A) Steel Posts

Provide steel posts in accordance with Subarticle 1605-2(A).

(B) Attachment Devices

Provide plastic ties, wire fasteners or other approved attachment device.

(C) 1/4" Hardware Cloth

Provide hardware cloth with 1/4 inch openings constructed from 24 gauge wire and with at least 48 inches width as specified in ASTM A740.

1632-3 CONSTRUCTION METHODS

(A) Type A

Place structural stone, Class B, around the outside perimeter of the inlet structure with approximately 2:1 side slopes and plate the upstream side with sediment control stone.

(B) Type B

Place structural stone, Class A, around the outside perimeter of the inlet structure with approximately 2:1 side slopes and plate the upstream side with sediment control stone.

(C) Type C

Construct rock inlet sediment trap Type C devices as shown in the plans and at other locations as directed by the Engineer. Attach hardware cloth to posts with wire staple or other acceptable methods.

1632-4 MAINTENANCE AND REMOVAL

Maintain the rock inlet sediment trap, remove and dispose of silt accumulations at the inlet sediment traps in accordance with Section 1630 or as directed by the Engineer.

Remove rock inlet sediment traps as the project nears completion, or as directed by the

Section 1633

- 1 Engineer. Dress the area to blend with existing contours, seed and mulch the area in
- 2 accordance with Section 1660.
- 3 **1632-5 MEASUREMENT AND PAYMENT**
- 4 Payment for rock inlet sediment traps will be made as follows:
- 5 *1/4" Hardware Cloth* will be measured and paid in linear feet of hardware cloth, measured in
- 6 place from end post to end post at each separate installation completed and accepted.
- 7 *Stone for Erosion Control, Class ____* will be measured and paid in accordance with
- 8 Article 1610-4.
- 9 *Sediment Control Stone* will be measured and paid in accordance with Article 1610-4.
- 10 *Silt Excavation* will be measured and paid in accordance with Article 1630-3.
- 11 Payment will be made under:

Pay Item	Pay Unit
1/4" Hardware Cloth	Linear Foot

SECTION 1635
ROCK PIPE INLET SEDIMENT TRAP

1635-1 DESCRIPTION

Construct, maintain and remove devices placed around outside perimeters of pipe structures, to reduce water velocity and trap sediment.

The conditions which occur during the construction of the project will determine the quantity of temporary rock pipe inlet sediment traps to be constructed. The quantity of inlet sediment traps may be increased, decreased or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a

Section 1636

change in the character of the work.

1635-2 MATERIALS

Refer to Division 10.

Item	Section
Sediment Control Stone, Standard Size No. 5 or 57	1005
Stone for Erosion Control, Class A or Class B	1042

1635-3 CONSTRUCTION METHODS

(A) Type A

Construct rock pipe inlet sediment trap Type A devices at locations shown in the plans or as directed by the Engineer.

(B) Type B

Construct rock pipe inlet sediment trap Type B devices at locations shown in the plans or as directed by the Engineer.

1635-4 MAINTENANCE AND REMOVAL

Maintain the rock pipe inlet sediment traps, remove and dispose of silt accumulations at the pipe inlet sediment traps in accordance with Section 1630 or as directed by the Engineer.

Remove rock pipe inlet sediment traps as the project nears completion, or as directed by the Engineer. Prepare a seed bed to blend with existing contours and seed and mulch in accordance with Section 1660.

1635-5 MEASUREMENT AND PAYMENT

Payment for temporary rock pipe inlet sediment traps will be as follows:

Stone for Erosion Control, Class ____ will be measured and paid in accordance with Article 1610-4.

Sediment Control Stone will be measured and paid in accordance with Article 1610-4.

Silt Excavation will be measured and paid in accordance with Article 1630-3.

SECTION 1651 SELECTIVE VEGETATION REMOVAL

1651-1 DESCRIPTION

Remove selected living trees and undesirable living undergrowth from areas of the right of way outside clearing limits in accordance with the contract. Work includes treating stumps with herbicide and repairing any damage to vegetation.

1651-2 MATERIALS

Refer to Division 10.

