DIVISION 300
Bases and Subbases

SOUTH CAROLINA
DEPARTMENT
OF TRANSPORTATION

May 2004

Table of Contents

Section **Page**

Table of Contents (continued)

Section **Page**

Table of Contents (continued)

Section **Page**

Table of Contents (continued)

Section **Page**

Table of Contents (continued)

Section **Page**

Table of Contents (continued)

Section **Page**

Table of Contents (continued)

Section **Page**

Table of Contents (continued)

Section **Page**

Section 300
General Guidelines

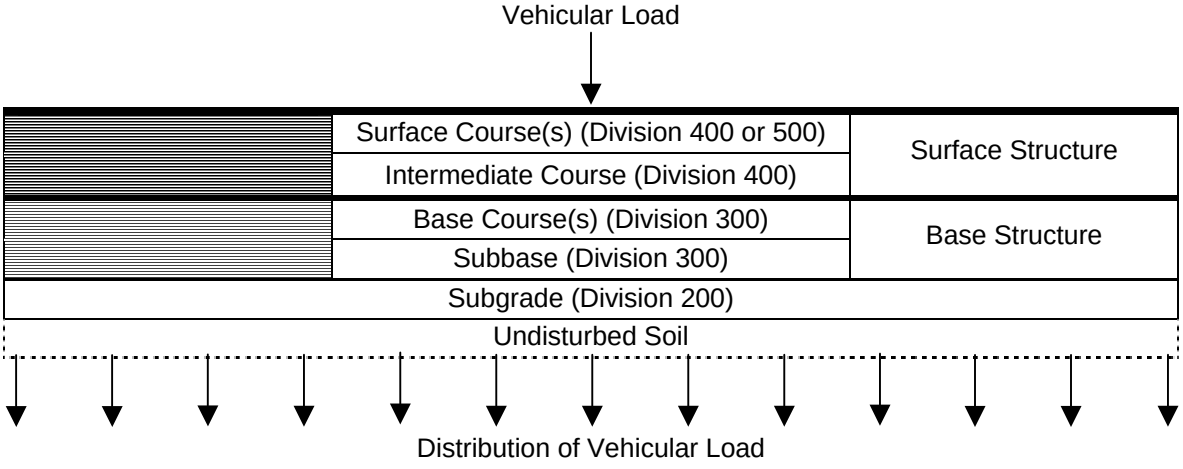
300.1 INTRODUCTION

To ensure good performance and longevity of a pavement structure, continuous and thorough inspection during the early stages of highway construction is critical. Pavement structure failures can often be traced to an improperly constructed subgrade, subbase, base course or drainage feature. Good field inspection will detect deficiencies early in the project, facilitating immediate corrective action and minimizing future pavement failures. Division 300 provides the SCDOT Inspector and Resident Construction Engineer with guidance that should be used in conjunction with sound engineering judgment and field experience to inspect the construction of highway pavement subbase and base courses.

300.2 PAVEMENT CONSTRUCTION: OVERVIEW

300.2.1 Pavement Structure

In general, a pavement structure is designed to carry the repetitive loads of projected vehicular traffic, taking into consideration the type of facility required, the number and type of vehicles that are expected to use the facility during its design life, the quality of materials available on the project and other design factors. The pavement structure itself consists of several layers of various material types and thicknesses, which are placed and compacted sequentially from the ground up. Each layer is designed to distribute the load it supports to the layer immediately below it, thus allowing the vehicular load directly supported by the surface courses to be uniformly distributed throughout the pavement structure to the subgrade foundation. This concept is illustrated in Figure 300A.



TYPICAL PAVEMENT STRUCTURE
Figure 300A

300.2.2 Subgrade Foundation

Earthwork must be completed and approved before initiating work on the subbase or any base course, including clearing and grubbing, roadway and drainage excavation, and embankment and subgrade construction (see Division 200). The subgrade is the foundation of the entire pavement structure; therefore, its construction must be closely inspected as discussed in Section 208. Once the subgrade has been approved by the District Construction Engineer, continue to monitor the subgrade for excessively wet areas, soft spots, ruts and grade deficiencies. Require the Contractor to correct such deficiencies in accordance with the provisions of the Contract before they are covered by a subsequent subbase or base course. Additional drainage, grading and compaction rework may be required to bring the subgrade into compliance. As needed, seek assistance from the Resident Construction Engineer.

300.2.3 Base Structure

The base structure within the pavement structure includes base courses and may include a subbase course, as well. The primary functions of the subbase and base courses are to:

- provide uniform structural support of the pavement;
- prevent volume changes in the subgrade (i.e., shrink, swell);
- minimize damage due to pavement pumping; and
- distribute traffic loads to the subgrade.

300.2.3.1 Subbase

The construction of a subbase is sometimes necessary to provide additional support for the pavement structure. The need for a subbase will be determined during the design phase and is based on criteria such as projected vehicular traffic and the strength characteristics of the underlying subgrade material. If warranted, the subbase will be defined in the Contract Plans and Specifications. In general, the subbase may be either a special treatment of the upper layer of the subgrade (see Section 301) or a layer of inexpensive, locally available aggregate material (see Section 302). Because a base course will overlay the subbase, closely monitor construction for compliance and obtain final approval of the subbase from the Resident Construction Engineer before initiating work on the base course.

300.2.3.2 Base Course

The base course is a structural layer that directly supports the surface structure, as shown in Figure 300A. As such, the base course must be constructed of suitable, durable material to withstand the relatively higher stresses imposed upon it. The Contract Plans and Specifications will designate, as determined during design, the number and type of base courses required and whether the base will be laid over a subbase or directly on top of the subgrade. The major Sections in this Division discuss the types of base courses that are typically used by SCDOT. Closely monitor construction for compliance and obtain final approval of each base course from the Resident Construction Engineer prior to initiating work on an overlying layer. The surface structure will be placed over the base structure.

300.2.4 Surface Structure

The surface structure, consisting of intermediate and surface courses as shown in Figure 300A, is the uppermost layer within the pavement structure. Because the surface structure directly bears the load of vehicular traffic, it must be constructed of the highest quality materials. The type of surface structure required for the project will be determined during the design phase and will be defined in the Contract Plans and Specifications. Closely monitor surface structure construction for compliance with respect to material quality, placement, consolidation, compaction, grade, cross slope, thickness and smoothness criteria. See Division 400 and Division 500, respectively, for additional information on the types of intermediate and surface courses that are typically constructed.

300.2.5 Geosynthetic Material Considerations

Geosynthetic materials (e.g., geotextiles, geocells, geogrids, geomembranes, geocomposites) are commonly used for various applications in highway construction. Section 815 discusses applications related to erosion and sediment control. Where geotextile fabric is used to separate layers within the pavement structure (e.g., subgrade, subbase, base course), the fabric allows the water to pass through the pavement structure without clogging. The water will be intercepted and carried away from the roadway by the underlying drainage structure. Such geosynthetic materials must be approved prior to installation. Obtain from the Contractor and submit to the Research and Materials Laboratory for approval the manufacturer's certification document for the geosynthetic material, which should include the manufacturer's name, fabric type or trade name, the project, the intended application on the project and the required test results (e.g., Minimum Average Roll Value). Verify that the material delivered to the project is labeled with the manufacturer's name, fabric type or trade name, Lot Number and the quantity of shipment. Retain these labels in the project file, referencing the information on SCDOT Form 100.10 – Materials Certification Log. See the *SCDOT Guide Instruction Manual for Inspectors of Earthwork and Base Course Construction* for additional information.

300.3 SUMMARY OF INSPECTION DUTIES

Pavement construction is a sequenced operation. Construction of the base course cannot begin until the subgrade and subbase, if specified, have been completed and approved. Similarly, construction of the surface course cannot begin until the base course has been completed and approved. Roadway longevity, in general, depends greatly on the quality of the work and materials that are incorporated into each of these pavement courses. Inspection must therefore be deliberate and thorough as each course is constructed, demonstrating acceptability prior to initiating construction of an overlying course. It is very difficult to assess, and possibly correct, a suspected deficiency in an underlying layer once covered by a subsequent layer. In addition, once the facility is opened to traffic, a deficiency in only one course, having gone undetected, can cause premature pavement failure. Consider the following guidelines during the early stages of pavement construction:

- Review project documentation and become familiar with the requirements of the Contract, including plans, cross-sections, *Standard Drawings*, *Standard Specifications*, Supplemental Specifications and Special Provisions. Remember that the Contract Plans, Special Provisions and Supplemental Specifications take precedence over the *Standard Specifications*. See Section 105.04 of the *Standard Specifications* for information on the order of precedence of Contract documents.

- Review the meeting minutes from the Preconstruction Conference and understand any special requirements of the project. Know the conditions that exist within the limits of construction, paying particular attention to erosion and sediment control and to any areas where it may be difficult for construction equipment to access the project.

- Know the material requirements of the project and ensure that materials obtained from sources outside the right-of-way are obtained from approved sources. Verify that construction equipment and base plants have been properly calibrated.

- Become familiar with the sampling and testing procedures required for the project. Pay particular attention to the type and frequency of the Quality Control Samples and Tests and the Independent Assurance Samples and Tests required for component materials and Contract pay items.

- Verify that sufficient drainage has been provided and that the drainage features, such as underdrains, have been properly installed. Ensure that the Contractor corrects any soft spots or otherwise unstable areas before placing embankment, subgrade, subbase or base course materials. Obtain final approval of the subgrade from the District Construction Engineer.

- During placement of material requiring moisture conditioning, monitor the differences in moisture content, density, color and texture to ensure it is being maintained at or near optimum, as established by the Research and Materials Laboratory. A change in these properties is a good indicator that the material being hauled to the project has changed.

- Prior to initiating work on a subsequent course, ensure that each layer of material is compacted to target density and that the course complies with the thickness and smoothness criteria specified in the Contract. Check line, grade and cross-section to ensure that the requirements of the project have been met.

Section 301
Cement Modified Subbase

301.1 DESCRIPTION OF WORK

Where the underlying subgrade material is determined to be of poor quality and more suitable soil or aggregate materials are either unavailable or uneconomical, the Contract will typically require that the subgrade be improved with cement in accordance with Section 301 of the *Standard Specifications*. The SCDOT Inspector will be responsible for verifying that the Contractor treats the existing subgrade as specified and where designated in the Contract Plans and Specifications. In general, the Contractor will be required to:

- pulverize the existing subgrade soil to a specified depth;
- apply Portland cement and water at a specified rate;
- thoroughly and uniformly mix the pulverized soil, cement and water materials;
- compact the resultant mixture to a target density;
- shape the compacted surface to the designated grade and cross slope;
- apply an asphalt curing material at a specified rate; and
- maintain the subbase surface in an acceptable condition during the operation.

For the reconstruction of an existing roadway, the Contract may specify the construction of a cement modified recycled base. The construction of a cement modified recycled base is similar to that of a cement modified subbase; however, the Portland cement will be mixed with the scarified and pulverized material of the existing pavement. When specified, the exceptions to Section 301 will be specified in the Special Provisions. Pay particular attention to the Contractor's sequence of operations, application rate of materials, depth and uniformity of mixing, moisture content during compaction, density obtained, curing period and the resultant thickness and smoothness of the completed subbase. Loose, segregated or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent base course, obtain final approval of the subbase from the Resident Construction Engineer and verify compliance for all test results.

301.2 PRECONSTRUCTION CONSIDERATIONS

301.2.1 Contract Document Review

Review the Contract Plans and Specifications and the publication *Guide Instruction Manual for Inspectors of Earthwork and Base Course Construction*. Pay particular attention to the requirements of Supplemental Specifications and Special Provisions that take precedence over *Standard Specifications*. Specifically note the required cross-section (e.g., width, depth, cross slope). Become familiar with the required materials, equipment and construction methods, sequence of operations, sampling and testing procedures and acceptance criteria. Know the measurements required for payment, applicable payment adjustments and the SCDOT Construction Forms that will be needed to document the prosecution and progress of the work.

301.2.2 Coordination of Project Personnel

Review the meeting minutes of the Preconstruction Conference. Meet with the Resident Construction Engineer and the Contractor Superintendent to ensure a complete and thorough understanding of inspection duties and to effectively communicate Contract requirements and any special directives to the Contractor.

301.2.3 Material Considerations

301.2.3.1 Subgrade Material

Additional sampling and testing of subgrade material is generally unnecessary at the time the subbase is to be constructed. See Section 301.2.6 for additional information.

301.2.3.2 Portland Cement and Water

Verify that Portland cement and water to be incorporated in the work conform to specified requirements and that quantities on the project are sufficient to ensure a continuous operation. Ensure that the Portland cement is supplied from a manufacturer listed on SCDOT Approval Sheet 6. Application rates will be established by the Research and Materials Laboratory.

301.2.3.3 Asphalt Prime Coat

Verify that the asphalt material to be used as the asphalt prime coat is supplied from a manufacturer listed on SCDOT Approval Sheet 38 and is of the type specified for the project. Several different types are generally acceptable; however, the Contract may specify the use of a particular type. If material type is optional, only one material type is to be used for curing; watch for evidence of cross-contamination with other asphalt materials used on the project. In addition, verify that the material is maintained in sufficient quantity to treat the surface area finished during the day's operation. Prolonged exposure of the finished subbase surface without being properly treated with an asphalt prime coat should generally be avoided.

301.2.4 Weather Considerations

Pay particular attention to the weather forecast before work on the cement modified subbase begins or resumes. Check the temperature forecast for acceptability. Do not allow work to be performed on an excessively wet or frozen subgrade.

301.2.5 Sampling and Testing Considerations

Accurate and representative sampling of work and materials cannot be overemphasized. An improperly taken sample may not be truly representative; and if testing is performed on such a non-representative sample, the test results will be meaningless with respect to assessing quality and adherence to specified requirements. SCDOT and Contractor personnel who are responsible for sampling and testing must be certified by the Department. It is the responsibility

of the Resident Construction Engineer to ensure that each Inspector is properly certified for the type of sampling and testing to be performed. Review and understand the applicable criteria for the Quality Control Samples and Tests and the Independent Assurance Samples and Tests that are documented in Section 106. Review and understand the procedures, equipment, safety precautions and acceptance criteria for the applicable sampling and testing procedures that are documented in Appendix C. See Appendix B for information on sample identification cards.

