

HORRY COUNTY SCHOOLS
PEE DEE ELEM. PARENT LOOP
DRG PROJECT NO. 20.120



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W. Austin Graham

SIGNATURE

5/14/20

DATE

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SECTION 013000

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.

1.2 CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- C. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion.
- D. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Engineer will schedule and preside over meeting after Notice of Award.
- B. Attendance Required: Engineer, Owner, appropriate governmental agency representatives, major Subcontractors and Contractor.
- C. Minimum Agenda:
 - 1. Reviewing procedures for the safety of the students and staff while working on HCS property
 - 2. Communication procedures.
 - 3. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
 - 4. Scheduling.
 - 5. Critical Work sequencing.

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PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Use of electronic CAD files of Project Drawings.
- G. Shop Drawings.
- H. Samples.
- I. Other submittals.
- J. Design data.
- K. Test reports.
- L. Certificates.
- M. Manufacturer's instructions.
- N. Manufacturer's field reports.
- O. Erection Drawings.
- P. Construction photographs.
- Q. Contractor review.
- R. Engineer review.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

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- B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with CSI Form 12.1A - Submittal Transmittal
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project and submit electronic submittals via email as PDF electronic files. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Engineer review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- K. Submittals not requested will not be recognized nor processed.
- L. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Architect/Engineer.

1.4 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Architect/Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.

- B. Submit electronic submittals via email as PDF electronic files.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.6 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Allowed uses include grading software and record drawings.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
 - 1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
 - 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
 - 3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
 - 4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
 - 5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
 - 6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

1.7 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.

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2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit electronic submittals via email as PDF electronic files.

1.8 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
1. Submit to Engineer for aesthetic, color, and finish selection.
 2. Submit Samples of finishes, textures, and patterns for Engineer selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

1.9 OTHER SUBMITTALS

- A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

1.10 TEST REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.11 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

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- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

1.12 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.13 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit report within 3 days of observation to Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.14 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.15 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.
- B. Contractor: Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.

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4. Determination of accuracy and completeness of dimensions and quantities.
 5. Confirmation and coordination of dimensions and field conditions at Site.
 6. Construction means, techniques, sequences, and procedures.
 7. Safety precautions.
 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.16 ENGINEER REVIEW

- A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner and Contractor.
- B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order, Field Order, or Work Change Directive.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 013300

SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Mockup requirements.
- F. Testing and inspection services.
- G. Manufacturers' field services.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

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- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Engineer shall be altered from Contract Documents by mention or inference in reference documents.

1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this Section and identified in individual product Specification Sections.
- B. Assemble and erect specified or indicated items with specified or indicated attachment and anchorage devices, flashings, seals, and finishes.

- C. Accepted mockups shall be comparison standard for remaining Work.
- D. Where mockup has been accepted by Engineer and is specified in product Specification Sections to be removed, remove mockup and clear area when directed to do so by Engineer.

1.7 TESTING AND INSPECTION SERVICES

- A. Owner will employ and pay for specified services of an independent firm to perform testing and inspection.
- B. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by authorities having jurisdiction.
 - 1. Laboratory: Authorized to operate in State of South Carolina.
 - 2. Laboratory Staff: Maintain full-time Professional Engineer on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.
- D. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.
 - 1. Submit final report indicating correction of Work previously reported as noncompliant.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Engineer and independent firm 24 hours before expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.
- F. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- H. Agency Responsibilities:

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1. Test Samples of mixes submitted by Contractor.
 2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
 3. Perform indicated sampling and testing of products according to specified standards.
 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
 6. Perform additional tests required by Engineer.
 7. Attend preconstruction meetings and progress meetings.
- I. Agency Reports: After each test, promptly submit two copies of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:
1. Date issued.
 2. Project title and number.
 3. Name of inspector.
 4. Date and time of sampling or inspection.
 5. Identification of product and Specification Section.
 6. Location in Project.
 7. Type of inspection or test.
 8. Date of test.
 9. Results of tests.
 10. Conformance with Contract Documents.
- J. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency or laboratory may not approve or accept any portion of the Work.
 3. Agency or laboratory may not assume duties of Contractor.
 4. Agency or laboratory has no authority to stop the Work.

1.8 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting and balancing as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

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D. Refer to Section 013300 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 014000

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Domestic Products: Except where specified otherwise, domestic products are required and interpreted to mean products mined, manufactured, fabricated, or produced in United States or its territories.
- E. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- F. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide bonded off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 012500 - Substitution Procedures.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 030000
SITE CONCRETE

PART 1- GENERAL

1.1 WORK INCLUDED

- A. The work included under this section consists of furnishing all material, forms, transportation and equipment, and performing all necessary labor to do all the plain and reinforced concrete work shown on the Drawings or incidental to the proper execution of the work, or as herein specified.
- B. Composition: Concrete shall be composed of cement, fine aggregate, coarse aggregate, and water, so proportioned and mixed as to produce a plastic workable mixture in accordance with all requirements under this section suitable to the specific conditions of placement.

1.2 SUBMITTALS

- A. All materials specified shall be certified by the producer or manufacturer that the furnished material meets the specific requirements of the specifications.

PART 2- PRODUCTS

2.1 MATERIALS

- A. Cement:
 - 1. Cement: Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C 150, Type I, Type II or Type III. Type III cement for high early strength concrete shall be used only for special locations and only with the approval of the Engineer. Type III cement shall be used in the construction of sanitary sewer manholes, wet wells and pump stations.
 - 2. Only one brand of cement shall be used in any individual structure unless approved by the Engineer. Cement which has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container which contains such cement will be rejected. No salvaged or reclaimed cement shall be used.
- B. Fine Aggregate: Fine aggregate shall conform to the requirements of Section 701, of the South Carolina Department of Transportation "Standard Specifications for Highway Construction", latest edition.
- C. Coarse Aggregate: Coarse aggregate shall conform to the requirements of Section 701 of the South Carolina Department of Transportation "Standard Specifications for Highway Construction", latest edition, except that slag shall not be used and the gradation shall be grade 57 as approved by the Engineer.
- D. Water: Water shall be taken from a potable water supply and shall be fresh, clean and free from injurious amounts of oil, acid, alkali or organic matter.
- E. Admixtures: No admixtures shall be used except by specific approval of the Engineer. When approved, admixtures shall meet the following minimum standards.

3. Air entraining agent: ASTM C 260
4. Water reducing and retarding admixture: ASTM C 494, Type D and free of chlorides.
- F. Membrane Curing Compound: Membrane curing compound shall conform to the requirements of AASHTO Designation M 148, Type 10-clear, or Type 2-white pigmented.
- G. Expansion Joint Filler:
 5. Preformed expansion joint filler shall be of the nonextruding and resilient bituminous type and conform to the requirements of AASHTO Designation M 213.
 6. Expansion joint filler shall be gray neoprene sponge rubber that conforms to AASHTO Designation M 153, Type I.
- H. Separation Board: Separation board shall be closed cell, non-extruding, PVC foam Grade #327 as manufactured by AC Horn, Inc., with a 20 psi maximum compressive strength to compress to 75% of thickness.
- I. Membrane: Membrane shall be a 6 mil polyethylene film.
- J. Reinforcing Steel:
 7. Reinforcing steel shall conform to the requirements of ASTM designation A 615, Deformed Grade 60, except where otherwise indicated.
 - a. The name of the manufacturer of the reinforcing steel shall be called out in the shop drawings together with a sketch showing the pattern of the deformation, including the mill mark.
 - b. Bar reinforcement shall be accurately fabricated in accordance with the latest CRSI Manual of Standard Practice. The Contractor shall have prepared and shall submit to the Engineer in sextuplicate, necessary shop drawings and bar lists. The Contractor shall be responsible for error made in shop drawings even though approved by the Engineer.
 8. Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM Designation A 185 and shall be formed with smooth cold-drawn wire.
 9. Cold-drawn wire for spirals shall be plain and shall conform to the requirements of ASTM Designation A 82 with a minimum yield strength of 70,000 psi.
 10. Bar Supports:

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- a. Bar supports for reinforcing steel shall conform to the requirements of CRSI Manual of Standard Practice, Chapter 3 and shall be of a height to furnish the concrete cover called for on Drawings. High chairs shall be furnished for bent or top bars in solid slabs. Bar supports to be in contact with exterior surfaces of concrete shall be Class C with plastic caps at least 1-inch in length on the leg tips, or Class E with stainless steel legs. Bar supports shall be spaced not more than 100 times the diameter of the bars to be supported, with not more than 1/4 spacing from the end of the supported bars to the first chair.
 - b. Bar supports for slabs on grade shall be plain concrete blocks, 3-inches high by 4-inches square with tie wires embedded in support. Concrete strength shall be at 3,000 psi at time of use.
- K. Forms: Forms shall be of wood, steel or other approved materials. The sheeting for all exposed surfaces shall be 5-ply plywood, unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. Forming for exposed exterior concrete from 1-foot below finished exterior grade to tope of structure shall be carefully fabricated so as to provide a smooth finish without defects. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of the Engineer. If it is his opinion that the interior surfaces of the forms are too irregular to produce the specified finish, they shall be lined with smooth, dense, moisture resistant hardboard or other material of which he approved.
- L. Nonshrink Grout: Nonshrink grout shall be nonmetallic, pre-mixed type and shall be Sauereisen F-100 Level Fill, Master Builders Masterflow 713, Burke Non-Ferrous, Non-Shrink Grout or approved equal.

2.2 CLASSIFICATION AND STRENGTH OF CONCRETE

- A. Class and minimum strength requirements for concrete shall be as tabulated below. Unless otherwise specified, Class A concrete shall be used.
- B. Strength Requirements: Concrete class and strength shall meet the minimum compressive strength requirements at the age of 7 and 28 days as shown in the following table. The compressive strengths shall be as determined by standard laboratory cylinder tests in accordance with the procedure set forth in ASTM Designation C 31 and C 39. (See Article 3.03 of this Section for quantity and testing of cylinders.)

Compressive Strength in Pounds Per Square Inch

For Design Class Purposes	3 Consecutive Cylinder Average		Low Cylinder	
	<u>7 Days</u>	<u>28 Days</u>	<u>7 Days</u>	<u>28 Days</u>
A 4000	2950	4250	2600	3750
B 3000	2100	3200	1850	2800
C 2500	1800	2700	1550	2300

2.3 PROPERTIES AND DESIGN OF CONCRETE MIX

- A. Tests and Design Mix:

1. The Contractor, 30 days before the beginning of concrete work, shall advise the Engineer of the proposed sources of the materials, or ready-mixed concrete, which the Contractor intends to use in the work. A design mix which has been used by the concrete supplies before, may be submitted for approval provided the proportions and strengths meet the requirements of this specification.
 2. The source and manufacturer of material after once having been approved shall not be changed by the Contractor, except as approved by the Engineer, and additional laboratory tests may be required by the Engineer to prove conformance with specification requirements.
 3. If during the progress of the work, tests indicate that concrete is not being produced in accordance with these Specifications the Engineer may order changes in the materials or their proportions so as to secure concrete as specified.
- B. Slump: Slumps shall be as low as possible consistent with proper placing. Low slump concrete shall be used for footing and slabs on grade. Medium slump concrete shall be used for walls, columns and suspended slabs. Concrete shall conform to the limits specified in the following schedule:

<u>Class of Concrete</u>	<u>Medium Slump</u>	<u>Low Slump</u>
A	4 to 5 in.	2 to 3 in.
B	4 to 5 in.	2 to 3 in.
C	5 to 6 in.	3 to 4 in.

PART 3- EXECUTION

3.01 PREPARATION

A. Concrete Mixing:

1. Equipment: The Concrete shall be ready-mixed and the equipment shall conform to the applicable requirements of ASTM Designation C 94.
2. Measurement: Equipment necessary to positively determine and control the actual amounts of all materials entering the concrete shall be provided by the Contractor or the concrete manufacturer. All materials shall be measured by weight, except that water may be measured by volume. A bag of cement weighs 94 pounds.

3.02 INSTALLATION

A. Forms:

1. Construction:
 - a. Forms shall be built true to line and grade, and shall be mortartight and sufficiently rigid to prevent displacement or sagging between supports. Particular attention shall be given to adequacy of supports and shoring, which is the Contractor's

responsibility. The surfaces of forms used for permanently exposed surfaces shall be smooth and free from irregularities, dents, sags, or holes. Forms for surfaces to receive stucco finish shall be suitable for its application. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal is at least 1 1/2 inch from any concrete surface. form ties shall be removed immediately after removal of forms, and holes shall be thoroughly plugged with grout within 24 hours after form removal and kept damp for 4 days to prevent shrinking.

- b. Wire ties will not be permitted. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges at expansion joints or at any other corner that are to remain, beams below grade shall have forms at both sides.
 - 2. Coating: Prior to the placing of steel reinforcement or concrete, forms for exposed surfaces shall be coated with nonstaining paraffin base oil or mineral oil, forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete.
 - 3. Removal: Forms and/or form supports shall not be removed from any concrete until it has obtained sufficient strength to support itself and any live loads it may be subjected to, and then only with the approval of the Engineer.
- B. Reinforcing Steel: When placed in the forms, reinforcement shall be clean and free of all rust, scale, dust, dirt, paint, oil or other foreign material and shall be accurately and securely positioned in the forms as shown on the Drawings before the placing of concrete. Reinforcing steel shall be wired or otherwise fastened together at intersections and shall be supported by concrete or metal supports, spacers or hangers. Bar supports, where adjacent to the ground, shall be set on precast concrete pads compressed into the subgrade. The Contractor shall obtain the Engineer's approval before fastening reinforcing steel at intersections by welding methods.
- 1. Splicing of reinforcement shall be held to a minimum and shall be placed at points of minimum stress. Bars shall be lapped at splices a minimum of 24 bar diameters unless otherwise shown on the Drawings or directed by the Engineer, and shall be rigidly wired or clamped.
 - 2. Wire fabric shall be straightened before placing and shall overlap one full space of mesh at ends and edges and shall be securely fastened. Fabric shall be supported so as to occupy its proper location in the concrete as shown on the drawings. Fabric shall not cross any expansion joints.
- C. Embedded Items: In addition steel reinforcement, pipes, inserts and other metal objects as shown, specified or ordered shall be built into, set in or attached to the concrete. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before concrete is placed, care shall be taken to determine that all embedded parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil or any foreign matter. No wood shall be embedded in concrete. The concrete shall be packed tightly around pipes and other metal work to prevent leakage and to secure perfect adhesion. Drains shall be adequately protected from intrusion of concrete.
- D. Separation Board: Two inch separation board shall be installed if indicated on the Drawings.

E. Concrete:

1. General: Reinforcement shall be secured in position, inspected and approved before placing concrete. Runways for transporting concrete shall not rest on reinforcing steel. Concrete not placed within 90 minutes from the time mixing is stated will be rejected and shall be removed from the job by the Contractor. Concrete shall be deposited as nearly as practicable in final position. Concrete shall not be allowed to drop freely more than six feet. All concrete shall be placed in daylight and (excepting seal concrete) shall be placed in the dry unless otherwise authorized by the Engineer in writing.
2. Compaction: Concrete shall be compacted by internal vibrating equipment, supplemented by hand rodding and tamping as required. Vibrators shall in no case be used to move the concrete laterally inside the forms. Internal vibrators shall maintain a speed of at least 5000 impulses per minute when submerged in concrete. (At least one spare vibrator in working condition shall be maintained at the site during concrete placing operations.) Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation. Vibrator shall be moved constantly and placed in each specific spot only once.
3. Bonding: Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be retightened. The cleaned surfaces shall be dampened, but not saturated, and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2-inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.
4. Protection: Rainwater shall not be allowed to increase the ratio of mixing water no to damage the surface finish. Concrete shall be protected form disfigurement, damage, vibration, internal fractures and construction overloads.

F. Curing:

1. All concrete, including gunite, shall be water cured by covering with a double thickness of clean burlap, cotton mats, or other approved material kept thoroughly saturated with water. The forms shall be kept wet until removed and upon removal, the curing specified herein shall be started immediately. Concrete shall be cured for a period of 7 days for normal Portland cement or 4 days for high early strength cement. Concrete poured in the dry shall not be submerged until it has attained sufficient strength to adequately sustain the stress involved nor shall it be subjected to flowing water across its surface until it has cured 4 days. Curing of gunite shall be started as soon as possible without damaging surface and not later than 2 hours after placing.
2. In lieu of wet burlap or cotton mats as specified above, concrete slabs may be covered with wet sand and kept moist for the specified curing period. The initial curing period of not less than 24 hours shall consist of the wet burlap or cotton mat method, then the wet sand method may be utilized until the end of the curing period.
3. Concrete surfaces which will not be coated, painted, plastered, stuccoed, covered with tile or floor covering or requiring a bonding surface may be cured by means of a membrane curing compound in lieu of the wet cure method. The curing compound shall be applied immediately after a satisfactory surface finish has been completed or forms have been removed. The rate of application of membrane curing compound shall be at least one gallon to every 200 square

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feet of exposed surface to be cured. The membrane curing compound and impervious covering shall be continuous and without defects and shall retain the required moisture in the concrete. Membrane curing compound that becomes damaged by rain, foot traffic or other conditions within 5 days of application shall be reapplied.

G. Finishes:

1. As soon as forms can safely be removed, all irregular projections shall be chipped off flush with the concrete surfaces. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush with the concrete surface immediately after removal of forms and water cured to prevent shrinkage. Honeycombing shall be cut out to expose a sound concrete surface prior to pointing. The use of mortar pointing or patching shall be confined to the repair of small defects in relatively green concrete. Where in the opinion of the Engineer substantial repairs are required, the defective concrete shall be cut out to sound concrete and repaired with gunite or the concrete shall be removed and reconstructed as directed.
2. Floor slabs shall be brought to a true and even finish by power or hand floating in a manner that will not bring excess fines to the surface. The consistency of the concrete shall be such that water does not accumulate at the surface. Unless otherwise shown on the Drawings, the surface shall be floated with a wood float and shall be steel troweled to a smooth finish. Troweling shall be the minimum to obtain a smooth, dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface. If so directed, the surface shall be brushed lightly with a push broom so as to produce a nonslip surface.
3. Concrete surfaces that are not exposed in the completed work will require no special finish other than such pointing up and rubbing as is necessary to leave them smooth and impervious.
4. Other surfaces which will be exposed in the completed work shall be finished by being rubbed smooth with a float and water or a carborundum brick. The final surface shall be smooth and dense, without pits, irregularities, blow holes or bubbles.

H. Grout:

1. Grout for pointing and patching shall consist of cement and fine aggregate mixed in the proportions used in the concrete and a minimum amount of water to produce a workable grout.
2. Material for grouting column base plates, anchor bolts, reinforcing bars, pipe sleeves and pump base plates shall be of the nonshrink type and shall be mixed and placed as recommended by the manufacturer. Machinery set on grout pads shall not be operated until the grout has cured for at least 24 hours.

3.3 FIELD QUALITY CONTROL

- A. General: The quality of the concrete as to conformance to the specifications is the entire responsibility of the Contractor until it is accepted in place in the structure and verified by the final cylinder tests made by the laboratory. Arrangements for field testing shall be made by the Contractor with the Owner's Special inspector.
- B. Compressive Tests: Standard laboratory compressive test cylinders will be obtained by the laboratory when concrete is discharged from the mixer at the site of the work. A set of 6 cylinders will be obtained for each 60 cubic yards or fraction thereof, placed each day, for each type of concrete. The

cylinders will be cured under laboratory conditions and will be tested in two groups of three at 7 and 28 days of age, respectively.

- C. Slump Tests: The laboratory of the Owner or their representative will make slump tests of Class A and Class B concrete as it is discharged from the mixer at the site of the work. Slump tests will be made for each 25 cubic yards or "pour" of concrete placed. Slump tests may be made on any batch and failure to meet specified slump requirements will be sufficient cause for rejection of that batch.
- D. Reports: Proper reports of all tests performed by the laboratory will be prepared by the laboratory and submitted promptly to the Special Inspector. Such reports shall be properly labeled so as to identify the portions of the project into which the materials have been placed.

END OF SECTION

SECTION 31 23 16 EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating topsoil.
2. Excavating subsoil for buildings, pavements, and landscape.
3. Backfilling building perimeter to subgrade elevations.
4. Backfilling site structures to subgrade elevations.
5. Filling under pavements or slabs-on-grade.
6. Undercutting and filling over-excavation.
7. Disposal of excess material.

B. Related Sections:

1. Section 31 10 00 - Site Clearing: Clearing site prior to excavation.
2. Section 31 25 13 - Erosion Controls: Controlling sediment and erosion from Work of this section.
3. Section 31 23 17 - Trenching: Excavating and backfilling for utilities.
4. Section 31 23 18 - Rock Removal.
5. Section 32 91 19 - Landscape Grading: Finish grading with topsoil to contours.

1.2 REFERENCES

A. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand- Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
6. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock

in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Dewatering Plan: Describe dewatering methods to be used to keep excavations dry if required.
- D. Samples: Submit, in air-tight containers, 10-pound sample of each type of fill to testing laboratory.
- E. Materials Source DOT Approval: Submit certification that aggregate and soil material suppliers are approved by the State Department of Transportation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Division 200 - Earthwork of the SCDOT Standard Specifications.
- B. Maintain one copy of document on site.
- C. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Project location.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Original surface soil typical of the area which is capable of supporting native plant growth. It shall be free of large stones, roots, waste, debris, contamination, or other unsuitable material which might hinder plant growth.
- B. Subsoil: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension, debris, waste, frozen material, and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

- C. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM, or SP-SC.
- D. Structural Fill: Clean course aggregate Gradation No. 57 conforming to Sections 801 of the SCDOT Standard Specifications.
- E. Borrow Material: Conform to subsoil requirements.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-woven, non-biodegradable, conforming to Section 804 of the SCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.
- C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- D. Verify underground structures are anchored to their own foundations to avoid flotation after backfilling.
- E. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION FOR EXCAVATION

- A. Call Local Utility Line Information service as indicated on Drawings not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility company to remove and relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or regraded without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site and protect from erosion.
- D. Remove from site excess topsoil not intended for reuse.

3.4 SUBSOIL EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate building foundations, structures, slabs-on-grade, paving, landscaping, and construction operations.
- C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.
- D. Slope banks with machine to angle of repose or less until shored.
- E. Do not interfere with 45-degree bearing splay of foundations.
- F. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- G. Trim excavation. Remove loose matter.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. Remove larger material as specified in Section 31 23 18.
- I. Notify Engineer and testing agency of unexpected subsurface conditions.
- J. Correct areas over excavated with granular fill and compact as required for fill areas.
- K. Remove excess and unsuitable material from site.
- L. Repair or replace items indicated to remain damaged by excavation.
- M. Excavate subsoil from areas to be further excavated, re-landscaped, or regraded.
- N. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- O. Remove from site excess subsoil not intended for reuse.
- P. Benching Slopes: Horizontally bench existing slopes greater than 3:1 to key placed fill material into slope to provide firm bearing.
- Q. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support excavations more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished subgrade, or design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.6 SURFACE WATER CONTROL

- A. Control and remove unanticipated water seepage into excavation.
- B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 13.
- C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.7 DEWATERING

- A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.
- B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.
- C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
 - 1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
 - 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- E. Discharge ground water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

- F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.8 PROOF ROLLING

- A. Proof roll areas to receive fill, pavement and building slabs to identify areas of soft yielding soils.
 - 1. Use loaded tandem-axle pneumatic tired dump truck or large smooth drum roller.
 - 2. Load equipment to maximum 50 tons gross weight and make a minimum of four passes with two passes perpendicular to the others.
- B. Undercut such areas to firm soil, backfill with granular fill, and compact to density equal to or greater than requirements for subsequent fill material.
- C. Do not proof roll or undercut until soil has been dewatered.