Item	Section
Herbicide	1060-13

1651-3 CONSTRUCTION METHODS

(A) Trees

Remove trees shown in the plans or designated by the Engineer. Measure all tree diameter sizes at a height of 4.5 feet above the ground.

(B) Undergrowth

Remove all undergrowth from areas shown in the plans, described in the specifications or designated, except for those plants designated to be preserved. All plants less than 4 inches in diameter, measured at a height of 4.5 feet above the ground shall be classified as undergrowth.

(C) General

Treat stumps with a herbicide immediately after cutting to prevent sprouting. Use the herbicide and the method and rate of application specified in the specifications. Follow all applicable instructions, warnings and safety precautions stated on the manufacturer's label, and comply with all laws and regulations governing herbicides that are in effect at the time of use.

When work is performed properly in accordance with these specifications, no subsequent re-cutting of sprouts or seedling growth will be required.

Dispose of all trees and undergrowth cut in accordance with Article 200-5.

1651-4 DAMAGE TO REMAINING VEGETATION

Conduct operations so as to prevent injury to trees, shrubs or other types of vegetation that are to remain growing, and also to prevent damage to adjacent property.

Remove broken branches and rough edges of scarred trees or shrubs. Shape and make smooth

Section 1657

these areas in accordance with generally accepted horticultural practice. Cut and dispose of any plants that are damaged beyond their value for landscape purposes and seed and mulch vegetation that is damaged by the Contractor at no cost to the Department.

1651-5 MEASUREMENT AND PAYMENT

Selective Tree Removal ___" will be measured and paid in units of each. Each tree removed will be paid at the contract unit price for the pay item size applicable to the actual tree diameter, measured at a height of 4.5 feet above the ground, as indicated in Table 1651-1.

TABLE 1651-1 SELECT TREE REMOVAL PAY ITEM SIZES	
Pay Item Size	Actual Tree Diameter
6 inch	4 inches up to 8 inches
10 inch	8 inches up to 12 inches
15 inch	12 inches up to 18 inches
18 inches	18 inches and over

Selective Undergrowth Removal will be measured and paid in acres, measured horizontally, completed and accepted.

Payment will be made under:

Pay Item	Pay Unit
Selective Tree Removal, 6"	Each
Selective Tree Removal, 10"	Each
Selective Tree Removal, 15"	Each
Selective Tree Removal, 18"	Each
Selective Undergrowth Removal	Acre

SECTION 1660 SEEDING AND MULCHING

1660-1 DESCRIPTION

Prepare seedbed; furnish, place and incorporate limestone, fertilizer and seed; compact seedbed; furnish, place and secure mulch; mow; and perform other operations necessary for the permanent establishment of vegetation from seed on shoulders, slopes, ditches or other roadside areas.

Perform seeding and mulching on all earth areas disturbed by construction and on portions of areas seeded under previous contracts as directed by the Engineer where there is unsatisfactory vegetative cover.

Adapt operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses or legumes.

Preserve the required line, grade and cross section of the area treated.

The actual conditions which occur during the construction of the project will determine the quantity of mowing. The quantity of mowing may be increased, decreased or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

1660-2 MATERIALS

Refer to Division 10.

Item	Section
Fertilizer	1060-2
Limestone	1060-3
Seed	1060-4
Mulch for Erosion Control	1060-5
Tacking Material	1060-5

The analysis of fertilizer and the kinds of seed will be as stated in the contract.

1660-3 COORDINATION WITH GRADING OPERATIONS

Perform seeding and mulching operations on a section by section basis immediately upon completion of earthwork sections in accordance with Article 225-2.

When grading operations have been suspended, and seeding and mulching has been performed on areas where work has been suspended, include in the work of seeding and mulching of the adjacent sections any necessary overlapping of operations on previously established vegetative cover.

Section 1660

When the Contractor fails or neglects to coordinate grading with seeding and mulching operations and to pursue diligently the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer. Such suspension will be in accordance with Article 108-7.