301.2.6 Subgrade Inspection and Approval

The SCDOT Inspector is responsible for inspecting the subgrade with respect to materials, grade, width, thickness, cross slope, density and drainage, as discussed in Section 208. Prior to initiating work on the subbase, the subgrade must be approved by the District Construction Engineer. Therefore, at the time the subbase is to be constructed, additional sampling and testing of the subgrade material is generally unnecessary. However, it is good construction practice to continually monitor the subgrade for evidence of unacceptability (e.g., excessively wet areas, high or low spots, ruts, muck, loose or segregated material). Require that unsuitable soil material be removed and replaced with acceptable material. Underdrains or rework (e.g., additional grading and compaction) may also be required before proceeding with subbase construction. As needed, seek guidance from the Resident Construction Engineer.

301.3 INSPECTION DURING CONSTRUCTION

301.3.1 Scarification Operation

Check the depth of scarification of the subgrade for compliance. Verify that the Contractor is not blading into the subgrade too deeply. Perform the required sieve analyses to verify that the gradation of the pulverized material (i.e., soil, existing pavement material) is within acceptable limits.

301.3.2 Application of Portland Cement

301.3.2.1 Moisture Content and Rate of Application

The application rate of cement and the initial optimum moisture content of the soil-cement mixture will be established by the Research and Materials Engineer based on a representative sample of the subgrade material to be treated. The application rate of cement is typically specified as pounds per square yard and the optimum moisture content is typically specified as percent moisture in the soil-cement mixture. The optimum moisture content should be tested using SC-T-29 twice per day or if material changes. Excessively dry conditions may warrant the application of additional water. Sudden downpours and rainy conditions may require the Contractor to halt work. Contact the Research and Materials Engineer for any needed assistance. See Section 301.3.4.1 for additional information on moisture content.

301.3.2.2 Spreading of Cement

Prior to the spreading of cement, verify that the Contractor has properly calibrated the spreader and closely monitor the rate of application to ensure that the cement is being spread uniformly across the entire width of the subgrade at a rate within ±5% of the pounds per square yard specified by the Research and Materials Engineer. Require the Contractor to recalibrate the spreader if necessary. The spreading operation must be continuous. Do not allow the Contractor to apply more cement along the length of the subgrade than can be completely processed in a single day's operation. The mixing operation, in particular the application of water, must commence within three hours of the application of cement. Check the application rate using SC-T-141 (see Appendix C).

301.3.3 Mixing Operation

301.3.3.1 Traveling Mixing Plant

To thoroughly blend the cement and subgrade soil materials, the Contractor will be required to use either a single-pass or a multiple-pass traveling mixing plant, as specified.

301.3.3.2 Dry Mixing

Dry mixing is used to pulverize and combine the air-dry soil and cement materials sufficiently to prevent cement balls from forming when water is added. Verify that dry mixing is maintained at the proper depth. Mixing deeper than that specified will dilute the mixture and possibly reduce the strength of the subbase. Watch for unpulverized lumps and require pre-wetting if evident.

301.3.3.3 Application of Water

Verify that the spray bar evenly distributes the water across the full width of the subgrade. Check the moisture content for acceptability and, if needed, require the rate of application to be adjusted. See Section 301.3.4.1 for additional information on moisture content.

301.3.3.4 Wet Mixing

After water has been introduced, the mixing of the moist soil and cement materials will continue until a uniform mixture has been obtained. At least twice daily, verify that 100% of the pulverized soil-cement mixture will pass a 2-inch sieve and at least 65% will pass a No. 4 sieve. The traveling plant should leave the treated subgrade in a loose condition ready for immediate compaction. Compaction must commence within 30 minutes of wet mixing.

301.3.3.5 Core Molding

Prior to compaction, core molding of the soil-cement mixture is required. Ensure that one set of two cores is molded each work day. Each core will be molded at 100% maximum dry density, according to the Standard Proctor Test, using the following procedures:

1. Preparation. Use a 4-inch split mold, available from the Research and Materials Laboratory, to mold the core. To prevent the core from sticking, spray the inside of the mold with a light coat of lubricant or use a large rubber membrane. Sieve a representative sample of the soil-cement mixture through a No. 4 sieve.

2. Core Molding. Mold each core in three equal layers at 25 blows per layer. Scarify the top of each layer approximately 0.125 inches deep to permit bonding of layers. Carefully remove the core from the mold.

3. Shipping and Handling. Immediately wrap each core in waterproof material (e.g., plastic food wrap) to prevent drying and then again in wet burlap to cushion and minimize overheating. Do not leave the cores in direct sunlight or in a parked vehicle where the temperature can exceed 70°F. Avoid rough handling. See Appendix B for information on processing Sample Identification Cards. Ideally, cores are to be cured for 7 days at 70°F and 100% relative humidity; therefore, it is necessary to ship the cores as soon as practical, preferably within 48 hours, to the Research and Materials Laboratory.

301.3.4 Compaction Operation

301.3.4.1 Moisture Content

The Research and Materials Laboratory will establish the initial moisture content for the soil-cement mixture. Prior to compaction, check to ensure that the moisture content is not more than two percentage points above but not less than that established as optimum. For example, if the optimum moisture content is 17%, an acceptable range for the moisture content during compaction will be between 17% and 19%, inclusive.

301.3.4.2 Density Testing

Compaction rolling must be completed within two hours of initial rolling. Check to ensure that the soil-cement mixture is uniformly compacted to not less than 95% of the maximum density. Use AASHTO T 134, SC-T-25 or SC-T-29, as appropriate, to determine the maximum density of the mixture (see Appendix C). Require the Contractor to adjust the compaction operation, as needed, to obtain the required density. The minimum requirement for density testing is one test each 1000 feet, per 2 lanes (on 4-lane sections, a test is required every 500 feet, etc.). Additional testing should be conducted, as needed, to ensure that proper compaction is being attained. See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. Contact the Resident Construction Engineer for any needed assistance.

301.3.5 Finishing Operation

Once the soil-cement mixture has been compacted to target density, the finishing operation will begin, which includes reshaping, light scarifying and finishing rolling, as needed, to bring the surface into compliance with the lines, grades and typical sections of the Contract Plans. Check

compliance of the finished surface using a 10-foot straight edge, hand level, engineer's level, total station or other suitable means. Acceptable tolerance for surface smoothness is ±0.375 inches along the subbase in the direction parallel to the centerline and ±0.5 inches across the subbase in the direction of the cross-section. Require the Contractor to correct high and low spots, as specified. Pay particular attention to evidence of severe rutting, equipment imprints and loose material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

301.3.6 Curing Operation

Immediately after the finishing operation, ensure that the Contractor cures the finished surface with an asphalt curing membrane, as specified. Pay particular attention to the type of asphalt material used and the rate of application. Too much asphalt material can actually create a slip plane in the pavement structure. The asphalt material should completely seal the subbase surface and fill all voids. Watch for damage to the membrane caused by traffic and require the Contractor to sand, dust or repair the membrane, as appropriate. The membrane must be allowed to set for a minimum of three days before a subsequent base course is applied.

301.4 POST-CONSTRUCTION CONSIDERATIONS

301.4.1 Construction Joints

At the end of each work day, ensure that the Contractor forms longitudinal and transverse construction joints, as specified, to properly key in the next day's work.

301.4.2 Checking Subbase Thickness

Test holes will be used to measure subbase thicknesses at various locations. These measurements will be used to calculate an average job thickness to assess compliance of the completed cement modified subbase. Phenolphthalein solution, available from the Research and Materials Laboratory, must be used in making these measurements. Dig a test hole at least 2 inches deeper than the specified depth of the cement modified subbase. Beginning at the bottom of the test hole, make a vertical groove in the side of the hole with a screwdriver or other suitable instrument. When the groove is moistened from bottom to top with an eye dropper of phenolphthalein solution on the groove side of the test hole, the solution turns red when it reacts with cement, which will clearly identify the thickness of the cement modified layer. Measure subbase thickness at staggered intervals not to exceed 500 feet in length per 2-lane width (250 feet for 4 lanes, etc.). See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. When computing the average job thickness, individual measurements exceeding the specified thickness by more than 1 inch will be considered the specified thickness plus 1 inch. For example, if the specified thickness is 6 inches and the measured thickness at one location is 7.5 inches, use 7 inches when computing the average thickness. Ensure that the Contractor corrects thickness deficiencies greater than 1 inch, which will require full-depth replacement. Document this information on SCDOT Form 300.01 – Depth Check Records. Ensure that the test holes are backfilled with suitable material and thoroughly compacted using a hand tamp.

301.4.3 Traffic and Maintenance Considerations

Do not allow local or construction traffic on the completed subbase until the specified curing period has elapsed. Unless required for a subsequent construction operation, it is generally good practice for construction equipment to avoid traveling on the subbase by using areas such as shoulders to travel along the project. The Contractor is responsible for maintaining the integrity of the completed subbase. Watch for marring and defects to the surface and require the Contractor to correct such damage in accordance with Contract provisions.

301.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

Measure and document in the Daily Work Report the surface area (i.e., width x length) of the completed and approved subbase. Payment will be made based on the Contract unit price; however, payment adjustment applies if the average thickness of the subbase is found to be more than 0.5 inch less than the thickness specified in the Contract. For example, if the Contract specifies a 6-inch cement modified subbase and the average thickness was determined to be less than 5.5 inches, ensure that payment is adjusted as specified. Ensure that ineligible quantities, such as those for corrective work, are not included for payment. Pay particular attention, however, to the provisions for rework due to rainy conditions. Obtain from the Contractor automatic printout tickets for Portland cement, which will be retained by the Resident Construction Engineer, and document in the Daily Work Report the weight of cement incorporated in the work. Portland cement will be paid for separately based on this weight, subject to the limits specified for the application rate.

Section 302
Soil-Aggregate Subbase

302.1 DESCRIPTION OF WORK

Where the underlying subgrade material is determined to be of poor quality and suitable aggregate material is economically available, the Contract may require the subgrade to be improved with a soil-aggregate subbase in accordance with Section 302 of the *Standard Specifications*. In general, the work for a soil-aggregate subbase consists of placing a layer of specified aggregate material on an approved subgrade or subbase. The aggregate material then will be mixed with the underlying material, to a specified depth, and thoroughly and uniformly compacted to a target density. To achieve the target density during compaction, the moisture content must be maintained at or near optimum for the mixture, as established by the Research and Materials Engineer.

The SCDOT Inspector will be responsible for verifying that the Contractor treats the subgrade as specified and where designated in the Contract Plans and Specifications. Pay particular attention to the Contractor's sequence of operations, application rate of material, depth and uniformity of mixing, moisture content during compaction and the density obtained. Loose, segregated or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent base course, obtain final approval of the subbase from the Resident Construction Engineer.

302.2 PRECONSTRUCTION CONSIDERATIONS

302.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents.

302.2.2 Coordination of Project Personnel

See Section 301.2.2 for guidance on coordinating project personnel.

302.2.3 Materials Considerations

The aggregate material for soil-aggregate subbase can be either crushed stone or gravel and must be sampled and tested prior to mixing with the approved subgrade or subbase material. Verify that aggregate materials are supplied from sources listed on SCDOT Approval Sheet 1 or Approval Sheet 2. Check gradation for compliance.

302.2.4 Weather Considerations

Pay particular attention to the weather forecast before work on the soil-aggregate subbase begins or resumes. Do not allow work to be performed on an excessively wet or frozen subgrade.

302.2.5 Sampling and Testing Considerations

See Section 301.2.5 for information on sampling and testing component materials and Contract pay items.

302.2.6 Subgrade Inspection and Approval

See Section 301.2.6 for information on subgrade inspection and approval.

302.3 INSPECTION DURING CONSTRUCTION

302.3.1 Application of Aggregate Material

The application rate of aggregate and the optimum moisture content of the soil-aggregate mixture will be established by the Research and Materials Engineer and denoted in the Contract Plans. The application rate is typically specified as the weight of aggregate per unit area and the optimum moisture content is typically specified as the percent moisture in the mixture. Excessively dry conditions may warrant the application of additional water. Sudden downpours and rainy conditions may require the Contractor to halt work. Contact the Research and Materials Engineer for any needed assistance.

Using the appropriate SCDOT Sampling and Testing Procedure (see Appendix C), check the application rate regularly to ensure compliance (i.e., weight of aggregate from automatic printout tickets divided by the area upon which the aggregate was spread). At the end of each workday, check and record in the Daily Work Report the weight of aggregate incorporated in the work, the area of subbase completed and approved and the actual application rate of aggregate. Remember that it is the Contractor's responsibility to achieve the specified rate of spread. The SCDOT Inspector is responsible for confirming the Contractor's work but should not take on the Contractor's duties.

302.3.2 Mixing Operation

After the aggregate has been spread, water will be sprayed over the materials and a thin layer of subgrade or subbase material will be mixed with the aggregate material. Water is added, as needed, to raise the moisture content of the mixture to the established optimum prior to compaction. Because it is very difficult to proportion the materials properly, only the most skilled motor-grader operator should be used for this work. A typical proportion is approximately 0.25 inch of subgrade or subbase material for each 100 pounds per square yard of aggregate material. Verify the grading depth and do not allow too much subgrade or subbase material to be incorporated into the mixture.

302.3.3 Compaction Operation

The compaction operation should immediately follow behind the mixing operation. Check to ensure that the soil-aggregate mixture is uniformly compacted to at least 95% of maximum dry density. Require the Contractor to adjust the compaction operation, as needed, to obtain the target density. Section 106 defines the type and frequency of Quality Control Samples and Tests and Independent Assurance Samples and Tests. The compacted subbase should be a uniform, dense surface that is free of loose material and rocky in appearance with all stone being thoroughly keyed. As needed, contact the Resident Construction Engineer for assistance.