3.9 BACKFILLING

- A. Scarify subgrade surface to depth of 4 inches.
- B. Compact subgrade to density requirements for subsequent backfill materials.
- C. Backfill areas to contours and elevations with unfrozen materials.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Place fill material in continuous layers and compact in accordance with Schedule at end of this Section.
- F. Employ placement method that does not disturb or damage other work.
- G. Maintain optimum moisture content of backfill materials to attain required compaction density.
- H. Support foundation walls and structures prior to backfilling.
- I. Backfill simultaneously on each side of unsupported foundation walls and structures until supports are in place.
- J. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.
- K. Make gradual grade changes. Blend slope into level areas.
- L. Remove surplus backfill materials from site.

3.10 BRIDGING DEGRADED SOILS – Not Used

3.11 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Within Building and Paved Areas: Plus or minus 1 inch from required elevations.
- C. Top Surface of Backfilling Within Landscape Areas: Plus or minus 2 inches from required elevations.

3.12 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.
- D. Repair or replace items indicated to remain damaged by excavation or filling.

3.13 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Independent laboratory, field inspecting, testing, adjusting, and balancing.
- B. Request visual inspection of bearing surfaces by Engineer and inspection agency before installing subsequent work.
- C. Laboratory Material Tests: In accordance with ASTM D1557 or AASHTO T180.
- D. In-Place Compaction Tests: In accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- F. Frequency of Tests:
 - 1. Building and Pavement Areas: Twice per lift for every 5,000 square feet.
 - 2. Landscape Areas: Twice per lift for every 10,000 square feet.

3.14 SCHEDULES

- A. Under Pavement and Slabs:
 - 1. Maximum 8-inch compacted depth.
 - 2. Compact material to a minimum of 95 percent of maximum density, except the top 12 inches.
 - 3. Compact top 12 inches to a minimum of 98 percent of maximum density.
- B. Under Landscape Areas:

1. Maximum 8-inch compacted depth.
 2. Compact to minimum 90 percent of maximum density.
- C. Footing Foundation Fill:
1. Structural fill to maximum 12-inch compacted depth.
 2. Compact to 98 percent of maximum density.

END OF SECTION

SECTION 31 23 17 TRENCHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating trenches for utilities and utility structures.
 - 2. Bedding.
 - 3. Backfilling and compacting to subgrade elevations.
 - 4. Sheeting and Shoring.
 - 5. Dewatering.
 - 6. Compacting backfill material.
- B. Related Sections:
 - 1. Section 33 23 13 - Erosion Controls: Diversion of water from excavations.
 - 2. Section 31 23 16 - Excavation and Fill: Topsoil and subsoil removal from site surface.
 - 3. Section 31 23 18 - Rock Removal: Removal of rock found during excavating.
 - 4. Section 31 25 13 – Erosion Controls: Controlling sediment and erosion from Work of this section.
 - 5. Section 33 11 16 - Water Utility Distribution Piping: Water piping and appurtenances.
 - 6. Section 33 31 00 - Sanitary Utility Sewerage Piping: Sanitary sewer piping and bedding.
 - 7. Section 33 41 00 - Storm Utility Drainage Piping: Storm sewer piping and bedding.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand- Cone Method.
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Utility Structures: Manholes, catch basins, inlets, valve vaults, hand holes, and other utility access structures as indicated on Drawings.
- C. Trench Terminology:
 1. Foundation: Area under bottom of trench supporting bedding.
 2. Bedding: Fill placed under utility pipe.
 3. Haunching: Fill placed from bedding to center line of pipe.
 4. Initial Backfill: Fill place from center line to 6 to 12 inches above top of pipe.
 5. Final Backfill: Fill placed from initial backfill to subgrade.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of South Carolina.
- C. Dewatering Plan if required: Describe methods of dewatering and disposal of water.
- D. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- E. Samples: Submit to testing laboratory, in air-tight containers, 10-pound sample of each type of fill.
- F. Materials Source: Submit name of imported fill material suppliers.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Division 200 of SCDOT Standard Specifications.
- B. Maintain one copy of document on site.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

- A. Subsoil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.
- B. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM or SP-SC.
- C. Foundation Stone: Clean course aggregate Gradation No. 57 conforming to Sections 801 of the SCDOT Standard Specifications.
- D. Bedding and Haunching Material:
 - 1. Rigid Pipe: Granular Fill.
 - 2. Flexible Pipe: Foundation Stone.
- E. Bedding for Structures: Foundation Stone.
- F. Initial Backfill to 6 inches Minimum Above Utility:
 - 1. Rigid Pipe: Subsoil Fill.
 - 2. Flexible Pipe: Foundation Stone.
- G. Final Backfill to Subgrade:
 - 1. Under Pavement: Granular Fill.
 - 2. Under Landscape: Subsoil Fill.

2.2 ACCESSORIES

- A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Section 804 of the SCDOT Standard Specifications.
- B. Concrete: Concrete conforming to Section 701 of the SCDOT Standard Specifications.
 - 1. Compressive strength of 3,000 psi at 28 days.
 - 2. Air entrained.
 - 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
 - 4. Maximum slump of 3.5 inches for vibrated concrete and 4 inches for non-vibrated concrete.

5. Minimum cement content of 564 lbs per cubic yard for vibrated and 602 lbs. per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 PREPARATION

- A. Call local utility line information service indicated on Drawings not less than three working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 LINES AND GRADES

- A. Excavate to lines and grades indicated on Drawings.
 1. Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.3 TRENCHING

- A. Excavate subsoil required for utilities.
- B. Remove lumped subsoil, boulders, and rock up of 1/3 cubic yard, measured by volume. Remove larger material as specified in Section 31 23 18.
- C. Perform excavation within 48 inches of existing utility service in accordance with utility's requirements.
- D. Do not advance open trench more than 200 feet ahead of installed pipe.
- E. Remove water or materials that interfere with Work.
- F. Trench Width: Excavate bottom of trenches maximum 16 inches wider than outside diameter of pipe or as indicated on Drawings.

- G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- H. Maintain vertical faces to an elevation equal to 12 inches above top of pipe.
 - 1. When Project conditions permit, side walls may be sloped or benched above this elevation.
 - 2. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.
- I. Support Utilities and Structures:
 - 1. Keep trench width at top of trench to practical minimum to protect adjacent or crossing utility lines
 - 2. Support utilities crossing trench by means acceptable to utility company.
 - 3. Do not interfere with 45-degree bearing splay of foundations.
 - 4. Provide temporary support for structures above and below ground.
- J. When subsurface materials at bottom of trench are loose or soft, excavate to firm subgrade or to depth directed by Engineer.
 - 1. Cut out soft areas of subgrade not capable of compaction in place.
 - 2. Backfill with foundation stone and compact to density equal to or greater than requirements for subsequent backfill material.
- K. Trim Excavation: Hand trim for bell and spigot pipe joints where required. Remove loose matter.
- L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.
- M. Place geotextile fabric over trench foundation stone prior to placing subsequent bedding materials.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work unless approved by Engineer.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 SURFACE WATER CONTROL

- A. Control and remove unanticipated water seepage into excavation.
- B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 13.
- C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.6 DEWATERING

- A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.
- B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.
- C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
 - 1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
 - 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- E. Discharge ground water and seepage water within excavation areas through filter bags or into settling basins prior to pumping water into drainage channels and storm drains.
- F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.7 BEDDING, HAUNCHING, AND INITIAL BACKFILL

- A. Place bedding full width of trench to the depth indicated on Drawings and compact to 95 percent maximum density. Excavate for pipe bells.
- B. Install utility pipe and conduit in accordance with the respective utility section.
- C. Support pipe uniformly along entire length of pipe.
- D. Carefully place haunching material to center of pipe, rod and tamp material to fill voids and provide uniform support of pipe haunches. Compact to 90 percent maximum density.
- E. Carefully place initial backfill to 6 inches above top of pipe or to depth indicated on Drawings. Compact to 95 percent maximum density.

3.8 FINAL BACKFILLING TO SUBGRADE

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact in accordance with schedule at end of this Section.
- D. Employ placement method that does not disturb or damage utilities in trench or foundation perimeter drainage.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Do not leave more than 50 feet of trench open at end of working day.
- G. Protect open trench to prevent danger to the public.

3.9 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess material offsite and legally.
- B. Furnish Engineer with certificate of disposal site or agreement from private property owner.

3.10 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.11 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform laboratory material tests in accordance with ASTM D1557 or AASHTO T180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- E. Frequency of Tests: Two tests per lift for every 1000 feet of trench.

3.12 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.13 SCHEDULE OF COMPACTION

- A. Under Pavement and Slabs:
 - 1. Granular Fill in maximum 8-inch loose lifts.
 - 2. Compact to minimum 95 percent maximum density except the top 12 inches.
 - 3. Compact top 12 inches to minimum 98 percent maximum density.
- B. Under Landscape Areas:
 - 1. Subsoil Fill in maximum 8-inch loose lifts.
 - 2. Compact to minimum 90 percent maximum density.
- C. In Unstable or Unsuitable Trench Foundation Areas:
 - 1. Foundation Stone in maximum 12-inch loose lifts.
 - 2. Compact to 98 percent maximum density.

END OF SECTION

SECTION 31 25 13 EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes installing, maintaining and removing:
 - 1. Silt Fence.
 - 2. Temporary Construction Entrances.
 - 3. Diversion Channels.
 - 4. Sediment Traps.
 - 5. Rip Rap.
 - 6. Stone Check Dams.
 - 7. Inlet Protection.
 - 8. Site Stabilization.
- B. Related Sections:
 - 1. Section 31 10 00 - Site Clearing.
 - 2. Section 31 23 16 - Excavation and Fill.
 - 3. Section 31 37 00 - Riprap.
 - 4. Section 32 91 19 - Landscape Grading.
 - 5. Section 32 92 19 - Seeding and Soil Supplements.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-pound) rammer and a 457-mm (18-inch) drop.
- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on geotextile, posts, woven wire, concrete mix design, and pipe.

- C. Manufacturer's Certificate: Certify products and aggregates meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Standard of quality shall conform to the standards and practices set forth in: "South Carolina Storm water Management and Sedimentation Control Handbook for Land Disturbance Activities", February 1998 or latest edition.
- B. Maintain one copy of document on site.

1.5 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section.

PART 2 PRODUCTS

2.1 GEOTEXTILE MATERIALS

- A. Engineering Fabric Materials: Non-biodegradable conforming to Section 815.02 of SCDOT Standard Specifications:
 - 1. Silt Fence: Type 3, Class A or B Engineering Fabric.
 - 2. Under Rip Rap or Construction Entrances: Type 2 Engineering Fabric.

2.2 STONE, AGGREGATE, AND SOIL MATERIALS

- A. Stone for Sediment Trap and Check Dam: Class B erosion control stone conforming to Division 800 of the SCDOT Standard Specifications. Minimum size 5 inches, midrange size 8 inches, and maximum size 12 inches equally distributed.
- B. Stone for Rip Rap: Class 1 erosion control stone conforming to Division 800 of the SCDOT Standard Specifications. Minimum size 5 inches, midrange size 10 inches, and maximum size 17 inches equally distributed.
- C. Washed Stone: Coarse aggregate, Gradation No. 57 conforming to Division 800 of the SCDOT Standard Specifications.
- D. Aggregate for Construction Entrance: Coarse aggregate, Gradation No. 4 or larger with maximum size of 3 inch, conforming to Division 800 of the SCDOT Specifications.
- E. Soil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as soil fill under optimum moisture conditions.

2.3 PLANTING MATERIALS

- A. General: Conform to South Carolina rules and regulations as specified in Section 810 of the SCDOT Standard Specifications for seed, agricultural ground limestone, fertilizers, and mulch.
- B. Temporary Seed Mixture:
 - 1. Late winter and early spring: Rye and Annual Lespedeza (Kobe)
 - 2. Summer: German Millet.
 - 3. Fall: Rye.
- C. Fertilizer: Commercial grade; recommended for grass.
- D. Lime: ASTM C602, Class O agricultural ground limestone containing a minimum 80 percent calcium carbonate equivalent.
- E. Mulch: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

2.4 CONCRETE

- A. Concrete: Class B concrete conforming to Section 701 of the SCDOT Standard Specifications.
 - 1. Compressive strength of 2,500 psi at 28 days.
 - 2. Air entrained.
 - 3. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
 - 4. Maximum slump of 2.5 inches for vibrated concrete and 4 inches for non-vibrated concrete.
 - 5. Minimum cement content of 508 lbs per cubic yard for vibrated and 545 lbs per cubic yard for non-vibrated concrete.

2.5 PIPE MATERIALS

- A. Pipe: Corrugated steel pipe and fittings conforming to Section 715.2.3 of SCDOT Standard Specifications.

2.6 ACCESSORIES

- A. Posts for Silt Fence and Inlet Protection: Steel posts 5 feet long, 1-3/8 inches wide, minimum weight 1.25 lbs/ft. conforming to Section 815.4.6 of the SCDOT Standard Specifications.
- B. Woven Wire Fence for Silt Fence: Minimum 32 inches high, minimum 5 horizontal wires, vertical wires spaced 12 inches apart, minimum 10 gage top and bottom wires, and minimum 12-1/2 gage; all other wires conforming to Section 815 of the SCDOT Standard Specifications.
- C. Attachment Devices for Silt Fence: No. 9 staple, minimum 1-1/2 inches long, or other approved attachment devices.
- D. Hardware Cloth for Inlet Protection: 24 gage, 1/4-inch mesh opening hardware cloth.

- E. Trash Rack for Pipe Riser: Cone shaped with #4 bars welded at each intersection of bars and sized to fit pipe riser. Conform to Division 800 of the SCDOT Standard Specifications.

2.7 SOURCE QUALITY CONTROL (AND TESTS)

- A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.
- B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.
- C. Make rock available for inspection at producer's quarry prior to shipment. Notify Architect/Engineer at least seven days before inspection is allowed.
- D. Allow witnessing of inspections and tests at manufacturer's test facility. Notify Architect/Engineer at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.
- C. Verify gradients and elevations of base or foundation for other work are correct.

3.2 SILT FENCE

- A. Install in accordance with Section 815 of the SCDOT Standard Specifications at locations shown on Drawings.
- B. Use wire fence with Class A fabric.
- C. Class B fabric may be used without woven wire backing subject to the following:
 - 1. Fabric is approved by Architect/Engineer.
 - 2. Maximum post spacing is 6 feet.
 - 3. Posts are inclined toward runoff source not more than 20 degrees from vertical.

3.3 TEMPORARY CONSTRUCTION ENTRANCES

- A. Excavate and compact subgrade as specified in Section 31 23 16.
- B. Install construction entrances to the dimensions and locations as shown on Drawings. Minimum thickness is 6 inches.

- C. Mound aggregate near intersection with public road to prevent site runoff entering road.
- D. Periodically dress entrances with 2-inch thick course aggregate when aggregate becomes clogged with soil.

3.4 DIVERSION CHANNELS

- A. Excavate channel as specified in Section 31 23 16.
- B. Windrow excavated material on low side of channel.
- C. Compact to 95 percent maximum density.
- D. On entire channel area, apply soil supplements and sow seed as specified in Section 32 92 19.
- E. Mulch seeded areas with hay as specified in Section 32 92 19.

3.5 SEDIMENT TRAPS

- A. Clear site as specified in Section 31 00 00.
- B. Construct trap by excavating and forming embankments as specified in Section 31 23 16.
- C. Place coarse aggregate or rock at outlet as indicated on Drawings.
- D. Place geotextile fabric as specified for rock lining.
- E. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 32 92 19.
- F. Mulch seeded areas with hay as specified in Section 32 92 19.
- G. Clean trap of accumulated sediment when directed but no less than when trap is half full of sediment.

3.6 ROCK LINING (RIP RAP)

- A. Excavate to depth of rock lining as indicated on Drawings or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining and replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.
- B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.

- C. Carefully place rock on geotextile fabric to produce an even distribution of pieces with minimum of voids and without tearing geotextile.
- D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and avoid displacement of underlying material. Arrange individual rocks for uniform distribution.

3.7 STONE CHECK DAM

- A. Determine length required for ditch or depression slope and excavate, backfill, and compact foundation area to firm, even surface.
- B. Place Class B erosion control stone in an even distribution of rock pieces with minimum voids to the indicated shape, height, and slope.
- C. Construct washed stone filter blanket against upstream face of stone check dam to the thickness indicated on Drawings.

3.8 INLET PROTECTION

- A. Install four posts around drainage structure and attach hardware cloth as indicated on Drawings.
- B. Place Class B erosion control stone at base of fabric and mound at approximately 2:1.
- C. Place washed stone filter blanket on upstream side(s).

3.9 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize, and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
 - 1. During non-germinating periods, apply mulch at recommended rates.
 - 2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 32 92 19 at 75 percent of permanent application rate with no topsoil.
 - 3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 92 19 permanent seeding specifications.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.10 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- C. Perform laboratory material tests in accordance with ASTM D1557 or AASHTO T180.
- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- F. Frequency of Tests: Twice per lift for every 10,000 square feet.

3.11 CLEANING

- A. When sediment accumulation in sedimentation structures has reached a point one-half depth of sediment structure or device, remove and dispose of sediment.
- B. Do not damage structure or device during cleaning operations.
- C. Do not permit sediment to erode into construction or site areas or natural waterways.
- D. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.12 SCHEDULES

- A. Erosion Control Schedule:

Erosion Control Element	Location	Size
Silt Fence		
Temporary Construction Entrance		
Diversion Channel		
Sediment Trap		
Rock Lining (Rip Rap)		
Stone Check Dams		
Inlet Protection		
Sediment Pond		

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate base course on a prepared subgrade.
- B. Related Sections:
 - 1. Section 31 23 16 - Excavation and Fill: Preparing subgrade under base course.
 - 2. Section 32 12 16 - Asphalt Paving: Binder and finish asphalt courses.
 - 3. Section 32 13 13 - Concrete Paving: Finish concrete surface course.
 - 4. Section 32 17 13 - Parking Bumpers.
 - 5. Section 33 05 13 - Manholes and Structures: Frames and lids penetrating aggregate base course.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-pound) rammer and a 457-mm (18-inch) drop.
- B. ASTM International:
 - 1. [ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).]
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Samples: Submit to testing laboratory 10-pound sample of each type of aggregate in airtight containers.

- C. Materials Source: Submit name of imported materials suppliers.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Divisions 300 and 800 of the SCDOT Standard Specifications.
- B. Maintain one copy of document on site.
- C. Furnish each aggregate material from single source throughout the Work.
- D. Use sources approved by SCDOT.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aggregate Base Course: Coarse aggregate Type A or B with a gradation of ABC conforming to Section 801 of SCDOT Standard Specifications.
- B. Fine Aggregate: Sand gradation 1S or 2S conforming to Section 801 of SCDOT standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verify existing conditions before starting work.
- B. Verify substrate has been inspected and gradients and elevations are correct and dry.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompact as specified in Section 31 23 16.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Place aggregate in minimum 4-inch and maximum 10-inch layers and roller compact to specified density. When total thickness is 10 inches or less, place in one layer. When total thickness is greater than 10 inches, place in two equal layers.
- B. Have each layer of material compacted and approved prior to placing succeeding layers.
- C. Level and contour surfaces to elevations and gradients indicated on Drawings.

- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Use mechanical tamping equipment in areas inaccessible to roller compaction equipment.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Thickness: 1/2 inch.
- C. Maximum Variation from Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Independent laboratory, field inspecting, testing, adjusting, and balancing.
- B. Laboratory Material Tests: Conform to Modified Proctor ASTM D1557 or AASHTO T180.
- C. In-place Compaction Tests: Conform to:
 - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- D. Compaction:
 - 1. 100 percent of maximum when measured in-place by standard methods.
 - 2. 98 percent of maximum when measured in-place by nuclear methods.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- F. Frequency of Compaction Tests: Two tests per layer for every 5,000 tons of aggregate base course.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Asphaltic Concrete Paving: Surface, binder, and base courses.
 - 2. Prime Coat and Tack Coat.
 - 3. Surface Sealer.
 - 4. Quality Control and Testing.
- B. Related Sections:
 - 1. Section 31 23 16 - Excavation and Fill: Compacted subbase for paving.
 - 2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
 - 3. Section 32 13 13 - Concrete Paving: Concrete curbs.
 - 4. Section 32 17 23 - Pavement Markings.
 - 5. Section 33 05 13 - Manholes and Structures: Frames and lids in pavement.

1.2 REFERENCES

- A. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product information and mix design.
- C. Manufacturer's Certification: Certify products are produced at a plant approved by SCDOT and that products meet or exceed specified requirements.
- D. Installer Certification: Certify installer is on list of SCDOT approved contractors with an approved Quality Control Plan.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Division 400 of SCDOT Standard Specifications.
- B. Maintain on site one copy of each document.
- C. Obtain materials from same source throughout.
- D. Installer Qualification: Company specializing in performing work of this Section with minimum 5 years experience.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt base course or intermediate course when ambient air or road surface temperature is less than 35 degrees F. or surface is wet or frozen.
- B. Do not place asphalt surface course when ambient air or road surface temperature is less than 50 degrees F. or wet.
- C. Place bitumen mixture when temperature is not more than 15 degrees F. below temperature at when initially mixed and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Asphalt Plant Mix Materials: Conform to Division 300 and 400 of SCDOT Standard Specifications. Reference to section 305 and 401 of SCDOT Standard.
- B. Prime Coat and Tack Coat: Conform to Division 300 and 400 of SCDOT Standard Specifications. Reference to section 402 and 403 of SCDOT Standard.
- C. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt concrete pavements. Conform to Division 400 of SCDOT Standard Specifications.
- D. Sand: Fine aggregate, gradation S1 or S2 conforming to Divisions 300 and 400 of SCDOT Standard Specifications.

2.2 ASPHALT PAVING MIX

- A. General: Use Superpave mix design conforming to Division 400 of SCDOT Standard Specifications.
- B. Wedging or Leveling Mix: Conform to intermediate course.
- C. Reclaimed Asphalt Pavement (RAP) Content: Use maximum 50 percent for base and intermediate courses, maximum 15 percent for surface course.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Section 00 14 00 - Quality Requirements: Testing, inspection, and analysis requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning Work.
- C. Obtain materials from plant approved by SCDOT.
- D. Test plant samples in accordance with Division 400 of SCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade and aggregate base is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 PRIME COAT

- A. Apply primer on aggregate base course at uniform rate of 0.2 to 0.5 gal/sq. yd. in accordance with Division 400 of SCDOT Standard Specifications.
- B. Apply primer to contact surfaces of curbs and gutters.
- C. Use clean sand to blot excess primer.

3.3 TACK COAT

- A. Apply tack coat on asphalt or concrete surfaces at uniform rate of 0.04 to 0.08 gallons/square yard in accordance with Division 400 of SCDOT Standard Specifications.
- B. Apply tack coat to contact surfaces of curbs and gutters.
- C. Coat surfaces of utility structures with oil to prevent bond with asphalt pavement. Do not tack-coat these surfaces.