1660-4 SEEDBED PREPARATION

Cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Shape and smooth uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, to provide for more effective seeding and for ease of subsequent mowing operations.

Scarify or otherwise loosen the soil to a depth of not less than 5 inches except as otherwise provided below or otherwise directed by the Engineer. Break clods and work the top 2 inches to 3 inches of soil into an acceptable seedbed by the use of soil pulverizers, drags or harrows; or by other methods approved by the Engineer. Remove all rock and debris 3 inches or larger on median, shoulder and ditch cut or fill slopes which are 3:1 or flatter, before the application of seed and fertilizer. Remove rock 6 inches and larger displaced during seeding operations.

Scarify, groove, trench or puncture all slope surfaces. The depth of preparation and the degree of smoothness of the seedbed may be reduced on cut slopes that are 2:1 and steeper, as permitted by the Engineer.

On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in a condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.

Limit seedbed preparation to within 2 feet of the edge of any pavement to a depth of 2 inches to 3 inches.

Do not prepare seedbed when the soil is frozen, extremely wet or when the Engineer determines that it is an otherwise unfavorable working condition.

1660-5 APPLYING AND COVERING LIMESTONE, FERTILIZER AND SEED**(A) General**

The contract will state the seasonal limitation for seeding operations; the kinds of grades of fertilizers; the kinds of seed; and the rates of application of limestone, fertilizer and seed.

Obtain approval from the Engineer before using equipment for the application, covering or compaction of limestone, fertilizer and seed. Approval may be revoked by the Engineer at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.

Apply limestone, fertilizer and seed within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer. When the Engineer determines that weather and soil conditions are unfavorable, do not distribute any limestone or fertilizer and do not sow any seed.

Take adequate precautions to prevent damage to traffic, structures, guardrails, traffic control devices or any other appurtenances during the application of fertilizer. Provide adequate covering or change methods of application as required to avoid such damage. Repair any damage that occurs, including any cleaning that may be necessary.

Section 1660

(B) Limestone and Fertilizer

Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, distribute limestone and fertilizer uniformly over the prepared seedbed at the specified rate of application and then harrow, rake or otherwise thoroughly work or mix into the seedbed.

(C) Seed

Distribute seed uniformly over the seedbed at the required rate of application, and immediately harrow, drag, rake or otherwise work so as to cover the seed with a layer of soil. Cover to a depth as directed by the Engineer. If two kinds of seed are to be used which require different depths of covering, sow separately.

When a combination seed and fertilizer drill is used, drill fertilizer with seed after applying and incorporating limestone into the soil. If using two kinds of seed requiring different depth of cover, the seed requiring the lighter cover may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

When using a hydraulic seeder for application of seed and fertilizer, do not allow the seed to remain in water containing fertilizer for more than 30 minutes before application unless otherwise permitted by the Engineer.

Compact the seedbed immediately after seed has been properly covered in the manner and degree approved by the Engineer.

(D) Modifications

When adverse seeding conditions are encountered due to steepness of slope, height of slope or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed and fertilizer; and compaction of the seedbed.

Such modifications with approval by the Engineer may include but not be limited to the following:

(1) The incorporation of limestone into the seedbed may be omitted as follows:

- (a) On cut slopes steeper than 2:1;
- (b) On 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or
- (c) On areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

(2) The rates of application of limestone, fertilizer and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.

(3) Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces or on other areas where soil conditions would make compaction undesirable.

1660-6 MULCHING**(A) General**

Mulch all seeded areas unless otherwise indicated in the contract or directed by the Engineer.

Use grain straw as mulch at any time of the year. If permission to use material other than grain straw is requested and the use of such material is approved by the Engineer, the seasonal limitations, the methods and rates of application, the type of binding material or

Section 1660

other conditions governing the use of such material will be established by the Engineer at the time of approval.

(B) Applying Mulch

Apply mulch within 24 hours after completion of seeding unless otherwise permitted by the Engineer. Exercise care to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

Spread mulch uniformly by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion and conserve soil moisture.