302.3.4 Finishing Operation

Once the soil-aggregate mixture has been compacted to target density, the finishing operation will begin, which includes shaping and finishing rolling, as needed, to bring the surface into compliance with the lines, grades and typical sections of the Contract Plans. Check compliance of the finished surface using a hand level, engineer's level, total station or other suitable means. Pay particular attention to evidence of severe rutting, equipment imprints and loose or segregated material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

302.3.5 Application of Asphalt Prime Coat

If the Contract specifies that an asphalt prime coat be applied to the surface of the soil-aggregate subbase, verify that the material is of the proper type, comes from a source listed on Approval Sheet 38 and is applied to the surface immediately behind the finishing operation at the specified application rate. Although the asphalt prime coat should completely seal the subbase surface and fill all voids, do not allow more asphalt prime coat to be applied than specified. Watch for overspray and damage to the finished asphalt prime coat caused by traffic and require the Contractor to repair the defective areas.

302.4 POST-CONSTRUCTION CONSIDERATIONS

The Contractor is responsible for maintaining the integrity of the completed and approved subbase surface. Unless required for a subsequent construction operation, it is generally good practice for construction equipment to avoid traveling on the subbase by using areas such as shoulders to travel along the project. Watch for defects in the subbase surface and require the Contractor to correct such damage in accordance with the provisions of the Contract.

302.5 DOCUMENTATION FOR PAYMENT

Aggregate for this work will be weighed on certified platform scales as defined in the provisions of the Contract. See Section 109 for additional information on measuring material quantities. If at any time the weight of a load is suspect, witness the Contractor reweighing the suspect load on certified platform scales. Obtain from the Contractor the automatic printout tickets showing

the weight of each load of aggregate incorporated in the completed and accepted soil-aggregate subbase. The Resident Construction Engineer will retain these tickets. Record the day's total in the Daily Work Report. Payment will be made based on this weight and the Contract unit price. Ensure that ineligible quantities, such as those for corrective work or in excess of those specified or otherwise approved, are not included for payment.

Section 303
Sand-Clay Base Course

303.1 DESCRIPTION OF WORK

The SCDOT Inspector will be responsible for verifying that the Contractor obtains materials and constructs the sand-clay base course in accordance with Section 303 of the *Standard Specifications* and any applicable Special Provisions. The work for a sand-clay base course consists of placing one or more lifts of naturally or artificially proportioned sand-clay material on an approved subgrade or subbase. The number of lifts will depend on the overall compacted thickness of the base course. Each lift of material then will be mixed and thoroughly and uniformly compacted to a target density. To achieve the target density during compaction, the moisture content must be maintained at or near optimum. Pay particular attention to the placement of material lifts, uniformity of mixing, moisture content during compaction, density obtained, application of asphalt prime coat and the resultant thickness and smoothness of the completed base course. Loose or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of the asphalt prime coat or any subsequent course, obtain final approval of the base course from the Resident Construction Engineer, with concurrence from the District Construction Engineer.

303.2 PRECONSTRUCTION CONSIDERATIONS

303.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents.

303.2.2 Coordination of Project Personnel

See Section 301.2.2 for guidance on coordinating project personnel.

303.2.3 Material Considerations

303.2.3.1 Sand-Clay Material

Unless specified otherwise, the Contractor is responsible for securing the source of sand-clay material (e.g., pits, fields), including all permits, right-of-way, access, haul roads, erosion control and property restoration. Verify that the Contractor meets these Contract provisions. A local source of naturally proportioned base material may be available. If such a source is unavailable, the Contractor will be responsible for securing sources of materials that can be artificially proportioned for use as the base material. Samples should be obtained in accordance with SC-T-21 (see Appendix C). The Research and Materials Laboratory will test samples to verify that the material meets specified requirements (e.g., gradation, liquid limit, plastic limit). Test results for pit samples will be provided for information only. No sand-clay base material will be accepted based on the test results of pit samples.

303.2.3.2 Asphalt Prime Coat

Verify that the asphalt material to be used for the asphalt prime coat is supplied from a source listed on Approval Sheet 38. Several different types are generally acceptable; however, the Contract may specify the use of a particular type. If material type is optional, only one material type is to be used for the asphalt prime coat; watch for evidence of cross-contamination with other asphalt materials used on the project. In addition, verify that the material is maintained in sufficient quantity to prime the base course in a continuous operation.

303.2.4 Weather Considerations

Pay attention to the weather forecast before work on the base course begins or resumes. Do not allow work to be performed on an excessively wet or frozen subgrade or subbase. In general, base course material that is not promptly compacted will act as a blotter when it rains, saturating the subgrade and becoming plastic under compaction. This will require the subgrade to be repaired at Contractor expense, as specified. Closely monitor the rain forecast and the timing of the compaction operation.

303.2.5 Sampling and Testing Considerations

See Section 301.2.5 for information on sampling and testing component materials and Contract pay items.

303.2.6 Subgrade / Subbase Inspection and Approval

The SCDOT Inspector is responsible for inspecting the subgrade and subbase with respect to materials, grade, width, thickness, cross slope, density and drainage, as discussed respectively in Section 208, Section 301 and Section 302. Shoulder work should be constructed, inspected and approved as discussed in Section 209. To facilitate construction operations, this work should be completed and approved at least 500 feet ahead of the base course work. Prior to initiating work on the base course, the subgrade and subbase must be approved by the District Construction Engineer. Therefore, at the time the base course is to be constructed, additional sampling and testing of subgrade or subbase material is generally unnecessary. However, it is good construction practice to continually monitor the subgrade or subbase for evidence of unacceptability (e.g., excessively wet areas, high or low spots, ruts, muck, loose or segregated material). Require that unsuitable materials be removed and replaced with acceptable materials. Underdrains or rework (e.g., additional grading and compaction) may also be required before proceeding with base course construction. As needed, seek guidance from the Resident Construction Engineer.

303.3 INSPECTION DURING CONSTRUCTION

303.3.1 Hauling and Placement Operation

Prior to placement, check the moisture content of the subgrade or subbase. Wetting may be necessary to recondition the surface if it has become too dry. At the material pit, the Contractor

is required to blade off and dispose of all deleterious materials from the surface prior to excavating the sand-clay material. During placement and mixing, however, it is good practice to continually monitor the operation for objectionable materials, including oversized stones, roots, sod and weeds. Require the Contractor to remove such objectionable materials. If found in excessive amounts, require removal and replacement of the base material. To minimize hauling over the work under construction, placement will typically begin at the station farthest from the pit. In general, hauling over the base should be avoided unless it is being constructed in lifts. Ensure that lifts are not placed too thick (i.e., 8-inch compacted thickness maximum). Verify that the Contractor evenly and uniformly spreads the base material over the approved and properly maintained subgrade or subbase. If naturally proportioned sand-clay material is not being used, pay particular attention to the acceptability of the windrow operation and the artificial proportioning of the materials. Such an operation will require the Contractor to control the proportioning of the materials during the mixing operation.

303.3.2 Spreading Operation

303.3.2.1 Mixing and Shaping

During mixing, do not allow equipment operators to mix the top surface of the subgrade or subbase with the sand-clay material. As the sand-clay material is being placed, verify that the Contractor immediately spreads and mixes the material until the base exhibits a homogeneous appearance throughout its width and depth. Verify that the Contractor adds water, as needed, to maintain the moisture content of the base material near optimum. To facilitate bonding of multiple lifts, ensure that the Contractor mixes the newly placed material with the top surface of the previous lift, as specified. Check the cross-section and grade to ensure conformance with the Contract Plans. As needed, require reshaping and removal and replacement of any unsuitable material encountered.

303.3.2.2 Sampling and Testing

Sampling and testing of each lift of sand-clay base course material is required after mixing and will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information on sampling and testing. Sample the sand-clay base material immediately after the mixing operation. If the sand-clay base course is to lie unsurfaced for a prolonged period of time, such as over the winter, delay the sampling. Sample the sand-clay base course every 1000 feet per two lanes. Take the sample through the full lift depth at the following locations:

- at or near the centerline,
- approximately 2 feet from the right edge, and
- approximately 2 feet from the left edge.

Immediately ship the samples to the Research and Materials Laboratory for testing (e.g., gradation, liquid limit, plastic limit). If the Laboratory reports that a sample has failed and requests that a check sample be taken, obtain and ship two check samples representing the

material that failed in accordance with the requirements for check samples documented in Section 106. Do not permit additional material to be placed over the lift until the sand-clay material samples have been tested and reported to be in compliance.

303.3.3 Compaction Operation

303.3.3.1 General

The compaction operation (i.e., blading and rolling) should follow immediately behind the mixing and shaping operation. Its purpose is to compress the soil particles into a dense mass by expelling air and reducing voids. Unless otherwise specified, the Contractor may choose the type of equipment to perform this operation; however, the use of pneumatic-tired rollers is fairly common and economical, because the tire pressure and/or weight of these rollers can be increased to generate high contact pressures. Rollers will generally work along the centerline and move toward the edge of the course. The compacted surface should be smooth and even textured. Watch for roller marks, knots and depressions and require the Contractor to adjust the roller pattern, as needed. For secondary roads where a sand-clay base course may be used in conjunction with an asphalt waterproofing or wearing surface, very little strength will be derived from the asphalt surface course. Thus, the strength of the overall pavement structure relies heavily on the strength of the sand-clay base course. Because density is a direct correlation to the resultant strength of the base course, it is paramount that each lift of the sand-clay material be thoroughly and uniformly compacted to target density.

303.3.3.2 Moisture Content

The optimum moisture content for the sand-clay material will be established using SC-T-25 or SC-T-29 (see Appendix C). Prior to compaction, check to ensure that the moisture content of the material is at or near optimum. The compaction operation is facilitated if the required water is added during the mixing and shaping operation.

303.3.3.3 Lift Thickness

Pay particular attention to the total compacted thickness of the sand-clay base course denoted on the Contract Plans. If greater than 8 inches, the Contractor will be required to construct the base course in multiple lifts of equal thickness, with each lift being compacted to 100% of maximum density before additional material is placed for a subsequent lift.

303.3.3.4 Density Testing

Density testing of each compacted lift of sand-clay base course material is required and will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information on sampling and testing. Check to ensure that each lift of sand-clay base course is uniformly compacted to 100% of the maximum density. The actual dry density is to be determined in accordance with SC-T-30, SC-T-31, SC-T-32 or SC-T-33, as appropriate. The

maximum dry density and optimum moisture content of the sand-clay base material will be determined by either the One-Point Proctor Method (SC-T-29) or by the field method of determining moisture-density relations of soils (SC-T-25). Do not permit an additional lift of sand-clay material to be placed until the required density of the underlying lift has been attained. See Appendix C for the sampling and testing procedures. If test results fail, require the Contractor to adjust the compaction operation or moisture content, as needed, to obtain the target density. The Resident Construction Engineer should retain SCDOT Form 200.02 – Percent Compaction by Nuclear Gauge or SCDOT Form 200.03 – Percent Compaction by Nuclear Gauge – Direct Read Gauge; however, SCDOT Form 200.01 – Field Density Test Report (Nuclear Gauge) must be sent to the Research and Materials Laboratory on a weekly basis. Reference additional testing for areas that fail and note the corrective actions to be taken.

303.3.4 Finishing Operation

Once the final lift of sand-clay base material has been compacted to target density, the finishing operation will begin, which includes reshaping and finishing rolling, as needed, to bring the surface into compliance with the lines, grades and typical sections of the Contract Plans. Check compliance of the finished surface using a hand level, engineer's level, total station or other suitable means. Be diligent in securing compliance of the surface. Require the Contractor to correct any areas that are not within reasonable conformity to the specified roadway section. Watch for severe rutting, equipment imprints, roller marks and loose or segregated material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

303.3.5 Checking Base Course Thickness

Immediately after the finishing operation but prior to the application of the asphalt prime coat, test holes will be used to measure base course thicknesses at various locations. These measurements will be used to calculate an average job thickness to assess compliance of the completed sand-clay base course. Measure base course thickness at staggered intervals not to exceed 250 feet in length per 2-lane width (125 feet for 4 lanes, etc.). See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. When computing the average job thickness, individual measurements exceeding the specified thickness by more than 0.5 inches will be considered the specified thickness plus 0.5 inches. For example, if the specified thickness is 6 inches and the measured thickness at one location is 7 inches, use 6.5 inches when computing the average thickness. Ensure that the Contractor corrects thickness deficiencies greater than 0.5 inches, as specified. Record the thickness measurements on SCDOT Form 300.01 – Depth Check Records. Ensure that the test holes are backfilled with suitable material and compacted using a hand tamp.

303.3.6 Application of Asphalt Prime Coat

The application of an asphalt prime coat will be required when a hot-mix asphalt or asphalt surface treatment will overlay the sand-clay base course. Do not allow the application of asphalt prime coat to begin until all other requirements have been met with respect to the

construction of the sand-clay base course and final approval has been obtained from the Resident Construction Engineer, with concurrence of the District Construction Engineer. Pay particular attention to the type of asphalt material used. Check that the application rate is within specified limits. Too much asphalt material can actually create a slip plane in the pavement structure. The asphalt material should completely penetrate the base surface and fill all voids. Watch for damage to the asphalt prime coat caused by traffic and require the Contractor to sand, dust or repair the asphalt prime coat, as appropriate. Pay particular attention to overspray and potential damage to adjacent property, and notify the Resident Construction Engineer for any needed assistance. See Section 401.4 for additional information on the application of asphalt prime coats.

303.4 POST-CONSTRUCTION CONSIDERATIONS

The Contractor is responsible for maintaining the integrity of the sand-clay base course during construction. During subsequent operations, watch for damage and defects caused by traffic and erosion and require the Contractor to repair the surface of the base in accordance with the provisions of the Contract.

303.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

Measure and document in the Daily Work Report the surface area (i.e., width x length) of the completed and approved sand-clay base course. Payment will be made based on the Contract unit price; however, payment adjustment applies if the average thickness of the base course is found to be more than 0.25 inch less than the thickness specified in the Contract. For example, if the Contract specifies a 6-inch sand-clay base course and the average thickness was determined to be 5.5 inches, ensure that payment is adjusted as specified. Ensure that ineligible quantities, such as those for corrective work, are not included for payment. Obtain from the Contractor all invoices for the asphalt prime coat material, which will be retained by the Resident Construction Engineer, and document in the Daily Work Report the volume of asphalt material used for asphalt prime coat. Prime coat will be paid for separately based on this volume.

