CHAPTER 300 - BASES

SECTION 301 – GENERAL REQUIREMENTS FOR BASES

301.01 GENERAL

This section describes general requirements for the construction of bases.

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.

301.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Contractor's proposed source of materials
- Planned typical section and Contractor's schedule for construction staking.
- Location and legal description of Contractor's proposed stockpile areas, borrow pits or other off-site facilities.
- Salvageable materials.
- Contractor's schedule/plan for the work, including the placement of temporary erosion and sediment control measures.
- Acceptable tolerance
- Drainage considerations

B. Acceptance of Materials

Confirm the Contractor's proposed material source is listed on the Approved Products List (APL). As soon as practical, obtain sufficient samples of the aggregate material that the Contractor will use to construct the roadway base. Consideration should be given to the method of measurement to be used to determine the thickness of the base course and discussed with the contractor.

C. Preparatory Work and Contractor Work Plans

1. Preparatory Work

Verify that the following earthwork has been completed before allowing the Contractor to begin work on the subbase or any base course:

- Clearing and grubbing,
- Roadway and drainage excavation, and
- Embankment and subgrade construction.

In addition, identify if any of following items of work must be completed before base placement:

- Cross drains and edge drains;
- Storm drain pipes;
- Conduit crossings for electrical; and
- Utility relocation work.

2. Subgrade Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of base course material.

Prior to placement of the base material, ensure that the subgrade is not frozen, in accordance with Section 202.04.A(5)(b) of the Standard Specifications.

When required in the plans, ensure that separator fabric and/or geosynthetic reinforcement has been installed in accordance with Sections 325 and 326 of the Standard Specifications and this Manual.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

301.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Complete the necessary sampling and testing of materials defined in the applicable section of this manual. Additionally, thickness measurements shall be made and recorded prior to placing any succeeding courses.

B. Equipment and Methods

Review the applicable section of the Standard Specifications and this manual for specific requirements regarding mixing equipment, spreaders, compactors, etc.

C. Construction Operations

1. General

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.

2. Subgrade Foundation

Satisfactory subgrade is important to the foundation of the entire pavement structure. No base course or surface course can render satisfactory service unless adequate support is provided by the subgrade upon which it rests. Therefore, the construction of the subgrade must be closely inspected.

It is essential that the subgrade surface be at proper line and grade, of correct cross-sectional shape, and of proper compaction. If any defect has developed in the subgrade or if it has incurred any damage, this defect or damage must be corrected before the base is placed. Additional drainage, grading, and compaction rework may be required to bring the subgrade into compliance.

Once the subgrade has been approved by the Resident Engineer, continue to monitor the subgrade for excessively dry or 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.

3. 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 necessary, 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 or a layer of inexpensive, locally available aggregate material.

Closely monitor subbase construction for compliance. Ensure that the Resident Engineer has provided final approval of the subbase before allowing the Contractor to initiate work on the overlying base course.

4. Base Course

The base course is a structural layer that directly supports the surface structure. 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. Subsequent sections in this manual will discuss the types of base courses that are typically used by ODOT.

Do not allow construction of base course on a rutted or pumping subgrade. Rutting and pumping usually occurs because the subgrade or underlying material is too wet or not thoroughly compacted. When non-cohesive soils are encountered, water and compaction may be essential immediately before placing base aggregates. The Contractor should limit the weight and speed of equipment to prevent damage when hauling over the subgrade or base course. If the Contractor's equipment or local traffic damages the subgrade or aggregate base, direct the Contractor to make the necessary corrections.

Closely monitor construction for compliance and ensure that the Resident Engineer approves each base course before allowing the Contractor to begin work on an overlying layer.

5. Finishing and Tolerances

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the base is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be

checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer will require the Contractor to correct the thickness and rework the material.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base for acceptance.

Thickness measurements shall be made and recorded prior to placing any succeeding courses.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, ensure the Contractor has prepared any necessary environmental statements for the plant site and any haul roads. Ensure that the best management practices for storm water management are monitored as required (see Section 220 of the Standard Specifications and this Manual).

Haul roads are to be kept to a minimum and must be located in such a manner as to cause the least amount of damage to the natural vegetation. In order to promote the best possible public relations, the owners of all lands traversed should be contacted before actual work on any haul road is started. Fences are not to be cut or gates left open without the owner's permission. Breaks in any right-of-way fences along the Interstate will require prior approval by FHWA. After completion haul roads should be cleaned up, and all damages repaired as required by the specifications and the owner's requirements.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of base material placement
- Areas in need of maintenance (e.g., rutting of subgrade, excessive moisture, etc.)
- Receipt of source certificates, delivery tickets, etc.

2. Measurement and Payment

Documentation will be done in accordance with the relevant pay items as described in this Construction Manual. Refer to the appropriate section for details.

301.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Ensure the necessary sampling and testing of materials defined in the applicable section of this manual has been completed. Additionally, thickness measurements are made and recorded prior to placing any succeeding courses.

B. Audit Requirements

Auditing of the documentation will be done in accordance with the relevant pay items as described in this Construction Manual. Refer to the appropriate section for details.

C. Protection of the Work

Check that the surface is satisfactorily maintained until the next course is ready to be placed.

301 CHECKLIST GENERAL REQUIREMENTS FOR BASES

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the Contractor submitted its proposed plants, equipment, and material sources?					
If gravel is used for the base course, is the pit cleared of vegetation, root mat, and other debris and over-burden?					
Is the subgrade properly compacted, graded, and shaped to the required cross-section?					
Has the Contractor set string line and grade?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor taking adequate precautions to prevent placing material on wet or frozen subgrade?					
Is base course material being uniformly spread and thoroughly compacted?					
Are base width and depth in compliance with the tolerance specified for the typical sections shown on the plans?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is base course within the tolerance specified for the plan thickness?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does the completed base course conform to the tolerance specified for the planned line, grade, and cross-section?					
Have subgrade drains been constructed if necessary?					

SECTION 303 – AGGREGATE BASE

303.01 GENERAL

This work consists of providing and placing one or more layers of aggregates, and specified additives, on a prepared subgrade or subbase.

303.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Distinguish the pay item included in the contract and the additional requirements when Plant Mixed item is specified
- Proposed source of material and material requirements
- Acceptable tolerances for elevation, smoothness, width and thickness
- Methods and equipment to be used to minimize disturbance or damage to the previous layers
- Subgrade requirements prior to and during construction
- Contractor's schedule/plan for the work

B. Acceptance of Materials

Aggregate base material can come from either an approved source (quarry), or from a non-approved source that will require project qualification.

1. Approved Quarried Material

Confirm the Contractor's proposed material source is listed on the Approved Products List (APL - Aggregates). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. As soon as practical, obtain sufficient samples of the aggregate base material that the Contractor will use to construct the roadway. The Residency Lab will perform applicable tests on these materials to determine:

- Verify the aggregate base material complies with the requirements of Table 703:1 of the Standard Specifications:
  - Gradation - AASHTO T 27
  - Liquid and Plastic Limits - AASHTO T 89 and T 90
- Maximum density and optimum moisture (proctor) - AASHTO T 180, Method D

2. Non-Approved Material (i.e. crushed concrete, on-site produced material, non-approved quarries, etc.)

The qualification process consists of a preliminary visual inspection and aggregate sampling by the Resident Engineer, and then testing by the Materials Division.

The Resident Engineer shall make a visit to the site where the aggregate is located, and make a reasonable effort to verify sufficient material is available to supply the needs of the project and is of reasonable uniformity in regards to quality and appearance (no quality control concerns). Contact the Materials Division if assistance is needed for the preliminary inspection.

If the preliminary visual inspection indicates a sufficient quantity of quality material, the Resident Engineer shall obtain a representative sample of the material for submission to the Materials Division for testing. The sample size must be at least 200 pounds moist and must be submitted at least 20 working days in advance of anticipated use to ensure laboratory testing and evaluation can be completed before any material is delivered to the project and/or incorporated in the work.

The Residency Lab will perform applicable tests on these materials to determine:

- Verify the aggregate base material complies with the requirements of Table 703:1 of the Standard Specifications:
  - Gradation - AASHTO T 27
  - Liquid and Plastic Limits - AASHTO T 89 and T 90
- Maximum density and optimum moisture (proctor) - AASHTO T 180, Method D

C. Preparatory Work and Contractor Work Plans

1. Contract Plans and Specifications

Review the Plan typical sections, specifically noting the allowable lift thickness, total required depth, and cross slope required.

Distinguish the pay item included in the contract and the additional requirements when Plant Mixed item is specified. Review the Standard Specifications, Special Provisions and Plan Notes.

2. Material Requirements

Review the requirements of the material being used and the related tests and acceptance criteria. Depending upon the Type of aggregate base being used the requirements (primarily gradation and density) may change from project to project

Ensure that material source is approved and that other material requirements are met.

3. Equipment

Gather the necessary inspection and sampling equipment. Verify the nuclear density gauge has a current calibration and is operating properly. Be prepared to check density, lift thickness, total depth, and surface tolerance.

4. Subgrade Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of base course material.

Prior to placement of the aggregate base, ensure that the subgrade is not frozen, in accordance with Section 202.04.A(5)(b) of the Standard Specifications.

When required in the plans, ensure that separator fabric and/or geosynthetic reinforcement has been installed in accordance with Sections 325 and 326 of the Standard Specifications and this Manual.

5. Staking

Spot check and verify that width and thickness have been properly staked.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

303.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Ensure that material being delivered to the project is from the same source as previously approved.

Document or perform applicable tests as follows:

- Gradation - AASHTO T 27 [Document in Template T27]

- Liquid and Plastic Limits - AASHTO T 89 and T 90 [Document in Remarks Field]
- Maximum density and optimum moisture (proctor) - AASHTO T 180 [Document in
- Template C95001]
- Compaction of base - AASHTO T 310. [Document in Template C95001].

The Residency will conduct the sampling and testing described above in accordance with the frequency guidelines defined in the Project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be visual appearance, consistency or inconsistency of the material being used, or density variation.

When using an approved quarry, notify Materials Division Aggregate Branch Manager if the material consistently fails to meet gradation or limits requirements.

B. Equipment and Methods

The Contractor's equipment operations must not cause undue segregation of the aggregate base material, and the compacted material must meet the requirements of the contract specifications. Inform the Resident Engineer and notify the Contractor if segregation is suspected. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the Contractor to take corrective action. Notify the Contractor of any equipment or operation that is an apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

1. Mixers

Ensure aggregate base material is properly mixed to a uniform moisture content and is free of any segregation. Conventional on-grade mixing (blending on the roadbed) of the aggregate base material is no longer allowed by the 2019 Standard Specifications for Plant Mixed Aggregate Base. When the pay item for plant mixed aggregate base is specified, the use of a stationary or traveling plant (pugmill, rotary drum or continuous mixer) is required. The intent of using a mixing plant is to ensure the uniformity of the mix and moisture to aid in compaction.