(C) Holding Mulch

Provide and apply tacking material to hold mulch in place in accordance with Article 1060-5. Apply emulsified asphalt tackifier at a rate of 0.10 gallons per square yard (approximately 484 gallons per acre). Apply cellulose hydromulches at a rate of 1000 pounds (dry weight) per acre. Apply other approved tackifiers at manufacturer's recommended application rate.

Take adequate precautions to prevent damage to traffic, structures, guardrails, traffic control devices or any other appurtenances during the application of asphalt binding material. Provide adequate covering or change methods of application as required to avoid such damage. Repair any damage that occurs, including any cleaning that may be necessary.

Take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes and promptly remove any blockage to drainage facilities which may occur.

1660-7 MAINTENANCE OF SEEDING AND MULCHING

Maintain areas where seeding and mulching have been performed in a satisfactory condition until final acceptance of the project.

Mow at the location and times as directed by the Engineer.

Correct areas of damage or failure due to any cause by repairing or completely reworking as directed by the Engineer.

Repair in accordance with Section 1661 where extensive seedbed preparation is unnecessary.

Rework seeding and mulching in accordance with this section where correction requires extensive seedbed preparation, or where earthwork repairs or complete reshaping are necessary.

As an exception to the above, repair areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, at no cost to the Department.

1660-8 MEASUREMENT AND PAYMENT

Seeding and Mulching will be measured and paid in acres, measured along the surface of the ground completed and accepted. No direct payment will be made for furnishing and applying the limestone and fertilizer as such work and materials will be incidental to the work covered by *Seeding and Mulching*.

Mowing will be measured and paid in acres measured along the surface of the ground mowed as directed by the Engineer. Where an area has been mowed more than once at the direction of the Engineer, separate measurement will be made each time the area is mowed.

Section 1661

- 1 Corrective work will be compensated where seeding and mulching has been damaged or has
2 failed to establish a satisfactory stand of vegetation.
- 3 Where correction can be made without extensive seedbed preparation, the work will be paid
4 in accordance with Article 1661-5 for *Seed for Repair Seeding* and *Fertilizer for Repair*
5 *Seeding*.
- 6 Where earthwork and seeding and mulching has been damaged to the extent that earthwork
7 repairs or complete reshaping are necessary, the Contractor will be paid at the contract unit
8 price for the excavated material required for repairs to the damaged earthwork, and at the
9 contract unit price for *Seeding and Mulching* for correcting the damaged seeding and
10 mulching.
- 11 As an exception to the above, repair, at no cost to the Department, any damage to earthwork
12 or seeded and mulched areas which is due to carelessness or neglect on the part of the
13 Contractor.
- 14 *Tacking Material* is incidental to *Seeding and Mulching* and no additional payment will be
15 made.
- 16 Payment will be made under:

Pay Item	Pay Unit
Seeding and Mulching	Acre
Mowing	Acre

SECTION 1670
PLANTING

1670-1 DESCRIPTION

Furnish, deliver and plant trees, shrubs, vines, ground covers, bedding plants and seedlings at locations shown in the plans or as directed by the Engineer, in accordance with these specifications.

The work of planting includes plant bed preparation, initial planting, plant establishment and replacement planting.

Perform the operations carefully to promote the continued life and healthy growth of all plants in their final location.

The actual conditions that occur during the construction of the project will determine the quantity of plant bed fumigation or post-emergent and pre-emergent herbicidal treatment for plant beds. The quantities of post-emergent and pre-emergent herbicidal treatment for plant beds may be increased, decreased or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

1670-2 MATERIALS

Refer to Division 10.

Item	Section
Fertilizer	1060-2
Herbicide	1060-13
Materials for Staking or Guying	1060-12
Mulch for Planting	1060-11
Nursery Grown Plant Materials	1060-10
Water	1060-9

Furnish nursery grown plant materials.

The contract will state the kind of herbicides to be used.

1670-3 WEATHER AND SEASONAL LIMITATIONS

Perform planting operations only between the dates shown in the contract except where otherwise permitted by the Engineer.

Do not plant when the temperature is below 32°F, when the plant hole is frozen or when soil to excavate and fill the plant hole is frozen or too wet.