Section 304
Coquina Shell Base Course

304.1 DESCRIPTION OF WORK

The material required for coquina shell base course is readily available in natural deposits in the Pee Dee coastal area. As such, this type of base course is typically specified as an alternative to graded aggregate base course (see Section 305) for secondary roads in SCDOT District No. 5 counties, which include Florence, Marlboro, Dillon, Darlington, Marion, Horry, Williamsburg and Georgetown. Note that earthwork quantities will be specified for graded aggregate base course and the elected use of coquina as an alternative will be 1.5 times the thickness of the graded aggregate base course. However, the lift thickness limitations as described in Section 304.3.3.3 still apply. Therefore, the use of coquina as an alternative to graded aggregate base course will require adjustment to the grade of the subgrade to allow for the additional thickness, and quantities for unclassified excavation and borrow excavation.

When specified, the SCDOT Inspector will be responsible for verifying that the Contractor obtains materials and constructs the coquina shell base course in accordance with Section 304 of the *Standard Specifications* and any applicable Special Provisions. In general, the work for coquina shell base course consists of placing one or more lifts of specified coquina shell material on an approved subgrade or subbase. The number of lifts will depend on the overall compacted thickness of the base course. Each lift of material then will be mixed, shaped and thoroughly and uniformly compacted to a target density. To achieve the target density during compaction, the moisture content must be maintained at or near optimum for the mixture, as established by the Research and Materials Engineer. Pay attention to the Contractor's sequence of operations, placement of material lifts, uniformity of mixing, moisture content during compaction, density obtained, application of asphalt prime coat and the resultant thickness and smoothness of the completed base course. Loose, segregated or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to application of asphalt prime coat and placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer, with concurrence from the District Construction Engineer.

304.2 PRECONSTRUCTION CONSIDERATIONS

304.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents.

304.2.2 Coordination of Project Personnel

See Section 301.2.2 for guidance on coordinating project personnel.

304.2.3 Material Considerations

304.2.3.1 Coquina Shell Material

Coquina shell base material is a mixture of aggregated shells, shell fragments and varying amounts of sand and clay materials that are obtained from naturally existing deposits. Verify that the material is supplied from a source listed on SCDOT Approval Sheet 4. If a new quarry is opened for a project, the Research and Materials Laboratory must be notified so that samples can be taken to assess the quality of the material and mining operations before use. Verify that the gradation requirements of the material are being met.

304.2.3.2 Asphalt Prime Coat

See Section 303.2.3.2 for information on asphalt material used for asphalt prime coat.

304.2.4 Weather Considerations

See Section 303.2.4 for information on weather considerations.

304.2.5 Sampling and Testing Considerations

See Section 301.2.5 for information on sampling and testing component materials and Contract pay items.

304.2.6 Subgrade / Subbase Inspection and Approval

See Section 303.2.6 for information on subgrade and subbase inspection and approval.

304.3 INSPECTION DURING CONSTRUCTION

304.3.1 Hauling and Placement Operation

Prior to placement, check the moisture content of the subgrade or subbase. Wetting may be necessary to recondition the surface if it has become too dry. At the material pit, the Contractor is required to blade off and dispose of all deleterious materials from the surface prior to excavating the material. During placement and mixing, however, it is good practice to continually monitor the operation for objectionable materials, including oversized stones, roots, sod and weeds. Require the Contractor to remove such objectionable materials. If found in excessive amounts, require removal and replacement of the base material. To minimize hauling over the work under construction, placement will typically begin at the station farthest from the pit. In general, hauling over the base should be avoided unless it is being constructed in lifts. Ensure that lifts are not placed too thick (i.e., 8-inch compacted thickness maximum). Verify that the base material is evenly and uniformly spread over the subgrade or subbase. Pay particular attention to segregated areas during placement and spreading, and require the Contractor to correct such areas in accordance with the provisions of the Contract.

304.3.2 Spreading Operation

304.3.2.1 Mixing and Shaping

During mixing, do not allow equipment operators to mix the top surface of the subgrade or subbase with the coquina shell material. As the coquina shell material is being placed, verify that the Contractor immediately spreads and mixes the material until the base exhibits a homogeneous appearance throughout its width and depth. Verify that the Contractor adds water, as needed, to maintain the moisture content of the base material near optimum, as established by the Research and Materials Engineer. Check the cross-section and grade to ensure conformance with the Contract Plans. As needed, require reshaping and removal and replacement of any unsuitable material encountered.

304.3.2.2 Sampling and Testing

Sampling and testing of each lift of coquina shell base course material is required after placement and mixing but before compaction. The sampling and testing will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information on sampling and testing. Sample the coquina shell base material immediately after the mixing operation but before compaction. If the coquina shell base course is to lie unsurfaced for a prolonged period of time, such as over the winter, delay the sampling. Sample the coquina shell base course every 1000 feet per two lanes. Take the sample through the full lift depth at the following locations:

- at or near the centerline,
- approximately 2 feet from the right edge, and
- approximately 2 feet from the left edge.

The size of the sample will be in accordance with SC-T-1 (See Appendix C). Immediately ship the samples to the Research and Materials Laboratory for testing. If the Laboratory reports that a sample has failed and requests that a check sample be taken, obtain and ship two check samples representing the material that failed in accordance with the requirements for check samples documented in Section 106. Do not permit additional material to be placed over the lift until the coquina shell base course material samples have been tested and reported to be in compliance.

304.3.3 Compaction Operation

304.3.3.1 General

The compaction operation (i.e., blading and rolling) should follow immediately behind the mixing and shaping operation. Its purpose is to compress the shell particles into a dense mass by expelling air and reducing voids. Unless otherwise specified, the Contractor may choose the type of equipment to perform this operation; however, the use of pneumatic-tired rollers is required for final rolling. Rolling will generally start at the edge and proceed toward the center,

except on superelevated curves where rolling proceeds from the lower to the upper side. The compacted surface should be smooth and even textured. Watch for roller marks, knots and depressions and require the Contractor to adjust the roller pattern, as needed. Because density is a direct correlation to the resultant strength of the base course, it is paramount that each lift of material be thoroughly and uniformly compacted to target density.

304.3.3.2 Moisture Content

The optimum moisture content for the coquina shell material will be established by the Research and Materials Engineer. Prior to compaction, check to ensure that the moisture content of the material is at or near optimum. The compaction operation is facilitated if the required water is added during the mixing and shaping operation.

304.3.3.3 Lift Thickness

Pay particular attention to the total compacted thickness of the coquina shell base course denoted on the Contract Plans. If greater than 8 inches, the Contractor will be required to construct the base course in multiple lifts, with each lift being compacted to 100% of maximum density before additional material is placed for a subsequent lift.

304.3.3.4 Density Testing

Density testing of each compacted lift of coquina shell base course material is required and will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information on sampling and testing. Check to ensure that each lift of coquina shell base course is uniformly compacted to 100% of the maximum density. Field density tests are to be determined in accordance with SC-T-30, SC-T-31, SC-T-32 and SC-T-33, as appropriate. The theoretical maximum dry density will be determined by the Research and Materials Engineer, based on representative 200-pound samples submitted from the field. Submit these samples as soon as practical. Do not permit an additional lift of coquina shell material to be placed until the required density of the underlying lift has been attained. See Appendix C for the sampling and testing procedures. If test results fail, require the Contractor to adjust the compaction operation or moisture content, as needed, to obtain the target density. The Resident Construction Engineer should retain SCDOT Form 300.02 – Density Test Report (Nuclear Gauge) or SCDOT Form 300.03 – Density Test Report (Nuclear Gauge) – Direct Read Gauge; however, SCDOT Form 200.01 – Field Density Test Report (Nuclear Gauge) must be sent to the Research and Materials Laboratory on a weekly basis. Reference additional testing for areas that fail and note the corrective actions to be taken.

304.3.4 Finishing Operation

Once the final lift of coquina shell base course material has been compacted to target density, the finishing operation will begin, which includes reshaping and finishing rolling, as needed, to bring the surface into compliance with the lines, grades and typical sections of the Contract

Plans. Check compliance of the finished surface using a hand level, engineer's level, total station or other suitable means. Be diligent in securing compliance of the surface. Require the Contractor to correct any areas that are not within reasonable conformity to the specified roadway section. Watch for severe rutting, equipment imprints, roller marks and loose or segregated material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

304.3.5 Checking Base Course Thickness

Immediately after the finishing operation but prior to the application of the asphalt prime coat, test holes will be used to measure base course thicknesses at various locations. These measurements will be used to calculate an average job thickness to assess compliance of the completed coquina shell base course. Measure base course thickness at staggered intervals not to exceed 250 feet in length per 2-lane width (125 feet for 4 lanes, etc.). See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. When computing the average job thickness, individual measurements exceeding the specified thickness by more than 0.5 inch will be considered the specified thickness plus 0.5 inch. For example, if the specified thickness is 6 inches and the measured thickness at one location is 7 inches, use 6.5 inches when computing the average thickness. Ensure that the Contractor corrects thickness deficiencies greater than 0.5 inch, as specified. Record the thickness measurements in SCDOT Form 300.01 – Depth Check Records. Ensure that the test holes are backfilled with suitable material and thoroughly compacted using a hand tamp.

304.3.6 Application of Asphalt Prime Coat

The application of an asphalt prime coat will be required when a hot-mix asphalt or asphalt surface treatment will overlay the coquina shell base course. Do not allow the application of asphalt prime coat to begin until all other requirements have been met with respect to the construction of the coquina shell base course and final approval has been obtained from the Resident Construction Engineer, with concurrence of the District Construction Engineer. Pay particular attention to the type of asphalt material used. Check that the application rate is within specified limits. Too much asphalt material can actually create a slip plane in the pavement structure. The asphalt material should completely penetrate the base surface and fill all voids. Watch for damage to the asphalt prime coat caused by traffic and require the Contractor to sand, dust or repair the asphalt prime coat, as appropriate. Pay particular attention to overspray and potential damage to adjacent property, and notify the Resident Construction Engineer for any needed assistance. See Section 401.4 for additional information on the application of asphalt prime coats.

304.4 POST-CONSTRUCTION CONSIDERATIONS

The Contractor is responsible for maintaining the integrity of the coquina shell base course during construction. During subsequent operations, watch for damage and defects caused by

traffic and erosion and require the Contractor to repair the surface of the base in accordance with the provisions of the Contract.

304.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

Measure and document in the Daily Work Report the surface area (i.e., width x length) of the completed and approved coquina shell base course. Payment will be made based on the Contract unit price; however, payment adjustment applies if the average thickness of the base course is found to be more than 0.25 inch less than the thickness specified in the Contract. For example, if the Contract specifies a 6-inch coquina shell base course and the average thickness was determined to be 5.5 inches, ensure that payment is adjusted as specified. Ensure that ineligible quantities, such as those for corrective work, are not included for payment. Obtain from the Contractor all invoices for the asphalt prime coat material, which will be retained by the Resident Construction Engineer, and document in the Daily Work Report the volume of asphalt material used for asphalt prime coat. Prime coat will be paid for separately based on this volume.

Section 305
Graded Aggregate Base Course

305.1 DESCRIPTION OF WORK

There are three types of graded aggregate base courses available to the Contractor under the provisions of Section 305 of the *Standard Specifications*:

- macadam base course,
- marine limestone base course, and
- recycled Portland cement concrete base course.

When the Contractor elects or is required to construct a graded aggregate base course the Contractor must elect to use only one of these alternatives for the project. The SCDOT Inspector will be responsible for verifying that the Contractor obtains materials and constructs the graded aggregate base course in accordance with Section 305 of the *Standard Specifications* and any applicable Special Provisions.

The composite aggregate material for this type of base course consists of both coarse and fine aggregate materials, which are proportioned so that the fines will fill voids and bind the coarse aggregate together once the composite mixture is placed and compacted. The type of coarse and fine aggregates required and the gradation of the composite mixture will depend on the alternative selected by the Contractor. Component aggregate materials must come from an SCDOT-approved source and the composite mixture must meet specified gradation requirements, after the material has been hauled and placed on the project.

The work for graded aggregate base course consists of placing one or more lifts of specified composite aggregate material on an approved subgrade or subbase. The number of lifts depends on the overall thickness of the compacted base course. Each lift of material then will be mixed, shaped and thoroughly and uniformly compacted to a target density. To achieve the target density during compaction, the moisture content should be maintained at or near optimum for the mixture, as established by the Research and Materials Engineer. Pay attention to the Contractor's sequence of operations, placement of material lifts, uniformity of mixing, moisture content during compaction, density obtained, application of asphalt prime coat and the resultant thickness and smoothness of the completed base course. Because this type of base course relies heavily on the gradation of the aggregate materials, extreme care should be taken to prevent segregation. Loose or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer, with concurrence from the District Construction Engineer prior to the application of asphalt prime coat.

305.2 PRECONSTRUCTION CONSIDERATIONS

305.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents.

305.2.2 Coordination of Project Personnel

See Section 301.2.2 for guidance on coordinating project personnel.

305.2.3 Material Considerations

305.2.3.1 Graded Aggregate Material

The composite mixture for graded aggregate base course consists of both coarse and fine aggregate materials, which are proportioned so that the fines will fill voids and bind the coarse aggregate together once the composite mixture is placed and compacted. The type of coarse and fine aggregates required and the gradation of the composite mixture will depend on the alternative selected by the Contractor. The following describes the composite mixtures for the alternative types available under the provisions of Section 305:

1. Macadam. The composite mixture for macadam base consists of crusher-run stone, gravel or slag, excluding marine limestone, and requires very little, if any, additional fines to be added, because the fine screenings produced by the crushing operation will be included in the mixture.

2. Marine Limestone. The aggregate material required for marine limestone base course is generally found in the coastal plains of South Carolina and consists of any limestone aggregate not meeting the classification of dolomitic limestone. Marine limestone aggregate and recrystallized limestone aggregate are considered marine limestone aggregate. The composite mixture will consist of the marine limestone aggregate and the fine material screenings produced by the mining or crushing operation.