3.4 PLACING ASPHALT PAVEMENT

- A. Install Work in accordance with Division 400 of SCDOT Standard Specifications.
- B. Place asphalt within 24 hours of applying prime coat or tack coat.
- C. Place asphalt in courses to the thicknesses and dimensions shown on the Drawings.
- D. Place binder and intermediate courses.
- E. Place surface course within 2 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
- F. Place surface course to thicknesses and dimensions shown on the Drawings.
- G. Compact each course by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- H. Perform rolling with consecutive passes to achieve even and smooth finish without roller

marks.

3.5 JOINTS

- A. Traverse Joints:
 - 1. When Work is suspended long enough to allow mixture to chill, construct transverse joint.
 - 2. Use butt joint when traffic will not pass over pavement.
 - 3. Use sloped wedge ahead of the end of pavement when traffic will pass over pavement. Place paper parting strip to removal of wedge.
 - 4. Tack coat edge of pavement prior to placing adjoining pavement.
- B. Longitudinal Joints:
 - 1. Tack the edge of longitudinal joints prior to placing adjoining pavement.
 - 2. Pinch joint by rolling immediately behind the paver.
 - 3. Offset longitudinal joints in each layer by approximately 6 inches.

3.6 TOLERANCES

- A. Density Compaction: Minimum of 92 percent of Maximum Specific Gravity (G_{mm}).
- B. Flatness: Maximum variation of 1/8-inch measured with 10-foot straight edge.
- C. Compacted Thickness: Within 1/4-inch.
- D. Variation From Indicated Elevation: Within 1/2-inch.

3.7 FIELD QUALITY CONTROL

- A. Section 00 14 00 - Quality Requirements: Independent testing firm, field testing, and inspecting.
- B. Perform Contractor Quality Control Program in accordance with Division 400 of SCDOT Standard Specifications.
- C. Take compaction tests every 2,000 linear feet or fraction thereof per day on pavement placed at the paver lay down width.
- D. Take 6-inch diameter full depth pavement cores every 2,000 linear feet or fraction thereof per day on pavement placed at the paver lay down width.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.8 PROTECTION OF FINISHED WORK

- A. Immediately after placement, protect pavement from mechanical injury for seven days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 305

GRADED AGGREGATE BASE

305.1 Description

- 1 This section contains specifications for the materials, equipment, construction, measurement, and payment for construction of a base course composed of the graded aggregate materials specified herein on a properly prepared foundation (subgrade or subbase) in conformance with the lines, grades, dimensions, and cross-sections shown on the Plans or as directed by the RCE.
- 2 When the Contract specifies a graded aggregate base course, the following base courses listed below may appear on the proposal as alternates:
 - Macadam Base Course,
 - Marine Limestone Base Course, or
 - Recycled Portland Cement Concrete Base Course.
- 3 When alternates appear in the proposal, select the intended bid alternate and provide unit bid prices only on that alternate.
- 4 Marine limestone aggregate is generally found in the coastal plain area of the state and is defined as any limestone aggregate not meeting the classification of dolomitic limestone. Fossiliferous limestone aggregate and recrystallized limestone aggregate are considered marine limestone aggregates.

305.2 Materials

305.2.1 Macadam Base Course

- 1 Use base course material composed of crushed stone, excluding marine limestone, filled and bound with screenings. Ensure that the aggregate is free from vegetable matter, sand, lumps or balls of clay, or other deleterious matter.

305.2.2 Marine Limestone Base Course

- 1 Use limestone base course materials produced from a single source or deposit that yields a satisfactory mixture conforming to all requirements of these specifications. Ensure that the Limestone Base Course does not contain clay, sand, organics, or other materials in sufficient quantity to be considered detrimental to the proper bonding, finishing, or strength of the base course.

305.2.3 Recycled Portland Cement Concrete Base Course

- 1 Use aggregate in the base course consisting of coarse aggregate of crushed, graded, recycled Portland cement concrete mixed together with sand, sand-gravel, soil or other approved materials having similar characteristics and combined as necessary to give a mixture conforming to the requirements given below.
- 2 Use aggregate that is free from lumps or balls of clay or other objectionable matter and does not contain metals, wood, brick, plastics, or other unacceptable

able debris.

- 3 When Recycled Portland Cement Concrete Base Course is selected, have the source inspected, sampled and tested, and approved by the MRE and RCE before any material is used in the work. Allow a minimum of 4 weeks for this sampling, testing, and approval.

305.2.4 Coarse Aggregate

305.2.4.1 General

- 1 Use material retained on the No. 4 sieve consisting of hard, durable aggregate particles that are reasonably free from thin or elongated pieces, disintegrated particles, vegetable matter, or other deleterious substances. Ensure that the maximum abrasion loss for coarse aggregate is 65% when subjected to the Los Angeles Abrasion Test (AASHTO T 96).

305.2.4.2 Coarse Aggregate for Macadam Base Course

- 1 Use coarse aggregate for Macadam Base Course consisting of hard, durable particles of crushed slag or stone, excluding marine limestone. Ensure that the aggregate is free from vegetable matter, sand, lumps or balls of clay, or other deleterious matter.
- 2 Ensure minimum weight for crushed slag used in Macadam Base Course, when dry and rodded, is 70 pounds per cubic foot. Use crushed slag that consists of angular fragments, reasonably uniform in density and quality, and reasonably free from glassy, thin or elongated pieces, dirt, or other objectionable material.

305.2.4.3 Coarse Aggregate for Marine Limestone Base Course

- 1 Use coarse aggregate for Marine Limestone Base Course consisting of sound, durable particles of marine limestone aggregate.

305.2.4.4 Coarse Aggregate for Recycled Portland Cement Concrete Base Course

- 1 Use coarse aggregate for Recycled Portland Cement Concrete Base Course consisting of sound, durable particles of recycled Portland cement concrete aggregate, excluding crushed concrete block or pipe.

305.2.5 Fine Aggregate

305.2.5.1 General

- 1 Use fine aggregate or binder material passing the No. 4 sieve subject to the requirements in this subsection.

305.2.5.2 Fine Aggregate for Macadam Base Course

- 1 Use fine aggregate for Macadam Base Course consisting of material produced by crushing operations, excluding marine limestone.

305.2.5.3 Fine Aggregate for Marine Limestone Base Course

- 1 Use fine aggregate for Marine Limestone Base Course consisting of marine limestone produced by mining or crushing operation. Sand will not be permitted as fine aggregate.

305.2.5.4 Fine Aggregate for Recycled Portland Cement Concrete Base Course

- 1 Use fine aggregate for Recycled Portland Cement Concrete Base Course consisting of material produced by the crushing operation, sand, soil, or other acceptable material. Ensure that these materials are obtained from sources approved by the MRE.

305.2.5.5 Composite Mixture

- 1 After the base course material is spread on the subgrade, mixed, and shaped, but prior to the beginning of compaction operations, make certain that the composite mixture conforms to the requirements in the following table.

Macadam Base Course	
Sieve Designation	Percentage by Weight Passing
2-inch	100
1½-inch	95 – 100
1-inch	70 – 100
½-inch	48 – 75
No. 4	30 – 60
No. 30	11 – 30
No. 200*	0 – 12
Liquid Limit	25 Max.
Plasticity Index	6 Max.

Marine Limestone Base Course	
Sieve Designation	Percentage by Weight Passing
2- inch	100
1½-inch	95 – 100
1-inch	70 – 100
½-inch	50 – 85

(table continued on the next page)

(table continued from the previous page)

Marine Limestone Base Course	
Sieve Designation	Percentage by Weight Passing
No. 4	30 – 60
No. 30	17 – 38
No. 200*	0 – 20
Liquid Limit	25 Max.
Plasticity Index	6 Max.

*AASHTO T 11 is used to determine the amount passing the No. 200 sieve.

Recycled Portland Cement Concrete Base Course	
Sieve Designation	Percentage by Weight Passing
2-inch	100
1½-inch	95 - 100
1-inch	70 - 100
½-inch	48 - 75
No. 4	30 - 60
No. 30	11 - 30
No. 200*	0 - 12
Liquid Limit	25 Max.
Plasticity Index	6 Max.

*AASHTO T 11 is used to determine the amount passing the No. 200 sieve.

305.2.5.6 Asphalt Materials

- 1 Use EA-P Special for priming the base course conforming to the requirements specified in **Section 407**.

305.3 Equipment

- 1 Ensure that the equipment necessary for the proper construction of the work is on site, in acceptable working condition, and approved by the RCE as to both type and condition before the start of work under this section. Provide sufficient equipment to enable prosecution of the work in accordance with the project schedule and completion of the work in the specified time.
- 2 Use a steel wheel roller capable of developing a pressure of 250 to 350 pounds per inch of roller width in the compression wheel for compaction. If necessary, use other rollers in conjunction with the steel wheel roller. Ac-

ceptable additional rollers are self-propelled or tractor drawn pneumatic tired rollers or vibratory rollers. Use a combination of the above rollers as necessary to produce a finished product that complies with these specifications.

305.4 Construction

305.4.1 Preparation of Subgrade

- 1 Construct the foundation for the graded aggregate base course in accordance with the requirements as specified in **Section 208**. Roll and compact the subgrade for at least 500 feet ahead of the placing of base course materials where feasible.
- 2 Construct shoulders in accordance with the requirements of **Section 209**, accurately trimmed to the alignment and grade of the base course to form a trench or channeled section as prescribed on the Plans.

305.4.2 Placing of Base Course Material

- 1 Deliver base course materials to the project with the necessary fines already included. Alternatively, add fines if necessary to obtain the desired density and stability. However, in any case provide material whose final gradation meets the requirements shown in **Subsection 305.2.5**.
- 2 Place the base course aggregate on the prepared foundation. Perform the spreading so that the finished base course conforms to the lines, grades, dimensions, and the typical cross-sections shown on the Plans or as directed by the RCE.
- 3 When the required compacted thickness is 10 inches or less, construct the base course in one layer. Where the required thickness is more than 10 inches, construct the base course in two or more layers of approximately equal thickness, and ensure that the maximum compacted thickness of any one layer does not to exceed 10 inches. Construct and compact each layer as specified before placing the succeeding layer.
- 4 Take care to prevent segregation of the fines from the coarse aggregates during the handling, spreading, or shaping of the materials. Correct all areas of segregated fine or coarse material before subsequent placement of overlying lifts.
- 5 If the foundation becomes unstable after the base course has been placed, repair the affected section. Repair the section by removing the base course material and unsatisfactory foundation material and replacing it with approved foundation material. Reconstruct the foundation to the required compaction and shape and then replace the base course at the required cross-section, grade, and compaction.

305.4.3 Compaction, Rolling, and Finishing

- 1 After the base course material is spread, continually machine it with motor graders or other suitable equipment and maintain the required section until the base course is thoroughly compacted. Compact each layer by the use of equipment specified in **Subsection 305.3**. If the foundation becomes unsta-

ble after the base course has been placed, repair the affected section. After removing the base course material and the unsatisfactory foundation material, place suitable subgrade material at the required compaction and shape and then, replace the base course material to the required cross-section, grade and compaction.

- 2 Start rolling the base course at the edge and proceed toward the center, except on superelevated curves where rolling operations proceed from the lower to the upper side. On areas not accessible for the operation of standard rollers, perform compaction using RCE approved rollers. Continue rolling until the layer is satisfactorily compacted for the full width and depth. Wet the base course when necessary. Extend rolling over the edges of each layer of base course materials for a distance of 2 feet on the shoulders. Continue blading and rolling until a dense, smooth, unyielding, and well-bonded base course is obtained.
- 3 If initial compaction has been performed and the voids are not filled, place fine aggregate on the base course in an amount only sufficient to fill the voids. Broom, wet, and roll the base course until the coarse aggregate is firmly set, bonded, and the base course is thoroughly compacted for the full width and depth. Compact each layer of the macadam base course while near optimum moisture with equipment capable of obtaining the required density for the full depth. Continue the rolling until the entire base course is compacted to not less than 100.0% of maximum laboratory density as determined by **SC-T-140**. When the total compacted thickness of the graded aggregate base course is more than 10 inches, place the materials in layers as specified in **Subsection 305.4.2** and compact each layer to the density specified above, regardless of layer thickness.
- 4 Determine the in-place density and moisture content of the graded aggregate base course with a nuclear moisture-density gauge or by other approved means.
- 5 On shoulder work or other applicable construction, do not use steel wheel rollers on the finished pavement, except at locations necessary for turning around. During all phases of the work, take extreme care to protect structures.

305.4.4 Surface Smoothness

- 1 Ensure that the finished surface of the base course varies neither more than $\frac{3}{8}$ inch from a straight edge 10 feet long when applied parallel to the centerline of the road, nor more than $\frac{1}{2}$ inch from the typical cross-section shown on the Plans. Provide necessary materials and perform such corrective work to repair any deviations exceeding the limits given above without additional compensation.

305.4.5 Thickness Tolerance of Base Course

- 1 The thickness of the completed base course is measured at staggered intervals not to exceed 250 feet for two-lane roads. Depth measurements are made by test holes through the base course. Where the base course is less

305.4.5**305.4.6**

than the specified thickness by more than $\frac{1}{2}$ inch, correct such areas by scari-fying, adding base course material, and re-compacting as directed by the RCE.

- 2 When the base course is paid for on a square yard basis, any measurement that exceeds the specified thickness by more than $\frac{1}{2}$ inch is considered as the specified thickness plus $\frac{1}{2}$ inch. The average job thickness is the average of the depth measurements. When the average job thickness is less than the specified thickness by more than $\frac{1}{4}$ inch and payment is by the square yard, an adjusted unit price is used for calculating payment. This adjusted unit price bears the same ratio to the contract unit price bid as the average job thickness bears to the specified thickness.
- 3 When the Contract includes more than one road, each road is considered separately.
- 4 No additional payment over the contract unit price is made for any base course where the average job thickness, determined as provided, exceeds the specified thickness.

305.4.6 Application of Prime Coat

- 1 When hot mix asphalt or an asphalt surface treatment is specified as the subsequent layer on a Graded Aggregate Base Course, apply a prime coat to the base course in accordance with **Subsection 401.4.18**. Before applying the prime coat, repair all irregularities in the base course and ensure that the base course has seasoned sufficiently to permit a uniform penetration and that the RCE has approved the density of the base course. Clean the base course of all mud, dirt, dust, and caked or loose material of any description by brooming, blowing, or other methods to expose the coarse aggregate in the base course.
- 2 When, in the opinion of the RCE, the asphalt material used to prime coat the base course may present a hazard to adjacent properties, the RCE may opt to delete the prime coat from a section of roadway.
- 3 Ensure that the rate of application of the prime coat material conforms to the application rates in the following table.

Base Course Material	Application Rate in Gallons per Square Yard of Asphalt (gal/yd ²)	
	Min.	Max.
Macadam Base Course	0.25	0.30
Marine Limestone Base Course	0.10	0.15
Recycled Portland Cement Concrete Base Course	0.25	0.30

- 4 Perform the application using the methods and requirements prescribed in pertinent portions of **Section 406**.

- 5 When it is necessary to maintain traffic on a road or a section of road before the prime coat has had time to sufficiently dry to prevent pickup, apply sand or some other approved granular material as a cover as directed by the RCE. The cost of furnishing this material and performing this work is included in the price of the base course or other items of work and no direct payment is made.

305.4.7 Weight Tickets

- 1 When the base course is measured by the ton, the requirements set forth in **Subsection 302.4.2** regarding weight tickets apply in all respects.

305.4.8 Maintenance

- 1 Machine the base course as often as is necessary to maintain it smooth and true to grade and cross-section and apply water as required to prevent raveling and keep the base course tightly bound until the prime coat is applied. Repair any defects or damage that develops.

305.5 Measurement

- 1 The quantity for the pay item Graded Aggregate Base Course is measured by the pay unit, either square yard or ton, specified in the Contract.
- 2 When paid by the square yard, the quantity for the pay item Graded Aggregate Base Course (of the required uniform thickness) is the surface area of the base constructed as specified and measured by the square yard (SY) of base course in-place, complete and accepted. The area of base course constructed outside the area designated is disregarded in computing the quantity.
- 3 Base course of variable thickness or base course of thickness for which there is no unit bid price bid is converted to square yards of equivalent area of a base course of a thickness for which there is a contract unit bid price. The conversion is based on the base course whose thickness is nearest to that of the base course without a unit price.
- 4 When paid for by the ton, the quantity for Graded Aggregate Base Course is the weight of the base course constructed as specified, measured by the of ton (TON), including water contained in the delivered base course material, weighed on approved scales and actually incorporated in the work, complete and accepted. If a visual inspection indicates excessive moisture in the base course, a deduction is made for the weight of water applied in excess of 2% above optimum moisture as determined by the RCE. The weight of base course constructed outside the area designated, wasted or lost due to the negligence of the Contractor, and applied in excess of the rate specified or directed in writing is disregarded in computing the quantity.

- 5 Measurement of Prime Coat is in accordance with **Subsection 401.5**.

305.6 Payment

- 1 Payment for the accepted quantity of Graded Aggregate Base Course, measured in accordance with **Subsection 305.5**, is determined using the

contract unit price for the item. Payment is full compensation for constructing the graded aggregate base course as specified or directed and includes preparing the foundation, furnishing, hauling, placing, spreading, mixing, adding water, shaping compacting, finishing, applying prime coat, maintenance, reconstruction (if necessary) of the base course, and all other materials, labor, equipment, tools, supplies, maintenance, and incidentals necessary to complete the work in accordance with the Plans, the Specifications, and other terms of the Contract.

- 2 Base course specified on a square yard basis and is deficient in thickness is paid for at the adjusted unit price in accordance with **Subsection 305.4.5**.
- 3 Payment for Prime Coat is in accordance **Subsection 401.6**.
- 4 Payment for each item includes all direct and indirect costs or expenses required to complete the work.
- 5 Pay items under this section include the following:

Item No.	Pay Item	Unit
3050104	Graded Aggregate Base Course (4" Uniform)	SY
3050105	Graded Aggregate Base Course (5" Uniform)	SY
3050106	Graded Aggregate Base Course (6" Uniform)	SY
3050107	Graded Aggregate Base Course (7" Uniform)	SY
3050108	Graded Aggregate Base Course (8" Uniform)	SY
3050110	Graded Aggregate Base Course (10" Uniform)	SY
3050112	Graded Aggregate Base Course (12" Uniform)	SY
3050199	Graded Aggregate Base Course	TON

DIVISION 400
ASPHALT PAVEMENTS
SECTION 401

HOT MIXED ASPHALT (HMA) PAVEMENT

401.1 Description

- 1 This section contains specifications for the materials, equipment, construction, measurement, and payment for hot mixed asphalt (HMA) base courses, intermediate courses, and surface courses, regardless of gradation of mineral aggregates or the kind, type, and amount of binder or additives.
- 2 Also included in this section are the operations carried out on new and existing asphalt pavements such as milling, surface planing, and full depth HMA patching of asphalt pavement. These operations are performed to repair deteriorated pavement or segregated pavement, remove wheel ruts and other surface irregularities, and provide or restore the appropriate cross-slope to the pavement indicated in the Plans or as instructed by the RCE. Installation of milled-in rumble strips is also included in this section.

401.2 Materials

401.2.1 Binder and Additives

401.2.1.1 General

- 1 Use binder conforming to all of the requirements of AASHTO M 320 and meeting the performance grading within the following table unless otherwise noted in the Contract. Use binder from sources listed on the most recent edition of *SCDOT Qualified Product List 37*. When required, use polymer modified binder consisting of a neat binder modified with an elastomer polymer producing a binder complying with the requirements of a PG76-22 as specified in AASHTO M 320 with the addition of a maximum phase angle of 75 degrees when testing unaged binder in accordance with AASHTO T 320. Use neat binder meeting the requirements for PG64-22 or PG76-22 consisting of production "straight-run" materials that have not been "air-blown" or blended with acid. Use elastomer polymer consisting of a styrene-butadiene (SB), styrene-butadiene-styrene (SBS), or styrene-butadiene-rubber (SBR). Thoroughly blend the composite materials at the asphalt refinery or terminal before being loaded into the transport vehicle. Use polymer modified binder that is heat and storage stable.

Performance Graded Binder		
Type Facility	Intermediate	Surface
Interstates	PG64-22	PG76-22
Primary and Secondary Routes	PG64-22	PG64-22
Critical Areas	PG76-22	PG76-22

401.2.1.2 Liquid Anti-Stripping Agent

- 1 When permitted and used, use liquid anti-stripping agents (ASA) as an asphalt anti-stripping additive in HMA mixes according to the requirements of **SC-M-402**. Use a liquid ASA that has been blended at the binder supplier's terminal at the percentage recommended by the supplier of the liquid ASA and verified during the SCDOT mix design approval process.

401.2.1.3 Hydrated Lime

- 1 Use hydrated lime as an asphalt anti-stripping additive in HMA mixes according to the requirements of **SC-M-402** unless a liquid ASA is permitted and used in accordance with **Subsection 401.2.1.2**. Use hydrated lime conforming to the requirements of AASHTO M 303, Type 1 from suppliers listed on the most recent edition of *SCDOT Qualified Product List 39*.

401.2.2 Aggregates

401.2.2.1 Mineral Aggregates

- 1 Use mineral aggregate that is composed of fine aggregate or a combination of coarse and fine aggregate. Meet the gradation requirements for coarse and fine aggregates that are specified in the tables entitled Gradation of Coarse Aggregates and Gradation of Fine Aggregates located in the Appendix of these specifications. Blend aggregates through separate bins at the cold elevator feeders and not in the stockpile. Coarse aggregate is defined as the portion of the total aggregate retained on a No. 4 sieve, and fine aggregate is the portion passing a No. 4 sieve. Before Department approval may be given for their individual use, provide fine aggregate, coarse aggregate, and any additives in combination with the specified percentage of binder meeting the requirements of the tests specified. In any mix, use aggregates with a combined effective specific gravity of 2.90 or less. Marine limestone use is restricted for surface and intermediate courses as outlined under **Sections 402 and 403**.

401.2.2.2 Mineral Filler

- 1 Use mineral filler that conforms to the requirements of AASHTO M 17.

401.2.2.3 Fine Aggregates

- 1 Use fine aggregate consisting of sand, stone, slag, gravel, screenings, or a combination of sand and screenings from sources listed on the most recent edition of *SCDOT Qualified Product List 1*. Use fine aggregate that is uni-

formly graded from coarse to fine, is free of lumps of clay, loam, or other foreign matter and does not have a coating of an injurious material. The RCE will sample the stockpiled materials at the plant site to ensure compliance with these requirements.

401.2.2.3.1 Sand

- 1 Use sand consisting of hard, sharp, angular grains of quartz or other durable rock, free from excessive quantities of clay or other deleterious substances, and containing not more than 10.0% total material passing the No. 200 sieve with a maximum of 6.0% clay, except as indicated below. Determine the amount of material passing the No. 200 sieve using **SC-T-5**. Determine the percent of clay using **SC-T-34**. Use sand that is free of clay balls, and if it has any clay contained within it, the clay is uniformly dispersed throughout the material. Excavate, blend, and stockpile the sand so that a uniform product is provided. When sands are blended, one of the sands may contain a maximum of 12.0% minus No. 200 material; however, do not exceed 10.0% total material passing the No. 200 sieve with a maximum of 6.0% clay in the composite blend.