Apply post-emergent herbicide when the weeds are near maturity but not when the weeds are under stress from drought, disease, insect damage or any other cause.

Do not apply post-emergent herbicide when rain is likely within the next 6 hours or as restricted on the product label.

1670-4 CARE AND HANDLING PLANTS

(A) General

Exercise utmost care in digging, loading, transporting, unloading, planting or otherwise handling plants and use adequate precautions to prevent injury to or drying out of the trunk, branches or roots; and to prevent freezing of the plant roots. Heel-in plants within 48 hours of delivery from the nursery, if they cannot be planted within that time.

Properly maintain all heeled-in plants until planted. Do not have plants remain heeled-in for more than 30 days. Open plants immediately when delivered in boxes or wrapped in

Section 1670

bundles or other forms of closed packages and inspect and dampen if necessary.

(B) Balled and Burlapped Plants

Protect the roots of balled and burlapped plants, if not immediately planted after delivery, by adequately covering with a soil, mulch or sawdust that is kept moist constantly in an acceptable manner appropriate to weather or seasonal conditions. Preserve the solidity of the plant ball carefully.

(C) Bare Rooted Plants

Refrigerate or immediately heel-in all plants, if not promptly planted, in moist soil, mulch or sawdust in an acceptable manner corresponding to generally accepted horticultural practice.

Protect the plants from drying out by means of wet canvas, burlap or straw or by other means acceptable while being transported or planted.

(D) Geophytes

Geophytes; bulbs, corms and tuberous plants; that are being shipped shall be packaged in containers that meet industry standards and have been pre-approved by the engineer. All individual packages shall be clearly labeled with quantity and cultivar name.

While bulbs, corms and tuberous plants are being transported or are being distributed in planting beds, or are awaiting planting after distribution, protect them from drying out by means of wet canvas, burlap, or straw, or by other means acceptable to the Engineer and appropriate to weather conditions and the length of time they will be out of the ground. Care shall be taken to avoid unnecessary injury to the bulbs before planting.

Pre-plant cool treatment is required for plants planted in a USDA Climatic Zones 9 and 10. Storage of bulbs, corms and tuberous plants which do not require pre-plant cool treatment shall be stored in open trays and placed in a 55°F - 65°F, dry place away from frost and heat and never allowed to dry out to the point of shriveling. Packing in slightly moist peat is preferred. The storage area shall be well-ventilated and ethylene-free. Do not store bulbs with fruit such as apples or pears which produces ethylene gas which can cause problems with flowering. Do not store bulbs in paper or plastic bags unless otherwise specified or approved by the Engineer. If a refrigerator is used it shall be frequently ventilated.

1670-5 PLANT LOCATION

Locate and mark on the ground locations for plants and outlines for areas to be planted or reforested and obtain approval from the Engineer before digging plant holes for beds.

Where so directed by the Engineer, furnish and install standard identification wires with plastic flags to designate individual plants in major planting areas.

Flags will not necessarily be needed for all plants required by the contract, but use these flags on portions of the project until plant locations in these portions are approved by the Engineer.

Unforeseen conditions may make it necessary to make minor adjustments in plant locations due to utility lines, traffic signs, rock, drainage, etc., and such adjustments will be permitted subject to approval by the Engineer.

1670-6 PRUNING

Prune shrubs and trees after planting as shown in the plans or as directed by the Engineer. Pruning done at any time in no way alters the Department's right to reject plant material. Prune in accordance with the International Society of Arboriculture pruning techniques, and according to shape, size and condition of the individual plant.

1670-7 PLANT BED TREATMENT

(A) General

Treat plant beds by application of herbicides where called for by the plans or directed by the Engineer.

(B) License

Make pesticide applications by or under the direct supervision of an applicator licensed by the North Carolina Department of Agriculture and Consumer Services.

(C) Post-Emergent Herbicidal Treatment

Post-emergent herbicidal treatment includes applications of a systemic post-emergent total vegetation control herbicide.

The contract will state the rates of application of the post-emergent herbicides.

Apply all herbicides in accordance with the manufacturer's instructions on the product label.