3. Recycled Portland Cement Concrete. The composite mixture for recycled Portland cement concrete base course is comprised of crushed, graded, recycled Portland cement concrete, excluding crushed concrete block or pipe, and the natural sand or crushed fines that are typically added to meet gradation requirements.

The composite mixture to be incorporated in the work must come from an SCDOT-approved source (e.g., quarry, production plant) and meet specified gradation requirements, after the material has been hauled and placed on the project. The Research and Materials Laboratory, not the SCDOT Inspector, is responsible for compliance sampling and testing for source approval (e.g., Los Angeles Abrasion Test (AASHTO T 96)). If a new facility is opened for a project, the District Engineering Administrator is responsible for notifying the Research and Materials Laboratory so that samples can be taken to assess compliance before use. Verify that the gradation of the composite mixture complies to specified requirements with no evidence of segregation.

305.2.3.2 Asphalt Prime Coat

See Section 303.2.3.2 for information on asphalt material used for asphalt prime coat.

305.2.4 Weather Considerations

See Section 303.2.4 for information on weather considerations.

305.2.5 Sampling and Testing Considerations

See Section 301.2.5 for information on sampling and testing component materials and Contract pay items.

305.2.6 Subgrade/Subbase Inspection and Approval

See Section 303.2.6 for information on subgrade and subbase inspection and approval.

305.3 INSPECTION DURING CONSTRUCTION

305.3.1 Hauling and Placement Operation

Prior to placement, check the moisture content of the subgrade or subbase. Wetting may be necessary to recondition the surface if it has become too dry. At the material source, the Contractor is required to remove all objectionable matter from the aggregate materials (e.g., roots, sod, weeds, balls of clay, wire, asphalt, insulation, wood, brick, plastic). This is especially important because the material will be produced at quarries and recycled material production plants. During placement and mixing, however, it is good practice to continually monitor the operation for objectionable materials and oversized stones. Require the Contractor to remove such objectionable materials. If found in excessive amounts, require removal and replacement of the base material. To minimize hauling over the work under construction, placement will typically begin at the station farthest from the material source. In general, hauling over the base should be avoided unless it is being constructed in lifts. Ensure that lifts are not placed too thick (i.e., 8-inch compacted thickness maximum). Verify that the Contractor evenly and uniformly spreads the base material over the approved and properly maintained subgrade or subbase. Pay particular attention to segregated areas during placement and spreading, and require the Contractor to correct such areas in accordance with the provisions of the Contract.

305.3.2 Spreading Operation

305.3.2.1 Mixing and Shaping

It is preferable that the composite mixture that is hauled from stationary plants meet specified gradation requirements before it is placed on the project; however, the Contract provisions allow for the fine aggregate component to be hauled separately and mixed in the correct proportion

with the coarse aggregate component on the subgrade or subbase. If mixing will occur on the project, do not allow equipment operators to mix the top surface of the subgrade or subbase with the graded aggregate material. As the graded aggregate material is being placed, verify that the Contractor immediately spreads and mixes the material until the base exhibits a homogeneous appearance throughout its width and depth. A uniform thickness for each lift should be attained. Verify that the Contractor adds water, as needed, to maintain the moisture content of the base material near optimum, as established by the Research and Materials Engineer. Only the most experienced motor grader operators should shape the base. Check the cross-section and grade to ensure conformance with the Contract Plans. As needed, require reshaping and removal and replacement of any unsuitable material encountered.

305.3.2.2 Checking Rate of Application

Where the Contract specifies that payment will be based on unit weight, an application rate for the graded aggregate material will be designated on the Contract Plans. Using the appropriate SCDOT Sampling and Testing Procedure (see Appendix C), check the application rate regularly to ensure compliance (i.e., weight of graded aggregate material from automatic printout tickets divided by the area upon which the material was spread). At the end of each workday, check and record in the Daily Work Report the weight of graded aggregate material incorporated in the work, the area of base course completed and approved and the actual application rate of aggregate. Remember that it is the Contractor's responsibility to establish the rate of spread. The SCDOT Inspector is responsible for confirming the Contractor's work but should not take on the Contractor's duties.

305.3.2.3 Sampling and Testing

Sampling and testing of each lift of graded aggregate material is required after placement and mixing but before compaction. The sampling and testing will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information. Where the Contractor elects to incorporate the fine aggregate component on the project, obtain and ship to the Research and Materials Laboratory one sample for each 1000 tons of the fine aggregate material to be incorporated in the work. Do not permit the fine aggregate material to be incorporated in the work until the Laboratory reports that the material has been found to be in compliance. Sample each lift of graded aggregate material before compaction. If the graded aggregate base course is to lie unsurfaced for a prolonged period of time, such as over the winter, delay the sampling. Sample the graded aggregate base course every 1000 feet per 2 lanes. Take the sample through the full lift depth at the following locations:

- at or near the centerline,
- approximately 2 feet from the right edge, and
- approximately 2 feet from the left edge.

The size of the sample will be in accordance with SC-T-1 (See Appendix C). Immediately ship the samples to the Research and Materials Laboratory for testing (e.g., gradation). If the Laboratory reports that a sample has failed and requests that a check sample be taken, obtain and ship two check samples representing the material that failed in accordance with the

requirements for check samples documented in Section 106. Do not permit additional material to be placed over the lift until the samples of the graded aggregate material have been tested and reported by the Laboratory to be in compliance.

305.3.3 Compaction Operation

305.3.3.1 General

The compaction operation (i.e., blading and rolling) should follow immediately behind the mixing and shaping operation. Its purpose is to compress the coarse and fine aggregate particles together into a dense mass by expelling air and reducing voids. Rolling will generally start at the edge and proceed toward the center, except on superelevated curves where rolling proceeds from the lower to the upper side. To facilitate minor corrective work, the Contractor should continually check lift thickness, grade and cross-section in a loose or lightly compacted condition. Once the graded aggregate base course has hardened, it is very difficult to correct surface deficiencies without completely ripping up the top layer of the compacted base. It is therefore extremely important that motor grader operators work in tandem with roller operators to maintain lift thickness and shape during compaction. The edge will generally be the most difficult to maintain and is subject to segregation. Rolling should generally extend 2 feet over the edge onto the shoulder. A drag broom is often pulled over the surface to deposit the excess fines into the surface voids. The compacted surface should be smooth and even textured. Watch for roller marks, knots and depressions and require the Contractor to adjust the roller pattern, as needed. Because density has a direct correlation to the resultant strength of the base course, it is critical that each lift be thoroughly and uniformly compacted to target density.

305.3.3.2 Moisture Content

One of the most important factors to consider is the amount of moisture in the graded aggregate material at the time it is compacted. Uniform distribution of water throughout the base material will result in the highest relative compaction with the least amount of compactive effort, assuming that the proper quantity of water is applied. The Research and Materials Engineer will establish the optimum moisture content for the graded aggregate base course material. Prior to compaction, check to ensure that the moisture content of the material is at or near optimum. The compaction operation is facilitated if the required water is added during the mixing and shaping operation.

305.3.3.3 Lift Thickness

Pay particular attention to the total compacted thickness of the graded aggregate base course that is denoted on the Contract Plans. If greater than 8 inches, the Contractor will be required to construct the base course in multiple lifts, with each lift being compacted to 100% of maximum density before additional material is placed for a subsequent lift.

305.3.3.4 Density Testing

During compaction, a hand shovel can be used to quickly assess the relative density of areas along the base course. The centerline will generally reach target density before the edges. With the shovel in vertical position, tap the handle end hard against the surface. If the surface is well compacted, a characteristic ring will be produced; otherwise, only a dull thud will be heard.

Density testing of each compacted lift of graded aggregate base course material is required and will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information on sampling and testing. Check to ensure that each lift of graded aggregate base course material is uniformly compacted to 100% of the maximum density. Field density tests are to be determined in accordance with SC-T-30, SC-T-31, SC-T-32 or SC-T-33, as appropriate (see Appendix C). The theoretical maximum dry density will be determined by the Research and Materials Engineer, based on representative 200-pound samples submitted from the field. Submit these samples as soon as practical. Do not permit an additional lift of graded aggregate base course material to be placed until the required density of the underlying lift has been attained. If test results fail, require the Contractor to adjust the compaction operation or moisture content, as needed, to obtain the target density. The Resident Construction Engineer should retain SCDOT Form 300.02 – Density Test Report (Nuclear Gauge) or SCDOT Form 300.03 – Density Test Report (Nuclear Gauge) – Direct Read Gauge; however, SCDOT Form 200.01 – Field Density Test Report (Nuclear Gauge) must be sent to the Research and Materials Laboratory on a weekly basis. Reference additional testing for areas that fail and note the corrective actions to be taken.

305.3.4 Checking Surface Smoothness

Once the final lift of graded aggregate base course has been compacted to target density, check compliance of the finished surface using a 10-foot straight edge, hand level, engineer's level, total station or other suitable means. Acceptable tolerance for surface smoothness is ±0.375 inch along the base in the direction parallel to the centerline and ±0.5 inch across the base in the direction of the cross-section. Be diligent in securing compliance of the surface. Require the Contractor to correct any areas that are not within reasonable conformity to the specified roadway section. Watch for severe rutting, equipment imprints, roller marks and loose or segregated material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

305.3.5 Checking Base Course Thickness

Immediately after compaction but prior to the application of the asphalt prime coat, test holes will be used to measure the thickness of the graded aggregate base course at various locations. Measure the base course thickness at staggered intervals not to exceed 250 feet in length per 2-lane width (125 feet for 4 lanes, etc.). See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. Verify that the Contractor corrects thickness deficiencies greater than 0.5 inches, as specified. Ensure that the test holes are backfilled with suitable material and thoroughly compacted using a hand tamp. If the Contract specifies that the graded aggregate base course will be paid for based on unit

area, these measurements will be used to calculate an average job thickness to assess compliance of the completed graded aggregate base course. When computing the average job thickness, individual measurements that exceed the specified thickness by more than 0.5 inch will be considered the specified thickness plus 0.5 inch. For example, if the specified thickness is 6 inches and the measured thickness at one location is 7 inches, use 6.5 inches when computing the average thickness. Record the thickness measurements on SCDOT Form 300.01 – Depth Check Records.

305.3.6 Application of Asphalt Prime Coat

The application of an asphalt prime coat will be required when a hot-mix asphalt or asphalt surface treatment will overlay the graded aggregate base course. Do not allow the application of asphalt prime coat to begin until all other requirements have been met with respect to the construction of the graded aggregate base course and final approval has been obtained from the Resident Construction Engineer, with concurrence of the District Construction Engineer. A light brooming of the surface will be required prior to application. Pay particular attention to the type of asphalt material used. Check that the application rate is within the specified range of acceptability. Note that application rate for asphalt prime coat differs based on the type of graded aggregate base. Too much asphalt material can actually create a slip plane in the pavement structure. The asphalt material should completely penetrate the base surface and fill all voids. Watch for damage to the asphalt prime coat caused by traffic and require the Contractor to sand, dust or repair the asphalt prime coat, as appropriate. Pay particular attention to overspray and potential damage to adjacent property, and notify the Resident Construction Engineer for any needed assistance. See Section 401.4 for additional information on the application of asphalt prime coats.

305.4 POST-CONSTRUCTION CONSIDERATIONS

The Contractor is responsible for maintaining the integrity of the graded aggregate base course during construction. During subsequent operations, watch for surface damage and defects and require the Contractor to repair the surface in accordance with the provisions of the Contract.

305.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

305.5.1 Graded Aggregate Base Course (Unit Area Basis)

Where graded aggregate base course is to be paid for based on unit area, measure and document in the Daily Work Report the surface area (i.e., width x length) of the completed and approved graded aggregate base course. Payment will be made based on the Contract unit price; however, payment adjustment applies if the average thickness of the base course is found to be more than 0.25 inch less than the thickness specified in the Contract. For example, if the Contract specifies a 6-inch graded aggregate base course and the average thickness was determined to be 5.5 inches, ensure that payment is adjusted as specified. Ensure that ineligible quantities, such as those for corrective work, are not included for payment.

305.5.2 Graded Aggregate Base Course (Unit Weight Basis)

Where graded aggregate base course is to be paid for based on unit weight, the aggregate material must be weighed on certified platform scales as defined in the provisions of the Contract. See Section 109 for additional information on measuring material quantities. If at any time the weight of a load is suspect, witness the Contractor reweighing the suspect load on certified platform scales. Obtain from the Contractor the automatic printout tickets showing the weight of each load of aggregate incorporated in the completed and accepted graded aggregate base course. The Resident Construction Engineer will retain these tickets. Record the day's total in the Daily Work Report. Payment will be made based on this weight and the Contract unit price. Ensure that ineligible quantities, such as those for corrective work or in excess of those specified or otherwise approved, are not included for payment.

305.5.3 Asphalt Material for Prime Coat

Obtain from the Contractor all invoices for the asphalt prime coat material, which will be retained by the Resident Construction Engineer, and document in the Daily Work Report the volume of asphalt material used for asphalt prime coat. Prime coat will be paid for separately based on this volume.

Section 306
Reserved

Section 307
Cement Stabilized Earth Base Course

307.1 DESCRIPTION OF WORK

Cement stabilized earth base course consists of a combination of local soil and Portland cement, uniformly mixed with water at optimum moisture content and compacted to the required density. Materials will be mixed either by a stationary pugmill or by road mixing. To determine percent cement and moisture, representative samples of the soil for this type of base course should be sent as soon as practical to the Research and Materials Laboratory. The SCDOT Inspector will be responsible for verifying that the Contractor treats the roadbed subgrade in accordance with Section 307 of the *Standard Specifications* and any applicable Special Provisions. Pay particular attention to the Contractor's sequence of operations, application rate of materials, depth and uniformity of mixing, moisture content during compaction, density obtained, curing period and the resultant thickness and smoothness of the completed base course. Loose, segregated or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer.

307.2 PRECONSTRUCTION CONSIDERATIONS

307.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents.

307.2.2 Coordination of Project Personnel

See Section 301.2.2 for guidance on coordinating project personnel.