2. Spreaders

During the spreading operation for plant mixed aggregate base, ensure the mixed aggregate base materials are transported to the roadbed and placed using an asphalt lay-down machine, unless otherwise approved by the Resident Engineer. Alternate methods of spreading may be used if plant mixed aggregate base is not specified or when one of the following conditions listed in Section 303.04.D(2) of the Standard Specifications exist:

- plan quantity for aggregate base is less than 2,500 cy

- aggregate base width is too narrow or variable for the use of the spreading equipment
- aggregate base is used for temporary pavement, shoulder, and county road
- aggregate base is place on an untreated subgrade
- aggregate base material is recycled concrete pavement generated within the project

3. Compactors

Unless otherwise specified, ensure the contractor uses the following equipment to achieve uniform density across the base:

- Non-vibratory steel-wheeled roller
- Vibratory compactor
- Pneumatic tired roller
- Tamping type roller
- Any combination of the above equipment.

C. Construction Operations

1. Mixing and Placement

When the aggregate is required to be plant mixed, the acceptable mixing method of the aggregate base materials and water are either using a stationary plant or traveling plant. On-grade mixing method is typically not allowed unless the aggregate base material is produced from recycled concrete pavement generated within the project or in other special circumstances with prior approval in accordance with Section 303.04.C of the Standard Specifications.

When the aggregate is not required to be plant mixed, any of the three mixing methods (stationary plant, traveling plant, or on-grade) referenced in 303.04.C are acceptable.

Prior to placement of the mixed aggregate base material, the subgrade upon which the first course is to be constructed must be thoroughly compacted and shall conform to the required cross-section and grade. Ensure that the subgrade is in compliance with Section 307, 310 or 311 of the Standard Specifications as required by the contract. When required in the plans, ensure that separator fabric and/or geosynthetic reinforcement has been installed in accordance with Sections 325 and 326 of the Standard Specifications and this Manual.

Watering of base courses must be done with care. Excess watering is wasteful, but more importantly, it may result in serious damage to the subgrade and reduce the chances of proper compaction of the aggregate base. This “sponginess” and

resultant movement under wheel loads is usually first noticed as excessive looseness of base materials. Be on the look out for soft spots that may develop in the roadway following rains or excessive watering. If this condition occurs, conduct a thorough investigation and have the Contractor perform corrective measures before paving.

When finishing to blue tops, the machine operator has a tendency to hit right on grade at the blue top, and be high in between. This condition should always be looked for and can be checked quickly by means of a string line. The Contractor should be aware of this and make adjustments or corrections during the grade check.

2. Spreading

During the spreading operation ensure the following in accordance with Section 303.04.D(1) and additionally for plant mixed aggregate base Section 303.04.D(2) of the Standard Specifications:

- The non-plant mixed aggregate base materials are transported to the roadbed and placed using equipment and methods that will not damage the underlying subgrade or separator fabric.
- The plant mixed aggregate base materials are transported to the roadbed and placed using an asphalt lay-down machine, unless otherwise approved by the Resident Engineer or when one of the conditions exist as defined in Section 303.04.D(2) of the Standard Specifications that allows an alternate method.
- Any separator fabric or geosynthetic reinforcement remains intact and free of wrinkles.
- Sufficient moisture content of the aggregate base material is achieved without over saturating the underlying subgrade material.
- The aggregate base material is placed in layers of from 4 in to 8 in compacted thickness.
- The aggregate base material is spread and compacted over the full width of the roadbed before placing a succeeding layer.
- The compacted layers are finished to the grades, elevations, and thicknesses shown on the Plans.
- Any segregated areas are corrected at no additional cost to the Department.
- The longitudinal and transverse joints are staggered at least 1 ft in each succeeding layer.
- When constructing successive layers of aggregate base, disturbance to the surface of the previously placed layer is minimized.
- Any ruts in the previous layer are filled and compacted.
- Placement procedures or equipment are adjusted to ensure compliance with the Contract requirements.

Ensure the Contractor makes adjustments to the equipment and methods if they fail to meet any of these requirements until such time that their process is in compliance with the specification requirements.

3. Compaction

Ensure each layer is compacted to the proper density in accordance with Section 303 of the Standard Specifications:

- Type A Aggregate Base - no less than 98 percent of maximum density
- Types B, C and D Aggregate Base – no less than 95 percent of maximum density

In most cases, pneumatic rollers or vibratory rollers will be used to compact the base material. The most positive means of determining the adequacy of water and compactive effort is by taking density tests. More frequent testing at the beginning of the work will usually pay off by preventing over-watering and over-rolling and by providing the Contractor and Inspector with a "feel" for the material.

During compaction, it is important that the Inspector closely observe the performance of the material. If it compresses and springs back (a condition known as “pumping”) the subgrade has been over-saturated and will require repairs. Any “pumping” areas observed must be repaired prior to paving. It cannot be overemphasized that the Inspector needs to be alert to over watering which can damage the subgrade.

The Type B, C and D aggregate base gradations are intended to provide a drainable aggregate base layer. Caution must be used when compacting these materials to prevent crushing the aggregates. Rolling effort should be kept to the minimum required to achieve density.

If water is required during compaction, ensure it is applied uniformly over the aggregate base to ensure a uniform texture, firmly keyed aggregates, and proper consolidation of layers.

4. Finishing and Tolerances

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the aggregate base is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer will require the Contractor to correct the thickness and rework the material.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base for acceptance.

Thickness measurements shall be made and recorded following final compaction and prior to placing any succeeding courses.

The aggregate base must be cured before applying the prime coat. The cured condition refers to having achieved target density and the base having no free surface moisture that would prevent the prime coat from sticking to the aggregate. The purpose of the prime coat is to maintain optimum moisture and must be applied in accordance with Section 408 of the Standard Specifications.

If the density required by the Contract is achieved, the Department will not consider moisture content as an acceptance criterion.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, ensure the Contractor has prepared any necessary environmental statements for the plant site and any haul roads. Ensure that the best management practices for storm water management are monitored as required (see Section 220 of the Standard Specifications and this Manual).

Haul roads are to be kept to a minimum and must be located in such a manner as to cause the least amount of damage to the natural vegetation. In order to promote the best possible public relations, the owners of all lands traversed should be contacted before actual work on any haul road is started. Fences are not to be cut or gates left open without the owner's permission. Breaks in any right-of-way fences along the Interstate will require prior approval by FHWA. After completion haul roads should be cleaned up, and all damages repaired as required by the specifications and the owner's requirements.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of area of aggregate base placement
- Compaction density
- Receipt of materials certificates, haul tickets, and scale or weigher certification

2. Measurement and Payment

The final quantity for this pay item will be determined by the method defined in Section 303.05 of the Standard Specifications. The volume of the compacted in-place Aggregate Base will be measured by multiplying the completed length of Aggregate Base by the area of the theoretical typical section shown on the Plans.

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below. +

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the quantity (CY) of the item completed, ensuring that the total quantities to date do not exceed the plan quantity.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

303.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Ensure that the "final" density requirement has been satisfied.

Perform applicable tests on these materials to determine:

- Compaction of base: AASHTO T 310. Direct transmission is the preferred method (rod projected into base as opposed to back-scatter mode). [Document in Template C95001].

Ensure that the prime coat has been properly applied.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Check that the surface is satisfactorily maintained until the next course is ready to be placed.

303 CHECKLIST - AGGREGATE BASE

Part 1:Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the pay item in the contract been identified as plant mixed or non-plant mixed aggregate base?					
For the plant mixed pay item, is the contractor aware of the additional equipment and methods requirements associated with this item?					
For the plant mixed pay item, are there any conditions as listed in section 303.04.D(2) that would allow an alternate method of spreading in lieu of an asphalt lay-down machine?					
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted source of materials?					
If material is from an approved quarry, have samples been taken and appropriate tests performed?					
If material is from other than an approved quarry, have samples been taken and submitted to Materials Division?					
Discussed placement procedures with contractor?					
Inspection and sampling equipment gathered? Appropriate proctor entered in the nuclear gauge?					

Part 2:During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the contractor achieving proper mixture of the aggregate base material and water?					
Does contractor have the proper spreading and compacting equipment on the project?					
Is aggregate base being placed uniformly and without segregation?					
Is subgrade and/or geotextile integrity being maintained?					
Have the proper number of quality assurance samples and tests been performed?					
Is the required compaction being achieved without degradation of the aggregate base material?					
Is the aggregate base being finished to the dimensions, slope and elevation tolerances specified?					
Is the aggregate base being properly cured without being allowed to “dry” out?					

Part 3:Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has prime coat been applied properly?					
Have all final densities been taken?					
Have all necessary measurements for length, width and thickness been taken and properly documented?					

Part 3:Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is contractor protecting the base adequately prior to placement of next course?					

SECTION 305 - CALICHE BASE

305.01 GENERAL

This work consists of constructing a base of approved deposits of calcareous and siliceous material constructed on the prepared subgrade.

305.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed source of material and material requirements
- Acceptable tolerances for elevation, smoothness, width and thickness
- Methods to be used to minimize disturbance or damage to the previous layers
- Subgrade requirements prior to and during construction
- Contractor's schedule/plan for the work

B. Acceptance of Materials

The Resident Engineer shall make a visit to the site where the caliche is located, and make a reasonable effort to verify sufficient material is available to supply the needs of the project and is of reasonable uniformity in regards to quality and appearance (no quality control concerns). Contact the Materials Division if assistance is needed for the preliminary inspection.

If the preliminary visual inspection indicates a sufficient quantity of quality material, the Resident Engineer shall obtain sufficient samples of the caliche base material that the Contractor will use to construct the roadway. The Residency Lab will perform applicable tests on these materials to determine:

- Verify the caliche base material complies with the requirements of Section 703.09 of the Standard Specifications:
    - Sample Preparation - OHD L-20
    - Gradation - AASHTO T 27
    - Liquid and Plastic Limits - AASHTO T 89 and T 90
    - Fractured Faces - OHD L-18
- Maximum density and optimum moisture (proctor) - AASHTO T 99

The base material passing a No. 4 sieve may contain fine aggregate made of natural sand, manufactured sand, stone dust, or other finely divided fragments, provided at least 50 percent of this material is a caliche type material.