401.2.2.3.2 Screenings

- 1 Use screenings consisting of hard, sharp, angular grains of durable materials produced from stone, slag, or gravel meeting the quality requirements of coarse aggregate under **Subsection 401.2.2.4**. When 15.0% or less screenings are used in a mix, do not use screenings containing more than 35% passing the No. 200 sieve as determined by **SC-T-5**. When more than 15.0% screenings are used in a mix, do not use screenings containing more than 15.0% passing the No. 200 sieve as determined by **SC-T-5**. Do not use screenings containing an excessive amount of flaky, micaceous, or other injurious particles. Use regular screenings having a sand equivalent value greater than 40 as determined by AASHTO T 176. When used, ensure that marine limestone screenings or fines contained in a crusher-run material produced from marine limestone material have a sand equivalent of 28 or greater as determined by AASHTO T 176.

401.2.2.4 Coarse Aggregate

- 1 Use coarse aggregate from sources that appear on the most recent edition of *SCDOT Qualified Product List 2* and are shown as approved for HMA or are otherwise approved by the MRE. Use coarse aggregate consisting of clean, washed, tough, durable particles of crushed stone, gravel, or approved crushed slag free from an excess of soft or laminated pieces, disintegrated particles, and vegetable or other deleterious substances and free from aggregate coated with soil or other objectionable matter. Where slag is used, use dry slag having a weight of not less than 75 pounds per cubic foot.
- 2 Unless otherwise specified in **SC-M-402**, the following aggregate requirements apply. Use crushed stone or gravel having an abrasion loss of not more than 60.0% determined by AASHTO T 96 unless otherwise noted. Use slag that has an abrasion loss of not more than 45.0% as determined by

AASHTO T 96. Use aggregates with not more than 10% flat and elongated particles based on a 5:1 ratio following **SC-T-77**.

- 3 Before use in an HMA mixture, test stockpiled slag for expansion following ASTM D 4792 and use material with an average total volumetric expansion of less than 0.50% at the completion of the curing period. Cure stockpiles not meeting the expansion criterion for an additional 2 months minimum before re-testing.
- 4 When the stockpiled material has been aged and passes the volumetric expansion requirements, provide the AME with a certification stating that the material has been cured according to specifications and an HMA mix design for verification. The AME will assign a stockpile number to the stockpile after reviewing the required certification. Age all steel slag used for mix designs in accordance with this specification.

401.2.2.5 Crusher-Run Material

- 1 When using crusher-run material in HMA, use material produced from areas in the quarry that does not allow the possibility of intrusion of overburden, dirt, sap rock, or any other deleterious material.
- 2 The AME will review for approval the process for manufacturing the crusher-run material and the quality control program for controlling production. Utilize a manufacturing process that ensures that a consistent gradation is maintained. Verify this consistent gradation using quality control tests performed by the producer on a daily basis. Make available to the AME all test results upon request.
- 3 Use coarse aggregate in the crusher-run material that is free of clay coatings or other harmful films. Use fines in the crusher-run that meet the quality requirements specified for screenings, including the sand equivalent requirement. Crusher-run material does not require screening before entering the cold feed bin(s) provided a uniform mixture is being produced. If segregation of the finished mixture is evident, the AME may require the crusher-run material to be screened into a coarse and a fine size before entering the cold feed bin(s).

401.2.2.6 Recycled Asphalt Pavement (RAP)

401.2.2.6.1 General

- 1 Ensure that the RAP meets one of the following categories:
 - Category 1: Milled RAP - asphalt material milled from Interstate, US Highway or Primary routes.
 - Category 2: Production Returns – material generated from plant waste, i.e., start-up / shut down material or Random RAP – crushed and screened material removed from secondary routes, private paving projects and/or plant overruns / rejected loads.

401.2.2.6.2 Stockpile Approval

- 1 Perform extraction tests at a rate of 1 per 1000 tons of RAP, with a minimum of 3 tests per stockpile. Process the RAP in such a manner that all particles pass a 2-inch screen before entering the plant, and are free of foreign matter or other contaminations. RAP particles retained on the 2-inch screen may be re-crushed in a manner that does not result in further degradation of the aggregates. Separate stockpiles of RAP material by categories. Erect and maintain a sign satisfactory to the AME on each stockpile to identify the category. Assure that no deleterious material is allowed in any stockpile.

401.2.2.6.3 Records

- 1 Maintain at the plant site a record system for all RAP stockpiles. Include at a minimum the following:
 - Stockpile identification and a sketch of all stockpile areas at the plant site.
 - RAP category (project, state route, plant waste, rejected loads).
 - Origin, dates milled, and the approximate number of tons in the stockpile.
 - All extraction test results.
- 2 At the plant site, make available to the RCE and AME the RAP stockpile records. The RCE or AME may reject by visual inspection any stockpiles that are not kept clean and free of foreign materials.

401.2.2.6.4 Composition of Recycled Mixture

- 1 Use recycled HMA meeting all applicable requirements contained in the specifications, except as indicated herein. Submit samples of RAP and additives proposed for use in the recycled HMA to the AME at least 30 days prior to the beginning of the work. Submit a minimum of 50 pounds of representative milled/processed material along with the RAP stockpile records and the asphalt mix design approval request on forms approved by the AME.
- 2 If milled material from a project is not available, submit at least 10 cores that are between 6 and 8 inches in diameter, sliced at the proposed milling depth that is representative of the material to be milled. In addition, perform a minimum of 6 extraction tests on cored roadway samples from random locations before submitting an asphalt mix design approval request. Submit extraction test results and cores representing the material to be milled with the asphalt mix design request. Ensure that the number of roadway cores obtained is sufficient to represent the entire length of roadway to be milled taking into consideration the length of the project, changing roadway conditions, etc. Conform all HMA to the job mix formulas approved by the MRE within the tolerance range specified.
- 3 Use a final product with a maximum calculated recovered combined absolute viscosity at 140°F of 8,000 poises as determined by **SC-T-95** and AASHTO T 202.

401.2.2.6.4**401.2.2.6.6**

- 4 Do not use softening agents, asphalt modifiers, rejuvenators, or recycling agents. Do not use RAP in any HMA mixture that requires or otherwise uses polymer-modified binder.
- 5 The AME will make random project inspections so that samples of recycled HMA can be obtained for checking the recovered absolute viscosity of the binder. For the maximum absolute viscosity at 140°F of the binder recovered from the field samples, do not exceed 14,000 poises.

401.2.2.6.5 Non-Fractionated RAP

- 1 In addition to the limits below, further limit RAP to 15% maximum when introduced in the hot elevator.
- 2 RAP stockpiles may contain RAP from sources indicated by the category and cannot be replenished once approved.
- 3 When used in HMA, do not exceed the maximum amounts of RAP in mixes shown in the following table.

Type Mix	Maximum % RAP	
	Category 1	Category 2
Surface Type B	10	10
Surface Types CM, C, and D	20	10
Intermediate Type B	15	10
Intermediate Type C	25	10
Asphalt Base Types A & B	30	10

401.2.2.6.6 Fractionated RAP

- 1 Mechanically separate RAP materials into appropriate sizes using a high frequency separation device.
- 2 Provide a QC plan approved by the AME, a fractionation device approved by the AME, and sufficient cold feed bins (one per RAP fractionation size) to handle the fine (passing No. 4 or ¼-inch sieve) and coarse material(s) generated during the fractionation process.
- 3 In addition to the limits in the table below, further limit RAP to 15% maximum when introduced in the hot elevator.
- 4 RAP stockpiles may contain RAP from sources as indicated by the category and may be replenished with RAP from sources of that same category.
- 5 When used in HMA, do not exceed the maximum amounts of RAP in mixes shown in the following table.

Type Mix	Maximum % RAP	
	Category 1	Category 2
Surface Type E Asphalt Base Types C & D	15 *	10 *
Surface Type B	15	10
Surface Types CM, C, and D	20	20
Intermediate Type B	25	10
Intermediate Type C (Binder Type 2)	25	25
Asphalt Base Types A & B	30	30

* Fine RAP only

401.2.2.7 Crushed Glass

- Crushed glass is permitted for use as an aggregate in HMA Aggregate Base Types A and B and Intermediate Type C. When used in these mixes, limit crushed glass to a maximum of 15% by weight of total aggregate. Do not exceed the limits of crushed glass in the following table.

Sieve	% Passing
3/8-inch	100.0
No. 200	8.0 max.

- When the stockpiled material is included in an HMA mix design, present a certification to the AME, along with the mix design for verification, stating that the material meets the required specifications. A stockpile number will be assigned to the stockpile after receiving the proper certification documents

401.2.2.8 Shingles

401.2.2.8.1 General

- Shingles are permitted in HMA Aggregate Base Types A and B, Intermediate Type C, and Surface Types C and D.
- If shingles are used, produce a uniform and reacted asphalt mixture of compatible paving grade binder, quality fine and coarse aggregates, anti-strip additive, and shredded shingles.

401.2.2.8.2 Amount of Shingles in the Mixture

- Limit the amount of the shingles used in each mix in accordance of the job mix formula requirements for that mix. When used, utilize 3% to 8% shingles by the total weight of the aggregate.

401.2.2.8.3 Shredded Shingles

- 1 Utilize shredded shingles that are produced primarily from the processing of shingles at a processing facility or during delivery to a landfill. Use shingles that are produced by ambient temperature grinding processes only. Optionally, use shingles of multiple types from multiple sources if the overall blend of shingles meets the gradation requirements. Ensure that the manufacturer of the roofing shingles has removed all debris such as nails, wood, metal, dirt, large stones, etc. and has rendered the materials to a particle size of less than ½ inch. Provide delivered material 99.7% (by weight) free of any debris.

401.2.2.8.4 Gradation

- 1 Use shingles that meet the requirements in the following table when tested in accordance with AASHTO T 27.

Sieve Size	% Passing
1/2-inch	100.0
No. 4	70.0 – 95.0
No. 100	15.0 max.
No. 200	7.00 max.

- 2 Do not exceed ½ inch for the length of the individual shingle particles. Use shingles that are sufficiently dry to be free flowing and to prevent foaming when blended with the hot binder. Ensure that the shingles are free of all chemicals, oils, or any other hazardous materials (e.g., asbestos). Only accept shredded shingles with a certification from the shingle supplier that the material conforms to these specifications.

401.2.2.8.5 Mix Design

- 1 Use the method of mix design described in **SC-T-80** for the design of HMA containing shingles. After heating the aggregates to the proper temperatures and approximately 1 hour before the addition of the binder, add the proper amount of the shingles (e.g., 8% of total weight of the aggregate or 0.080 x total weight of aggregate), mix thoroughly, and place the mix back in the oven. After approximately an additional 1-hour, add the required amount of the binder and mix. Check the temperature of the mixture to ensure that it has reached the compaction temperature before applying the compactive effort.
- 2 During the mix design verification, approval of the mixture will be based on the calculated absolute viscosity of the mixture. Use material with a recovered absolute viscosity at 140°F less than 12,000 poises as determined by **SC-T-95** and AASHTO T 202.

401.2.2.8.6 Extraction

- 1 Perform the extraction process in accordance with requirements described in these specifications. Follow the testing procedures described in **SC-T-75** to

obtain the binder content of the mixture.

401.2.3 Composition of Mixture

401.2.3.1 Submission of Materials and Job Mix Formula

- 1 Provide all asphalt mix designs for approval by the MRE. Prepare the mix designs in a laboratory approved by the AME following **SC-T-82**. Ensure that technicians designing mixes are certified as a Level 2S, HMA Mix Design Technician. Use a mix with the appropriate materials that complies with all specifications. Prepare mix designs following **SC-T-80** and AASHTO T 312.
- 2 In the job mix formula, indicate a single definite percentage of aggregate passing each required sieve and a single definite percentage of binder contained in the mixture. This percentage of binder is the percentage recovered by **SC-T-64** or **SC-T-75** and does not include any binder that may be absorbed in the aggregates. If an anti-stripping agent or other additives are required, in the job mix formula, indicate the percent of each to be incorporated in the mixture.
- 3 Submit the proposed mix design formula in writing and obtain the approval of MRE for the intended source of materials before starting any work or producing any mixture for acceptance.
- 4 The AME may make adjustments in the submitted job mix formula and if so, will provide advice as to the job mix formula to be used.

401.2.3.2 Gradation Test Method

- 1 Determine the gradation of HMA indicated in **SC-M-400**.

401.2.3.3 Tolerances

- 1 Conform mixtures controlled and accepted according to the standard procedure to the tolerances listed in the table below. Do not use any job mix formula, with or without the tolerances, outside of the master range provided in **SC-M-402** unless otherwise stated.

Sieve Size % Passing	Intermediate Courses	Surface Courses
3/8-inch & larger	± 7.0%	± 7.0%
No. 4	± 6.0%	± 7.0%
No. 8	± 6.0%	± 6.0%
No. 30	± 5.0%	± 5.0%
No. 100	± 4.0%	± 4.0%
No. 200	± 2.0%	± 2.0%

401.2.3.4 Moisture Susceptibility

- 1 Subject all intermediate and surface courses to the indirect tensile strength (ITS) test during the mix design and during actual production of the mix.

Conduct the test in accordance with **SC-T-70**.

- 2 Use intermediate and surface courses with a minimum wet conditioned strength of 65.0 psi and a minimum tensile strength ratio (TSR) of 85.0% during mix design.
- 3 Resubmit the HMA job mix request for mixtures that do not meet the minimum wet conditioned strength or minimum TSR requirements.
- 4 Specimens may be molded in the field anytime during construction to determine the moisture susceptibility of an asphalt mix. Produce HMA having a minimum wet conditioned strength of 60.0 psi and a minimum TSR of 80.0% after plant mixing.

401.2.3.5 Dust to Asphalt Ratio

- 1 Maintain the dust to asphalt ratio for all intermediate and surface courses, except for Surface Type E, in the limits of 0.60 to 1.20. The dust to asphalt ratio is defined as the percentage of material passing the No. 200 sieve divided by the percentage of binder. Determine the total amount passing the No. 200 sieve on mix designs by AASHTO T 11. Determine the amount passing the No. 200 sieve in the field by **SC-T-64**, **SC-T-76**, or **SC-T-92**.

401.2.3.6 Wash Gradations

- 1 Use wash gradations on coarse and fine aggregates to determine the combined blend of aggregates in the total mixture during mix designs. Determine aggregate washed gradations by AASHTO T 11. Submit washed gradations on forms approved by the AME when requesting a job mix formula.

401.2.3.7 Aggregate Selection

- 1 Use a combination of aggregates so that mix adjustments can be readily performed to correct mix design and field problems related to air voids, dust to asphalt ratio, and gradation. Use at least 3 uniformly graded aggregated types to compose an asphalt mix design: fine, intermediate, and coarse aggregates. Do not use less than 8% of any given aggregate type in any mix.

401.2.3.8 Rutting Susceptibility

- 1 HMA used for Interstate and high volume routes will be subjected to the Asphalt Pavement Analyzer (APA) procedure during the mix design process and may be subjected to testing during actual production of the mixture, as deemed necessary by the AME. Perform the testing in accordance with AASHTO TP 63 in a testing laboratory approved by the AME. Fabricate and test 6 cylindrical samples with the interior temperature of the APA set at 64°C. Set the downward force at 100 pounds with the hoses pressurized to 100 psi. Compact each specimen to 4 ±1% air voids. Meet the requirements for the specimen's average rut depth as listed in **SC-M-402**.

401.2.4 Mix and Pavement Samples

- 1 Samples of the HMA in use will be taken and tested as many times daily as deemed necessary by the RCE and the mixture must be maintained uniform

throughout the project within the applicable tolerances.

- 2 Furnish samples of HMA for testing from trucks at the asphalt plant site, trucks at the roadway site, or samples cut from the completed pavement structure. When areas of the pavement are so removed, replace with new HMA and refinish. No additional compensation is allowed for furnishing test samples and replacing the areas with new HMA.

401.2.5 Material for Full Depth Patching

- 1 Select the patch material from the HMA mixes approved for use in the project. Provide patch material that meets all requirements established for those mixes.

401.3 Equipment

401.3.1 General

- 1 The method employed in performing the work and all equipment, plants, machinery, tools, etc., used in handling the materials and performing any part of the work is subject to the approval of the RCE before work is started. The method will be changed or improved as required when found unsatisfactory. Maintain all equipment, tools, machinery, and plants used in a satisfactory working condition. Provide sufficient equipment to enable prosecution of the work in accordance with the project schedule and completion of the work in the specified time.

401.3.2 Mixing Plants

- 1 Use either a batch mixing plant or a drum mixing plant that is designed, equipped and operated so that the weighing, proportioning, and mixing of the materials results in a uniform and satisfactory asphalt mixture meeting the requirements of these specifications. At the plant site, provide sufficient storage space for separate stockpiles, bins, or stalls for each size of aggregate. Keep the different sizes separated until they are delivered, without segregation, by the feeder or feeders to the boot of the cold elevator or elevators in their proper proportions. Maintain the storage yard in a neat and orderly condition with separated stockpiles readily accessible for sampling. Provide separate dry storage of adequate capacity for mineral filler when used. During production of mixes for Department projects, provide full access to the control room and other areas of the plant.
- 2 Use mixing plants of sufficient capacity and that are coordinated to adequately handle the proposed construction. Unless otherwise specified, ensure that mixing plants comply with the requirements contained in **SC-M-401**.
- 3 Ensure that mixing plants for RAP conform to the requirements of **Subsection 401.3.6**.

401.3.3 Hydrated Lime Systems

- 1 Use a lime proportioning system meeting the requirements of **SC-M-401**.

- 2 Obtain approval by the AME for all lime systems, including the continuous premixing pugmill, before any mix is produced.

401.3.4 Shingle Blending Equipment

- 1 If a mechanical system is used to add the required amount of shingles to the HMA, utilize a system that is fully integrated with controls for mineral aggregate, binder, and anti-strip additive. During the pre-construction meeting, discuss and determine the system and methods of adding the shingles to the mix. The AME will inspect the system (manual or mechanical) for approval.

401.3.5 Shingle Storage Area and Silos

- 1 Provide a storage area for storing the shredded shingles that is kept free and clear of all debris such as dirt, wood, paper, stones, etc.
- 2 If the mixture is discharged from the mixer into a hot mix surge or storage silo, operate the bin so that segregation of the mixture is minimized and mixture is not stored overnight.

401.3.6 Mixing Plants for Recycled Asphalt Pavement (RAP)

401.3.6.1 General

- 1 Produce the recycled HMA in a batch plant or drum mix plant meeting all applicable requirements of the specifications and that is modified in a manner satisfactory to the AME to accomplish the hot recycling process. Ensure that the plant is capable of producing uniform mixtures meeting the requirements in **Subsection 401.2.2.6** at the temperatures specified.
- 2 Use a plant capable of meeting all applicable local, state, and federal pollution control requirements. Be familiar with all regulations and be aware that plant emissions resulting from the recycling process may be monitored.

401.3.6.2 Batch Plants for RAP

- 1 Introduce RAP into the plant at the hot elevator or in the weigh hopper.
- 2 When RAP is introduced into the weigh hopper, accurately weigh and proportion the RAP using an automatic proportioning system. Ensure that the RAP weight tolerance is $\pm 1.5\%$ of the total batch weight. Print the RAP weight for each batch on the weight ticket along with the weight of the other batched materials.
- 3 In addition to the maximum limits in the tables provided in **Subsection 401.2.2.6**, further limit the amount of RAP to 15% maximum when RAP is introduced in the hot elevator. Continuously weigh, control, and monitor the RAP cold feed rate and virgin aggregate cold feed rate. Ensure that the weighing system is accurate to 0.5%. Provide a means for conveniently diverting RAP and virgin aggregates into trucks or other containers for checking the accuracy of the cold feed delivery systems. Calibrate the plant before starting production.

- 4 Make provisions electronically for introducing the determined moisture content of the cold feed materials (RAP and virgin aggregates) in the belt weighing system and automatically correcting wet material weights to dry material weights. Determine the moisture content of the RAP and virgin aggregates twice a day during production or when the AME deems necessary. Record the moisture test results on the daily plant report.
- 5 Equip the hot elevator RAP introduction systems so that the dry RAP and dry virgin aggregate rates, in tons per hour, are printed on a cold feed ticket at a time interval prescribed by the AME. Submit the cold feed tickets to the RCE at the end of each day's production.

401.3.6.3 Drum Mixing Plants for RAP

- 1 Continuously weigh, control, and monitor the interlocked RAP cold feed rate and virgin aggregate cold feed rate. Utilize a weighing system with an accuracy of 0.5%. Provide a means for conveniently diverting RAP and virgin aggregates into trucks or other containers for checking the accuracy of the cold feed delivery systems. Calibrate the plant before starting production.
- 2 Make provisions to electronically introduce the determined moisture content of the cold feed materials (RAP and virgin aggregates) in the belt weighing systems and automatically correct wet material weights to dry material weights. Determine the moisture content of the RAP and virgin aggregates twice a day during production or when the AME deems necessary. Record the moisture test results on the approved daily plant report.
- 3 Introduce the RAP in the plant at a location far enough down-stream from the burner away from the flame and extremely hot gases.
- 4 Equip the drum mixing plant with a printer to print the following plant information:
 - Dry virgin aggregate rate in tons per hour.
 - Dry RAP rate in tons per hour.
 - Binder in tons per hour.
 - Total virgin aggregates, RAP, and binder in tons per hour.
- 5 Print the above mentioned plant information on a ticket at a time interval prescribed by the AME. Submit the plant information tickets to the RCE at the end of each day's production.

401.3.7 Hauling Equipment

- 1 Use trucks for hauling asphalt mixture that have tight, clean, smooth metal beds and, to prevent the mixture from adhering to the bed, have been thinly coated with an asphalt release agent listed on the most recent edition of *SCDOT Qualified Product List 17*. Do not use petroleum-based products to prevent asphalt mixtures from adhering to the beds. In all cases, after spraying with solution, raise truck beds so that excess material drains before placing mixture in the truck. Place a hole at a suitable location in the truck bed for checking the temperature of the mixture. Provide and have installed on vehi-

cles a cover made of canvas or suitable material that provides an essentially weather-tight enclosure to completely cover and protect the mixture from inclement weather or where there is evidence of a crust forming. Do not use mesh tarps for covers.

401.3.8 Batch and Truck Scales

- 1 Provide truck scales at the plant site to obtain the net weight of each load of finished mixture and that meet the requirements of **SC-M-401**.

401.3.9 Silos for Storage of HMA

- 1 Ensure that silos used for storage of HMA conform to the requirements of **SC-M-401**.

401.3.10 Pavers

- 1 Unless otherwise permitted or directed by the RCE, spread the asphalt mixture by means of a mechanical self-powered paver capable of spreading and finishing the asphalt mixture without segregation to the depth and width required, true to line, grade, and crown set by the RCE. Equip the paver with hoppers and distributing screws or satisfactory devices for placing the mixture uniformly in front of the screed. When extendable screeds are used, sufficiently extend the distributing screws or augers to provide uniform distribution of the mixture for the full width of the screed. Use a screed or strike-off assembly that operates by cutting, crowding, or other practical action that is effective on the mixture at workable temperatures without tearing, shoving, or gouging and that produces a finished surface of the smoothness and texture required. Use a screed that is adjustable as to level and has an indicating level attached.
- 2 Use a paver that is capable of operating at variable speeds consistent with uniform and continuous laying of the mixture. Avoid stop and go operations of the paver.
- 3 On projects of sufficient length, in addition to the above requirements, equip the paver with a system for automatically controlling the pavement cross-slope and for automatically controlling the longitudinal profile. As the paver moves forward, ensure that the system causes the paver to automatically anticipate and make adjustments for undulations encountered on the existing surface.
- 4 Attach to the paver a 40-foot mobile stringline, a 40-foot long ski, or an approved electronic leveling device with the mobile stringline or ski reference used to establish the longitudinal profile. Use a grade-following sensor that is capable of following the taut string, wire, or other reasonable rigid grade reference produced by the leveling device. Use an automatic cross-slope device that is adjustable and is able to obtain the proper super-elevation going into curves and able to maintain the maximum super-elevation within curves once reaching the maximum super-elevation. For tying into an existing layer of material, use the existing material as the grade reference for the grade following sensor.