307.2.3 Material Considerations

307.2.3.1 Soil Material

The soil material used in the construction of cement stabilized earth base course will be either the in-situ soil material of the roadbed, excavated sand-clay material or a combination of these materials. Work cannot begin until an analysis of the soil to determine the application rate of cement and the optimum moisture content for the soil-cement mixture has been conducted. Obtain and submit a sample to the Research and Materials Laboratory and verify that soil gradation is established and maintained in compliance.

307.2.3.2 Portland Cement and Water

See Section 301.2.3.2 for guidance on inspecting Portland cement and water.

307.2.3.3 Asphalt Prime Coat

See Section 301.2.3.3 for guidance on inspecting the asphalt material used for curing.

307.2.4 Weather Considerations

See Section 301.2.4 and Section 303.2.4 for information on weather considerations.

307.2.5 Sampling and Testing Considerations

See Section 301.2.5 for information on sampling and testing component materials and Contract pay items.

307.2.6 Subgrade Inspection and Approval

If the Contractor uses the stationary plant method, the subgrade must be constructed and approved in accordance with the provisions of Section 208 of the *Standard Specifications*. If the road mixing method is used, the roadbed subgrade will be processed into a soil-cement layer similar to that for a cement modified subbase (see Section 301.2.6).

307.3 INSPECTION DURING CONSTRUCTION

307.3.1 Method and Timing of Operations

Mixing of the soil, cement and water materials will be by the stationary plant method unless road mixing is specified or otherwise approved. Pay particular attention to specified limitations on elapsed time and the time of starting various construction operations, especially with respect to introducing water to cement, mixing and compaction.

307.3.2 Stationary Plant Mixing Operations

307.3.2.1 Soil-Cement Mixture Production

Where the stationary mixing method is used, excavated sand-clay material (see Section 303.2.3.1) will be mixed by a pugmill in correct proportion with Portland cement and water. The percent cement and moisture will be established by the Research and Materials Engineer based on a representative sample of the soil material. Percent cement will be based on dry unit weight of soil and must be maintained within ±5% of the established percent during mixing. The optimum moisture content will typically be specified as percent moisture in the mixture.

307.3.2.2 Hauling and Placement

The soil-cement mixture will be hauled to the project in trucks, covered by tarps while transported. Prior to placement, check the moisture content of the subgrade. Wetting may be

necessary to recondition the subgrade surface if it has become too dry. The soil-cement mixture should be homogeneous in appearance. During placement, monitor the mixture for objectionable materials, including oversized stones. Require the Contractor to remove such objectionable materials. If found in excessive amounts, require removal and replacement of the base material. To minimize hauling over the work under construction, placement will typically begin at the station farthest from the plant. In general, hauling over the base should be avoided unless constructed in lifts. Verify that the soil-cement mixture is placed and shaped in uniform lift thickness to the required grade and cross-section before compaction. Do not allow dumping of the mixture in piles or windrows.

307.3.3 Road Mixing Operations

307.3.3.1 Scarification and Pulverization Operation

Check the depth of scarification of the roadbed subgrade for compliance. Verify that the Contractor is not blading into the subgrade too deep. Perform the required sieve analyses to verify that the gradation of the pulverized material is within acceptable limits, and verify that the loosened soil is shaped to the required grade and cross-section before the spreading of cement.

307.3.3.2 Spreading of Cement

The application rate of cement and the optimum moisture content of the soil-cement mixture will be established by the Research and Materials Engineer based on a representative sample of the soil material (i.e., roadbed subgrade and/or sand-clay material). The application rate will typically be specified as weight of cement per unit area of spread. The optimum moisture content will typically be specified as percent moisture in the soil-cement mixture. Prior to spreading cement, verify that the Contractor has properly calibrated the spreader and closely monitor the rate of application to ensure that the cement is being spread uniformly across the entire width of the subgrade at a rate within ±5% of the rate per square yard established by the Research and Materials Engineer. Require the Contractor to recalibrate the spreader if necessary. Use SC-T-141 (see Appendix C) to check the application rate. The spreading operation must be continuous. Do not allow the Contractor to apply more cement along the length of the subgrade than can be completely processed in a single day's operation.

307.3.3.3 Mixing and Shaping Operation

Once the cement has been spread, dry mixing will be performed to pulverize and combine the air-dry soil and cement materials sufficiently to prevent cement balls from forming when water is added. Verify that dry mixing is maintained at the proper depth. Mixing deeper than that specified will dilute the mixture and possibly reduce the strength of the base course. Watch for unpulverized lumps and require pre-wetting if evident. Once the cement has been spread, do not allow construction equipment other than that required for mixing and shaping (i.e., road mixing machine, disc harrows, road graders) to traverse the material. As moisture is added, verify that the spray bar evenly distributes the water across the full width of the material. Do not allow water to accumulate on the surface. Water should be evenly distributed throughout the

mass. Check the moisture content for acceptability and, if needed, require the rate of application to be adjusted. Pay particular attention to the moisture content along the edges. Ensure that the Contractor mixes the soil and cement materials to a homogeneous mass for the full required depth. Do not allow the moist mixing operation to carve too deeply into the underlying roadbed subgrade. Check gradation of the moist soil-cement mixture for compliance. Monitor the operation for evidence of objectionable materials, including oversized stones, roots, sod and weeds and require removal or rework, as needed. Mixing should continue uninterrupted to leave the base in a loose and moist condition ready for immediate compaction. Compaction must commence within 30 minutes of moist mixing. If core molding is required, see Section 301.3.3.5 for guidance.

307.3.4 Compaction Operation

307.3.4.1 Moisture Content

The Research and Materials Engineer will establish the optimum moisture content for the soil-cement mixture. Prior to compaction, check to ensure that the moisture content is not more than two percentage points above nor less than that established as optimum. For example, if the optimum moisture content is 17%, an acceptable range for the moisture content during compaction will be between 17% and 19%, inclusive.

307.3.4.2 Density Testing

The compaction operation should immediately begin after shaping the loose soil-cement mixture. Compaction rolling must be completed within two hours of initial rolling. Check to ensure that the soil-cement mixture is uniformly compacted to not less than 95% of the maximum density. Use AASHTO T 134, SC-T-25 or SC-T-29, as appropriate, to determine the maximum density of the mixture (see Appendix C). Require the Contractor to adjust the compaction operation, as needed, to obtain the required density. The minimum requirement for density testing is one test each 1000 feet, per 2 lanes, each layer (on 4-lane sections, a test is required every 500 feet, each layer, etc.). Additional testing should be conducted, as needed, to ensure that proper compaction is being attained. See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. Contact the Resident Construction Engineer for any needed assistance. For density testing, the Resident Construction Engineer should retain SCDOT Form 200.02 – Percent Compaction by Nuclear Gauge or SCDOT Form 200.03 – Percent Compaction by Nuclear Gauge – Direct Read Gauge; however, SCDOT Form 200.01 – Field Density Test Report (Nuclear Gauge) must be sent to the Research and Materials Laboratory on a weekly basis.

307.3.5 Finishing Operation

Once the soil-cement mixture has been compacted to target density, the finishing operation will begin, which includes reshaping, light scarifying and finishing rolling, as needed, to bring the surface into compliance with the lines, grades and typical sections of the Contract Plans. Check compliance of the finished surface using a 10-foot straight edge, hand level, engineer's level, total station or other suitable means. Acceptable tolerance for surface smoothness is ±0.375

inches along the base course in the direction parallel to the centerline and ±0.5 inches across the base course in the direction of the cross-section. Require the Contractor to correct high and low spots, as specified. Pay particular attention to evidence of severe rutting, equipment imprints and loose material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

307.3.6 Curing Operation

Immediately after the finishing operation, ensure that the Contractor cures the finished surface with an asphalt curing membrane, as specified. Prior to applying the asphalt material, ensure that the surface is broomed and maintained in a moist condition. Pay particular attention to the specified elapsed time after finishing, the type of asphalt material used and the rate of application. Too much asphalt material can actually create a slip plane in the pavement structure. The asphalt material should completely seal the surface and fill all voids. Watch for damage to the membrane cased by traffic and require the Contractor to sand, dust or repair the membrane, as appropriate. The finished surface should generally be treated as soon as practical; however, surface treatment can be delayed until the following morning if weather conditions allow. The membrane should generally be allowed to set for 7 days prior to the application of a subsequent course.

307.4 POST-CONSTRUCTION CONSIDERATIONS

307.4.1 Construction Joints

See Section 301.4.1 for guidance on inspecting construction joints.

307.4.2 Checking Base Course Thickness

Test holes will be used to measure base course thicknesses at various locations. These measurements will be used to calculate an average job thickness to assess compliance of the completed cement stabilized earth base course. Phenolphthalein solution, available from the Research and Materials Laboratory, is useful in making these measurements. Dig a test hole at least 2 inches deeper than the specified depth of the cement stabilized earth base course. Beginning at the bottom of the test hole, make a vertical groove in the side of the hole with a screwdriver or other suitable instrument. When the groove is moistened from bottom to top with an eye dropper of phenolphthalein solution on the groove side of the test hole, the solution turns red when it reacts with cement, which will clearly identify the thickness of the cement modified layer. Measure base course thickness at staggered intervals not to exceed 250 feet in length per 2-lane width (125 feet for 4 lanes, etc.). See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. When computing the average job thickness, individual measurements exceeding the specified thickness by more than 0.5 inch will be considered the specified thickness plus 0.5 inch. For example, if the specified thickness is 6 inches and the measured thickness at one location is 7 inches, use 6.5 inches when computing the average thickness. Ensure that the Contractor corrects thickness deficiencies greater than 0.5 inch, which will require full-depth replacement.

Document this information in the Daily Work Report, and ensure that test holes are backfilled with suitable material and thoroughly tamped.

307.4.3 Traffic and Maintenance Considerations

Do not allow local traffic or construction equipment on the completed base course until the specified curing period has elapsed. Unless required for a subsequent construction operation, it is generally good practice for construction equipment to avoid traveling on the base course by using areas such as shoulders to travel along the project. Where crossings are approved, ensure that the Contractor covers the base course with at least 8 inches of earth to protect the finished surface. Once cured, light construction traffic will be permitted within 1000 feet ahead of the paving operation. The Contractor is responsible for maintaining the integrity of the completed base course. Watch for marring and defects to the surface and require the Contractor to correct such damage in accordance with the provisions of the Contract.

307.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

Measure and document in the Daily Work Report the surface area (i.e., width x length) of the completed and approved cement stabilized earth base course. Payment will be made based on the Contract unit price; however, payment adjustment applies if the average thickness of the base course is found to be more than 0.25 inch less than the thickness specified in the Contract. For example, if the Contract specifies a 8-inch cement stabilized earth base course and the average thickness was determined to be 7.5 inches, ensure that payment is adjusted as specified. Ensure that ineligible quantities, such as those for corrective work, are not included for payment. Pay particular attention, however, to the provisions for reconstructive work due to rainy conditions. Measure and document in the Daily Work Report the volume, dimensions and calculations for any approved unclassified excavation of unsuitable or unstable material. Use the average end area method based on cross-sectional area and length measurements made in the field. Obtain from the Contractor automatic printout tickets for Portland cement, which will be retained by the Resident Construction Engineer, and document in the Daily Work Report the weight of cement incorporated in the work. Portland cement will be paid for separately based on this weight, subject to the limits specified for the application rate.

Section 308
Cement Stabilized Aggregate Base Course

308.1 DESCRIPTION OF WORK

Cement stabilized aggregate base course consists of a combination of either macadam or marine limestone aggregate material and Portland cement, uniformly mixed with water at optimum moisture content and placed and compacted to the required density on the subgrade. Materials typically will be mixed either in stationary pugmill or by road mixing. To determine percent cement and moisture, representative samples of the aggregate material for this type of base course should be sent as soon as practical to the Research and Materials Laboratory. The SCDOT Inspector will be responsible for verifying that the Contractor treats the roadbed subgrade in accordance with Section 308 of the *Standard Specifications* and any applicable Special Provisions. Pay particular attention to the Contractor's sequence of operations, application rate of materials, depth and uniformity of mixing, moisture content during compaction, density obtained, curing period and the resultant thickness and smoothness of the completed base course. Loose, segregated or rutted areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer.

308.2 PRECONSTRUCTION CONSIDERATIONS

308.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents.

308.2.2 Coordination of Project Personnel

See Section 301.2.2 for guidance on coordinating project personnel.

308.2.3 Material Considerations

308.2.3.1 Graded Aggregate Material

The aggregate material for cement stabilized aggregate base course will be either macadam or marine limestone as discussed in Section 305.2.3.1.

308.2.3.2 Portland Cement and Water

See Section 301.2.3.2 for guidance on inspecting Portland cement and water.

308.2.3.3 Asphalt Prime Coat

See Section 301.2.3.3 for guidance on inspecting the asphalt material used for curing.

308.2.4 Weather Considerations

See Section 301.2.4 and Section 303.2.4 for information on weather considerations.

308.2.5 Sampling and Testing Considerations

See Section 301.2.5 for information on sampling and testing component materials and Contract pay items.

308.2.6 Subgrade/Subbase Inspection and Approval

See Section 303.2.6 for information on subgrade and subbase inspection and approval.

308.3 INSPECTION DURING CONSTRUCTION

308.3.1 Method and Timing of Operations

Aggregate, cement and water materials will generally be mixed in a stationary pugmill. Pay particular attention to specified limitations on elapsed and starting time of various construction operations, especially with respect to introducing water to cement, mixing and compaction.

308.3.2 Aggregate-Cement Mixture Production

Aggregate and cement materials must be supplied from a source listed on SCDOT Approval Sheet 1, Approval Sheet 2 and Approval Sheet 6, as appropriate and will mixed by a stationary pugmill in correct proportion with Portland cement and water. The percent cement and moisture will be established by the Research and Materials Engineer based on a representative sample of the material. Percent cement will be based on dry unit weight of soil and must be maintained within ±5% of the established percent during mixing. The optimum moisture content will typically be specified as percent moisture in the mixture.