C. Preparatory Work and Contractor Work Plans

1. Contract Plans and Specifications

Review the Plan typical sections, specifically noting the allowable lift thickness, total required depth, and cross slope required.

Review the Standard Specifications, Special Provisions and Plan Notes.

2. Material Requirements

Review the requirements of the material being used and the related tests and acceptance criteria. Ensure that material source is approved and that other material requirements are met. Ensure that the caliche material is sampled from uniformly blended windrows.

3. Equipment

Gather the necessary inspection and sampling equipment. Verify the nuclear density gauge has a current calibration and is operating properly. Be prepared to check density, lift thickness, total depth, and surface tolerance.

4. Subgrade Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of base course material.

Prior to placement of the caliche base, ensure that the subgrade is not frozen, in accordance with Section 202.04.A(5)(b) of the Standard Specifications.

5. Staking

Spot check and verify that width and thickness have been properly staked.

D. Safety and Environmental Issues

If the Contractor stockpiles caliche, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

305.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Ensure that material being delivered to the project is the same as previously approved.

Document or perform applicable tests as follows:

- Sample Preparation - OHD L-20
- Gradation - AASHTO T 27 [Document in Template T27]
- Liquid and Plastic Limits - AASHTO T 89 and T 90 [Document in Remarks Field]
- Fractured Faces - OHD L-18
- Maximum density and optimum moisture (proctor) - AASHTO T 99 [Document in Template C95001]
- Compaction of base - AASHTO T 310. [Document in Template C95001].

The Residency will conduct the sampling and testing described above in accordance with the frequency guidelines defined in the Project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be visual appearance, consistency or inconsistency of the material being used, or density variation.

B. Equipment and Methods

If the Contractor chooses to blend the caliche material with coarse or fine aggregates from another source, the Contractor's mixing operations must not cause undue segregation of the caliche base material, and the compacted material must meet the requirements of the contract specifications. Inform the Resident Engineer and notify the Contractor if segregation is suspected. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the Contractor to take corrective action. Notify the Contractor of any equipment or operation that is an apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

1. Mixers

Ensure the caliche base material is properly mixed to a uniform moisture content and is free of any segregation. Do not allow the Contractor to exceed the amount that can be uniformly mixed by the equipment on the project during one day's operation. Before mixing is complete, ensure the mixture has uniform moisture for the length of the section being treated to ensure workability and prevent excess wet and dry spots in the finished blend. Using excess water during mixing and placing must be avoided to prevent undue softening of the subgrade.

If the Contractor chooses to blend the caliche material with aggregates from another source, this may be achieved by use of a stationary or traveling plant (pugmill,

rotary drum or continuous mixer) or by on-site mixing (blending on the roadbed). Ensure the blended material passing the No. 4 sieve is at least 50 percent caliche by weight. If material is to be combined and blended on the roadbed, the materials must be weighed, delivered and placed in measured windrows, each in the proper proportions before blending.

2. Spreaders

After the blended windrow has been tested and approved by the Resident Engineer, the caliche base material must be spread uniformly over the length and width of the section, being careful to prevent segregation of the mixture. Ensure that the thickness of each layer of caliche base material does not exceed the compaction equipment's capability to obtain the specified density of at least 100 percent of maximum density, determined in accordance with AASHTO T 99.

3. Compactors

Unless otherwise specified, ensure the contractor uses the following equipment to achieve uniform density across the base:

- Non-vibratory steel-wheeled roller
- Vibratory compactor
- Pneumatic tired roller
- Tamping type roller

Any combination of the above equipment.

C. Construction Operations

1. Placement

Prior to placement of the caliche base material, the subgrade upon which the first course is to be constructed must be thoroughly compacted and shall conform to the required cross-section and grade. Ensure that the subgrade is in compliance with Section 310 or 311 of the Standard Specifications as required by the contract.

Ensure that the thickness of each layer of caliche base material placed does not exceed the compaction equipment's capability to obtain the specified density of at least 100 percent of maximum density, determined in accordance with AASHTO T 99.

Watering of base courses must be done with care. Excess watering is wasteful, but more importantly, it may result in serious damage to the subgrade and reduce the chances of proper compaction of the caliche base. This "sponginess" and resultant movement under wheel loads is usually first noticed as excessive looseness of base materials. Be on the look out for soft spots that may develop in the roadway

following rains or excessive watering. If this condition occurs, conduct a thorough investigation and have the Contractor perform corrective measures before paving.

When finishing to blue tops, the machine operator has a tendency to hit right on grade at the blue top, and be high in between. This condition should always be looked for and can be checked quickly by means of a string line. The Contractor should be aware of this and make adjustments or corrections during the grade check.

2. Compaction

Based on the results of field tests, ensure that the optimum moisture content is attained before compaction. Additional water may be required.

Observe the compaction operation for obvious signs of improper operation. Verify that the target density is being obtained. Pay particular attention to the density obtained near edges and joints.

Ensure that the thickness of each layer of caliche base material does not exceed the compaction equipment's capability to obtain the specified density of at least 100 percent of maximum density, determined in accordance with AASHTO T 99.

In most cases, pneumatic rollers or vibratory rollers will be used to compact the base material. The most positive means of determining the adequacy of water and compactive effort is by taking density tests. More frequent testing at the beginning of the work will usually pay off by preventing over-watering and over-rolling and by providing the Contractor and Inspector with a "feel" for the material.

During compaction, it is important that the Inspector closely observe the performance of the material. If it compresses and springs back (a condition known as "pumping") the subgrade has been over-saturated and will require repairs. Any "pumping" areas observed must be repaired prior to paving. It cannot be overemphasized that the Inspector needs to be alert to over watering which can damage the subgrade.

If water is required during compaction, ensure it is applied uniformly over the caliche base to ensure a uniform texture and proper consolidation of layers.

3. Finishing and Tolerances

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the caliche base is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer will require the Contractor to correct the thickness and rework the material.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base for acceptance.

Thickness measurements shall be made and recorded following final compaction and prior to placing any succeeding courses.

The caliche base must be cured before applying the prime coat. The cured condition refers to having achieved target density and the base is saturated surface dry. The purpose of the prime coat is to maintain optimum moisture and must be applied in accordance with Section 408 of the Standard Specifications.

D. Safety and Environmental Considerations

If the Contractor stockpiles caliche, either on or off site, ensure the Contractor has prepared any necessary environmental statements for the plant site and any haul roads. Ensure that the best management practices for storm water management are monitored as required (see Section 220 of the Standard Specifications and this Manual).

Haul roads are to be kept to a minimum and must be located in such a manner as to cause the least amount of damage to the natural vegetation. In order to promote the best possible public relations, the owners of all lands traversed should be contacted before actual work on any haul road is started. Fences are not to be cut or gates left open without the owner's

permission. After completion haul roads should be cleaned up, and all damages repaired as required by the specifications and the owner's requirements.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of caliche base placement

2. Measurement and Payment

The final quantity for this pay item will be determined by the method defined in Section 305.05 of the Standard Specifications. The volume of the compacted in-place Caliche Base will be measured by multiplying the completed length of Caliche Base by the area of the theoretical typical section shown on the Plans.

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the quantity (CY) of the item completed, ensuring that the total quantities to date do not exceed the plan quantity.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

305.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Ensure that the "final" density and moisture requirements have been satisfied.

Perform applicable tests on these materials to determine:

- Compaction of base: AASHTO T 310. [Document in Template C95001].

Ensure that the prime coat has been properly applied.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Check that the surface is satisfactorily maintained until the next course is ready to be placed.

305 CHECKLIST - CALICHE BASE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted source of materials?					
Is the Contractor proposing to blend materials from different sources?					
Have material samples been taken and appropriate tests performed?					
Discussed placement procedures with contractor?					
Inspection and sampling equipment gathered? Appropriate proctor entered in the nuclear gauge?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does contractor have the proper compaction equipment on the project?					
If the Contractor chose to blend materials from different sources, was the minus No. 4 material a minimum of 50% caliche?					
Is caliche base being placed with uniform moisture content and without segregation?					
Is subgrade integrity being maintained?					
Have the proper number of quality assurance samples and tests been performed?					
Is the required compaction being achieved?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the caliche base being finished to the dimensions, slope and elevation tolerances specified?					
Is the caliche base being properly cured without being allowed to “dry” out?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has prime coat been applied properly?					
Have all final densities been taken?					
Have all necessary measurements for length, width and thickness been taken and properly documented?					
Is contractor protecting the base adequately prior to placement of next course?					

SECTION 307 - SUBGRADE TREATMENT

307.01 GENERAL

This work consists of providing, placing, and compacting one or more layers of a mixture of soil, chemical additives, and water to achieve a stable subgrade. Chemical additives used to stabilize or modify are defined as cementitious additives (portland cement, fly ash, or cement kiln dust) or lime additives.

307.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

The Preconstruction Meeting agenda should include the following topics for subgrade treatment:

- Testing for sulfate content in the subgrade material and water used for mixing
- If sulfates are present, discuss potential mellowing period
- Discuss whether treatment is for stabilization or modification
- The depth of treatment, additive type and percent of additive indicated in the plans
- The Contractor's proposed type and source of chemical additive
- Determination of soil classification of the subgrade material and resulting percent of chemical additive as per charts in OHD L-50 & OHD L-51
- When mix designs are required by the charts in OHD L-50 & OHD L-51, discuss the importance of completing them early by a Department-approved lab (link for "ODOT Qualified Labs" can be found at Laboratory Qualification Policy)
- Extents of varying soil types and whether or not pre-treatment is required
- Acceptable tolerances for elevation, smoothness, width and thickness
- Subgrade requirements prior to and during construction
- Contractor's method, plan and schedule for the work
- Dust control during chemical additive placement and mixing
- Personal safety and environmental protection measures
- Load restrictions and non-payment for overweight vehicles

B. Acceptance of Materials

If the Contract requires chemical subgrade treatment, a soil classification test will be required to determine the appropriate type and percentage of chemical to be used. Once a soil classification is determined, if any visible changes in the soil characteristics become apparent, additional sampling and testing must be done to identify any potential change to the soil classification and resulting change to the appropriate additive application rate.