Apply post-emergent herbicide when the weeds are near maturity but not when the weeds are under stress from drought, disease, insect damage or any other cause. If cloudy weather or other poor growing conditions are present, extend this 7 day period until there are visible signs of herbicidal activity. Reapply if necessary to achieve a thorough control.

(1) Post-Emergent Application for Plant Bed Preparation

Apply a systemic post-emergent total vegetation control herbicide to the bed area before any tilling or mowing is performed. Perform no tilling or mowing for at least 7 days after the application. Thoroughly till the bed after the waiting period, or when injury to the vegetation appears. Prepare the soil in good tilth with no clods over one inch present and before planting.

(2) Post-Emergent Application for Plant Bed Maintenance

Apply a systemic post-emergent herbicidal treatment in accordance with product label in a manner to ensure no damage to planted material. Perform no mowing or vegetation removal by other means for at least 7 days after the application.

(D) Pre-Emergent Herbicidal Treatment

Pre-emergent herbicidal treatment includes the application of a pre-emergent herbicide.

Apply a pre-emergent herbicide to the plant bed after the existing vegetation has been completely controlled by a post-emergent herbicide application as specified in herein and after installation of planting and mulching as described in Articles 1670-9 and 1670-10. Apply pre-emergent herbicide following planting and mulching of plant bed before germination of weed seeds. An additional application of post-emergent herbicidal treatment may be necessary to control emerged weeds, as directed by the Engineer, if sufficient time has lapsed between tillage and installation of plant material and mulch. No direct payment will be made for additional post-emergent herbicidal work if such work is due to carelessness or neglect on the part of the Contractor.

Apply herbicide evenly over the soil surface with properly calibrated equipment at the specified rate.

If at least 0.5 inches of rainfall does not occur within 15 days of application of pre-emergent herbicidal treatment, apply at least 0.5 inches of water (2.8 gal/sy) uniformly over the planting area to activate the herbicide.

Section 1670

1670-8 EXCAVATION OF PLANT HOLES

Provide cylindrical shaped plant hole excavations for plants other than reforestation plants, with the plant location stake marking the center of the circle and with the sides of the hole being approximately vertical. When mechanical means are used which make digging of cylindrical holes impractical, the complete hole shall have the minimum dimensions as shown in the plans.

When plants are to be grouped together in a plant bed as contrasted to widely separated individual plants, and when so indicated in the plans, loosen and pulverize clods to a depth of not less than 5 inches for the entire area of the plant bed by means of a scarifier, disc, spade or other appropriate means before plant holes are dug.

Plant reforestation plants in holes made by a planting spade, planting bar or other means which meet the approval of the Engineer. Make the hole of sufficient size to accommodate the entire extended root system of the plant without cramping.

When geophytes; bulbs, corms and tuberous plants; are to be grouped together in a plant bed as contrasted to widely separated individual plants, and when so indicated in the plans, loosen and pulverize clods to a depth of not less than 8 inches, or as indicated in the plans, for the entire area of the plant bed by means of a scarifier, disc, spade or other appropriate means before plant holes are dug.

Place plants in holes made by a planting spade, planting bar or other means which meet the approval of the Engineer. Make the hole of sufficient size to accommodate the entire plant structure without cramping. Take care to plant all plants at a uniform depth as indicated in the plans or directed by the Engineer.

When geophytes are to be planted separately as individual plants or in small separated groups, loosen and pulverize clods with a spade, auger or other means which meet the approval of the Engineer. Individual planting holes shall be to a depth of not less than 8 inches, or sufficient size to accommodate the entire plant structure without cramping or to a depth as indicated in the plans or directed by the Engineer.

1670-9 PLANTING, BACKFILLING AND WATERING

(A) General

The plans will state the kind and rate of application of fertilizer. Apply fertilizer during backfilling operations in a manner that will ensure proper placement of the fertilizer and avoid injury to the roots.