308.3.3 Hauling and Placement

The aggregate-cement mixture will be hauled to the project in trucks, covered by tarps while transported. Prior to placement, check the moisture content of the subgrade. Wetting may be necessary to recondition the subgrade surface if it has become too dry. The aggregate-cement mixture should be homogeneous in appearance. During placement, monitor the mixture for objectionable materials, including oversized stones. Require the Contractor to remove such objectionable materials. If found in excessive amounts, require removal and replacement of the base material. To minimize hauling over the work under construction, placement will typically

begin at the station farthest from the plant. In general, hauling over the base should be avoided unless constructed in lifts. Verify that the aggregate-cement mixture is placed and shaped in uniform lift thickness to the required grade and cross-section before compaction. Do not allow dumping of the mixture in piles or windrows. Compaction must commence within 3 hours of mixing. If core molding is required, see Section 301.3.3.5 for guidance.

308.3.4 Compaction Operation

308.3.4.1 General

The compaction operation (i.e., blading and rolling) should follow immediately behind the placement and shaping operation. Its purpose is to compress the aggregate particles together into a dense mass by expelling air and reducing voids. Rolling will generally start at the edge and proceed toward the center, except on superelevated curves where rolling proceeds from the lower to the upper side. To facilitate minor corrective work, the Contractor should continually check lift thickness, grade and cross-section in a loose or lightly compacted condition. Once the cement stabilized aggregate base course has hardened, it is very difficult to correct surface deficiencies without completely ripping up the top layer of the compacted base. It is therefore extremely important that motor grader operators work in tandem with roller operators to maintain lift thickness and shape during compaction. The edge will generally be the most difficult to maintain and is subject to segregation. Rolling should generally extend 2 feet over the edge onto the shoulder. A drag broom is often pulled over the surface to deposit the excess fines into the surface voids. The compacted surface should be smooth and even textured. Watch for roller marks, knots and depressions and require the Contractor to adjust the roller pattern, as needed. Because density is a direct correlation to the resultant strength of the base course, it is paramount that each lift be thoroughly and uniformly compacted to target density.

308.3.4.2 Moisture Content

The Research and Materials Engineer will establish the optimum moisture content for the aggregate-cement mixture. Prior to compaction, check to ensure that the moisture content is not more than two percentage points above nor less than that established as optimum. For example, if the optimum moisture content is 17%, an acceptable range for the moisture content during compaction will be between 17% and 19%, inclusive.

308.3.4.3 Density Testing

During compaction, a hand shovel can be used to quickly assess the relative density of areas along the base course. The centerline will generally reach target density before the edges. With the shovel in vertical position, tap the handle end hard against the surface. If the surface is well compacted, a characteristic ring will be produced; otherwise, only a dull thud will be heard. Density testing of each compacted lift of cement stabilized aggregate base course material is required and will be performed in accordance with the criteria for Quality Control Samples and Tests and Independent Assurance Samples and Tests discussed in Section 106. See Section 301.2.5 for additional information on sampling and testing. Check to ensure that each lift of

cement stabilized aggregate base course material is uniformly compacted to at least 98% of the maximum density. Field density tests are to be determined in accordance with SC-T-30, SC-T-31, SC-T-32 or SC-T-33, as appropriate (see Appendix C). The theoretical maximum dry density will be determined by the Research and Materials Laboratory, based on representative 200-pound samples submitted from the field. Submit these samples as soon as practical. Do not permit an additional lift of cement stabilized aggregate base course material to be placed until the required density of the underlying lift has been attained. If test results fail, require the Contractor to adjust the compaction operation or moisture content, as needed, to obtain the target density. The Resident Construction Engineer should retain SCDOT Form 300.02 – Density Test Report (Nuclear Gauge) or SCDOT Form 300.03 – Density Test Report (Nuclear Gauge) – Direct Read Gauge; however, SCDOT Form 200.01 – Field Density Test Report (Nuclear Gauge) must be sent to the Research and Materials Laboratory on a weekly basis. Reference additional testing for areas that fail and note the corrective actions to be taken.

308.3.5 Checking Surface Smoothness

Once the final lift of cement stabilized aggregate base course has been compacted to target density, check compliance of the finished surface using a 10-foot straight edge, hand level, engineer's level, total station or other suitable means. Acceptable tolerance for surface smoothness is ±0.375 inches along the base in the direction parallel to the centerline and ±0.5 inches across the base in the direction of the cross-section. Be diligent in securing compliance of the surface. Require the Contractor to correct any areas that are not within reasonable conformity to the specified roadway section. Watch for severe rutting, equipment imprints, roller marks and loose or segregated material, and notify the Resident Construction Engineer, as needed, to assess corrective measures.

308.3.6 Curing Operation

Immediately after compaction, ensure that the Contractor cures the finished surface with an asphalt curing membrane, as specified. Prior to applying the asphalt material, ensure that the surface is broomed and maintained in a moist condition. Pay particular attention to the specified elapsed time after finishing, the type of asphalt material used and the rate of application. Too much asphalt material can actually create a slip plane in the pavement structure. The asphalt material should completely seal the surface and fill all voids. Watch for damage to the membrane cased by traffic and require the Contractor to sand, dust or repair the membrane, as appropriate. The finished surface should generally be treated as soon as practical; however, surface treatment can be delayed until the following morning if weather conditions allow. The membrane should generally be allowed to set for 7 days prior to the application of a subsequent course.

308.4 POST-CONSTRUCTION CONSIDERATIONS

308.4.1 Construction Joints

See Section 301.4.1 for guidance on inspecting construction joints.

308.4.2 Checking Base Course Thickness

Test holes will be used to measure base course thicknesses at various locations. These measurements will be used to calculate an average job thickness to assess compliance of the completed cement stabilized aggregate base course. Measure base course thickness at staggered intervals not to exceed 250 feet in length per 2-lane width (125 feet for 4 lanes, etc.). See Section 106 for additional information on Quality Control Samples and Tests and Independent Assurance Samples and Tests. When computing the average job thickness, individual measurements exceeding the specified thickness by more than 0.5 inches will be considered the specified thickness plus 0.5 inch. For example, if the specified thickness is 8 inches and the measured thickness at one location is 9 inches, use 8.5 inches when computing the average thickness. Ensure that the Contractor corrects thickness deficiencies greater than 0.5 inches, which will require full-depth replacement. Document this information on SCDOT Form 300.01 – Depth Check Records, and ensure that test holes are backfilled with suitable material and thoroughly tamped.

308.4.3 Traffic and Maintenance Considerations

Do not allow local traffic or construction equipment on the completed base course until the specified curing period has elapsed. Unless required for a subsequent construction operation, it is generally good practice for construction equipment to avoid traveling on the base course by using areas such as shoulders to travel along the project. Where crossings are approved, ensure that the Contractor covers the base course with at least 3 inches of screenings or sand to protect the finished surface. Once cured, light construction traffic will be permitted within 1000 feet ahead of the paving operation. The Contractor is responsible for maintaining the integrity of the completed base course. Watch for marring and defects to the surface and require the Contractor to correct such damage in accordance with the provisions of the Contract.

308.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

Measure and document in the Daily Work Report the surface area (i.e., width x length) of the completed and approved cement stabilized aggregate base course. Payment will be made based on the Contract unit price; however, payment adjustment applies if the average thickness of the base course is found to be more than 0.25 inches less than the thickness specified in the Contract. For example, if the Contract specifies an 8-inch cement stabilized aggregate base course and the average thickness was determined to be 7.5 inches, ensure that payment is adjusted as specified. Ensure that ineligible quantities, such as those for corrective work, are not included for payment. Pay particular attention, however, to the provisions for reconstructive work due to rainy conditions. Obtain from the Contractor automatic printout tickets for Portland cement, which will be retained by the Resident Construction Engineer, and document in the Daily Work Report the weight of cement incorporated in the work. Portland cement will be paid for separately based on this weight, subject to the limits specified for the application rate.

Section 309
Hot-Mix Sand Asphalt Base Course

309.1 DESCRIPTION OF WORK

Hot-mix sand asphalt base course work consists of fine aggregate material and a performance graded asphalt binder, properly proportioned and mixed in an approved hot-mix asphalt plant, and placed and compacted on an approved subgrade or subbase. Materials are typically mixed in a hot-mix asphalt batch or drum mix plant. To assess gradation and determine percent asphalt binder required, a representative sample of the fine aggregate material must be sent as soon as practical to the Research and Materials Laboratory. The Research and Materials Laboratory and District Asphalt Manager are responsible for the inspection and approval of hot-mix asphalt plant operations. The SCDOT Inspector will be responsible for verifying that the Contractor constructs the hot-mix sand asphalt base course in accordance with Section 309 of the *Standard Specifications* and any applicable Special Provisions. Pay particular attention to the Contractor's sequence of operations, method of hauling and placement, appearance and temperature of the mix, depth and uniformity of lifts, compaction method, density of mat, thickness of the base course and the application of asphalt tack coat. Substandard thickness and segregated areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer.

309.2 PRECONSTRUCTION CONSIDERATIONS

309.2.1 Contract Document Review

See Section 301.2.1 for guidance on reviewing Contract documents. The SCDOT Inspector should also review hot-mix asphalt plant, hauling, placement and compaction operations as discussed in Section 401 and, as needed, reference the following publications:

- *SCDOT Asphalt Inspector's Guide Manual*,
- *SCDOT Asphalt Roadway Technician (ART) Course*,
- *AASHTO Hot-Mix Asphalt Paving Handbook*, and
- *AASHTO Segregation Causes and Cures for Hot-Mix Asphalt*.

309.2.2 Coordination of Project Personnel

When preparing for hot-mix asphalt construction, hold a conference to discuss project issues, including reasons for rejecting loads of mix, with SCDOT and Contractor personnel in charge of hot-mix asphalt production and operations at the project site. This may include the Asphalt Materials Engineer, District Asphalt Manager, Resident Construction Engineer, SCDOT Inspector and the Contractor's Plant and Roadway Superintendents. See Section 301.2.2 for additional guidance on coordinating project personnel.

309.2.3 Material Considerations

309.2.3.1 Performance Graded Asphalt Binder

Performance graded asphalt binders are used by the Department for all of its hot-mix asphalt mixtures. The performance grade (PG) designates a numeric syntax for various types of asphalt binders that are used for various applications. See Section 401 for additional information on performance grades and inspection of asphalt binders. Check to ensure that the asphalt binder used for the hot-mix sand asphalt base course is of the proper type and is supplied from a source listed on SCDOT Approval Sheet 37.

309.2.3.2 Aggregate Materials

The gradation and proportion of coarse and fine aggregate materials in hot-mix asphalt mixtures vary based on the design and intended application of the mixture. Many different types of designs are used. The provisions of Section 309 stipulate the requirements for hot-mix sand asphalt base course. The aggregate for this type of base course consists of local sand or local sand containing other approved materials. Check to ensure that the aggregate material is supplied from a source listed on SCDOT Approval Sheet 1 and Approval Sheet 2. Samples of the aggregate must be submitted to the Research and Materials Laboratory as soon as practical to determine compliance (SC-T-5, SC-T-34) and the percent of asphalt binder required for the base course. See Appendix C for SCDOT Sampling and Testing Procedures.

309.2.3.3 Hot-Mix Asphalt Mixture

The Contract will specify the type of hot-mix sand asphalt base course to be constructed. The Contractor will establish the percent of asphalt binder for the mixture based on laboratory test results. The Asphalt Materials Engineer will verify and approve the Contractor's mix design. Note that a Job Mix Formula is not required and the specified percent asphalt range is not a tolerance limit. Percent binder will be controlled as established in *Control and Acceptance of Hot Mix Asphalt Mixtures*. The Contractor's Plant Superintendent will be responsible for mix production, and the District Asphalt Manager will be responsible for verifying compliance of plant operations and the mixture. The Contract Special Provision will define the responsibilities of each party. Verify that the hydrated lime anti-stripping agent is supplied from a source listed on SCDOT Approval Sheet 39.

309.2.4 Weather Considerations

Weather plays an important role and is a very controlling factor in the production and compaction of hot-mix asphalt courses. See the provisions of Section 401.17 of the *Standard Specifications* and Section 303.2.4 for additional information.

309.2.5 Sampling and Testing Considerations

In general, quality control is the responsibility of the Contractor and quality assurance is the responsibility of SCDOT. The required sampling and testing procedures and acceptance criteria

are complex and should be thoroughly reviewed and understood by all parties prior to initiating the construction of a hot-mix asphalt course (e.g., Quality Control, Quality Acceptance, Independent Assurance). The sampling and testing procedures and acceptance criteria, including payment adjustments, and the responsibilities of the Asphalt Materials Engineer, District Asphalt Manager, Resident Construction Engineer, SCDOT Inspector and the Contractor's Asphalt Technicians are well defined in Section 401 of the *Standard Specifications* and the Contract Special Provisions. See Section 301.2.5 for additional information.

309.2.6 Subgrade/Subbase Inspection and Approval

See Section 303.2.6 for information on subgrade and subbase inspection and approval.

309.3 INSPECTION DURING CONSTRUCTION

309.3.1 General

Section 401 provides an extensive discussion on hot-mix asphalt plant operations and pavement construction inspection, which also applies to hot-mix sand asphalt base course. In addition, pay particular attention to the following:

1. Hauling. Verify that the beds of trucks are properly coated with a release agent and that the mixture is adequately protected by a tarp. See SCDOT Approval Sheet 17.

2. Mix Inspection. Check the temperature of the loads of mix to ensure that they are between 250°F and 325°F when they arrive at the job site. Visually inspect the loads for conformance. Blue smoke is an indication that the mix is too hot. Crusting of the mix is an indication that it is too cold. A flat, shiny load sitting in the truck is an indication of too much asphalt binder. Watch for segregation. Reject unacceptable loads.

3. Placement. Check the rate of spread for conformance. Lifts should not exceed 4 inches of compacted thickness. Watch for segregation, especially along the edges and at joints. Verify that joints in the lifts overlap a minimum of 6 inches.

4. Compaction. Pay attention to the temperature of the mixture at the time of compaction rolling to ensure that optimum density is being obtained. Some mixtures exhibit problems if compacted during the tender zone. Note that sand-asphalt bases may be extremely tender and may require the material to cool down to allow the roller to compact the mixture without any significant horizontal or vertical displacement. Verify that density sampling and testing is being performed as specified in the provisions of the Contract. Pay attention to the quality acceptance and density criteria (see Sections 401.30 and 401.31 of the *Standard Specifications*).