Care should be taken in the western part of the State to avoid placing chemical additives in sulfate-containing soils. The obvious presence of gypsum is a good indication of sulfate soils. Test the subgrade soils in accordance with OHD L-49 to determine the soluble sulfate content of the soil. In accordance with OHD L-50 & OHD L-51, if the soluble sulfate content is greater than 8,000 ppm, treatment with calcium-based additives is not recommended. Further, if the sulfate content exceeds 1,000 ppm or if gypsum is visible, treatment may not be suitable and Materials Division should be contacted before performing subgrade treatment. And finally, if any soluble sulfate content is greater than 500 ppm, additional samples for soluble sulfate testing should be taken throughout the length represented by the sample to assure the extent and level of the sulfate containing soil.

The Contractor will submit the proposed sources of additives. The Residency will verify that the proposed sources of additives are on the Approved Products List (APL – Hydraulic Cements)(APL - Fly Ash)(APL – Cement Kiln Dust(CKD)). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. If Lime is being used the source will not be on the APL and will be accepted by lab test results in accordance with Section 706 of the Standard Specifications.

The percent of additives may be determined by using the OHD L charts or by mix design.

1. OHD L Charts

As soon as practical, obtain sufficient samples of the materials that the Contractor will use to construct the subgrade. Perform applicable tests on subgrade materials prior to treatment to determine:

- Soil classification: AASHTO M 145.
- Maximum density: AASHTO T 99.

When reporting the maximum density, provide a physical description of the soil to help the inspector determine the proctor to be used when determining the type and percent of additive required for varying soil types that may be encountered.

2. Mix Design

When indicated by the OHD L charts, the mix design will be performed by Materials Division. When the Contractor requests using a different additive or does not wish to wait for Materials Division to perform the required mix design, the mix design must be performed by a laboratory qualified by the Materials Division at no additional cost to the Department.

C. Preparatory Work and Contractor Work Plans

Before work on the subgrade treatment begins, consider the following:

1. Contract Plans and Specifications

Review the Contract, Plans and Specifications. Specifically note the depth of treatment, required cross-sectional tolerance and whether treatment is for the purpose of subgrade stabilization or modification. Check for any changes in the Method of Measurement or Basis of Payment, including whether the cost of the chemical additive is included in the contract unit price of the subgrade treatment.

If the plans require a depth of treatment greater than 8 inches, it will be necessary to place the additive in multiple layers.

If a sulfate potential has been indicated in the Plan notes, a mellowing period may be required.

Lime pretreatment for extents of A-6 or A-7 soils may be necessary to ensure proper treatment with cementitious additives.

2. Material Requirements

Become familiar with the material and processing requirements of the Contract Specifications (e.g., slurry mixing) and the related tests and acceptance criteria. If the lime slurry method is specified in the plans (i.e. urban areas, areas of low to moderate sulfate content, etc.) the Resident Engineer must contact the Pavement Design Engineer before any substitutions are allowed.

3. Contractor Proposed Additive Substitution

If the Contractor proposes the substitution of a cementitious additive not shown on the Plans, a proposal must be submitted to the Resident Engineer for approval. The proposal must include the following:

- The test results performed by a Department-approved laboratory (link for "ODOT Qualified Labs" can be found at Laboratory Qualification Policy);
- The recommended percent of additives; and
- The cost comparison of the planned and proposed additives.

Additive substitution cannot be made prior to the Resident Engineer approval.

4. Load Restrictions

The Department is obligated by state statute (47 O.S. § 14-109) and by policy (ODOT Policy Directive No. D-404-3) to monitor the delivery weights of vehicles supplying materials to our construction projects. The statute states in part that "Except for loads moving under special permits, no department or agency of this state shall pay for any material that exceeds the legal weight limits."

Delivery tickets received on the project and used to support payment for contract items paid by delivery weight, shall contain at a minimum the following information printed on each delivery ticket:

- The maximum gross vehicle weight of the delivery vehicle allowed by statute
- The total gross weight of the delivery vehicle
- The tare weight of the delivery vehicle
- The payload weight of the delivered material

Section 105.13 of the Standard Specifications addresses load restrictions and allows the Contractor to exceed the normal legal load limits within the project limits, but only with the written permission of the Resident Engineer.

Refer to Construction Control Directive No. 20020213 for a detailed explanation of the requirements for overweight deliveries.

5. Equipment

Gather the necessary inspection and sampling equipment. Verify the nuclear density gauge has a current calibration and is operating properly. Be prepared to check density, lift thickness, total depth, and surface tolerance.

Obtain color-sensitive indicator solutions, such as phenolphthalein or thymol blue, to measure the thickness and uniformity of the compacted soil and chemical mixture in accordance with Sections 301.04.A(2) and 307.04.I of the Standard Specifications. These solutions may be obtained from the Materials Division.

6. Application Rate

For the purposes of this Manual, the term "Application Rate" refers to how much additive must be mixed over a given area in order to ensure the required percentage of additive is used. Review and fully understand how to effectively determine and verify additive quantities and the rate of application for the required width and depth of treatment.

Before beginning subgrade treatment, the following information must be determined:

- Dry unit weight (Maximum Density in pounds per cubic foot) of the soil – from the AASHTO T 99 test results performed on the untreated subgrade material
- Soil classification of the subgrade material - AASHTO M 145
- Percent of additive required - from charts in OHD L-50 & OHD L-51 or test results from Department-approved lab (link for "ODOT Qualified Labs" can be found at Laboratory Qualification Policy)
- Depth of treatment (feet) required - shown on the plans
- Width of treatment (feet) - usually the width of the Contractor's equipment

Once these factors have been determined, perform the following steps to ensure the proper application of additive:

(a) Dry Method

- Multiply the dry unit weight of the soil by the percent of additive to calculate the pounds per cubic foot of additive required. (120.00#/CF x 0.06 = 7.20 #/CF)
- Multiply the depth of treatment in feet by the width of treatment in feet by 1 foot to determine the cubic feet of treated subgrade per linear foot of stationing. (0.6667 ft x 12.00 ft x 1.00 ft = 8.00 CF/LF)
- Multiply the pounds per cubic foot of additive by the cubic feet of treated subgrade per linear foot of stationing to determine the pounds per linear foot of additive. (7.20 #/CF x 8.00 CF/LF = 57.60 #/LF)
- Divide the delivered pounds (tons x 2,000) of each load of additive by the pounds per linear foot of additive to determine how far each load should be spread. (20,000# / 57.60 #/LF = 347 LF)
- Mark the beginning station, measure the calculated length and mark the ending station. Ensure that particular load of additive is evenly distributed over the area to be treated before mixing begins

(b) Slurry Method (Lime)

- Multiply the "dry unit weight of the soil" by the "percent of lime" to calculate the "pounds per cubic foot of lime required". (120.00#/CF x 0.06 = 7.20 #/CF)
- Multiply the depth of treatment in feet by the width of treatment in feet by 1 foot to determine the cubic feet of treated subgrade per linear foot of stationing. (0.6667 ft x 12.00 ft x 1.00 ft = 8.00 CF/LF)
- Multiply the pounds per cubic foot of lime by the cubic feet of treated subgrade per linear foot of stationing to determine the pounds per linear foot of lime. (7.20 #/CF x 8.00 CF/LF = 57.60 #/LF)
- Multiply the total weight of each delivered load of slurry by the percent of lime solids by weight established at the time of mixing to determine the delivered pounds of lime. (50,000# x 0.38 = 19,000#)

  Note: Verify that the slurry mixture contains at least 1 ton (2,000#) of lime for every 500 gal of water, and contains a maximum of 40 percent lime.
- Divide the delivered pounds of each load of lime by the pounds per linear foot of lime to determine how far each load should be spread. (19,000# / 57.60 #/LF = 330 LF)
- Mark the beginning station, measure the calculated length and mark the ending station. Ensure that particular load of lime is evenly distributed over the area to be treated before mixing begins

D. Safety and Environmental Issues

1. Become familiar with the hazard potential and first-aid requirements of bodily contact with lime and other chemical additives.

Chemical additives are odorless white, grayish-white or yellow materials. Contact can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract.

Contact can cause severe irritation or burning of eyes, with the potential of permanent damage. Eye protection (goggles preferred) should be worn. Be aware of wind direction and potential for windblown materials. Do not allow the contractor to place chemical additives if the wind blows the additive off the subgrade area. Excessive dust may create a hazard for the traveling public or cause damage to surrounding vehicles.

Extended contact can cause drying and irritation of skin due to the removal of the natural oils. Gloves should be worn when taking samples. Wash skin with plenty of water if you come in contact with these materials.

Prolonged inhalation could cause irritation of the respiratory system. Long-term exposure may cause permanent damage. A dust mask should be worn when taking samples and when wind conditions stir up the materials.

Non-toxic but could cause burning of gastrointestinal tract if swallowed. Be careful to not ingest.

These materials are alkaline and if released into water or moist soil will cause an increase in pH. Do not allow water runoff to carry excess additive or treated subgrade material from the subgrade work area.

2. Become familiar with the hazard potential and first-aid requirements of bodily contact with phenolphthalein and thymol blue indicator solutions.

These two indicator solutions are odorless clear to purplish brown liquids which have been strongly diluted by the Materials Division before being supplied to the Residencies. Contact can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract.

Contact can cause irritation or burning of eyes, with little potential for permanent damage. Eye protection (goggles preferred) should be worn.

Extended contact can cause drying and irritation of skin. Gloves should be worn when testing subgrade. Wash skin with plenty of water if you come in contact with these materials.

Prolonged inhalation could cause irritation of the respiratory system. A dust mask should be worn when testing subgrade.

Non-toxic but could cause burning of gastrointestinal tract if swallowed. Be careful to not ingest.

Neither of these solutions is considered to be an ecological threat. Care should be taken to prevent the release of either of these solutions into storm sewers and ditches which lead to waterways.

Refer to Material Safety Data Sheets (MSDS) for details on these indicator solutions ingredients, physical and chemical characteristics, effect on health, handling precautions, emergency and first aid procedures, etc.

[MSDS - phenolphthalein and MSDS - thymol blue]

307.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

In the western part of the State avoid placing chemical additives in sulfate-containing soils. The obvious presence of gypsum is a good indication of sulfate soils. Test the subgrade soils and water intended for mixing in accordance with OHD L-49 to determine the soluble sulfate content of the soil and water. In accordance with OHD L-50 & OHD L-51, if the soluble sulfate content is greater than 8,000 ppm, treatment with calcium-based additives is not recommended. Further, if the sulfate content exceeds 1,000 ppm or if gypsum is visible, treatment may not be suitable and Materials Division should be contacted before performing subgrade treatment. And finally, if any soluble sulfate content is greater than 500 ppm, additional samples for soluble sulfate testing should be taken throughout the length represented by the sample to assure the extent and level of the sulfate containing soil.