- 5 If desired, use manual operation for constructing irregularly shaped and minor areas. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. If the specified surface tolerance is not obtained and maintained, suspend the paving operations until satisfactory corrections, repairs, or equipment replacements are made.

401.3.11 Rollers

401.3.11.1 General

- 1 At the job site, provide the RCE with the manufacturer's literature for the rollers being used, in order that the RCE can determine that the rollers conform to the specifications. Check the tire pressure in the pneumatic-tired rollers upon request and without additional compensation. Check the weight of any roller in use in the presence of the RCE.
- 2 Maintain roller speeds that give maximum compaction and a smooth pavement.

401.3.11.2 Steel-Wheel Rollers

- 1 Use steel wheel rollers that are between 8 and 12 tons in weight. Develop a minimum pressure of 250 pounds per inch of roller width in the compression wheel for these rollers under working conditions. Use rollers in good working condition and capable of reversing without backlash. Equip rollers with adjustable scrapers to keep the rollers clean and with efficient means of keeping the wheels wet to prevent mixes from sticking to the rollers.
- 2 Keep the surface of the rollers free of flat areas, openings, or projections that could mar the surface of the pavement.

401.3.11.3 Pneumatic-Tire Rollers

- 1 Use pneumatic-tire rollers that are self-propelled and have an effective rolling width of not less than 60 inches. Equip the rollers with pneumatic tires of equal size and diameter that are capable of exerting uniform contact pressures. Pressures varying from 60 psi to 80 psi are recommended. Adjust contact pressure by adjusting the ballast or tire inflation pressures. Place the wheels of the rollers so that one pass accomplishes complete coverage equal to the rolling width of the machine. Ensure a minimum of a ¼-inch overlap of the tracking wheels and ensure that the wheels do not wobble. Construct the roller so that the contact pressure is uniform for all wheels, and the tire pressure of the several tires does not vary more than 5 pounds per square inch. Use pneumatic-tire rollers that are constructed with enough ballast space to provide the uniform wheel loading required. Vary the total operating weight and tire pressure of the roller directed by the RCE to obtain contact pressures that results in adequate compaction.

401.3.11.4 Vibratory Rollers

- 1 Use vibratory rollers that weigh at least 8 tons and have either 1 or 2 vibrating wheels. Operate the roller at a speed, frequency, and amplitude that

yields maximum compaction and a smooth pavement.

401.3.12 Field Laboratory and Equipment

- ¹ Provide and maintain in good condition a fully equipped field laboratory, meeting the requirements of **SC-T-81** and furnish all supplies necessary for performing the quality control inspection and testing at the asphalt plant. Furnish all the necessary electricity, fuel, and gas and furnish and maintain all necessary piping and valves. Provide full and ready access for the RCE and MRE during all production and testing. Make immediately available all records to the RCE and MRE at the asphalt plant upon request. Permit the RCE and AME to perform quality control or other tests as deemed necessary. Provide a substantial platform, constructed to the proper height, for use by the RCE and AME in obtaining HMA samples and inspecting mixtures in truck beds. All testing equipment and supplies will be inspected for approval by the AME.

401.3.13 Cutting Equipment for Milled-In Rumble Strips (MIRS)

- ¹ Use a rotary type cutting head for MIRS. Use a head with a maximum outside diameter of 24 inches and a minimum length of 16 inches. Equip the cutting head with the cutting tips arranged in such a pattern that provide a relatively smooth cut. Ensure that the cutting head(s) is mounted on its own independent suspension from that of the power unit to allow the tool to self-align with the slope of the shoulder and/or any irregularities in the shoulder surface. Equip the cutting tool with guides to provide consistent alignment of each cut in relation to the roadway and provide uniformity and consistency throughout the project.

401.3.14 Equipment for Milling Existing Asphalt Pavement

- ¹ Use a milling machine capable of performing the work to the specified width, depth, and cross-slope as shown in the Plans or as directed by the RCE.

401.3.15 Equipment for Planing Existing Asphalt Pavement

- ¹ Use a planing or milling machine equipped with a cutting mandrel with carbide-tipped cutting teeth designed specifically for planing asphalt pavement to close tolerances. Make certain that the equipment accurately establishes slope elevations and profile grade controls. Ensure that a vacuum-equipped street sweeper, capable of removing all loose material from the roadway without causing dust to escape into the air, follows immediately behind the grinding machine. Provide necessary vehicles and equipment for loading and hauling away milled material and cleaning the road surface after planing.

401.4 Construction

401.4.1 General

- ¹ Construct the base, intermediate, or surface course consisting of one or more courses of binder coated mineral aggregates on the prepared surface in accordance with these specifications and the specific requirements of the type

401.4.1

401.4.5.2

specified. Conform the courses to the required lines, dimensions, thickness, and typical cross-section or specified rate of application.

- 2 Conform the production, spreading, compaction, etc. to the applicable requirements of the Specifications.

401.4.2 Plant Production

- 1 Conform HMA production to the requirements of **SC-M-400** unless otherwise specified.
- 2 If it is believed that the HMA is not accurately represented by the field laboratory results, the RCE may contact the AME to investigate the mixture. This investigation may involve the testing of additional HMA material from the paver, delivery truck, or roadway cores.

401.4.3 Paving from Multiple Plants

- 1 To avoid intermixing HMA, do not pave the same lane using mix from more than one plant during a day's production.

401.4.4 Weather and Surface Temperature Restrictions

- 1 Do not apply HMA when the existing surface is wet or frozen. Place HMA in accordance with the following table.

Lift Thickness (inches)	Minimum Ambient Temperature (°F)*
1.0 or less	55.0
1.1 to 2.0	45.0
2.1 to 3.0	40.0
3.1 to 4.5	35.0
* Measure ambient air temperature in the shade with a calibrated thermometer away from artificial heat following SC-T-84 .	

- 2 Do not place HMA surface courses, including Surface Type E, during the months of December, January, and February, except with written permission of the DOC.

401.4.5 Plant Calibration

401.4.5.1 General

- 1 Calibrate the asphalt plant before production so that the mix conforms to the job mix formula and field criteria. Keep stockpile aggregate gradation test results and calibration charts or graphs immediately available to the RCE at the plant upon request.

401.4.5.2 Batch Plant

- 1 When a batch plant is used, calibrate the cold feed bins to the correct proportions on the job mix information sheet. Develop calibration charts or

graphs for each individual cold feed bin. Sample each hot bin and perform gradation tests on each hot bin sample. Determine the percentage of material weighed from each hot bin. Immediately correct the automatic proportioning system when it does not consistently deliver materials within the full range of batch sizes within the tolerances stated in **SC-M-401**. Ensure that the automatic proportioning system can be corrected when the binder content does not reasonably compare with the extraction test results.

401.4.5.3 Drum Mixer Plants

- 1 When a drum mixer plant is used, calibrate the cold feed bins to the correct proportions on the job mix information sheet. Develop calibration charts or graphs for each individual cold feed bin. Recalibrate binder systems when there is variance in the binder content or when the RCE deems necessary. Determine the moisture content of the aggregates before entering the drum at least two times a day or when the RCE or AME deems necessary. Keep calibration charts or graphs and aggregate moisture content test results immediately available to the RCE and AME in the field laboratory upon request.

401.4.5.4 Contractors Monitoring Operations

- 1 Monitor the gradation and quality of materials that are delivered to the asphalt plant. When one or more aggregate gradations do not reasonably conform to the gradation on the job mix information sheet, resubmit another job mix design request.

401.4.5.5 Failing Samples

- 1 Adjust plant production and address samples that are out of tolerance as indicated in **SC-M-400**.

401.4.6 Use of HMA Stored in Silos and Surge Bins

- 1 Ensure that storage of HMA in silos is conducted following the requirements stated in **SC-M-401**.
- 2 The RCE is not obligated to purchase any HMA stored in a silo or surge bin that does not comply with the job mix formula and/or mixture field criteria. HMA that the RCE determines is segregated or contains too much binder due to migration will be rejected.

401.4.7 Preparation of Binder

- 1 Heat the binder to a temperature range recommended by the binder supplier in tanks designed to provide uniform heating of the entire content and to provide a continuous supply of the binder to the mixer at a uniform temperature. Do not heat the unmodified binder to more than 325°F or greater than the temperature recommended by the binder supplier at any time before or after shipment to the plant site.

401.4.8 Preparation of Aggregate

- 1 At the plant, dry and heat the aggregate for the mixture. Heat the aggregate to a temperature between 250°F and 325°F or within the temperature

range recommended by the binder supplier.

401.4.9 Preparation of Mixture

- 1 Heat and prepare the ingredients in a manner that produces a mixture that, when discharged, is at a temperature recommended by the binder supplier, except for HMA Base Type C and D, which requires a temperature to provide complete coating of all particles (typically 240°F to 275°F).
- 2 Whenever possible, devote the full production of the plant to the project in order that the work is performed as continuously as practical. Do not intermix different job mixes in a silo.

401.4.10 Mixing: Batch, Drum, and Continuous Mix Plants

- 1 In order to give the correct individual proportions, follow the HMA job mix formula at all asphalt plants. Dry the aggregates to a consistent mixing temperature before introducing the binder into the HMA. Mix the correct proportions of aggregate, mineral filler, lime, and binder to produce a homogenous asphalt mix in which all particles are thoroughly coated. Use asphalt plants meeting **SC-M-401**, with lime systems checked initially by the AME before producing HMA for Department projects. Use a plant that is able to produce a consistent asphalt mix, without problems with segregation, mix temperature, and varying binder content to meet requirements of the Specifications.

401.4.11 Blending of Hydrated Lime

- 1 Uniformly blend hydrated lime with the damp aggregate at a rate of 1% by weight of dry aggregate. Use damp aggregate containing a minimum of 3% moisture. Use a water spray delivery system if aggregate moisture is less than 3% or when the RCE deems it necessary to prevent lime from becoming airborne. Adjust the production rate so that there is not any retained moisture in the finished mix.
- 2 Perform aggregate moisture tests at least two times a day or when deemed necessary by the RCE. Obtain the aggregate moisture samples at a location between the water spray delivery system and the lime feed system. Keep a record of the test results in an easily accessible location at the asphalt plant for review by the RCE and MRE.
- 3 Determine the percentage of hydrated lime being introduced into the HMA in accordance with **SC-T-71** or **SC-T-78**. Check the percentage of hydrated lime at least two times a day or when the RCE deems necessary. Additionally, when **SC-T-78** is used, verify the weighing system accuracy at least one time per week or as often as the RCE deems necessary.
- 4 Maintain a daily record of aggregate moisture tests and lime percentage determinations on a form approved by the AME. Maintain the amount of hydrated lime by dry aggregate weight in the range of 0.90% to 1.10%. Upon request, make all records immediately available to Department personnel at the asphalt plant.

401.4.12 Milling Existing Asphalt Pavement

- 1 Mill the existing asphalt pavement to the specified width, depth, and cross-slope at locations shown on the Plans or as directed by the RCE. Monitor the milled surface to ensure smoothness and to reduce excess scarification marks or other damage as determined by the RCE. Establish the longitudinal profile of the milled surface by using a skid sensor on the side of the cut. Dispose of the milled material. Thoroughly clean the milled surface of all loose particles.
- 2 Tie milled surfaces to existing drives and intersections. Conduct additional milling in these areas as necessary.

401.4.13 Planing Existing Asphalt Surfaces

- 1 Conduct planing operations in a manner that produces a uniform finished surface of the required texture, grade, and cross-slope. Conduct planing operations in a continuous manner to ensure uniformity. It is not acceptable to conduct frequent halting of the planing operations to load and unload trucks.
- 2 Substantially plane and texture all of the surface area indicated. Extra planing to eliminate small depressed areas is not required if the cumulative total of these un-textured areas does not exceed 5% of the total treated area. It is critical that the planed surface does not allow water to accumulate at the edges of the pavement. Extend planing operations into the paved shoulders or other adjacent pavement a sufficient distance to prevent the construction of a "lip" or other area that retains water on the roadway surface.
- 3 Before commencing work, construct a test section of at least 500 feet in length. The purpose of the test section is to determine the appropriate forward speed for the planing equipment and to demonstrate that the equipment is providing a surface texture, cross-slope, and lane/shoulder configuration satisfactory to the RCE and consistent with this specification.
- 4 Create a "corduroy" texture consisting of a transverse pattern with grooves spaced no greater than 0.2 inches center to center and running generally parallel to the pavement centerline. Ensure that the maximum depth from high to low points on the planed surface is $\frac{1}{8}$ inch.
- 5 After completion of the planing process, test the ground pavement surface transversely and longitudinally with a 10-foot straightedge. Conduct the straightedge testing at no additional cost to the Department. Conduct testing parallel and normal to the pavement centerline. The RCE will determine the minimum frequency of testing and may require additional testing. Perform additional planing at no additional expense to the Department on all areas with high or low spots in excess of $\frac{1}{8}$ inch or in areas where the RCE determines that the appropriate cross slope and grades are not met.
- 6 Before allowing traffic on the planed pavement, clean the pavement of dust and debris using appropriate equipment. Use a vacuum sweeper if instructed to do so by the RCE.

401.4.14 Removal of Existing Asphalt Pavement before Patching

- 1 Remove the deteriorated pavement to the width and length as determined by the RCE, with the face of the cut being straight and vertical. Construct patches with a minimum patch size of 6 feet X 6 feet with at least 25 feet between patches. Remove the pavement to the depth indicated in the Plans. If unstable material is encountered at this point, remove additional material as directed by the RCE. Backfill the volume of material removed below the patch with material meeting the requirements of **Section 305**, Graded Aggregate Base and thoroughly compact in layers not exceeding 4 inches with vibratory compactors. Thoroughly tack the sides of the existing asphalt pavement before placing the asphalt patch material in the hole. Place the patch material in layers not exceeding 3 inches. Thoroughly compact each layer with a vibratory compactor and pneumatic roller. Conduct the work so that patches are opened and filled the same day, with the roadway being opened to traffic by late that same day. Ensure that the finished patch is smooth riding. Do not apply asphalt mixture when the existing surface is wet or frozen.

401.4.15 Conditioning of Subgrade

- 1 Before placing any HMA base course mixture, prepare the subgrade in accordance with the requirements specified in **Section 208**.

401.4.16 Surface Preparation and Leveling

- 1 Prepare base courses as specified in the applicable sections of Division 300.
- 2 Thoroughly sweep the base course, old pavement, or existing surface so that it is clean and free from dust and foreign material. Maintain it until the HMA is placed.
- 3 Bring irregularities in the surface of the existing pavement or old base (including widened shoulders where settled) to uniform contour by leveling with HMA. Place the leveling HMA in a separate operation from the specified depth of surface course. Thoroughly compact the leveling HMA until it conforms to the surrounding surface. Where necessary, perform the leveling with a motor grader or paver.

401.4.17 Transportation and Delivery of Mixes

- 1 Transport the HMA from the plant to the point of use in vehicles meeting the requirements of **Subsection 401.3.7**. Do not permit any load of HMA to leave the plant so late in the day that it cannot be spread, finished, and compacted during daylight of that same day unless an approved artificial lighting system is provided.
- 2 Deliver the HMA to the spreader at a temperature within 20°F of the temperature set at the plant.

401.4.18 Application of Prime or Tack Coat

- 1 Where the Plans call for HMA to be placed directly on a sand clay base course, coquina shell base, or graded aggregate base course and the priming of which is not otherwise provided, apply a prime coat meeting the requirements of **Section 303, 304, 305, or 306** as applicable. A prime coat is not required when HMA is placed directly on the subgrade.
- 2 Before laying any HMA on existing pavements or on unsealed asphalt surface treatment course, uniformly apply a tack coat by use of the distributor spray bars at the rate of 0.05 to 0.15 gallons per square yard as measured by **SC-T-86**. Ensure that all nozzles on the distributor are fully open and operational and are turned at the same angle to the spray bar, which is approximately 30 degrees. In addition, place the spray bar at the proper height above the pavement and apply the proper pressure to provide a uniform double or triple lap of the liquid asphalt material. Place lesser amounts on new pavements and greater amounts on older pavements to ensure a bond between the surface being paved and the overlying course. In areas where it is impractical to use distributor spray bars, such as crossovers, small areas, etc., it is permissible to apply the material by the use of the handheld nozzle. In both cases, apply the actual rate of application as directed by the RCE. Provide a tack coat consisting of binder or emulsified asphalt from a supplier listed on the most recent edition of *SCDOT Qualified Product List 37 or 38*. The acceptable grades of emulsified asphalt are RS-1, MS-1, MS-2, HFMS-1, HFMS-2, SS-1, CRS-1, CRS-2, CMS-2, and CSS-1. Emulsified asphalt, with the exception of grades RS-1 and CRS-1, may be diluted with up to 50% with water provided the dilution is performed at the manufacturing plant by the manufacturer using acceptable procedures. Do not dilute any of the emulsions at the point of use.
- 3 In all cases, regardless of the type tack material used, ensure that the existing pavement or unsealed asphalt surface treatment course is dry and thoroughly cleaned before applying the tack material.
- 4 When HMA sand base course is constructed in layers, clean and scarify the compacted layer as directed by the RCE before placing the next successive layer. When considered necessary by the RCE, apply a tack coat between layers as stipulated above.
- 5 Coat contact surfaces of headers, curbs, gutters, edges of existing pavement, manholes, catch basins, etc. with a thin uniform coating of asphalt tack coat material just before the HMA is placed against them.
- 6 Apply the tack coat as outlined above in a sufficient length of time in advance of the laying of the HMA to permit drying but not so far in advance or over such an area to cause it to lose its adhesiveness.
- 7 No additional compensation is provided for furnishing and applying the tack coats as specified in this subsection.

401.4.19 Spreading and Finishing

- 1 Upon arrival at the point of use, dump the HMA into the mechanical spreader and immediately spread and strike off true to the line, grade, and cross-section stipulated and to such appropriate loose depth for each successive course that when the work is completed, the specified thickness or weight per square yard is achieved. Determine HMA placement rates using **SC-T-85**. Deliver and spread all HMA while in a thoroughly workable condition and free from lumps. Handle material in such a manner to reduce segregation. Dump the HMA in the center of the hoppers and take care to avoid overloading and spilling material on the base.
- 2 If during construction it is found that the spreading and finishing equipment leaves tracks or indented areas in the new course that are not satisfactorily corrected by the scheduled operations, or which produce other permanent blemishes, discontinue the use of such equipment and provide other satisfactory spreading and finishing equipment.
- 3 Provide competent personnel who are capable of performing the work for the correction of all pavement irregularities. Correct irregularities in HMA courses while the mixture is still hot. Give special attention to the straight edging of construction joints immediately following the final rolling. Provide a qualified employee to perform the straight edging.
- 4 Immediately after a course is placed and before roller compaction is started, check the surface and adjust any inequalities. Remove all fat spots and irregular areas and replace them with satisfactory material. Correct irregularities in alignment and grade along the outside edge by the addition or removal of HMA before the edge is rolled.
- 5 Unless otherwise directed by the RCE, do not allow the compacted thickness of any single constructed course to exceed the following thicknesses:
 - 4½ inches for HMA Aggregate Base Course,
 - 3 inches for HMA Sand Base Course,
 - 3 inches for HMA Intermediate Course, or
 - 2 inches for HMA Surface Course.
- 6 Place each layer to such thickness as instructed by the RCE. Overlap the joints in the layers a minimum of 6 inches where practical.
- 7 When multiple lifts are being placed in a single day, ensure that the interior mat temperature of the previous lift is less than 175°F when measured at the mid-point of the depth of mat with a calibrated thermometer following **SC-T-84**.
- 8 If desired, in ditch paving, narrow widening, deep or irregular sections, intersections, turnouts, driveways, or at other locations where it is impractical to spread and finish the HMA by standard methods, use approved spreading equipment or acceptable hand methods. When it is considered necessary to improve the profile and cross-section of an existing pavement before placing the additional normal layer of HMA, the RCE may require that the material be

spread with a blade grader or other type of construction equipment that will give the desired results. Do not dump the loads faster than the material can be properly handled. Perform the raking carefully and skillfully to avoid segregation and so that after the first pass of the roller over the raked HMA, minimal back-patching is required.

- 9 Provide approved means for keeping all small tools clean and free from accumulations of asphalt material.
- 10 Locate the finished surface of surface courses placed adjacent to curbs, gutter, manholes, etc., approximately ¼ inch above the edges of these structures.

401.4.20 Compaction (Standard)

- 1 Ensure that compaction is obtained following the requirements stated in **SC-M-400**.
- 2 Ensure that the intermediate rolling is completed before the mat temperature drops below 175°F.
- 3 To prevent adhesion of HMA to the steel-wheel roller, keep the wheels moistened, without using excess water. Do not use oil.
- 4 In areas such as ditches or along forms, curbs, headers, and walls not accessible for the operation of rollers as specified herein, perform compaction with hand or mechanical tampers, hand-drawn steel wheel rollers, or self-propelled tandem steel wheel rollers as directed by the RCE.
- 5 Ensure that the surface of the HMA after compaction is smooth and true to the established crown and grade. Remove any mixture that becomes loose and broken, mixed with dirt, or in any way defective and replace it with fresh HMA. Immediately compact the fresh HMA to conform to the surrounding area.

401.4.21 Compaction Monitoring

- 1 Monitor the compaction process and make adjustments in equipment or roller patterns so that the finished HMA pavement meets the specified in-place density requirement. Conduct in-place density tests at least every 500 feet per paving lane width by conducting density-gauge tests at randomly selected locations approved by the RCE and at least 1 foot from any unsupported edge. Determine randomly selected locations by **SC-T-101**.
- 2 Do not start production in a lot until the roadway cores from the previous day's production have been obtained unless permission is given by the RCE. Obtain all density tests and cores required for compaction determination using equipment and procedures approved by the RCE.

401.4.22 Weak Base or Poor Surface Conditions

- 1 If in the judgment of the RCE a weak base or poor surface condition results in a density lower than the minimum specified, the RCE may establish a "maximum practical density" lower than that specified.

401.4.23 Joints

- 1 Roll longitudinal joints directly behind the paver. Position the paver so that in spreading, the material overlaps the edge of the lane previously placed by 1 to 2 inches. Leave the loose material high enough to allow for compaction to the depth of the previously rolled lane. Push back the overlapped material by means of lutes or other suitable tools to the edge of the "cold" joint. Perform this work in a manner that provides a uniform joint when rolled.
- 2 Carefully construct and thoroughly compact transverse joints to provide a smooth riding surface. Straightedge or stringline joints to ensure true alignments.
- 3 Construct longitudinal and transverse joints in a careful manner and present the same texture, density, and smoothness as other sections of the course.
- 4 Make joints between old and new pavements, or between successive strips, in a manner that ensures proper bond between the old and new surface for the full depth of the course. Thoroughly coat the joints, transverse and longitudinal, with an approved asphalt tack coat material before placing adjacent material. If necessary, form joints by cutting back on the course. Include the cost of cutting back and coating joints in the contract unit price for the HMA.
- 5 On projects containing multiple courses, arrange the width of the lanes so that the longitudinal joints of each successive course are offset from the joints of the previous course at least 6 inches where practicable. Construct the width of each lane in the top layer the same as the width of the design travel lanes, unless directed otherwise by the RCE.