Scarify the walls and floor of the plant hole after the plant hole is dug. Place the plant in the prepared plant hole at the proper position as regards to depth, alignment, final grade of the surrounding ground level and vertical placement of the trunk. Maintain this position during all subsequent backfilling and watering operations. Set plants with the root collar at the same depth as grown in the nursery or raise above grade as indicated in the plans.

Moisten the soil with water after one-half to two-thirds of the backfilling and tamping has been completed, if the soil in the plant holes is not sufficiently moist. Apply water to moisten all soil but not a quantity that will saturate the soil to the extent of excluding all air from around the roots. Place the remainder of the backfill after complete absorption of water.

Construct water rings around all plants, except reforestation plants, in accordance with details shown in the plans. A water ring consists of a ridge of firmed soil in a ring around the plant and of a minimum inside diameter equal to the diameter of the plant hole. This ridge is approximately 6 inches high and is compacted firmly enough to hold water.

(B) Balled and Burlapped Plants

Handle balled and burlapped plants by the ball and place in the plant hole so that the soil of the ball will not be loosened from the roots. After the hole has been almost completely backfilled and the soil thoroughly firmed under and around the ball, cut the burlap away and remove from around the stem of the plant. Complete backfilling so as to avoid loosening of the soil of the root ball.

(C) Container Grown Plants

Planting requirements for container grown plants are the same as applicable to balled and burlapped plants. Remove container immediately before planting. During the removal of the container, take sufficient precautions to ensure that the soil and roots inside the container are undisturbed. Scarify roots when directed by the Engineer.

(D) Bare Rooted Plants

Before the plant is placed in the plant hole, cut off smoothly any bruised or broken parts of roots. Place the plant in its proper position in the hole and backfill. Carefully place the backfill material, worked around and under the roots and compacted in a manner that avoids bruising or breaking the roots.

(E) Reforestation Plants

Reforestation includes tree reforestation and shrub reforestation. Type, mixture, size, furnish description and spacing will be as shown on the reforestation detail sheet in the plans.

Before beginning reforestation, each area to be reforested will be measured by the Engineer to determine the exact number of acres for tree reforestation or shrub reforestation therein and the quantity of each species of seedling to be planted within the area.

Where structures or plantings do not adequately delineate the outline of the area to be reforested, stake the outline of the area as directed by the Engineer. Furnish cypress, cedar, oak, locust or other wood stakes approved by the Engineer. Provide stakes with a minimum industry standard of 2 inches x 2 inches (nominal) size and approximately 30 inches in length with a 15 inch white top. Drive stakes in the ground with approximately 18 inches remaining above the ground line and place as necessary to define and delineate the reforestation outline.

Ensure sample stock of reforestation seedlings are inspected by the Engineer, for general health and moisture content, within 24 hours before planting.

After the plant hole has been prepared, place the plant upright in the hole at the correct depth without crowding or bunching the roots. Firm the soil around the root system from the bottom of the plant hole to natural ground elevation.

Upon completion of planting the required number of seedlings within all areas to be reforested, the Contractor will be relieved of further responsibility in connection with reforestation except for damage caused directly by the Contractor.

(F) Geophytes

When planting geophytes; bulbs, corms and tuberous plants; take care to place all plants at a uniform depth as indicated in the plans or directed by the Engineer. All plants shall be set upright as originally grown and at the proper spacing and depth from the natural ground elevation. Soil that is backfilled into the hole to obtain the proper depth shall be firmed before plant placement. Soil backfilled over the plant shall be firmed.

Section 1670

Planting shall be accomplished when the soil temperature is 40°F to 45°F or as directed by the Engineer. No phase of this work shall be performed when the temperature is below 32°F, when the plant holes are frozen or when soil to excavate and fill the plant hole is frozen or too wet.

Geophytes shall be watered as stated in the contract or as directed by the Engineer. Watering will be required for geophytes if the soil in the plant hole is not sufficiently moist. Apply water to moisten all soil, but not in a quantity that will create standing water or saturate the soil to the extent of excluding all air from around the plant.

1670-10 MULCH FOR PLANTING

Place mulch within 7 days of initial planting as a top layer on the backfilled plant hole and water ring. Place mulch approximately 4 inches deep as shown in the plans or as directed by the Engineer. Place additional mulch as directed by the Engineer during establishment.