Ensure that material being delivered to the project is the same as previously approved and that the source is on the Approved Products List (APL – Hydraulic Cements)(APL - Fly Ash)(APL – Cement Kiln Dust(CKD)). If Lime is being used the source will not be on the APL and will be accepted by lab test results in accordance with Section 706 of the Standard Specifications. The Residency will collect samples of the lime material and submit them to the Materials Division for testing in accordance with the frequency guidelines defined in the Project's Sampling and Testing Checklist generated by SiteManager. If the available lime index is between 80 and 90 percent, a pay adjustment will be required for acceptance in accordance with Section 307.06 of the Standard Specifications. If the available lime index is below 80 percent, additional lime will need to be added to bring the index up to 90 percent at no additional cost to the Department.

As the Contractor is preparing the subgrade, be observant of any visible changes that could warrant the use of a different proctor, percent of additive or additive type. If any visible changes in the soil characteristics become apparent, additional sampling and testing in accordance with Section 307.02.B of this manual may be necessary.

Ensure that preliminary testing of the subgrade soil-additive mixture is performed to determine the optimum moisture content and maximum density in accordance with

AASHTO T-99. The Contractor may have this testing performed by a Department-approved laboratory (link for "ODOT Qualified Labs" can be found at Laboratory Qualification Policy) at no additional cost to the Department, upon the approval of the Resident Engineer. The results of this testing will be used when determining the field density during the Contractor's initial mixing and compaction operations.

Sample the treated subgrade to determine the maximum density and optimum moisture. For lime treated subgrade, ensure that the material has been allowed to cure for the duration established in Section 307.04.F.(2) of the Standard Specifications. For cementitious treated subgrade, ensure that the treated material is sampled and tested for maximum density and optimum moisture as soon as possible.

Conduct density tests as required to ensure the Contractor's conformance with compaction requirements.

Perform applicable tests on these materials to determine:

- Maximum density and optimum moisture (proctor): AASHTO T 99.
- Compaction of embankment: AASHTO T 310. [Document in Template C95001].

If visible changes occur in the material, perform the following tests:

- Soil classification: AASHTO M 145.
- Maximum density and optimum moisture (proctor): AASHTO T 99 or T 180.
- Compaction of embankment: AASHTO T 310. [Document in Template C95001].
- Soluble sulfate content in soil: OHD L-49.

The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be visual appearance, consistency or inconsistency of the material being used, or density variation.

B. Equipment and Methods

The Contractor's equipment operations must result in the uniform mixing of the chemical additive and the subgrade material to the depth specified in the plans. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the Contractor to take corrective action. Notify the Contractor of any equipment or operation that is an apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

1. Mixers for Lime Slurry

Ensure the contractor does not use compressed air in any of the slurry mixing methods. The lime must be mixed with water into a slurry using one of the following methods to ensure the lime and water slurry is a uniform mixture until spread:

(a) Central Plant

Mixing requirements must be met by using integral paddles, recirculating pumps, or other devices. The slurry distributor truck must be equipped with a recirculating pump or agitator that can keep the lime and water in a uniform mixture until spread.

(b) Transit Mix

Ensure the contractor uses a Department-approved method to weigh or meter the lime from the storage bin into the tank transit mix truck. The tank transit mix truck must be equipped with a recirculating pump or agitator that can maintain a uniform mixing of lime and water while in transit.

2. Spreaders

Dry Method

When placing chemical additives using dry methods of application, ensure the contractor uses approved types of spreading equipment that can distribute the additive uniformly over the subgrade work area.

Lime Slurry Method

When placing lime additive using the slurry method, ensure the contractor uses a distributor truck equipped with a recirculating pump or agitator that can maintain a uniform mixing of lime and water. The slurry must be applied through spray bars under pressure to assure a uniform flow and distribution.

3. Mixers for Subgrade

Ensure the contractor uses a pulver mixer equipped with a spray bar in the mixing chamber that is capable of producing a soil-additive mixture with a moisture content within the specified range. Verify that the mixing procedure uniformly disperses the additive and water through the soil to the depth specified in the plans.

4. Compactors

Unless otherwise specified, ensure the contractor uses the following equipment to achieve uniform density across the base:

- Non-vibratory steel-wheeled roller
- Vibratory compactor
- Pneumatic tired roller
- Tamping type roller
- Any combination of the above equipment.

C. Construction Operations

1. Preparation of the Existing Roadbed

Before beginning any subgrade treatment, ensure that the roadbed is shaped and compacted to the dimensions and elevations shown on the Plans or as directed by the Resident Engineer. The contractor must roll the subgrade and correct any soft areas revealed by this rolling in a manner approved by the Resident Engineer. During this rolling, visually observe areas that exhibit signs of unstable material (pumping subgrade under wheel load, obviously wet or saturated material, etc.). If the subgrade fails to meet density or visual requirements, the Contractor must take corrective actions prior to placement of the additive.

When incorporating chemical additives into a clay soil the Resident Engineer should direct the contractor to scarify and loosen the subgrade material before applying the additive. The contractor will only be allowed to scarify and loosen a length of roadway on which the additive application and mixing can be completed in one day. Ensure that the subgrade material is not loosened below the depth of specified additive treatment.

The Resident Engineer may waive portions of the work if excessive rock is encountered. Excessive rock is defined as subgrade material consisting of at least 25 percent particles with a dimension greater than 2½ in. The contractor should perform exploratory scarifying directed by the Resident Engineer to make an excessive rock determination.

2. Application of Chemical Additive

The forecasted weather conditions should be considered before the contractor schedules the delivery and begins the application of chemical additive. The contractor will only be allowed to apply additives for subgrade stabilization when the air temperature is at least 40° F and rising, and for subgrade modification when the air temperature is at least 33° F and rising. The air temperature should be measured at a location 4 ft above the ground, in the shade, and away from artificial heat. Additives may not be applied if the ground is frozen. Do not allow the contractor to place chemical additives if the wind blows the additive off the subgrade area. Excessive dust may create a hazard for the traveling public or cause damage to surrounding vehicles.

Ensure the contractor is using the same additive type, source, percent of additive and application rate as previously determined in accordance with Sections 307.02.B and 307.02.C.6 of this Manual. Any substitutions the contractor proposes for type of additive must be evaluated in accordance with Section 307.02.C.3 of this Manual.

(a) Cementitious Additive

If the plans require subgrade stabilization or modification, and the soils encountered have a PI greater than 20 (typically an A-6 or A-7 soil), lime pretreatment will be required to lower the PI of this material to below 20 prior to incorporating the cementitious additive. If saturated subgrade is encountered, you may want to consider performing lime pretreatment on these areas. Determine the percent of lime to be used in accordance with OHD L-51, mix the soil in accordance with Section 307.04.F.(2)(a) of the Standard Specifications and allow to cure for 72 hours. Obtain samples of the lime pretreated soil and determine the group classification of this material. The cementitious stabilization process may proceed once the test results indicate the properties of the soil meet an A-1 through A-6 Group Classification.

The contractor must use dry methods of application for placing the cementitious additive on the subgrade. It is critical that the contractor complete the mixing, compacting, and finishing operations on the same day that the additives are placed. Once the cementitious additive becomes wet, the hydration process begins and the treated subgrade must be mixed, compacted and finished before the initial set of the additive occurs. Any additional mixing, compacting or finishing will only damage the structural integrity of the treated subgrade. Therefore, it is critical to complete this operation on the first day and if any additional work is required on the following day, the area should be removed and replaced.

- Do not apply cementitious additive using the slurry method
- Do not allow the additive to become wet before mixing
- Do not place on a wet subgrade
- Do not apply cementitious additives if wind blows the additive off the subgrade work area – any lost additive must be replaced at no additional cost to the Department
- Remove additive exposed to moisture and replace before completion of the first mixing operation, at no additional cost to the Department.

(b) Lime Additive

Ensure the contractor places the lime on an area of subgrade where the first mixing operations can be completed on the same day. Ensure the lime additive is not exposed to open air for more than six hours.

There are two different methods that can be used for the delivery and placement of the lime additive.

(1) Dry Method

When applying lime additive using the dry method, the contractor may use quick lime or hydrated lime. The use of a by-product lime is not allowed.

a. Quick Lime

Quick lime typically comes in the form of small pellets and is delivered in bulk. Ensure the contractor's equipment for spreading the lime is an approved type which is capable of distributing the lime uniformly and at controlled amounts.

b. Hydrated Lime

Hydrated lime typically comes in the form of a powder and is delivered in bags. Hydrated lime may be used for dry-method application when approved by the Resident Engineer, and only under unusual circumstances or when it would be impossible or impractical to use other methods.

(2) Slurry Method

If the lime slurry method is specified in the plans (i.e. urban areas, areas of low to moderate sulfate content, etc.) the Resident Engineer must contact the Pavement Design Engineer before allowing a substitution to the dry method. The slurry method must be performed in accordance with Section 307.03.B.1 of this Manual.

3. Mixing

Ensure the contractor spreads the additive uniformly and at the rate previously determined, and mixes the additive with the subgrade uniformly and continuously. The Contractor must complete the mixing operation during the same day that the additive is applied. Before field mixing begins, ensure that preliminary testing of the subgrade soil-additive mixture is performed to determine the optimum moisture content and maximum density in accordance with AASHTO T-99. The Contractor may have this testing performed by a Department-approved laboratory (link for "ODOT Qualified Labs" can be found at Laboratory Qualification Policy) at no additional cost to the Department, upon the approval of the Resident Engineer. To allow for moisture loss during the mixing process, the contractor should increase the moisture content by from 2 to 5 percentage points above the optimum moisture content for the mixture.

Ensure the Contractor uses a pulver mixer equipped with a spray bar in the mixing chamber and capable of producing a soil-additive mixture with a moisture content

within the specified range. The method of mixing shall be an approved procedure using traveling mixing equipment that uniformly disperses the additive and water throughout the soil materials.

No treated layer shall exceed 8 inches in depth. The Resident Engineer may approve the use of special equipment or methods to vary the mixing depths. If the plans require a depth of more than 8 inches of treated subgrade consider the following:

- For cut sections, remove enough subgrade material to allow for no more than 8 inches of treatment at one time.
- For fill sections, treat the final lifts of embankment to complete the required depth to the typical section shown on the plans allowing for no more than 8 inches of treatment at one time
- Each layer will be completed in accordance with Section 307 of the Standard Specifications before proceeding with the next layer. This includes any mixing, curing, compaction, etc.