401.4.24 Milled-in Rumble Strips (MIRS)

- 1 If MIRS are called for in the Plans, place them in the mainline paved shoulder only. Do not place MIRS on ramp shoulders.
- 2 Construct MIRS with finished dimensions of 7 inches ($\pm \frac{1}{2}$ inch) wide in the direction of travel and a minimum of 16 inches long measured perpendicular to the direction of travel. Construct the depressions with a concave circular shape with a minimum $\frac{1}{2}$ -inch depth at center. Place the MIRS perpendicular to the roadway on 12-inch centers. Begin the MIRS on the shoulder, 10 inches from the right edge of the travelway.
- 3 Do not construct MIRS on the median paved shoulder unless specified in the Plans. If the median shoulder is specified, construct the milled area 4 inches from the left edge of the travelway on the shoulder.
- 4 If desired, use removed pavement material suitable for recycling on the project or for other operations at no additional expense to the Department.
- 5 At the end of each working day, remove all equipment to a location where it does not present a hazard to traffic. Clean the pavement by sweeping or flushing; and reopen the work area to traffic each day.

401.4.25 Requirements for Recycled Asphalt Pavement (RAP)

- 1 Conform the production, spreading, compaction, etc. of the RAP to the applicable requirements of the **Subsection 401.3.6**.

401.4.26 Protection of Surface

- 1 Protect the newly constructed surface from traffic until the mixture has hardened sufficiently to prevent distortion. Keep the surface clean and free from foreign material when the shoulders are being constructed.

401.4.27 Finished Surface Requirements**401.4.27.1 General**

- 1 After compaction, ensure that the finished surface of the intermediate or surface course is smooth, of uniform texture, and true to the specified crown and grade.

401.4.27.2 Variability

- 1 When checked with a 10-foot straightedge applied parallel to the centerline of the pavement, ensure that the finished surface of the intermediate course does not vary more than $\frac{1}{4}$ inch and the finished surface course does not vary more than $\frac{1}{8}$ inch as measured from the bottom of the straightedge to the top of the finished surface. Correct intermediate or surface courses not meeting these finished surface requirements by repairing or if necessary, by removing and replacing subject to the approval of the RCE.

401.4.27.3 Ride Quality

- 1 In addition to meeting any specified requirements for surface tolerances, ensure that the intermediate and surface courses meet the satisfactory riding qualities for the HMA placed as determined by the RCE.

401.4.28 Segregation Identification and Correction

- 1 Segregation is defined as areas of non-uniform distribution of coarse and fine aggregate particles in a compacted HMA pavement.
- 2 Conduct necessary production, storage, loading, placing, and handling procedures to prevent segregation. Prevent placement of a segregated HMA mat by making plant modifications or providing auxiliary equipment.
- 4 Correct segregated areas in HMA courses at no additional expense to the Department. Meet all compaction and rideability requirements on roads with corrected segregated areas.
- 5 Correct segregated HMA courses that are not considered riding courses by removing and replacing segregated areas for the full depth of the course and extend at least 10 feet on either side of the segregated areas for the full width of the paving lane.
- 6 Correct all segregated HMA riding courses and segregated courses placed immediately below open graded friction courses by removing and replacing these segregated areas for the full depth of the riding course and extend at

least 300 feet on either side of the segregated areas.

- 7 Overlay the entire roadway with an open grade friction course when more than 25% of the final roadway surface area is corrected due to segregation. Place the open graded friction course at no additional expense to the Department.
- 8 Meet all compaction and rideability requirements on roads with corrected segregated areas.

401.4.29 Rideability

- 1 Ensure that pavement rideability meets the requirements of **SC-M-403**.

401.4.30 Plant Tickets

- 1 Record in triplicate on forms approved by the RCE the net weight of each load of HMA, the accumulated net weight of the loads for the day, and if loaded from a silo, the silo identification number.
- 2 When each load of HMA is delivered to the work, present the original copy of the plant ticket for the load to the RCE. Maintain the stub copy until the completion of the work. Deliver copies to the RCE at the end of the project.
- 3 Note any changes in the amounts designated on all copies of the tickets necessitated by the rejection of material and the reason stated for rejection.
- 4 At any time during the delivery of material and for the purpose of checking the weighing equipment at the plant, the RCE may request that any truckload of HMA delivered to the work be weighed on tested and approved platform scales at no additional expense to the Department.

401.5 Measurement

- 1 The quantity for HMA Intermediate Course and HMA Surface Course is the weight of the material placed determined by using approved scales with no deduction made for the weight of asphalt materials, hydrated lime, liquid anti-striping agent, or any other admixtures and is measured by the ton (TON) of material, complete in place, and accepted,
- 2 The quantity for HMA base course is measured by the unit specified in the Contract. When measurement is specified by the ton (TON), measurement is in accordance with the requirements of this subsection. When measurement is specified by the square yard (SY), measurement is in accordance with the requirements of **Section 309** or **310** for Asphalt Base Course.
- 3 The quantity for Liquid Binder (of the performance grade specified) in the HMA is measured by the ton (TON) of liquid asphalt binder contained in the work and accepted. The amount of binder in the HMA is determined by **SC-T-63**, **SC-T-64**, or **SC-T-75** or, at the option of the RCE, from the amounts printed on the load tickets using an approved ticket printer. In order to check scale accuracy when using a ticket printer for measurement of binder, perform periodic extraction tests (not for pay purposes) on HMA other than those that contain marine limestone or slag.

- 4 Weight of binder that may be absorbed by the aggregate is not included in the quantity of binder.
- 5 When the binder content is not being measured by ticket printout, the quantity of binder in the HMA is the percentage of binder determined at the field laboratory unless otherwise directed by the RCE.
- 6 HMA wasted or lost due to negligence, HMA or binder applied in excess of the rate specified or directed in writing, or HMA applied beyond the limits of the work is deducted from pay quantity.
- 7 The quantity for Milling Existing Asphalt Pavement is surface area of asphalt pavement milled to the specified depth measured and is measured by the square yard (SY), complete in-place, and accepted. The measurement is made on the surface of the road or area designated for milling. No additional measurement is made for variable milling needed to tie in to existing drives and intersections unless specifically directed by the RCE.
- 8 The quantity for Surface Plane Asphalt Pavement is the surface area of the road planed to the specified texture and is measured by the square yard (SY), complete, and accepted. Surface planing conducted outside of the area designated for planing is disregarded in the quantity, except where necessary to provide acceptable cross-slope and lane/shoulder transition as directed by the RCE.
- 9 The quantity for Full Depth Asphalt Pavement Patching is surface area of full depth asphalt pavement patched to a uniform depth and is measured by the square yard (SY), complete, and accepted. Base course material used in the patching work is measured by the ton (TON) of Graded Aggregate Base in accordance with **Subsection 305.5**.
- 10 The quantity for Milled-In Rumble Strip is the sum of the length of the segments of rumble strips milled into the asphalt pavement as indicated on the Plans or as directed by the RCE and is measured by the mile (MI), complete, and accepted. The length of a segment is measured along the inside edge of the shoulder from the center of the first rumble strip in a segment to the center of the last rumble strip in that segment. Where MIRS are provided on more than one shoulder, the segments on each shoulder are measured separately and then, added together.

401.6 Payment

- 1 Adjustments in the contract unit bid prices for HMA courses are determined in accordance with **SC-M-400**. The unit bid prices of HMA courses may be adjusted due to fluctuations in the Monthly Asphalt Price Index or the Monthly Fuel Price Index only if specified as applicable in the Special Provisions.
- 2 Payment for the accepted quantity for HMA Intermediate Course or HMA Surface Course (of the type specified), measured in accordance with **Subsection 401.5**, is determined using the contract (or adjusted) unit price for the applicable pay item. For specific requirements and listing of pay items for the HMA Intermediate Courses and HMA Surface Courses, refer to

Sections 402 and 403, respectively.

- ³ Payment for the accepted quantity for Asphalt Base Course (of the type specified), measured in accordance with **Subsection 401.5**, is determined using the contract (or adjusted) unit price for the applicable pay item. For specific requirements and listing of pay items for the asphalt base courses, refer to **Sections 309 and 310**.
- ⁴ The above mentioned contract (or adjusted) unit prices and payments for all HMA courses are full compensation for constructing the HMA base course, intermediate course, or surface course as specified or directed and includes furnishing, mixing, hauling, placing, and compacting the HMA course; furnishing and applying a tack coat; determining the compaction of the course; and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.
- ⁵ Unless otherwise specified in the Contract, hydrated lime and any other admixtures are not paid for separately. Include all costs for furnishing and incorporating the hydrated lime and any other admixtures into the HMA in the contract (or adjusted) unit price of the HMA course.
- ⁶ Payment the accepted quantity for Liquid Asphalt Binder (of the performance grade specified), measured in accordance with **Subsection 401.5**, is determined using the contract (or adjusted) unit price for the applicable pay item. Payment is full compensation for providing the required liquid asphalt binder as specified or directed and includes all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.
- ⁷ Payment for the accepted quantity for full depth Full Depth Asphalt Pavement Patching (of the specified uniform depth), measured in accordance with **Subsection 401.5**, is determined using the contract (or adjusted) unit price for the applicable pay item. Payment is full compensation for patching deteriorated asphalt pavement as specified or directed and includes cleaning, removing, and disposing of debris from the patching work, and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.
- ⁸ Base course material used in the full depth asphalt pavement patching work is paid for as Graded Aggregate base in accordance with **Subsection 305.6**.
- ⁹ Payment for the accepted quantity for Milling Existing Asphalt Pavement (for the depth specified), measured in accordance with **Subsection 401.5**, is determined using the contract unit price for the applicable pay item. Payment is full compensation for milling the existing asphalt pavement as specified or directed and includes cleaning, removing, and disposing of debris from the milling work, and all other materials, labor, equipment, tools, supplies, trans-

portation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.

- 10 Payment for the accepted quantity for Surface Plane Asphalt Pavement, measured in accordance with **Subsection 401.5**, is determined using the contract unit bid price for the applicable pay item. Payment is full compensation for surfacing planing asphalt pavement as specified or directed and includes straightedge testing of planed surface; cleaning, removing, and disposing debris from planing work; and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.
- 11 Payment for the accepted quantity for Milled-In Rumble Strip measured in accordance with **Subsection 401.5**, is determined using the contract unit price for the applicable pay item. Payment is full compensation for milling the rumble strips into asphalt pavement as specified or directed and includes cleaning, removing, and disposing of debris from the work, and all other materials, labor, equipment, tools, supplies, transportation, and incidentals necessary to fulfill the requirements of the pay item in accordance with the Plans, the Specifications, and other terms of the Contract.
- 12 Payment for each item includes all direct and indirect costs and expenses necessary to complete the work.
- 13 Pay items under this section includes the following:

Item No.	Pay Item	Unit
4011004	Liquid Asphalt Binder PG64-22	TON
4011008	Liquid Asphalt Binder PG76-22	TON
4011010	Liquid Asphalt Binder PG82-22	TON
4012030	Full Depth Asphalt Pavement Patching 3" Uniform	SY
4012040	Full Depth Asphalt Pavement Patching 4" Uniform	SY
4012060	Full Depth Asphalt Pavement Patching 6" Uniform	SY
4012080	Full Depth Asphalt Pavement Patching 8" Uniform	SY
4012100	Full Depth Asphalt Pavement Patching 10" Uniform	SY
4012120	Full Depth Asphalt Pavement Patching 12" Uniform	SY
4013001	Surface Plane Asphalt Pavement	SY
4013XXX	Milling Existing Asphalt Pavement (X)"	SY
4013990	Milling Existing Asphalt Pavement (Variable)	SY
4019000	Milled-In Rumble Strip	MI

SECTION 402

HMA INTERMEDIATE COURSE

402.1 Description

- 1 This section contains specifications for the materials, equipment, construction, measurement, and payment for hot mixed asphalt (HMA) intermediate courses composed of mineral aggregate and binder, mixed in an approved asphalt plant, constructed on a prepared surface, and in conformance with the lines, grades, dimensions, thickness, and typical cross-section shown on the Plans or as otherwise specified.

402.2 Materials

402.2.1 General

- 1 Provide and use materials that meet the applicable requirements of **Subsection 401.2** and **SC-M-402**.

402.2.2 Composition of Mixture

- 1 Combine the mineral aggregates and binder in such proportions so that the composition by weight of the finished HMA is within the composition limits shown in **Subsection 401.2.3** and **SC-M-402**.

402.3 Equipment

- 1 Provide equipment meeting the requirements of **Subsection 401.3**.

402.4 Construction

- 1 Construction HMA intermediate courses in accordance with the requirements specified in **Subsection 401.4**.

402.5 Measurement

- 1 Measurement of the quantity for HMA Intermediate Course Type (A, B, or C) is performed in accordance with **Subsection 401.5**.

402.6 Payment

- 1 Payment for the accepted quantity for HMA Intermediate Course Type (A, B, or C) is determined in accordance with **Subsection 401.6**.
- 2 Payment for each item includes all direct and indirect costs and expenses required to complete the work.

402.6

402.6

3 Pay items under this section include the following:

Item No.	Pay Item	Unit
4020310	HMA Intermediate Course Type A	TON
4020320	HMA Intermediate Course Type B	TON
4020330	HMA Intermediate Course Type C	TON

SECTION 403

HMA SURFACE COURSE

403.1 Description

- 1 This section contains specifications for the materials, equipment, construction, measurement, and payment for HMA surface courses composed of mineral aggregate and binder, mixed in an approved plant, constructed on a prepared surface, and in conformance with the lines, grades, dimensions, thickness, and typical cross-section shown on the Plans or as otherwise specified.

403.2 Materials

403.2.1 General

- 1 Use materials that meet the applicable requirements of **Subsection 401.2** and **SC-M-402**.

403.2.2 Composition of Mixture

- 1 Combine the mineral aggregates and binder in such proportions that the composition by weight of the finished HMA is within the limits set forth in **SC-M-402**.
- 2 A job mix formula is not required for the HMA Surface Course Type E; however, maintain a binder content within an allowable variation $\pm 0.4\%$ of the content approved by the MRE.
- 3 If included in the Contract, use HMA Surface Course Type C or D for Ditch Paving.

403.3 Equipment

- 1 Provide equipment meeting the requirements of **Subsection 401.3**.

403.4 Construction

- 1 Construct HMA surface courses in accordance with the requirements specified in **Subsection 401.4**.

403.5 Measurement

- 1 Measurement of the quantity for HMA Intermediate Course Type (A, B, CM, C, D, or E) is determined in accordance with **Subsection 401.5** with the following addition:
 - When the item of HMA Surface Course for Ditch Paving is included in the Contract, the binder in the ditch paving mixture is not measured for separate payment.

403.6 Payment

- 1 Payment for the accepted quantity for HMA Intermediate Course Type (A, B, CM, C, D, or E) is determined in accordance with **Subsection 401.6** with the following addition:

- When the item HMA Surface Course for Ditch Paving is included in the Contract, the cost of the binder material in the ditch paving mixture is considered included in the contract unit price for the work and is not paid for separately.
- 2 Payment for each item includes all direct and indirect costs and expenses required to complete the work.
- 3 Pay items under this section include the following:

Item No.	Pay Item	Unit
4030310	HMA Surface Course Type A	TON
4030320	HMA Surface Course Type B	TON
4030330	HMA Surface Course Type CM	TON
4030340	HMA Surface Course Type C	TON
4030350	HMA Surface Course Type D	TON
4030360	HMA Surface Course Type E	TON
4037000	HMA Surface Course for Ditch Paving	TON

SECTION 32 13 13 CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete sidewalks.
 - 2. Concrete integral curbs and gutters.
 - 3. Concrete median barriers.
 - 4. Concrete base and surface for parking areas and roads.
 - 5. Small miscellaneous slabs.
- B. Related Sections:
 - 1. Section 31 23 23 - Excavation and Fill: Compacted subgrade for paving.
 - 2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
 - 3. Section 32 12 16 - Asphalt Paving: Asphalt wearing course.
 - 4. Section 32 17 23 - Pavement Markings.
 - 5. Section 33 05 13 - Manholes and Structures: Frames and lids in paving.

1.2 REFERENCES

- A. American Association of State Highway Transportation Officials (AASHTO)
 - 1. AASHTO M 31 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - 2. AASHTO M 32 - Steel Wire, Plain for Concrete Reinforcement.
 - 3. AASHTO M 282 - Joint Sealants, Hot Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.
- B. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- C. ASTM International:
 - 1. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 2. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - 3. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 4. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - 5. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 6. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

- D. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Concrete Mix Design: Submit concrete mix design 30 days prior to use of concrete.
- C. Product Data: Submit data on joint materials, admixtures, and curing compounds.
- D. Manufacturer's Certification: Certify products are produced at a plant approved by SCDOT and that products meet or exceed specified requirements.
- E. Installer Certification: Certify installer is on list of SCDOT prequalified contractors with an approved Quality Control Plan.
- F. Process Control Plan: Submit process control plan for delivering and placing concrete.
- G. Samples: Submit two sample panels, 2 inch x 12 inch in size, illustrating exposed aggregate finish.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with section 501 of SCDOT Standard Specifications, except as modified herein.
- B. Maintain one copy of document on site.
- C. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section and prequalified by SCDOT.
- B. Installer: Company specializing in performing Work of this Section and prequalified by SCDOT.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not place concrete when base surface temperature or air temperature in the shade is 40 degrees F and falling or surface is wet or frozen.

- C. Do not place concrete when air temperature in the shade is 95 degrees F and rising or when concrete temperature is greater than 95 degrees F.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Slip Form Methods: Use slip form methods wherever possible.
- B. Fixed Form Materials: Metal conforming to Section 501 of SCDOT Standard Specifications.

2.2 JOINT MATERIALS

- A. General: Conform to Section 501 of SCDOT Standard Specifications.
- B. Joint Filler: Sponge rubber or cork type conforming to ASTM D1751 (AASHTO M213) or bituminous, non-extruding, resilient type conforming to ASTM D1752 (AASHTO M153), Type 1; thickness as indicated on Drawings.
- C. Silicone Sealant: Low modulus, cold applied, single component, chemically curing silicone material.
 - 1. Type NS: Non-sag silicone, toolable.
 - 2. Type SL: Self-leveling silicone, tooling not required.
- D. Rubber Asphalt Sealant: Hot poured rubber asphalt joint sealer conforming to AASHTO M282 (ASTM D3406).
- E. Bond Breaker:
 - 1. General: Product that does not stain or adhere to the sealant and is chemically inert and resistant to oils, gasoline, solvents, and primer.
 - 2. For On-Grade Pavements: Circular backer rod, diameter 25 percent larger than joint width.
 - a. Type L, For Cold Pour Sealants Only: Closed cell expanded polyethylene foam. Use with Type NS silicone only.
 - b. Type M, For Cold or Hot Pour Sealants: Closed cell polyolefin with closed skin over an open cell core.
 - 3. For Bridge Decks Only: Bond breaking tape, extruded polyethylene with pressure sensitive adhesive on one side, minimum 0.005 inches thick.

2.3 REINFORCEMENT

- A. General: Conform to Section 501 of SCDOT Standard Specifications.
- B. Reinforcing Steel: ASTM A615 (AASHTO M 31); 60 ksi yield grade; deformed billet steel bars; epoxy coated finish.
- C. Dowels and Tie Bars: ASTM A615 (AASHTO M 31); 60 ksi yield grade, plain steel,

epoxy coated finish.

- D. Welded Wire Fabric Steel: Deformed type, ASTM A497; unfinished.

2.4 CONCRETE MATERIALS

- A. Concrete Materials: Provide fine aggregate, coarse aggregate, Portland Cement, fly ash, ground granulated blast furnace slag, water, air entraining agent, and chemical admixtures in accordance with Section 501 of SCDOT Standard Specifications.

2.5 ACCESSORIES

- A. Curing Compound: ASTM C309 (AASHTO M-148), Type 1 clear or translucent or Type 2 white pigmented.

2.6 CONCRETE MIX

- A. Mix and deliver concrete in accordance with Section 501 of SCDOT Standard Specifications.
- B. Roadway and Area Pavement concrete: Air entrained conforming to the following criteria:
 - 1. Flexural Strength: 650 psi at 28 days.
 - 2. Slump: 1.5 inch maximum for slip form method, 3 inches maximum for fixed form hand methods.
 - 3. Minimum Cement Content: 526 pounds/cubic yard.
 - 4. Maximum Water/Cement Ratio: 0.559.
 - 5. Air Entrainment: Between 4.5 and 5.5 percent.
- C. Class A Concrete for sidewalk, curb, curb and gutter, and other incidental site concrete: Air entrained, vibrated conforming to the following criteria:
 - 1. Compressive Strength: 3,000 psi at 28 days.
 - 2. Maximum Slump Vibrated: 3.5 inches.
 - 3. Minimum Cement Content: 564 pounds/cubic yard.
 - 4. Maximum Water/Cement Ratio for Angular Aggregate: 0.532.
 - 5. Maximum Water/Cement Ratio for Rounded Aggregate: 0.488.
 - 6. Air Entrainment: 6.0 percent plus or minus 1.5 percent.
- D. Use accelerating admixtures in cold weather only when approved by the Engineer in writing. Use of admixtures will not relax cold weather placement requirements.
- E. Use calcium chloride only when approved by the Engineer in writing.
- F. Use set retarding admixtures during hot weather only when approved by the Engineer in writing.

2.7 SOURCE QUALITY CONTROL AND TESTS

- A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services.

- B. Submit proposed mix design of each class of concrete to independent firm for review prior to commencement of Work.
- C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.
- D. Test samples in accordance with ACI 301 for compressive strength (cylinders) and flexural strength (beams.)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify compacted base course is acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole, catch basin, and other utility structure frames with oil to prevent bond with concrete pavement.
- C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

- A. Place reinforcement as indicated on Drawings.

- B. Interrupt reinforcement at contraction and expansion joints.
- C. Place dowels to achieve pavement and curb alignment as detailed.
- D. Provide doweled joints 18 inches on center at transverse joints with one end of dowel set in capped sleeve to allow longitudinal movement.

3.5 PLACING CONCRETE

- A. Place concrete in accordance with Section 501 of SCDOT Standard Specifications.
- B. Place concrete using the slip form technique wherever possible.
- C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Place concrete to pattern indicated on Drawings.

3.6 PAVEMENT JOINTS

- A. Provide expansion, contraction, and construction joints as indicated on Drawings.
- B. Place expansion joints at 60 foot maximum intervals. Place contraction joints at 20-foot maximum intervals. Align pavement joints with curb, gutter, and sidewalk joints.
- C. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/2 inch for backer rod and sealant placement.
- D. Saw cut contraction joints 3/16 inch wide or as indicated at an optimum time after finishing. Cut 1/3 into depth of slab.