No mulching will be required for reforestation plants.

1670-11 WATER FOR PLANTING

Water at the time of planting as specified in Article 1670-9 and at the Contractor's election and the Engineer's approval. Water with gravity flow or low pressure applicators which have been approved by the Engineer, and which will not erode soil around the plant root system or damage to plants. Saturate the soil around each plant thoroughly at each watering.

1670-12 STAKING OR GUYING

Stake or guy plants as shown in the plans or as directed by the Engineer to prevent damage.

Ensure that the plant is attached and held rigid to the support in a manner that will prevent chafing or other injury to the bark, and that will permit normal development of the trunk or branch.

1670-13 INITIAL PLANTING

Initial planting will be complete when the plants have been placed in the plant hole, backfilled, fertilized, watered, mulched, staked and guyed, and the plants are in an acceptable condition.

1670-14 ESTABLISHMENT

Begin establishment for all initial or replacement plants immediately after they are planted. Maintain trees, shrubs, vines and groundcovers, and the area of planting until final acceptance of the project. Mow and maintain the area around trees and shrubs for a distance of 6 feet beyond the outside limits of water rings or 6 feet beyond the limits of the guy stakes, whichever is greater; within shrub beds; and for a distance of 6 feet outside the perimeter of the shrub beds. Establishment includes cutting of grass and control of weeds; watering; fertilization; replacement of mulch; repair or replacement of guy stakes, guy wires and water rings; and other work as directed by the Engineer to ensure the survival and growth of plant material and the satisfactory appearance of the project. Remove dead plant material from the project during the establishment period.

1670-15 REPLACEMENT PLANTING

Replace any trees, shrubs, wetland plantings or other plant materials that are dead, in an unhealthy condition, damaged during installation or stolen. Replacement plant materials shall conform to the guidelines of the *American Standard for Nursery Stock*. Replacement of reforestation plants will not be required.

Perform replacement planting within the planting season specified in the contract or as directed by the Engineer.

1670-16 FINAL INSPECTION

All planting shall be completed and all plants shall be in a living and healthy condition at the time of final inspection.

1670-17 MEASUREMENT AND PAYMENT

(Plant Species and Size Indicated in Contract) will be measured and paid in units of each, other than reforestation plants, planted and accepted.

Reforestation will be measured and paid in acres of land measured along the surface of the ground.

Wetland Reforestation will be measured and paid in acres of land, measured along the surface of the ground.

Post-emergent Herbicidal Treatment will be measured and paid in square yards of plant bed measured along the surface of the ground.

Pre-emergent Herbicidal Treatment will be measured and paid in square yards of plant bed measured along the surface of the ground.

Geophytes (plant species and size indicated in contract) will be measured and paid in units of each that have been planted and accepted.

Mulch for Planting will be measured and paid in cubic yards. Where mulch is furnished in bales or bags, the number of cubic yards in each bale or bag will be determined and then multiplied by the number of bales or bags of the same size which have been acceptably furnished and placed. Where mulch is furnished in trucks, each truck will be measured by the Engineer and shall bear a legible identification mark indicating its capacity. Load each truck to at least its measured capacity at the time it arrives at the site of the work.

Water for Planting will be measured and paid in units of 1,000 gallon units. Measurement of water will be made by means of an approved metering device at the source of supply, or by determining the volumetric capacity of tank trucks used to deliver water to the project and recording the number of loads delivered by each truck.

No payment will be made for plant bed preparation, tillage, staking or guying and fertilization, for this work will be incidental to other work in the contract.

Payment will be made under:

Pay Item	Pay Unit
(Plant species and size indicated in contract)	Each
Reforestation	Acre
Wetland Reforestation	Acre
Post-Emergent Herbicidal Treatment for Plant Beds	Square Yard
Pre-Emergent Herbicidal Treatment for Plant Beds	Square Yard
Geophytes	Each
Mulch for Planting	Cubic Yard
Water for Planting	1,000 Gallons