In areas designated by the Engineer as excessive rock, the contractor must pulverize and mix in two separate stages. Excessive rock is defined as subgrade material consisting of at least 25 percent particles with a dimension greater than 2½ in. The contractor should perform exploratory scarifying directed by the Resident Engineer to make an excessive rock determination. The particle size requirement may be waived by the Engineer. It is the intent that the completed layer of treated material comply with the Standard Specifications as to uniformity of treatment additive, density, moisture content, and depth insofar as practicable.

(a) Cementitious Treatment

In order to ensure uniform mixing, visually inspect the soil-additive mixture after passing through the pulver mixer. It is critical that all clods in the mixture be reduced in size in accordance with the specifications. It may be necessary to have a 1 ½ inch and ¾ inch sieve on site to visually verify the following gradation requirements (further lab testing may be necessary to confirm on-site observations):

SIEVE SIZE	**PERCENT PASSING**
1 1/2 inch	100
3/4 inch	50 minimum

The gradation and moisture content requirements must be achieved to the depths specified in the plans in a single mixing of the cementitious additive. If gradation or moisture requirements are not met or if incomplete mixing is observed, a second pass with a pulver mixer will be required at the Contractor's expense. If a second pass is necessary, it must be performed

before the initial set of the additive occurs or compaction begins. The Engineer may further require that the Contractor modify the work process to meet the above requirements in a single mixing.

Cementitious additive shall be added and the section shall be repulverized at the correct moisture content to any portion of the work area that the additive has hydrated prior to compaction at the contractor's expense, unless waived by the Engineer.

(b) Lime Treatment

(1) First Mixing

Ensure the soil, lime, and water is mixed to achieve a uniform mixture of material with a maximum diameter of 1½ inches. Water will be added in the first mixing process to ensure proper chemical reaction between the lime and soil. The mixture will be allowed adequate time to cure.

When using hydrated lime, the additive and water may be introduced with the soil simultaneously prior to the mixing. When using quick lime, it is important to mix the additive with the soil prior to introducing the water to minimize harmful exposure of the heat of hydration from the chemical reaction to the workers. Ensure the contractor uses approved means to turn under a significant portion of the quick lime within 2 hours after spreading and before adding water. To initiate hydration, sufficient water must be added within 6 hours after spreading.

When using hydrated lime, allow a curing time of 72 hours at temperatures above 40 °F . When using quick lime, allow a curing time of 48 hours at temperatures above 40 °F. The Resident Engineer may extend the cure time if the temperature falls below 40 °F during the curing period. The Standard Specifications do not require cure time extensions for modification or lime pretreatment.

Ensure the contractor maintains the treated subgrade in a moist condition during the curing period. The treated area should be sealed by lightly rolling the surface to repel water and maintain moisture. If directed by the Resident Engineer, the contractor must rescarify portions of the treatment area and provide additional sprinkling to ensure proper moisture.

(2) Final Mixing

After the specified curing time, ensure uniform mixing by visually inspecting the soil-additive mixture. It is critical that all clods in the mixture be reduced in size in accordance with the specifications. It

may be necessary to have a 1 ½ inch and No. 4 sieve on site to visually verify the following gradation requirements (further lab testing may be necessary to confirm on-site observations):

SIEVE SIZE	PERCENT PASSING
1 1/2 inch	100
No. 4	60 minimum

The gradation and moisture content requirements must be achieved to the depths specified in the plans. If gradation or moisture requirements are not met or if incomplete mixing is observed, a second pass with a pulver mixer will be required at the Contractor's expense. The Engineer may further require that the Contractor modify the work process to meet the above requirements.

(3) Lime Pretreatment

If the plans require subgrade stabilization or modification, and the soils encountered have a PI greater than 20 (typically an A-6 or A-7 soil), lime pretreatment will be required to lower the PI of this material to below 20 prior to incorporating the cementitious additive. If saturated subgrade is encountered, you may want to consider performing lime pretreatment on these areas. Mix the lime pretreatment in a single mixing in accordance with Section 307.03.C.3.b.1 of this Manual.

(4) Compaction

Before beginning compaction, conduct moisture-density tests on roadway samples to verify the target density for the soil-additive mixture. Use the AASHTO T99 test method modified to provide one compacted specimen of the mixture.

Ensure the contractor compacts the soil-additive mixture immediately after final mixing, and completes compaction on the same day as the mixing. Compaction must be completed before an appreciable loss of moisture occurs. Ensure compaction within 2 percentage points of optimum moisture content for the mixture. The Resident Engineer may authorize changes or adjustments in the moisture requirements.

Visually inspect the surface for irregularities, depressions or weak spots, and ensure the contractor scarifies, reshapes, sprinkles, and recompacts with rolling to immediately correct.

Ensure the contractor uniformly compacts the depth of the soil-additive mixture to at least 95 percent of maximum density. Determine field density in accordance with AASHTO T 310.

In excessive rock areas, the Resident Engineer may adjust the requirements for soil-additive mixture uniformity, target density, and optimum moisture. The contractor must provide substantial compliance to the specification requirements in these areas, as approved by the Resident Engineer. The Resident Engineer may waive the density and moisture content requirements and approve compaction by visual observation.

(5) Finishing and Curing

Ensure the contractor compacts the final layer of the treated subgrade to the lines, grades, and typical sections shown on the Plans. The completed section must be finished with a light roller to prevent hairline cracks. Sprinkle the treated subgrade to maintain the moisture content until placing a prime coat seal or succeeding layer. Its critical to maintain the moisture content to ensure that the full benefit of the chemical additive is achieved by proper curing and to reduce the potential for shrinkage cracks.

Prevent the contractor from placing construction loads or operating equipment until the treated subgrade has cured and can withstand the loads without damaging the subgrade. If the subgrade deforms under the construction loads and cannot return back to its original condition, or if it deflects more than 1 inch, allow the subgrade additional curing time before operating equipment on the subgrade.

The Department will not pay for the replacement and refinishing of the treated subgrade if the material loses the required stability, density, or finish before the next course is placed.

(6) Tolerances

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Typically, the contractor will perform a trimming operation upon completion of the curing of the treated subgrade. Ensure that the treated subgrade is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications, and that these

measurements are taken after completion of any trimming operations:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer should contact the Pavement Design Engineer to determine whether the contractor will be required to make corrections or accept it at a reduced cost.
- After completing the final grade, use a color-sensitive indicator solution, such as phenolphthalein or thymol blue, to measure the thickness and uniformity of the compacted soil and chemical mixture. Apply the indicator solution along the side of a small hole excavated to the required depth of

chemical treatment and note the depth and uniformity of the color change.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base for acceptance.

Thickness measurements shall be made and recorded following final trimming and prior to placing any succeeding courses.

The treated subgrade must be cured before applying the prime coat. The cured condition refers to having achieved target density and the base is saturated surface dry. The purpose of the prime coat is to maintain optimum moisture and must be applied in accordance with Section 408 of the Standard Specifications.

D. Safety and Environmental Considerations

1. Become familiar with the hazard potential and first-aid requirements of bodily contact with lime and other chemical additives.

Chemical additives are odorless white, grayish-white or yellow materials. Contact can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract.

Contact can cause severe irritation or burning of eyes, with the potential of permanent damage. Eye protection (goggles preferred) should be worn. Be aware of wind direction and potential for windblown materials. Do not allow the contractor to place chemical additives if the wind blows the additive off the subgrade area. Excessive dust may create a hazard for the traveling public or cause damage to surrounding vehicles.

Extended contact can cause drying and irritation of skin due to the removal of the natural oils. Gloves should be worn when taking samples. Wash skin with plenty of water if you come in contact with these materials.

Prolonged inhalation could cause irritation of the respiratory system. Long-term exposure may cause permanent damage. A dust mask should be worn when taking samples and when wind conditions stir up the materials.

Non-toxic but could cause burning of gastrointestinal tract if swallowed. Be careful to not ingest.

These materials are alkaline and if released into water or moist soil will cause an increase in pH. Do not allow water runoff to carry excess additive or treated subgrade material from the subgrade work area.

2. Become familiar with the hazard potential and first-aid requirements of bodily contact with phenolphthalein and thymol blue indicator solutions.

These two indicator solutions are odorless clear to purplish brown liquids which have been strongly diluted by the Materials Division before being supplied to the Residencies. Contact can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract.

Contact can cause irritation or burning of eyes, with little potential for permanent damage. Eye protection (goggles preferred) should be worn.

Extended contact can cause drying and irritation of skin. Gloves should be worn when testing subgrade. Wash skin with plenty of water if you come in contact with these materials.

Prolonged inhalation could cause irritation of the respiratory system. A dust mask should be worn when testing subgrade.

Non-toxic but could cause burning of gastrointestinal tract if swallowed. Be careful to not ingest.

Neither of these solutions is considered to be an ecological threat. Care should be taken to prevent the release of either of these solutions into storm sewers and ditches which lead to waterways.

Refer to Material Safety Data Sheets (MSDS) for details on these indicator solutions ingredients, physical and chemical characteristics, effect on health, handling precautions, emergency and first aid procedures, etc.

[MSDS - phenolphthalein and MSDS - thymol blue]

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Volume and type of chemical additive applied to subgrade
- Length (station extents) and width of area of treated subgrade
- Receipt of material certificates, equipment certificates, and haul/load tickets

2. Measurement and Payment

When the contract includes pay items 307(J) Modified Subgrade or 307(K) Stabilized Subgrade paid by the SY, the cost of the chemical additives is included in the SY unit price and will not be paid for separately by the Ton.

(a) Ton Unit of Measure Pay Items

Verify that the bagged lime indicates the manufacturer's certified weight. Base payment of lime on the index requirements defined in Section 307.06 of the Standard Specifications.

Documentation of these Ton items will be performed within the SiteManager / Daily Work Reports / Work Items tab.

1. Select the appropriate pay item from the list of contract pay items.
2. When documenting a quantity for progressive payment, enter either a descriptive location or the station-to-station extents, preferably both, in the appropriate fields.
3. In the Placed Quantity field, enter the quantity placed that day.
4. In the Remarks bubble enter the Book/Folder/Envelope # to provide the location of the documentation for the calculations (i.e., ticket audit spreadsheet, truck load tickets, etc.), or explain how the quantity was derived (i.e., number of bags multiplied by the weight per bag, certified truck load weight, etc.).
5. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

(b) Square Yard Unit of Measure Pay Items

Documentation of these Square Yard items will be performed within the SiteManager / Daily Work Reports / Work Items tab.