3.7 SIDEWALK, CURB, AND CURB AND GUTTER JOINTS

- A. Provide sawn joints at 5-foot intervals. Provide 3/4 inch expansion joint at 30 feet maximum and between sidewalks and curbs and structures.
- B. Align sidewalk, curb and gutter joints with pavement joints.

3.8 FINISHING

- A. Area Paving: Heavy broom.
- B. Sidewalk Paving: Light broom. [Brush to 6 inch radius with smooth trowel joint edges.]

- C. Median Barrier: Light broom and trowel joint edges.
- D. Curbs and Gutters: Light broom.
- E. Inclined Vehicular Ramps: V-grooves with mechanical equipment and spring tines, perpendicular to slope.

3.9 EXPOSED AGGREGATE

- A. Apply surface retarder where exposed aggregate finish is indicated.
- B. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush exposing aggregate to match sample panel.
- C. Sand blast concrete surfaces to achieve aggregate exposure surface to match sample panel.

3.10 CURING

- A. Place curing compound on concrete surfaces immediately after finishing.
- B. Cover with burlap or polyethylene film to protect from cold weather and rain.

3.11 JOINT SEALING

- A. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- C. Extend joint filler from bottom of pavement to within 1/2 inch of finished surface.

3.12 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.
- B. Maximum Variation From True Position: 1/2 inch.
- C. Maximum Variation in thickness: 1/2 inch.

3.13 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Prepare three concrete test beams for every 1,333 or less square yards of pavement for each class of concrete placed each day.
- C. Prepare one additional test beam during cold weather and cured on site under

same conditions as concrete it represents.

- D. One slump test will be taken for each set of test cylinders taken.
- E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
- F. Take one 4-inch diameter core for every 1,333 square yards or less of pavement for each class of concrete placed each day.

3.14 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavement for 7 days minimum after finishing.

3.15 SCHEDULES

- A. Concrete Sidewalks: Class A Concrete, compressive strength of 3,000 psi at 28 days, 4 inches thick, buff color Portland cement, light broom finish.
- B. Roadway Pavement Concrete: Non-reinforced, flexural strength of 650 psi at 28 days, 8 inches thick, wood float finish.
- C. Propane Tank Slab: Class AA Concrete, 4,500 psi 28 day concrete, 6 inches thick, 6/6-6 x 6 inch mesh reinforcement, light broom finish.

END OF SECTION

SECTION 32 17 13
PARKING BUMPERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast concrete parking bumpers.
 - 2. Parking bumper anchors.
- B. Related Sections:
 - 1. Section 32 12 16 - Asphalt Paving.
 - 2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit unit configuration, dimensions.

1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate the Work with pavement placement and parking striping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Gage Brothers Concrete Products.
 - 2. Southern Cast Stone Co., Inc.
 - 3. Parking Bumper Co.
 - 4. Substitutions: Equal per Section 01 60 00 - Product Requirements.

2.2 CONCRETE BUMPERS

- A. Precast Reinforced Concrete Mix: Minimum compressive strength of 5,000 psi at 28 days, air entrained to 5 to 7 percent.
- B. Use rigid molds constructed to maintain precast units uniform in shape, size, and

finish. Maintain consistent quality during manufacture.

- C. Embed reinforcing steel and drill or sleeve for two dowels.
- D. Cure units to develop concrete quality and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.
- E. Minor patching in plant is acceptable providing appearance of units is not impaired.

2.3 CONFIGURATION

- A. Nominal Size: 6 inches high, 8 inches wide, 6 feet long.
- B. Profile: Manufacturer's standard cross section with sloped vertical faces, square ends, and drainage slots.

2.4 ACCESSORIES

- A. Dowels: Steel, unfinished, 1/2 inch diameter, 24 inches long, pointed tip conforming to ASTM A615.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with two dowels for each unit bumper.
- D. Core drill concrete pavement 1/8 inch larger than dowel. Seal annular space around hole with grout or sealant.

END OF SECTION

SECTION 32 17 23 PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Traffic lines, legends and markings on asphalt and concrete surfaces.
 - 2. Waterborne Traffic Paint.
 - 3. Thermoplastic Pavement Markings.
 - 4. Glass beads.
- B. Related Sections:
 - 1. Section 32 12 16 - Asphalt Paving.
 - 2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M247 - Standard Specification for Glass Beads Used in Traffic Paint.
- B. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 PERFORMANCE REQUIREMENTS

- A. Paint Adhesion: Adhere to road surface forming smooth continuous film one minute after application.
- B. Paint Drying: Tack free by touch so as not to require coning or other traffic control devices to prevent transfer by vehicle tires within 10 minutes after application.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit paint formulation for each type of paint and glass beads if required.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Submit instructions for application temperatures, eradication requirements, application rate, line thickness, and application of glass beads if required.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Division 600 of SCDOT Standard Specifications.
- B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 5 years experience.
- B. Applicator: Company specializing in performing work of this section with minimum 5 years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Invert containers several days prior to use when paint has been stored more than two months. Minimize exposure to air when transferring paint. Seal drums and tanks when not in use.
- C. Where glass beads are required, store glass beads in cool, dry place. Protect from contamination by foreign substances.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer or:
 - 1. Waterborne Paint: Apply when ambient air temperature and surface temperature is minimum 40 degrees F and rising and a maximum of 160 degrees F.
 - 2. Thermoplastic: Do not apply until ambient air temperature and temperature of the pavement is 50 degrees F or higher.
- C. Do not apply materials during rain or snow when relative humidity is outside humidity ranges or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Volatile Organic Content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

PART 2 PRODUCTS

2.1 PAINTED PAVEMENT MARKINGS

- A. Manufactures:
 - 1. Ennis Paint Co., (ennispaint.com).
 - 2. Franklin Paint Company (franklinpaint.com).
 - 3. EZ-Liner Industries (ezliner.com).

4. TAPCO, Inc. (tapconet.com).
 5. Pervo Paint Company (pervo.com).
 6. Substitutions: Equal per Section 01 60 00 – Product Requirements.
- B. Furnish materials in accordance with Division 600 of SCDOT Standard Specifications.
- C. Waterborne Paint: Ready mixed, fast dry waterborne traffic paints, lead-free, non-toxic, suitable for roadway or parking lots.
- D. Thermoplastic: Alkyd based ready mixed, fast dry, lead free, non toxic, for roadways.
- E. Glass Beads: AASHTO M247, Type 1, coated to enhance embedment and adherence with paint.

2.2 EQUIPMENT

- A. Roadway Application for Continuous Longitudinal Lines: Use equipment with following capabilities.
1. Dual nozzle paint gun to simultaneously apply parallel lines of indicated width in solid or broken patterns or various combinations of those patterns.
 2. Pressurized bead-gun to automatically dispense glass beads onto painted surface, at required application rate.
 3. Measuring device to automatically and continuously measure length of each line placed, to nearest foot.
 4. Device to heat paint to manufacturer's temperature recommendation for fast dry and thermoplastic applications.
- B. Machine Calibration: Calibrate machines to meet specified tolerances.
- C. Other Equipment: For application of crosswalks, intersections, stop lines, legends and other miscellaneous items by walk behind strippers, hand spray or stencil trucks, apply with equipment meeting requirements of this section. Do not use hand brushes or rollers. Optionally apply glass beads by hand.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Do not apply paint to concrete surfaces until concrete has cured for 28 days.

3.2 PREPARATION

- A. Maintenance and Protection of Traffic:
1. Provide short term traffic control in accordance with Section 01 50 00 - Temporary Facilities and Controls.
 2. Prevent traffic from interrupting or driving on newly applied markings before markings dry.

3. Maintain roadway travel lanes between 7:00 a.m. to 9:00 a.m. and between 4:00 p.m. and 6:00 p.m.
 4. Maintain access to existing businesses and other properties requiring access.
- B. Surface Preparation.
1. Clean and dry paved surface prior to painting.
 2. Blow or sweep surface free of dirt, debris, oil, grease, or gasoline.
 3. Spot location of final pavement markings as specified and as indicated on Drawings by applying pavement spots 25 feet on center.
 4. Notify Engineer after placing pavement spots and minimum three days prior to applying traffic lines.

3.3 EXISTING WORK

- A. Remove existing markings in an acceptable manner. Do not remove existing pavement markings by painting over with black paint. Remove by methods that will cause least damage to pavement structure or pavement surface. Satisfactorily repair any pavement or surface damage caused by removal methods.
- B. Clean and repair existing or remaining lines and legends.

3.4 APPLICATION

- A. Agitate paint for 1-15 minutes prior to application to ensure even distribution of paint pigment.
- B. Dispense paint at temperature recommended by manufacturer to wet-film thickness of 15 mils.
- C. Dispense thermoplastic at temperature recommended by manufacture to thickness of:
1. 120 mils for center lines, skip lines, transverse markings, and legends.
 2. 90 mils for edge lines diagonals and arrow symbols.
- D. Apply glass beads at rate of 1 to 3 pounds per gallon of paint.
- E. Apply markings to indicated dimensions at indicated locations.
- F. Prevent splattering and over spray when applying markings.
- G. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free.
- H. When vehicle crosses a marking and tracks it or when splattering or overspray occurs, eradicate affected marking and resultant tracking and apply new markings.
- I. Collect and legally dispose of residues from painting operations.

3.5 APPLICATION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.

- B. Maximum Variation from Wet Film Thickness: 1 mil.
- C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8 inch.
- D. Maintain cycle length for skip lines at tolerance of plus or minus 6 inches per 40 feet and line length or plus or minus 3 inches per 10 feet.
- E. Maximum Variation from Specified Application Temperature: Plus or minus 5 degrees F.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.
- C. Repair lines and markings which after application and curing do not meet following criteria:
 - 1. Incorrect Location: Remove and replace incorrectly placed patterns.
 - 2. Insufficient Thickness, Line Width, Paint Coverage, Retention or Glass Bead Coverage (where required): Prepare defective material by acceptably grinding or blast cleaning to remove substantial amount of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.
 - 3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface one foot beyond affected area. Apply new markings on cleaned surface in accordance with this Section.
- D. Replace failed or defective markings in entire section of defective markings within 30 days after notification when any of the following exists:
 - 1. Marking is discolored or exhibits pigment loss and is determined to be unacceptable by visual comparison with beaded color plates.
 - 2. If glass beads are used, the average retro-reflectivity is less than 375 mcd/m²/1x for white pavement markings and 250 mcd/m²/1x for yellow pavement markings.
- E. When eradication of existing paint lines is necessary, eradicate by shot blast or water blast method. Do not gouge or groove pavement more than 1/16 inch during removal. Limit area of removal to area of marking plus 1 inch on all sides. Prevent damage to transverse and longitudinal joint sealers, and repair any damage according to requirements in Section 32 12 16 or Section 32 13 13.
- F. Maintain daily log showing work complete, results of inspections or tests, pavement and air temperatures, relative humidity, presence of any moisture on pavement, and any material or equipment problems. Make legible entries in log in ink, sign, and submit by end of each work day. Enter environmental data into log prior to starting work each day and at two additional times during day.

3.7 PROTECTION OF FINISHED WORK

- A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free. Follow manufacturer's recommendations or use minimum of 30 minutes. Consider barrier cones as satisfactory protection for materials requiring more than two minutes dry time.

3.8 SCHEDULES

- A. Pavement Markings:

Items	Location
4 inch white paint	Parking lot lines
4 inch yellow paint	Parking lot lane lines
24 inch white thermoplastic	Stop line
4 inch yellow thermoplastic	Roadway center lines
4 inch white thermoplastic	Roadway edge lines

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fence framework, fabric, and accessories.
 - 2. Excavation for post bases.
 - 3. Concrete foundation for posts and center drop for gates.
 - 4. Manual gates and related hardware.
 - 5. Barbed wire, 3 strand on fence top.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - 5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
 - 6. ASTM A585 - Standard Specification for Aluminum-Coated Steel Barbed Wire.
 - 7. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 8. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 9. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 10. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
 - 11. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric.
 - 12. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
 - 13. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
 - 14. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
 - 15. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
 - 16. ASTM F1183 - Aluminum Alloy Chain Link Fence Fabric.
 - 17. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.
- B. Chain Link Fence Manufacturers Institute:
 - 1. CLFMI - Product Manual.

- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SYSTEM DESCRIPTION

- A. Fence Height: As indicated on Drawings.
- B. Line Post Spacing: As indicated on Drawings, 12 feet maximum.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.
- D. Manufacturer's Installation Instructions: Submit installation requirements including post foundation anchor bolt templates if required.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.
- B. Operation and Maintenance Data: Procedures for submittals.

1.6 QUALITY ASSURANCE

- A. Supply material in accordance with CLFMI - Product Manual.
- B. Comply with Section 806 of SCDOT Standard Specifications except as modified herein. Maintain one copy of document on site.
- C. Perform installation in accordance with ASTM F567.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years experience.
- B. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- B. Identify each package with manufacturer's name.
- C. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Pipe Framing: ASTM F1083 Schedule 40 galvanized steel pipe, welded construction; coating conforming to ASTM F1043 Type A on pipe exterior and interior.
- B. Hot Rolled Steel Framing: ASTM A1011 hot rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum Grade 50; coating conforming to ASTM F1043 Type B on pipe exterior and interior.
- C. Steel Fence Fabric: ASTM A392 zinc coated wire fabric or ASTM A491 aluminum coated wire fabric. [ASTM F668 PVC coated.]
- D. Aluminum Alloy Pipe Framing: ASTM B429.
- E. Aluminum Alloy Fence Fabric: ASTM F1183
- F. Barbed Wire: ASTM A121 galvanized steel or ASTM A585 aluminum coated steel; 12 gage thick wire, 2 strands, and 4 points at 3 inch on center.
- G. Concrete: Class A concrete in accordance with Section 701 of SCDOT Standard Specifications with 3000 psi compressive strength at 28 days.

2.2 COMPONENTS

- A. Nominal fence height less than 6 feet:
 - 1. Line Posts: 1.9 inch diameter.
 - 2. Corner and Terminal Posts: 2.88 inch.
 - 3. Gate Posts: 3.5 inch diameter.
 - 4. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
 - 5. Gate Frame: 1.66 inch diameter for welded fabrication.
- B. Nominal Fence height 6 feet or more:
 - 1. Line Posts: 2.38 inch diameter.
 - 2. Corner and Terminal Posts: 3.5 inch.
 - 3. Gate Posts: 4.5 inch diameter.
 - 4. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
 - 5. Gate Frame: 1.66 inch diameter for welded fabrication.
- C. Fabric: 2 inch diamond mesh interwoven wire, 11 gage thick steel, 9 gage thick aluminum, top selvage knuckle end closed, bottom selvage knuckle end closed.
- D. Tension Wire: 7 gage thick steel, single strand.
- E. Tension Band: 3/16 inch thick by 3/4 inch wide steel.
- F. Tie Wire: Aluminum steel wire, 9-gage or 6-gage as indicated.

2.3 ACCESSORIES

- A. Caps: Cast steel galvanized, galvanized pressed steel, malleable iron galvanized, or

aluminum alloy; sized to post diameter, set screw retainer.

- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.
- C. Extension Arms: Cast steel galvanized or galvanized pressed steel to accommodate 3 strands of barbed wire, single arm, for placing vertical or sloped to 45 degrees as indicated on Drawings.
- D. Gate Hardware: Fork latch with gravity drop, center gate stop and drop rod; two 180 degree gate hinges for each leaf and hardware for padlock keyed to match hardware as directed by Architect/Engineer.

2.4 GATES

- A. General:
 - 1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
 - 2. Design gates for operation by one person.
 - 3. Deliver gates factory assembled.
 - 4. Finish is to be galvanized, aluminum coated, or PVC coated to match fence.
- B. Swing Gates:
 - 1. Fabricate gates to permit 180 degree swing.
 - 2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

2.5 FINISHES

- A. Galvanized Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 2.0 oz/sq. ft. coating.
- B. Aluminum Coated Components and Fabric: Aluminum coating to ASTM A792/A792M for components and ASTM A491 for fabric; 0.40 oz/sq. ft.
- C. Vinyl Coated Components and Fabric: Vinyl coating, 10 mil thick, over metallic coated wire, medium green, dark green or black color in accordance with ASTM F934 as indicated on Drawings.
- D. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq. ft. coating.
- E. Accessories: Same finish as framing.

2.6 CONCRETE

- A. Concrete for foundations: Class A Concrete conforming to Section 701 of the SCDOT Standard Specifications.
 - 1. Compressive strength of 3,000 psi at 28 days.
 - 2. Air entrained.
 - 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
 - 4. Maximum slump of 3.5 inch for non-vibrated concrete and 4 inch for vibrated concrete.
 - 5. Minimum cement content of 564 lbs per cubic yard for non-vibrated and 602 lbs

per cubic yard for vibrated concrete.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, accessories, and gates in accordance with ASTM F567.
- B. Set intermediate, terminal, gate, and corner posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- C. Footing Depth from Finished Grade:
 - 1. Line Posts for Nominal Fence Height Less Than 6 Feet: 2.25 feet.
 - 2. Line Posts for Nominal Fence Height 6 Feet or More: 2.5 feet.
 - 3. Corner, Gate, Pull, and Terminal Posts: 3 feet.
- D. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- E. Install top rail through line post tops and splice with 6 inch long rail sleeves.
- F. Install center and bottom brace rail on corner gate leaves.
- G. Place fabric on outside of posts and rails.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- M. Install bottom tension wire stretched taut between terminal posts.
- N. Install support arms sloped inward, outward, or vertical as indicated and attach barbed wire; tension, and secure.
- O. Support gates from gate posts. Do not attach hinged side of gate from building wall.
- P. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf. Install latch, catches, and drop bolt.
- Q. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- R. Connect to existing fence at an existing terminal post, new terminal post, or an existing line post converted to terminal post by installation of brace rails and brace rods.
- S. Install posts with 6 inches maximum clear opening from end posts to buildings, fences,

and other structures.

- T. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.
- U. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.
- V. Extend concrete footings 1 inch above grade and trowel, forming crown to shed water.
- W. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 ERECTION TOLERANCE

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: 1/4 inch.
- C. Maximum Offset from Indicated Position: 1 inch.
- D. Minimum distance from property line: 6 inches.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
 - 2. Testing Topsoil.
 - 3. Supplying Topsoil.
 - 4. Scarifying substrate surface.
 - 5. Placing and lightly compacting topsoil.
 - 6. Removing excess topsoil from site.
- B. Related Sections:
 - 1.
 - 2. Section 31 23 16 - Excavation and Fill: Cutting and filling to site subgrade.
 - 3. Section 31 23 17 - Trenching: Backfilling trenches to subgrade.
 - 4. Section 32 92 19 - Seeding.
 - 5. Section 32 92 23 - Sodding.
 - 6. Section 32 93 00 - Plants: Topsoil fill for trees, plants and ground cover.

1.2 REFERENCES

- A. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Test Results: Submit results of topsoil tests to determine soil amendments required.
- C. Samples: Submit to testing laboratory for independent test, in air-tight containers, 10 pound sample of topsoil.
- D. Materials Source: Submit name and location of imported materials source.

1.4 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with applicable portions of Division 800 of SCDOT Standard Specifications.
- C. Maintain one copy on site.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.
- B. Suitable material excavated from site, amended per requirements of tests is acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding, and planting is required to thickness as scheduled. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to plant material, buildings, and pavement to prevent damage.

- E. Lightly compact placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

- A. Prohibit construction traffic over topsoil. Scarify and regrade disturbed areas.

3.7 SCHEDULES

- A. Compacted topsoil thicknesses:
 - 1. Seeded Areas: 6 inches.
 - 2. Sodded Areas: 4 inches.
 - 3. Shrub Beds: 18 inches.
 - 4. Flower Beds: 12 inches.
 - 5. Planter Boxes: To within 3 inches of box rim.
 - 6. Trees: As indicated on Drawings.

END OF SECTION

SECTION 32 92 19
SEEDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fertilizing.
 - 2. Seeding.
 - 3. Hydroseeding.
 - 4. Mulching.
 - 5. Maintenance.
- B. Related Sections:
 - 1. Section 32 84 00 - Planting Irrigation: Irrigation system for seeded areas.
 - 2. Section 32 91 19 - Landscape Grading: Preparation and placement of topsoil in preparation for the Work of this Section.
 - 3. Section 32 92 23 - Sodding.
 - 4. Section 32 93 00 - Plants.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
- B. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.
- C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Invoices or proof of purchase to verify quantities specified.
- F. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; and, types, application frequency, and recommended coverage of fertilizer.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Section 810 of SCDOT Standard Specifications.
- B. Maintain copy of document on site.

1.6 QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.
- B. Installer: Company specializing in performing work of this Section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers showing percentage of seed mix, germination, inert matter and weeds; year of production; net weight; date of packaging; and location of packaging. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 MAINTENANCE SERVICE

- A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for minimum of three cuttings.

PART 2 PRODUCTS

2.1 TOPSOIL MATERIALS

- A. Conform to Section 32 91 19. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

2.2 SEED MIXTURE

- A. Furnish materials in accordance with South Carolina Board of Agriculture rules and regulations as specified in Section 810 of SCDOT Standard Specifications.

1. Piedmont Region:

Tall fescue	80 lbs/acre
Sericea lespedeza	20 lbs/acre
Kobe lespedeza	10 lbs/acre

2.3 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis. When test is not available, use 10-10-10 mixture of Nitrogen, phosphoric acid, and soluble potash.
- C. Lime: ASTM C602, Class T or Class O agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.
- E. Erosion Fabric: Jute matting, open weave.
- F. Herbicide: As required to combat type of weeds encountered.
- G. Stakes: Softwood lumber, chisel pointed.
- H. String: Inorganic fiber.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Administrative Requirements: Verification of existing conditions before starting Work.
- B. Verify prepared soil base and topsoil are ready to receive the Work of this Section.

3.2 FERTILIZING

- A. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.
- B. Apply fertilizer at application rate recommended by soil analysis.
- C. Apply after smooth raking of topsoil and prior to roller compaction.
- D. Do not apply fertilizer at same time or with same machine used to apply seed.
- E. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

- A. Apply seed evenly in two intersecting directions at the rates shown above. Rake in lightly.

- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season:
 - 1. Piedmont Region:
 - a. Fall: August 15 – September 15.
 - b. Late Winter: February 15 – March 21.
- D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- E. Roll seeded area with roller not exceeding 112 lbs/linear foot.
- F. Immediately following seeding and rolling, apply mulch to thickness of 1/8 inch. Maintain clear of shrubs and trees.
- G. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

- A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 6 lbs per 1,000 square feet evenly in one pass.
- B. Apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.5 SEED PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 12 inches. Space stakes at 5 feet on center.
- B. Cover seeded slopes where grade is greater than 3 H:1 V with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.
- D. Secure outside edges and overlaps at 36 inch intervals with stakes.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.6 MAINTENANCE

- A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas showing bare spots.
- H. Repair washouts or gullies.
- I. Protect seeded areas with warning signs during maintenance period.

3.7 SCHEDULE

- A. Lawn Area: Mix Type 1, 4-inch top soil.
- B. Pond Slopes: Mix type 2, 4-inch top soil.

END OF SECTION

SECTION 32 92 23
SODDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fertilizing.
 - 2. Sod installation.
 - 3. Maintenance.
- B. Related Sections:
 - 1. Section 32 92 19 - Seeding.
 - 2. Section 32 93 00 - Plants.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
- B. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.
- C. Turfgrass Producers International:
 - 1. TPI - Guideline Specifications to Turfgrass Sodding.