5. Finishing. Do not allow rolling equipment to park on the surface of a freshly compacted mat. Check the surface smoothness, grade and cross-section for compliance using a 10-foot straightedge, engineer's level, total station or other suitable means.

309.3.2 Application of Asphalt Tack Coat

The application of an asphalt tack coat will be required between each lift of hot-mix sand asphalt base course. Do not allow the operation to begin until all other requirements have been met for the construction of the lift and final approval has been obtained from the Resident Construction Engineer. Drying and light brooming of the surface may be required when necessary prior to application. Pay particular attention to the type of asphalt material used. Optional types may be specified in the Contract. Only one type should be used, and it should not be mixed with other asphalt materials used on the project. Check the application rate for compliance. Too much asphalt material can create a slip plane in the pavement structure and too little will inhibit bonding between layers. The asphalt material should completely penetrate the lift and fill all voids. Watch for damage to the surface of the asphalt tack coat. Pay particular attention to overspray and potential damage to adjacent property, and notify the Resident Construction Engineer for any needed assistance. See Section 401 for additional information on the application of asphalt tack coat.

309.4 POST-CONSTRUCTION CONSIDERATIONS

309.4.1 Construction Joints

The construction of transverse and longitudinal joints in hot-mix asphalt mats must be constructed with exactness and inspected with diligence to ensure acceptability and quality of the final product, primarily due to the difficult nature of working with the hot-mix asphalt material. Improper construction causes segregation, mat separation and surface defects. Pay particular attention to the respective location of joints in lifts and courses. See Section 401 and Section 301.4.1 for additional guidance on inspecting joints.

309.4.2 Checking Base Course Thickness

When base course thickness is specified, core samples will be obtained to evaluate compliance.

309.4.3 Traffic and Maintenance Considerations

Do not allow local traffic or construction equipment on the completed base course until the specified curing period has elapsed. Unless required for a subsequent construction operation, it is generally good practice for construction equipment to avoid traveling on the base course by using areas such as shoulders to travel along the project. Where crossings are approved, ensure that the Contractor adequately protects the finished surface of the base course. Once cured, light construction traffic will be permitted ahead of the paving operation, as approved by the Resident Construction Engineer. The Contractor is responsible for maintaining the integrity of the completed base course. Watch for marring and other surface defects and require the Contractor to correct such damage in accordance with the Contract provisions.

309.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

309.5.1 Hot-Mix Sand Asphalt Base Course

The base course material must be weighed on certified platform scales as defined in the provisions of the Contract. See Section 109 for additional information on measuring material quantities. If at any time the weight of a load is suspect, witness the Contractor reweighing the suspect load on certified platform scales. Obtain from the Contractor the automatic printout tickets showing the weight of each load of base course material incorporated in the completed and accepted hot-mix sand asphalt base course. These tickets will be retained by the Resident Construction Engineer. Record the day's total in the Daily Work Report. Payment will be made based on this weight and the Contract unit price. Ensure that ineligible quantities, such as those for corrective work or in excess of those specified or otherwise approved, are not included for payment. SCDOT Form 400.04 – Daily Report of Asphalt Road Inspection should be completed.

309.5.2 Performance Graded Asphalt Binder

Document in the Daily Work Report the authorized weight of the asphalt binder incorporated in the completed and approved base course. The asphalt binder will be paid for separately based on this weight. Obtain from the Contractor automatic printout tickets for the asphalt binder, which will be retained by the Resident Construction Engineer. The Resident Construction Engineer will be provided with field laboratory extraction tests to check quantity. Be sure to include quantity adjustments for authorized increases or decreases to asphalt binder or required based on field laboratory extraction tests. Do not include quantities for unauthorized excess or waste. SCDOT Form 400.03 – Daily Report of Asphalt Plant Inspection must be completed.

309.5.3 Asphalt Material for Tack Coat

For the purpose of demonstrating compliance, document in the Daily Work Report the volumetric quantity, distribution area (i.e., length x width), application rate and type of asphalt material used for asphalt tack coat; however, asphalt tack coat will not be paid for separately. Document the rate on SCDOT Form 400.04 – Daily Report of Asphalt Road Inspection.

Section 310
Hot-Mix Asphalt Aggregate Base Course

310.1 DESCRIPTION OF WORK

Hot-mix asphalt aggregate base course work consists of coarse and fine aggregate material and a performance graded asphalt binder, properly proportioned and mixed in an approved hot-mix asphalt plant, and placed and compacted on an approved subgrade or subbase. The Research and Materials Laboratory and District Asphalt Manager are responsible for inspection and approval of hot-mix asphalt plant operations. The SCDOT Inspector will be responsible for verifying that the Contractor constructs the hot-mix asphalt aggregate base course in accordance with Section 310 of the *Standard Specifications* and any applicable Special Provisions. Pay particular attention to the Contractor's sequence of operations, method of hauling and placement, appearance and temperature of the mix, depth and uniformity of lifts, compaction method, density of mat, thickness of the base course and the application of tack. Substandard thickness and segregated areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer.

310.2 PRECONSTRUCTION CONSIDERATIONS

310.2.1 Contract Document Review

See Section 309.2.1 for guidance on reviewing Contract documents.

310.2.2 Coordination of Project Personnel

See Section 309.2.2 for guidance on coordinating project personnel.

310.2.3 Material Considerations

310.2.3.1 Performance Graded Asphalt Binder

See Section 309.2.3.1 for information on inspecting performance graded asphalt binders.

310.2.3.2 Aggregate Materials

Verify that the type and gradation of aggregate materials conform to the requirements specified in the provisions of Section 310 of the *Standard Specifications*. See Section 309.2.3.2 for additional information.

310.2.3.3 Hot-Mix Asphalt Mixture

The Contract will specify the type of hot-mix asphalt aggregate base course to be constructed. The Contractor will establish the percent of asphalt binder for the mixture based on laboratory test results. The Asphalt Materials Engineer will verify and approve the Contractor's mix design. A Job Mix Formula is not required for Asphalt Aggregate Base Course; however, the asphalt binder content for this HMA mixture will be verified and a Mix Design Form generated. The percent asphalt will be maintained within the specified range and tolerance in Section 310 of the *Standard Specifications*. See Section 309.2.3.3 for additional information.

310.2.4 Weather Considerations

Weather plays an important role and is a very controlling factor in the production and compaction of hot-mix asphalt mixtures. See the provisions of Section 401.17 of the *Standard Specifications* and Section 303.2.4 for additional information.

310.2.5 Sampling and Testing Considerations

See Section 309.2.5 for information on sampling and testing.

310.2.6 Subgrade / Subbase Inspection and Approval

See Section 303.2.6 for information on subgrade and subbase inspection and approval.

310.3 INSPECTION DURING CONSTRUCTION

Section 401 provides an extensive discussion on hot-mix asphalt plant operations and pavement construction, which applies to the construction of hot-mix asphalt aggregate base course. In addition, pay particular attention to the following:

1. Hauling. Verify that the beds of trucks are properly coated with a release agent and that the mixture is adequately protected by a tarp. Release agents must be supplied from a source listed on SCDOT Approval Sheet 17.

2. Mix Inspection. Check the temperature of the loads of mix to ensure that they are between 250°F and 325°F when they arrive at the job site. Visually inspect the loads for conformance. Blue smoke is an indication that the mix is too hot. Crusting of the mix is an indication that it is too cold. A flat, shiny load sitting in the truck is an indication of too much asphalt binder. Watch for segregation. Reject unacceptable loads.

3. Placement. Check the rate of spread for conformance and verify that the course is the proper thickness prior to compaction. Watch for segregation, especially along the edges, at joints and on the end of each load.

4. Compaction. Steel wheel tandem rollers weighing 8 to 10 tons are generally required. Initial rolling should begin when the mat has cooled sufficiently to support the weight of the rollers. Perform the required density testing.

5. Finishing. Do not allow rolling equipment to park on the surface of a freshly compacted mat. Check the surface smoothness, grade and cross-section for compliance using a 10-foot straightedge, engineer's level, total station or other suitable means.

310.4 POST-CONSTRUCTION CONSIDERATIONS

The guidance for post-construction inspection discussed in Section 309.4 applies to hot-mix asphalt aggregate base course work.

310.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

310.5.1 Hot-mix Asphalt Aggregate Base Course

Hot-mix asphalt aggregate base course material must be weighed on certified platform scales as defined in the provisions of the Contract. See Section 109 for additional information on measuring material quantities. If at any time the weight of a load is suspect, witness the Contractor reweighing the suspect load on certified platform scales. Obtain from the Contractor the automatic printout tickets showing the weight of each load of hot-mix asphalt aggregate material incorporated in the completed and accepted hot-mix asphalt aggregate base course. The Resident Construction Engineer will retain these tickets. Record the day's total in the Daily Work Report. Payment will be made based on this weight, the Contract unit price, and any price adjustments described in the contract. Ensure that ineligible quantities, such as those for corrective work or in excess of those specified or otherwise approved, are not included for payment.

310.5.2 Performance Graded Asphalt Binder

Document in the Daily Work Report the authorized weight of the asphalt binder incorporated in the completed and approved base course. The asphalt binder will be paid for separately based on this weight. Obtain from the Contractor automatic printout tickets for the asphalt binder, which will be retained by the Resident Construction Engineer. SCDOT Form 400.03 – Daily Report of Asphalt Plant Inspection must be completed.

310.5.3 Asphalt Material for Tack Coat

For the purpose of demonstrating compliance, document on SCDOT Form 400.04 – Daily Report of Asphalt Road Inspection the application rate and type of asphalt material used for asphalt tack coat; however, asphalt tack coat will not be paid for separately.

Section 311
Permeable Asphalt Base Course

311.1 DESCRIPTION OF WORK

Permeable asphalt base course consists of crushed stone and a performance graded asphalt binder, properly proportioned and mixed in an approved hot-mix asphalt plant, and placed and compacted on an approved subgrade or subbase. Its purpose is to allow water to adequately drain. The Research and Materials Laboratory and District Asphalt Manager are responsible for inspection and approval of hot-mix asphalt plant operations. The SCDOT Inspector will be responsible for verifying that the Contractor constructs the permeable asphalt base course in accordance with the Contract Plans, Special Provisions and applicable Subsections of Section 401 of the *Standard Specifications*. Pay particular attention to the Contractor's sequence of operations, method of hauling and placement, mix appearance and temperature, compaction method, density of mat and the resultant thickness of the base course. Substandard thickness, overly compacted mats and segregated areas are unacceptable and will require immediate correction by the Contractor. After construction and prior to placement of any subsequent course, obtain final approval of the base course from the Resident Construction Engineer.

311.2 PRECONSTRUCTION CONSIDERATIONS

311.2.1 Contract Document Review

See Section 309.2.1 for guidance on reviewing Contract documents.

311.2.2 Coordination of Project Personnel

See Section 309.2.2 for guidance on coordinating project personnel.

311.2.3 Material Considerations

311.2.3.1 Performance Graded Asphalt Binder

See Section 309.2.3.1 for information on inspecting performance graded asphalt binders.

311.2.3.2 Aggregate Materials

Crushed stone, exclusive of limestone, will typically be required for permeable asphalt base course. Verify that the type and gradation of the aggregate material conform to the requirements specified in the Contract Special Provisions. See Section 309.2.3.2 for additional information.

311.2.3.3 Hot-Mix Asphalt Mixture

Verify that the gradation of the mix is properly established and maintained. The Research and Materials Engineer will verify the percent of asphalt binder for the mixture based on laboratory test results. Percent asphalt will be maintained within the range and tolerance as specified in the Contract Special Provisions. See Section 309.2.3.3 for additional information.

311.2.4 Weather Considerations

Weather plays an important role and is a very controlling factor in the production and compaction of hot-mix asphalt courses. See the provisions of Section 401.17 of the *Standard Specifications* and Section 303.2.4 for additional information.

311.2.5 Sampling and Testing Considerations

See Section 309.2.5 for information on sampling and testing.

311.2.6 Subgrade / Subbase Inspection and Approval

See Section 303.2.6 for information on subgrade and subbase inspection and approval.

311.3 INSPECTION DURING CONSTRUCTION

Section 401 provides an extensive discussion on hot-mix asphalt plant operations and pavement construction, which applies to the construction of permeable asphalt base course. In addition, pay particular attention to the following:

1. Hauling. Verify that the beds of trucks are properly coated with a release agent and that the mixture is adequately protected by a tarp. Release agents must be supplied from a source listed on SCDOT Approval Sheet 17.

2. Mix Inspection. Check the temperature of the loads of mix to ensure that they are between 250°F and 325°F when they arrive at the job site. Visually inspect the loads for conformance. Blue smoke is an indication that the mix is too hot. Crusting of the mix is an indication that it is too cold. A flat, shiny load sitting in the truck is an indication of too much asphalt binder. Watch for segregation. Reject unacceptable loads.

3. Placement. Check the rate of spread for conformance and verify that the course is the proper thickness prior to compaction. Watch for segregation, especially along the edges, at joints and on the end of each load.

4. Compaction. The purpose of the compaction will be to densify the mat sufficiently to support the load of paving equipment. Steel wheel tandem rollers weighing 8 to 10 tons are generally required. Initial rolling should begin when the mat has cooled sufficiently to

support the weight of the rollers. Do not allow the mat to be overdensified as this will hinder the performance of the free-draining layer.

5. Finishing. Do not allow rolling equipment to park on the surface of a freshly compacted mat. Check the surface smoothness, grade and cross-section for compliance using a 10-foot straightedge, engineer's level, total station or other suitable means.

311.4 POST-CONSTRUCTION CONSIDERATIONS

After construction, care should be exercised to ensure that the porous surface of the mat is not clogged with dirt or debris. Ensure that the surface is maintained free of contamination from soil and other materials. Require the Contractor to clean and repair the base course, as needed, in accordance with the provisions of the Contract. See Section 309.4 for additional post-construction inspection considerations.

311.5 DOCUMENTATION AND PAYMENT CONSIDERATIONS

The guidance presented in Section 310.5 applies to the documentation and payment considerations for permeable asphalt base course.