1. Select the appropriate item from the list of contract pay items.
2. In the appropriate fields, enter both a descriptive location and the station-to-station extents.
3. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.
4. In the Remarks bubble, document the method used for calculating the quantity (i.e., spreadsheet, hand calculations, etc.) for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

5. For additional areas or additional locations, with different dimensions, select the 'New' button to create a new row for the selected pay item.

307.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Ensure that the "final" density and moisture requirements have been satisfied.

Perform applicable tests on these materials to determine:

- Compaction of embankment: AASHTO T 310. [Document in Template C95001].

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Check that the surface is satisfactorily maintained until the next course (e.g., base course) is ready to be placed.

307 CHECKLIST - SUBGRADE TREATMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted source of materials?					
Is the chemical additive on the APL?					
Have material samples been taken and appropriate tests performed (soil classification, sulfate content, etc.)?					
Discussed placement procedures with contractor?					
Has the application rate been calculated based upon the required percentage of additive?					
Inspection and sampling equipment gathered? Appropriate proctor entered in the nuclear gauge?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the Contractor able to place, spread and mix the chemical additive without causing excessive dust?					
Does contractor have the proper mixing and compaction equipment on the project?					
Is subgrade treatment being performed with uniform chemical additive application rate and moisture content?					
Is the Contractor treating the subgrade to the required depth as indicated in the plans and specifications?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proper number of quality assurance samples and tests been performed?					
Is the required compaction being achieved?					
Is the treated subgrade being finished to the dimensions, slope and elevation tolerances specified?					
Is the treated subgrade being properly cured without being allowed to “dry” out?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has prime coat been applied properly?					
Have all final densities been taken?					
Have all necessary measurements for length, width and thickness been taken and properly documented?					
Is contractor protecting the subgrade adequately prior to placement of next course?					

SECTION 310 - SUBGRADE

310.01 GENERAL

This work consists of preparing the existing materials for the immediate construction of subbase, base, pavement, or surface.

310.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Contract requirements for subgrade preparation (Method A or B)
- Location of known existing features, such as utilities, stakes and survey monuments, and other objects designated to remain that could be damaged during construction
- Acceptable tolerances for elevation, smoothness, width and depth
- Subgrade requirements prior to and during construction
- Contractor's method, plan and schedule for the work

B. Acceptance of Materials

1. Method A

None required

2. Method B

As soon as practical, obtain sufficient samples of the in-place materials to be utilized in the construction of the roadway subgrade. Perform applicable tests on these materials to determine:

- Maximum density and optimum moisture (proctor). AASHTO T 99

When reporting the maximum density, provide a physical description of the material/soil to assist the inspector in determining the proctor to be used when measuring roadway compaction.

C. Preparatory Work and Contractor Work Plans

Review the Contract, Plans and Specifications. Specifically note whether Method A or Method B is to be used. Method B will require additional testing and compaction.

Ensure that all earthwork, including installation of drainage structures, within the project section has been substantially completed and stabilized prior to allowing work to begin on the subgrade.

The Contractor is responsible for notifying the utility companies and requesting that the utilities be located prior to commencing work. Operators of underground utilities can be notified by calling the Oklahoma One Call system telephone number (1-800-522-OKIE).

D. Safety and Environmental Issues

If indicated in the contract or required by the onsite conditions, ensure that all erosion and sediment control installations are complete and in accordance with the Plans and Specifications, and that a copy of the ODEQ Authorization to Discharge permit is received by the ODOT Residency from the Contractor before allowing the Contractor to proceed with earth-disturbing operations.

For Subgrade Method B, the Standard Specifications require measurement of in-place field density and soil moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

310.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

1. Method A

None required

2. Method B

During the processing and compaction of the material being used for the subgrade, be observant of any visible changes which could warrant the use of a different proctor or additional sampling and testing of the material. Also be observant of areas that exhibit signs of underground water (springs, seepage, cattails, willows etc.) that could possibly require the installation of underdrain. Contact Materials Division to request a seepage investigation.

Conduct density tests as required to ensure the contractor's conformance with compaction requirements. During construction, visually observe areas that exhibit signs of unstable material (pumping subgrade under wheel load, obviously wet and/or saturated material, etc.). In any instance where the subgrade fails to meet density or visual requirements, the contractor must take corrective actions.

Perform applicable tests on these materials to determine:

- Compaction of subgrade. AASHTO T 310. [Document in Template C95001].

If visible changes occur in the material perform the following tests:

- Maximum density and optimum moisture (proctor). AASHTO T 99.

- Compaction of subgrade. AASHTO T 310. [Document in Template C95001]..

B. Equipment and Methods

Before Subgrade Method B operations begin, there is certain equipment that should be onsite for proper completion of the work. Adequate equipment could include: pulver mixer or disc, grader, water truck, and compaction equipment suitable for the type of soils being used (steel-wheel for granular material and sheep foot for clayey material).

Verify that the contractor provides a water source and watering equipment of sufficient capacity to ensure proper moisture content and compaction of the material being worked.

Contractor should have equipment onsite to properly manipulate and compact the material to achieve uniformity in the material and moisture content. The contractor could use a motor grader, tractor with disc and sheepfoot, etc. to accomplish this.

Generally speaking, subgrade material with enough plasticity index to allow the material to ball up in your fist are best compacted by use of a sheep foot roller in combination with a pneumatic roller. When rolling first begins with the sheep foot roller, you will notice a line in the surface of the subgrade created by the outside edge of the roller drum as it cuts into the material. As proper compaction is achieved by the sheep foot roller, the line marks will no longer be created by the outside edge of the roller drum because the sheep foot roller will have "walked itself out" of the subgrade material, and the roller will be walking on the nubs of the sheep foot such that the outside edges of the roller drum no longer touch or cut a line into the lift being compacted.

Generally speaking, sandy materials with adequate moisture content are best compacted by use of a vibrating flat steel drum roller.

C. Construction Operations

1. General

For subgrade Method A or B every effort should be made to provide a firm, uniform subgrade that will minimize differential settlement. Such settlement will eventually develop under the wheel paths of vehicular traffic. Soft, unstable material must be removed and replaced with suitable material. Such material will cause irregularities to be reflected in the final surface course. Continually check compliance of the cross-section of the subgrade using a hand level, engineer's level, or by other suitable means. The Contractor should not be permitted to place the next layer on the subgrade until its density, cross-section, and grade have been approved by the Engineer.

2. Subgrade Method A for Traffic-Bound Surface Course

Ensure the contractor shapes and crowns the width of the existing roadbed with a blade grader to the grade shown on the Plans. Verify the cross-section has at least a 2 percent crown or as directed by the Resident Engineer.

Visually inspect the subgrade for any unstable soil and exposed rocks larger than 3 inches and ensure that these are removed and replaced with acceptable material. Verify that the subgrade layer is finished to a smooth, uniform surface and this condition is maintained until placement of the next layer.

3. Subgrade Method B for All Other Subbases, Bases, Pavement, or Surface

Ensure the contractor scarifies or processes the subgrade to create uniform moisture to a depth of 8 inches. In rock cuts that cannot be scarified or otherwise processed, the subgrade must be shaped with material in accordance with Section 202.02.B, "Selective Subgrade Topping" of the Standard Specifications, or as directed by the Resident Engineer.

Observe and report areas that are encountered which appear to have insufficient stability or strength to allow for the proper completion of the work. Do not proceed with the construction until the Resident Engineer is notified and has the opportunity to observe the area. Possible corrective actions before proceeding with construction include undercut & replacement of the unstable material, installation of underdrain, chemical treatment of the soil, installation of geo-fabric and aggregate base, etc. If undercut beyond 12 inches is authorized for payment by the Resident Engineer, the inspector must record accurate measurements of the area removed for the basis of payment for this work. If the unstable material is within the top 12 inches of the subgrade or in an embankment placed by the contractor, it will be removed and aerated or replaced at no additional expense to the Department.

Compaction enhances subgrade bearing capacity and performance by reducing shrinkage, swelling and permeability. Verify that the top 8 inches of the subgrade is uniformly compacted to a minimum 95 percent of maximum density and a moisture content within 2 percentage points of optimum, in accordance with AASHTO T 99. It is critical to perform density testing just prior to placing the next layer, because the subgrade will lose its compaction if exposed for any length of time to weather. Mechanical tampers may be used to compact sections of the subgrade inaccessible to rolling equipment.

At times, a small amount of additional material must be added so that the surface can be graded to plan elevation. The existing surface should be scarified before any additional material is placed. This prevents planing and slippage between the two layers. The subgrade should be recompacted according to the requirements of the Specifications.

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the subgrade is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- It is the responsibility of the contractor to ensure the subgrade has been processed to 8 inches. Due to the difficulty of measuring the depth after processing and compaction is completed, there is no need for the inspector to verify that the thickness tolerance has been achieved. While the contractor is processing the subgrade, the inspector can use a probe and tape measure to monitor the depth.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base for acceptance.

D. Safety and Environmental Considerations

If indicated in the contract or required by the onsite conditions, ensure that all erosion and sediment control installations are complete and in accordance with the Plans and Specifications, and that a copy of the ODEQ Authorization to Discharge permit is received by the ODOT Residency from the Contractor before allowing the Contractor to proceed with earth-disturbing operations.

For Subgrade Method B, the Standard Specifications require measurement of in-place field density and soil moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of area of completed subgrade
- Location and removal of any unsuitable material
- Final compaction density

2. Measurement and Payment

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

310.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

1. Method A

None required

2. Method B

Ensure that the "final" density and moisture requirements have been satisfied.

Perform applicable tests on these materials to determine:

- Compaction of subgrade. AASHTO T 310. [Document in Template C95001].

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Verify that the subgrade layer is finished to a smooth, uniform surface and maintain this condition until placement of the succeeding layer. The subgrade will lose its compaction if exposed for any length of time to weather.

If the plans require application of prime coat, ensure the required moisture content is maintained in the completed subgrade. The purpose of the prime coat is to maintain optimum moisture and must be applied in accordance with Section 408 of the Standard Specifications.

310 CHECKLIST – SUBGRADE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Discussed subgrade preparation method to be used (A or B) and requirements of each?					
Have underground utilities been located and protected?					
If required, has the Contractor secured erosion and sediment control ODEQ permits?					
Have all soil samples been taken for preliminary testing for Method B?					
Inspection and sampling equipment gathered? Appropriate proctor entered in the nuclear gauge for Method B?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does contractor have the proper scarifying, grading and compacting equipment on the project?					
Is the material being used free of debris or other unsuitable material?					
Has undercut been authorized and documented?					
Has subgrade been checked for stability?					
Is the Contractor manipulating the subgrade to the required depth as indicated in the plans and specifications for Method B?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Are drainage ditches and other erosion and sediment control measures being adequately maintained?					
Is the subgrade being finished to the dimensions, slope and elevation tolerances specified?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have all necessary final measurements been made and properly documented?					
Have all final densities been taken for Method B?					
Has contractor placed topsoil and permanent erosion control measures?					
If required, has prime coat been applied properly?					
Is contractor protecting the base adequately prior to placement of next course?					