1.3 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for sod grass species, fertilizer, mulch, and other accessories.
- C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- E. Invoices or proof of purchase to verify quantities specified.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

- A. Sod: Root development capable of supporting its own weight without tearing, when suspended vertically by holding upper two corners.
- B. Perform Work in accordance with Section 813 of SCDOT Standard Specifications.
- C. Maintain one copy of document on site.

1.7 QUALIFICATIONS

- A. Sod Producer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver sod on pallets. Protect exposed roots from dehydration.
- C. Do not deliver more sod than can be laid within 24 hours.

1.9 MAINTENANCE SERVICE

- A. Maintain sodded areas immediately after placement until grass is well established and exhibits vigorous growing condition for three cuttings.

PART 2 PRODUCTS

2.1 GENERAL

- A. Furnish materials in accordance with South Carolina Board of Agriculture rules and regulations as specified in Section 813 of SCDOT Standard Specifications.

2.2 TOPSOIL MATERIALS

- A. Conform to Section 32 91 19. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

2.3 SOD

- A. Sod: TPI defined Field grown; cultivated grass sod; type indicated below; with strong fibrous root system, free of stones, burned or bare spots; containing no more than five weeds per 1,000 square feet.

Cool Season Grasses	Varieties	Region
Kentucky Bluegrass Blend		Mountain
Tall Fescue Blend	Adventure, Brookston, Falcon, Finelawn, Galway,	Mountain and Piedmont
	Hounddog, Jaguar, Olympic, Rebel	
Tall Fescue/Kentucky Bluegrass Blend		Mountain and Piedmont
Warm Season Grasses	Varieties	Region
Hybrid Bermuda Grass	Vamont, Tifway, Tifway II, Tifgreen	Piedmont and Coastal Plain
Zoysia Grass	Emerald, Meyer	Piedmont and Coastal Plain
Centipede Grass		Piedmont and Coastal Plain
St. Augustine Grass	Raleigh	Piedmont and Coastal Plain

2.4 ACCESSORIES

- A. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis. When test is not available, use 10-10-10 mixture of Nitrogen, phosphoric acid, and soluble potash.
- B. Lime: ASTM C602, Class T or Class O agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.
- C. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.
- D. Herbicide: As required to combat type of weeds encountered.
- E. String: Inorganic fiber.
- F. Wood Pegs: Softwood, sufficient size and length to anchor sod on slope.

2.5 HARVESTING SOD

- A. Machine cut sod and load on pallets in accordance with TPI guidelines.
- B. Cut sod in area not exceeding 1 sq yd, with minimum 1/2 inch and maximum 1 inch topsoil base.

PART 3 EXECUTION

3.1 EXAMINATION

SODDING

- A. Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify prepared soil base and topsoil are ready to receive the Work of this Section.

3.2 FERTILIZING

- A. Apply lime at the application rate recommended by topsoil analysis or 2 tons per acre (100 pounds per 1000 square feet). Work lime into top 6 inches of soil.
- B. Apply fertilizer at application rate recommended by soil analysis or 1,000 lbs per acre (25 pounds per 1,000 square feet) of 10-10-10 fertilizer in fall or 5-10-10 fertilizer in spring.
- C. Apply after smooth raking of topsoil and prior to roller compaction.
- D. Do not apply fertilizer at same time sod is applied.
- E. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod within 48 hours of being cut and within 24 hours after topsoil is prepared and fertilized.
- C. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas.
- E. Place top elevation of sod 1/2 inch below adjoining paving.
- F. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. When using "big roll", lay sod parallel to slope. Drive pegs flush with soil portion of sod.
- G. Do not place sod when temperature is lower than 32 degrees F.
- H. Prior to placing sod, on slopes exceeding 8 inches per foot or where indicated, place surface mesh over topsoil. Securely anchor mesh in place with wood pegs sunk firmly into ground.
- I. Water sodded areas immediately after installation. Saturate soil to 4 inches.
- J. After sod and soil have dried, roll sodded areas to bond sod to soil and to remove minor depressions and irregularities. Roll sodded areas with roller not exceeding 112 pounds.

- K. Roll before first watering.

3.4 MAINTENANCE

- A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas showing bare spots.
- H. Repair washouts or gullies.
- I. Protect sodded areas with warning signs during maintenance period.

3.5 SCHEDULE

- A. Lawn Area: Sod Type 1, 4-inch top soil.
- B. Pond Slopes: Sod Type 2, 4-inch top soil.

END OF SECTION

SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Storm drainage piping.
 - 2. Accessories.
 - 3. Concrete Collars.
- B. Related Sections:
 - 1. Section 31 23 17 - Trenching: Excavation, bedding, and backfill requirements for trenching required by this Section.
 - 2. Section 33 01 32 - Sewer and Manhole Testing: Pressure, infiltration, and deflection tests.
 - 3. Section 33 05 14 - Utility Manholes and Structures: Concrete and masonry manholes, catch basins, inlets, junction boxes, and frames and grates for storm drains.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials
 - 1. AASHTO M36 – Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
 - 2. AASHTO M190 – Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - 3. AASHTO M196 – Corrugated Aluminum Pipe for Sewers and Drains.
 - 4. AASHTO M294 – Corrugated Polyethylene Pipe
- B. ASTM International:
 - 1. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - 2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 3. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 4. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low- Pressure Air Test Method.
 - 5. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
 - 6. ASTM C1103 - Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
 - 7. ASTM D2321 - Standard Practice for Underground Installation of Thermo-plastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by

the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for pipe and pipe accessories.
- C. Manufacturer's Installation Instructions: Submit special procedures required to install products specified.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SCDOT Standard Specifications.
- B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Block individual and stockpiled pipe lengths to prevent moving.
- C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
- D. Do not place pipe flat on ground. Cradle to prevent point stress.
- E. Store UV sensitive materials out of direct sunlight.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with local storm drain authority.
- C. Notify affected utility companies minimum of 72 hours prior to construction.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

- A. Reinforced Concrete Pipe (RCP): ASTM C76, bell and spigot or tongue and groove ends.
 - 1. Pipe Class: Class III with Wall Type B, or as otherwise specified on Drawings.
 - 2. Fittings: Reinforced concrete.
 - 3. Joints: ASTM C443, rubber compression gasket.
- B. HDPE Corrugated Polyethylene Pipe: AASHTO M294, Type S or Type D.
 - 1. Fittings: PVC conforming to pipe specifications.
 - 2. Joints: ASTM F477, elastomeric gaskets.
- C. Corrugated Metal Pipe (CMP):
 - 1. Steel Pipe: AASHTO M36.
 - 2. Aluminum Pipe: AASHTO M196.
 - 3. Fittings: Corrugated Steel or Aluminum to match pipe.
 - 4. Joints: Corrugated coupling bands, galvanized steel or aluminum to match pipe, minimum 10 inches wide; connected with two neoprene "O" ring gaskets per and two galvanized steel bolts.
- D. Bituminous Coated CMP: AASHTO M 190, Coated inside and out with 0.050 inch thick bituminous coating.

2.2 MANHOLES AND STRUCTURES

- A. Manholes: As specified in Section 33 05 14 and indicated on Drawings; covers inscribed with "STORM SEWER."
- B. Catch Basins, Inlets and Junction Boxes: Conform to Section 33 05 14 and as indicated on Drawings.

2.3 CONCRETE AND GROUT

- A. Concrete: Class A Concrete conforming to Divisions 500 and 700 of the SCDOT Standard Specifications.
 - 1. Compressive strength of 3,000 psi at 28 days.
 - 2. Air entrained.
 - 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
 - 4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
 - 5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

- B. Grout: Non-shrink, non-metallic in accordance with Divisions 500 and 700 of SCDOT Standard Specifications with a compressive strength of at least 5,000 psi at 3 days.

2.4 BEDDING AND COVER MATERIALS

- A. General: Conform to Section 31 23 17 for bedding and backfill around and on top of pipe.
- B. Bedding for Rigid Pipe (RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.
- C. Bedding for Flexible Pipe (HDPE and CMP): Clean coarse aggregate Gradation No. 57 conforming to Division 700 of the SCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Excavate pipe trench in accordance with Section 31 23 17.
- B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.
- C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- D. Provide sheeting and shoring in accordance with Section 31 23 17.
- E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 17.
- F. Maintain optimum moisture content of bedding material to attain required compaction density.

3.3 INSTALLATION – PIPE

- A. Install in accordance with manufactures instructions and as indicated on Drawings.
- B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.
- C. Seal joints watertight.

- D. Lay pipe to slope gradients indicated on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet. Begin at downstream end and progress upstream.
- E. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.
- F. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.
- G. Lay bell and spigot pipe with bells upstream.
- H. Connect pipe to existing sewer system as indicated on Drawings at existing manhole or using doghouse manhole connection per Section 33 05 14.
- I. Install underground marking tape continuously 12 inches above pipe line.
- J. Connect to subdrainage tile system piping. Refer to Section 33 46 00.
- K. Install site storm drainage system piping to 5 feet of building and plug.

3.4 INSTALLATION - CONNECTION TO EXISTING STRUCTURES

- A. Core drill existing manhole to clean opening. Do not use pneumatic hammers, chipping guns, and sledge hammers.
- B. Install watertight neoprene gasket and seal with non-shrink concrete grout.
- C. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint. Use epoxy binder between new and existing concrete.
- D. Prevent construction debris from entering existing sewer line when making connection.

3.5 INSTALLATION – MANHOLES, CATCH BASINS AND CLEANOUTS

- A. Install manholes in accordance with Section 33 05 14.
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Form and place cast-in-place concrete base pad or pre-cast concrete base with provision for storm sewer pipe end sections.
- D. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.
- E. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
- F. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Request inspection prior to and immediately after placing bedding.
- C. Perform tests on storm drain system in accordance with Section 33 01 34 and local code. Perform the following tests:
 - 1. Gravity Sewer Testing:
 - a. Low Pressure Air Test.
 - b. Infiltration Test.
 - 2. Deflection Testing of Plastic Piping.
 - 3. Manhole Testing: Vacuum Test.
 - 4. Notify Engineer 72 hours in advance of test and have witness test.
- D. Soil Compaction Testing: In accordance with Section 31 23 17.
- E. When tests indicate Work does not meet specified requirements, remove work, replace, and retest.

3.7 PROTECTION OF FINISHED WORK

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
 - 1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
 - 2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

SECTION 33 42 13 PIPE CULVERTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe culverts.
 - 2. Joints and accessories.
 - 3. Bedding.
 - 4. Slope protection at pipe end.
- B. Related Sections:
 - 1. Section 31 23 17 - Trenching: Excavating and backfilling for culvert piping.
 - 2. Section 31 37 00 – Riprap: Erosion protection at culvert ends.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M36 – Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
 - 2. AASHTO M190 – Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - 3. AASHTO M196 – Corrugated Aluminum Pipe for Sewers and Drains.
 - 4. AASHTO M294 - Specification for Corrugated Polyethylene Pipe, 305- to 915-mm (12- to 36-In.) Diameter.
 - 5. AASHTO M294 - Corrugated Polyethylene Pipe
- B. ASTM International:
 - 1. ASTM A929 - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.
 - 2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - 3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - 5. ASTM C506 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
 - 6. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
 - 7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe, fittings and accessories.
- C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Accurately record actual locations of pipe runs, connections, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- B. Operation and Maintenance Data: Procedures for submittals.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

- A. Reinforced Concrete Pipe (RCP): ASTM C76, bell and spigot or tongue and groove ends.
 - 1. Pipe Class: Class III with Wall Type B, unless otherwise shown on Drawings.
 - 2. Fittings: Reinforced concrete.
 - 3. Joints: ASTM C443, rubber compression gasket.
- B. Reinforced Non-Circular Concrete Pipe:
 - 1. Reinforced Concrete Arch Pipe: ASTM C506, Class A-III.
 - 2. Reinforced Horizontal Elliptical Concrete Pipe: ASTM C507, Class HE-II.
 - 3. Reinforced Vertical Elliptical Pipe: ASTM C507, Class VE-III.
- C. HDPE Corrugated Polyethylene Pipe: AASHTO M294, Type S or Type D.
 - 1. Fittings: PVC conforming to pipe specifications.
 - 2. Joints: ASTM F477, elastomeric gaskets.
- D. Corrugated Metal Pipe (CMP):
 - 1. Steel Pipe: ASSHTO M36, Gage 16 for 6" through 48", Gage 14 for 54", Gage 12 for 60".
 - 2. Fittings: Corrugated Steel or Aluminum to match pipe.
 - 3. Joints: Corrugated coupling bands, galvanized steel or aluminum to match pipe, minimum 10 inches wide; connected with two neoprene "O" ring gaskets per and two galvanized steel bolts.
- E. Bituminous Coated CMP: AASHTO M 190, Coated inside and out with 0.050 inch thick bituminous coating.

2.2 BEDDING AND COVER MATERIALS

- A. General: Conform to Section 31 23 17 for bedding and backfill around and on top of pipe.
- B. Bedding for Rigid Pipe (RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.
- C. Bedding for Flexible Pipe (HDPE and CMP): Clean course aggregate Gradation No. 57 conforming to Division 700 of the SCDOT Standard Specifications.
- D. Cover and Fill: Conform to Section 31 23 17.

2.3 ACCESSORIES

- A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Division 800 of the SCDOT Standard Specifications for Type 1 Engineering Fabric.
- B. Concrete: Class A Concrete conforming to Division 700 of the SCDOT Standard Specifications.
 - 1. Compressive strength of 3,000 psi at 28 days.
 - 2. Air entrained.
 - 3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
 - 4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
 - 5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 EXCAVATION AND BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17.
- B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

- C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- D. Provide sheeting and shoring in accordance with Section 31 23 17.
- E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 17.
- F. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION – PIPE

- A. Install in accordance with manufactures instructions and as indicated on Drawings.
- B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.
- C. Seal joints watertight.
- D. Begin at downstream end and progress upstream.
- E. Keep pipe and fittings clean until work is completed and accepted by Engineer.
- F. Lay bell and spigot pipe with bells upstream.
- G. Repair surface damage to pipe with protective coating with two coats of compatible bituminous paint coating.
- H. Install cover at sides and over top of pipe

3.5 PIPE ENDS

- A. Place fill at pipe ends to match embankment slopes, concrete aprons, adjacent construction, end sections, or end walls as indicated on Drawings.

3.6 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Lay pipe to alignment and slope gradients noted on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet.
- C. Maximum Variation from Intended Elevation of Culvert Invert: 1/2 inch.
- D. Maximum Offset of Pipe From Indicated Alignment: 1 inch.
- E. Maximum Variation in Profile of Structure from Intended Position: 1 percent.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and

balancing.

- B. Request inspection prior to and immediately after placing bedding.
- C. Soil Compaction Testing: In accordance with Section 31 23 17.
- D. When tests indicate Work does not meet specified requirements, remove work, replace, and retest.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 46 00
SUBDRAINAGE AND PERFORATED PIPE SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Infiltration system piping.
 - 2. Geotextile Fabric.
 - 3. Rock Bedding.
 - 4. Fittings and Cleanouts.
- B. Related Sections:
 - 1. Section 31 23 17 - Trenching: Excavation, bedding, and backfill requirements for trenching required by this Section.
 - 2. Section 33 41 00 – Storm-Utility-Drainage-Piping-SC.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials
 - 1. AASHTO M292 – Corrugated Polyethylene Drainage Pipe.
 - 2. AASHTO M294 – Corrugated Polyethylene Pipe.
- B. ASTM International:
 - 1. ASTM C33, Standard Specification for Concrete Aggregates.
 - 2. ASTM D737, Standard Test Method for Air Permeability of Textile Fabrics.
 - 3. ASTM D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 4. ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 5. ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 6. ASTM D3776, Standard Test Method for Mass per Unit Area (Weight) of Fabric.
 - 7. ASTM D3786, Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method.
 - 8. ASTM D3887, Standard Specification for Tolerances for Knitted Fabrics
 - 9. ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - 10. ASTM D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
 - 11. ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 12. ASTM D4751, Standard Test Method for Determining the Apparent Opening Size of a Geotextile.
 - 13. ASTM D4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
 - 14. ASTM D6241, Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products using a 50-mm Probe
 - 15. ASTM D6707, Standard Specification for Circular-Knit Geotextile for Use in Sub-surface Drainage Applications
 - 16. ASTM F405, Standard Specification for Corrugated Polyethylene (PE) Pipe and

- 17. Fittings.
ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

- C. SCDOT Standard Specifications:
 - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data for pipe and pipe accessories.
- C. Manufacturer's Installation Instructions: Submit special procedures required to install products specified.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Geotextile fabric.
- F. Rock gradation results.
- G. Polyethylene pipe and fittings (including slot perforation pattern).
- H. PVC pipe and fittings (including perforation pattern).

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SCDOT Standard Specifications.
- B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 5 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Block individual and stockpiled pipe lengths to prevent moving.
- C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
- D. Do not place pipe flat on ground. Cradle to prevent point stress.
- E. Store UV sensitive materials out of direct sunlight.
- F. Geotextile: During shipment and storage, the rolls of fabric shall be protected against deterioration from the sun, mud, dirt, dust, and other deleterious conditions at all times.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with local storm drain authority.
- C. Notify affected utility companies minimum of 72 hours prior to construction.

PART 2 PRODUCTS

2.1 GEOTEXTILE FABRIC

- A. The fabric shall have complete resistance to deterioration from ambient temperatures, acid, and alkaline conditions, and shall be indestructible to microorganisms and insects. The material shall be resistant to short-term (until placement) deterioration by ultraviolet light or protected until placement, as recommended by the manufacturer, such that no deterioration occurs.
- B. Fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, shall consist of long chain synthetic polymers composed of at least eighty five percent (85%) by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages.
- C. The property values shown below are not design values, but represent the minimum accepted physical characteristics of the geotextile required. The number represents a value to be confirmed by the manufacturer. These values represent minimum average roll values (for example, any roll tested shall meet or exceed the minimum values in the table).

Property	Value	Test Method
Grab Strength	120 lbs.	ASTM D4632
Grab Tensile Elongation	55%	ASTM D4632
Burst Strength	225 psi	ASTM D3786
Puncture Resistance	65 lbs.	ASTM D4833
Trapezoid Tear Strength	50 lbs.	ASTM D4533
Apparent Opening Size	70, U.S. Standard Sieve	ASTM D4751
Permittivity	1.7 sec. ⁻¹	ASTM D4491
Water Flow Rate	140 gal./min./ft. ²	ASTM D4491

- D. Geotextile fabric for pipe underdrains shall be Mirafi 140N or equivalent.

2.3 DRAIN SLEEVE

Property	Value	Test Method
Weight	3.5 – 3.9 oz./yd ² .	ASTM D3776
Thickness	0.040 in.	
Burst Strength (min)	120 psi	ASTM D3887
Puncture Resistance (min)	180 lbs.	ASTM D6241
Air Permeability	700 ft. ³ /ft. ² /min.	ASTM D737
Apparent Opening Size	30, U.S. Standard Sieve	ASTM D4751
Permittivity (min)	2.4 sec. ⁻¹	ASTM D4491
Water Flow Rate	300 gal/min/ft. ² (2" Constant Head)	ASTM D4491

2.3 ROCK BEDDING

- A. Unless otherwise shown in the DRAWINGS, rock shall consist of dense, clean, uniformly graded material with a maximum size of two (2) inches and less than five percent (5%) passing the three-eighths inch (3/8") sieve. Coarse concrete aggregate meeting the requirements of ASTM C33 No. 4 may be used.

2.4 HDPE PIPE AND FITTINGS

- A. ADS Heavy Duty Pipe meeting ASTM F405 with slotted or circular perforations providing a minimum inlet area as required by AASHTO M252 or AASTO M294 Class 2 perforations.. The slotted perforation pattern shall be in accordance with AASHTO M252 or AASHTO M294 Class 2 perforations providing a flow rate for six-inch (6") diameter pipe of ninety four hundredths (0.94) GPM at a one-foot (1') pressure head. The pipe is available in ten-foot (10') joints, one hundred (100), and one thousand five hundred (1,500) linear foot rolls. The pipe shall include a factory- installed drain sleeve that meets the requirements of ASTM D6707 (ADS Drain-Sleeve or approved equal).
- B. HDPE pipe and fittings shall be made in accordance with ASTM F405.
- C. HDPE pipe shall be Type S or approved equal.

2.5 PVC PIPE AND FITTINGS

- A. Specifications and Dimensions:
 - 1. PVC pipe and fittings shall be made in accordance with ASTM D1784.
 - 2. The pipe shall be designed, manufactured, tested, inspected and marked in accordance with the provisions of this SPECIFICATION and ASTM D3034. The minimum wall thickness shall be SDR 35.
 - 3. Nominal pipe lengths of pipe shall be twenty (20) feet, with shorter lengths provided as required by DRAWINGS, alignment, and grade.
- B. Joint Type:
 - 1. Pipe joints shall be made using an integral bell with an elastomeric gasket push- on type joint. The joint shall comply with the requirements of ASTM D3212.
 - 2. Gaskets shall meet the requirements of ASTM F477.
 - 3. Solvent-cement joints are strictly prohibited.
- C. Perforations:
 - 1. PVC piping shown on the DRAWINGS to be perforated shall be perforated to the pattern shown on the DRAWINGS. If no pattern is shown on the DRAWINGS, four (4) one-quarter inch (1/4") diameter holes shall be provided at six-inch (6") centers at the quarter points of the pipe. No perforation shall be made within six (6) inches from either end of the pipe.

2. Laterals, drain lines away from the structure, and the top ten (10) feet of cleanout risers shall have a solid wall.

PART 3 EXECUTION

3.1 TRENCHING

- A. The underdrain shall be trenched into the native soil a maximum of six (6) inches if so shown on the DRAWINGS to the grades shown on the DRAWINGS. The trenches shall slope uniformly at the grade shown on the DRAWINGS.

3.2 GEOTEXTILE FABRIC

- A. All perforated pipe shall be wrapped with geotextile fabric.
- B. Perforated pipe in cleanout risers shall be wrapped in geotextile fabric. Suitable means shall be found to seal the seam and maintain the position of the fabric during backfilling.
- C. Care shall be taken not to tear any geotextile fabric during backfilling.

3.3 ROCK

- A. Rock shall be placed on the geotextile fabric to the depth shown prior to placement of the underdrain pipe. After the pipe is in place, rock shall be placed along and over the top of the pipe in a manner that shall not damage the pipe.

3.4 HDPE PIPE AND FITTINGS

- A. The pipe shall be installed in accordance with the manufacturer's written instructions, a copy of which shall be maintained on site during pipe installation.

3.5 PVC PIPE AND FITTINGS

- A. General: When laying PVC pipe out on a curve, the joints may be deflected up to seventy five percent (75%) of the maximum value permitted by the manufacturer of the pipe. Tighter curves shall be made by either using shorter lengths of pipe or by using manufactured bends.
- B. Perforated Pipe: Perforated pipe shall be placed in the rock bedding as shown on the DRAWINGS.
- C. Solid Pipe: Solid PVC pipe shall be placed on six (6) inches of sand bedding, unless the native soil is capable of providing uniform support as approved by ENGINEER or shown on the DRAWINGS.

3.6 CLEAN-OUTS

- A. The clean-out risers shall be protected from damage during the backfilling operations.
- B. The ring and cap shall be secured in place with a reinforced concrete collar as shown on the DRAWINGS.

END OF SECTION