SECTION 311 - PROCESSING EXISTING BASE AND SURFACE

311.01 GENERAL

This work consists of removing, processing, reusing, or disposing of existing aggregate surface course, base course, or asphalt surface.

311.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Contract requirements for method of processing of existing base and surface (A, B, C or D)
- Location of known existing features, such as utilities, stakes and survey monuments, and other objects designated to remain that could be damaged during construction
- Acceptable tolerances for elevation, smoothness, width and depth
- Subgrade requirements prior to and during construction
- Contractor's method, plan and schedule for the work

B. Acceptance of Materials

1. Method A

None required

2. Methods B, C and D

As soon as practical, obtain sufficient samples of the processed materials to be used for subgrade, base courses, shoulders or drives. For Method B sample the combined soil / surface mixture after it has been processed. For Method C and D sample the processed surface material from the windrow.

Perform applicable tests on these materials to determine:

- Maximum density and optimum moisture (proctor). AASHTO T 99

When reporting the maximum density, provide a physical description of the material/soil to assist the inspector in determining the proctor to be used when measuring roadway compaction.

C. Preparatory Work and Contractor Work Plans

Review the Contract, Plans and Specifications. Specifically note whether Method A, B, C or D is to be used. Methods B, C and D will require additional testing and compaction.

Ensure that all earthwork, including installation of drainage structures, within the project section has been substantially completed and stabilized prior to allowing work to begin on the subgrade.

The Contractor is responsible for notifying the utility companies and requesting that the utilities be located prior to commencing work. Operators of underground utilities can be notified by calling the Oklahoma One Call system telephone number (1-800-522-OKIE).

D. Safety and Environmental Issues

If indicated in the contract or required by the onsite conditions, ensure that all erosion and sediment control installations are complete and in accordance with the Plans and Specifications, and that a copy of the ODEQ Authorization to Discharge permit is received by the ODOT Residency from the Contractor before allowing the Contractor to proceed with earth-disturbing operations.

For Methods B, C and D, the Standard Specifications require measurement of in-place field density and soil moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

311.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

1. Method A

None required

2. Methods B, C and D

During the processing and compaction of the material, be observant of any visible changes which could warrant the use of a different proctor or additional sampling and testing of the material. Also be observant of areas that exhibit signs of underground water (springs, seepage, cattails, willows etc.) that could possibly require the installation of underdrain. Contact Materials Division to request a seepage investigation.

Conduct density tests as required to ensure the contractor's conformance with compaction requirements. For Method B test the combined soil / surface mixture after it has been compacted. For Method C and D test the compacted surface material used for the base courses, shoulders or drives.

During construction, visually observe areas that exhibit signs of unstable material (pumping under wheel load, obviously wet and/or saturated material, etc.). In any

instance where the material fails to meet density or visual requirements, the contractor must take corrective actions.

Perform applicable tests on these materials to determine:

- Compaction. AASHTO T 310. [Document in Template C95001].

If visible changes occur in the material perform the following tests:

- Maximum density and optimum moisture (proctor). AASHTO T 99.
- Compaction. AASHTO T 310. [Document in Template C95001]..

B. Equipment and Methods

Before operations begin, there is certain equipment that should be onsite for proper completion of the work. Adequate equipment could include: pulver mixer or disc, grader, water truck, and compaction equipment suitable for the materials encountered.

Verify that the contractor provides a water source and watering equipment of sufficient capacity to ensure proper moisture content and compaction of the material being worked.

Contractor should have equipment onsite to properly manipulate and compact the material to achieve uniformity in the material and moisture content. The contractor could use a motor grader, tractor with disc and sheepfoot, etc. to accomplish this.

When performing Method B, if the material encountered has enough plasticity index to allow the material to ball up in your fist, it is best compacted by use of a sheep foot roller in combination with a pneumatic roller. When rolling first begins with the sheep foot roller, you will notice a line in the surface of the subgrade created by the outside edge of the roller drum as it cuts into the material. As proper compaction is achieved by the sheep foot roller, the line marks will no longer be created by the outside edge of the roller drum because the sheep foot roller will have "walked itself out" of the subgrade material, and the roller will be walking on the nubs of the sheep foot such that the outside edges of the roller drum no longer touch or cut a line into the lift being compacted.

Granular materials (for Methods B, C or D) with adequate moisture content are best compacted by use of a vibrating flat steel drum roller.

C. Construction Operations

1. General

For Method A, B, C or D, ensure the contractor loosens or scarifies the existing aggregate or asphalt to its full depth and width, and that the material is broken into pieces that will pass a 3 inch sieve. The material must be placed in windrows on the subgrade or shoulder. The contractor must take care to avoid contamination of the material due to excess soil or other foreign material. The Department will not pay for the costs of reworking damaged or contaminated material.

For Method B, C or D every effort should be made to provide a firm, uniform layer that will minimize differential settlement. Such settlement will eventually develop under the wheel paths of vehicular traffic. Soft, unstable material must be removed and replaced with suitable material. Such material will cause irregularities to be reflected in the final surface course. Continually check compliance of the cross-section of the subgrade/subbase/base course using a hand level, engineer's level, or by other suitable means. The Contractor should not be permitted to place the next layer until its density, cross-section, and grade have been approved by the Engineer. Ensure the processed material is compacted to at least 95 percent of maximum density, determined in accordance with AASHTO T 99.

2. Method A - For Salvage and Stockpiling

This method is specified when the processed material is to be salvaged and stockpiled.

Ensure the contractor prepares the storage area by removing grass, weeds and other waste before stockpiling the material. The addition of excess amounts of soil or other foreign material which would render the processed material unusable must be prevented. The processed material must be loaded and hauled to storage locations shown on the Plans.

3. Method B, C or D

These methods are specified when the processed material is to be used in the subgrade (B), as a subbase (C) or as a base course, shoulders or drives (D).

Observe and report areas that are encountered which appear to have insufficient stability or strength to allow for the proper completion of the work. Do not proceed with the construction until the Resident Engineer is notified and has the opportunity to observe the area. Possible corrective actions before proceeding with construction include undercut & replacement of the unstable material, installation of underdrain, chemical treatment of the soil, installation of geo-fabric and aggregate base, etc. If undercut beyond 12 inches is authorized for payment by the Resident Engineer, the inspector must record accurate measurements of the area removed for the basis of payment for this work. If the unstable material is within the top 12 inches of the subgrade or in an embankment placed by the contractor, it will be removed and aerated or replaced at no additional expense to the Department.

Compaction enhances bearing capacity and performance by reducing shrinkage, swelling and permeability. Verify that the layer is uniformly compacted to a minimum 95 percent of maximum density and a moisture content within 2 percentage points of optimum, in accordance with AASHTO T 99. It is critical to perform density testing just prior to placing the next layer, because the material will lose its compaction if exposed for any length of time to weather. Mechanical tampers may be used to compact sections inaccessible to rolling equipment.

At times, a small amount of additional material must be added so that the surface can be graded to plan elevation. The existing surface should be scarified before any additional material is placed. This prevents planing and slippage between the two layers. The layer should be recompacted according to the requirements of the Specifications.

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the subgrade/subbase/base course is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- It is the responsibility of the contractor to ensure the material has been processed to the specified depth. Due to the difficulty of measuring the depth after processing and compaction is completed, there is no need for the inspector to verify that the thickness tolerance has been achieved. While the contractor is processing the subgrade/subbase/base course, the inspector can use a probe and tape measure to monitor the depth.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base for acceptance.

Method B - For Use in Subgrade

Ensure the contractor places the processed material in windrows on the shoulder during shaping and conditioning of the subgrade. After the subgrade work is completed, the contractor must spread the processed material uniformly over the width of the section and compact with the subgrade.

If the contractor can demonstrate the ability to effectively pulverize, uniformly combine and compact the full layer of the existing surface material and subgrade, the windrowing of the surface material may not be necessary.

Method C - For Use as Subbase

Ensure the contractor spreads the processed material evenly on the previously shaped, conditioned and compacted subgrade and compact.

Method D - For Use in New Base Courses, Shoulders or Drives

Ensure the contractor places the processed material on the completed subgrade as a base course, shoulder, or drive, or blends this material uniformly with new material for any course. The contractor must obtain approval by the Resident Engineer before using processed material.

D. Safety and Environmental Considerations

If indicated in the contract or required by the onsite conditions, ensure that all erosion and sediment control installations are complete and in accordance with the Plans and Specifications, and that a copy of the ODEQ Authorization to Discharge permit is received by the ODOT Residency from the Contractor before allowing the Contractor to proceed with earth-disturbing operations.

For Methods B, C and D, the Standard Specifications require measurement of in-place field density and soil moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Volume of material salvaged
- Station limits of processed surfaces
- Depth of processing
- Volumes of water

2. Measurement and Payment

The final quantity for this pay item will be determined by the method defined in Section 311.05 of the Standard Specifications. The length of the completed processing of base will be measured along the centerline to the nearest foot as shown on the Plans.

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the quantity (LF) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

311.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

1. Method A

None required

2. Method B, C and D

Ensure that the "final" density and moisture requirements have been satisfied.

Perform applicable tests on these materials to determine:

- Compaction. AASHTO T 310. [Document in Template C95001].

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Verify that the subgrade/subbase/base course layer is finished to a smooth, uniform surface and maintain this condition until placement of the succeeding layer. The layer will lose its compaction if exposed for any length of time to weather.

If the plans require application of prime coat, ensure the required moisture content is maintained in the completed subgrade. The purpose of the prime coat is to maintain optimum moisture and must be applied in accordance with Section 408 of the Standard Specifications.

311 CHECKLIST - PROCESSING EXISTING BASE AND SURFACE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Discussed subgrade/subbase/base course preparation method to be used (A, B, C or D) and requirements of each?					
Have underground utilities been located and protected?					
If required, has the Contractor secured erosion and sediment control ODEQ permits?					
Have all samples of the processed materials been taken for preliminary testing for Methods B, C or D?					
Inspection and sampling equipment gathered? Appropriate proctor entered in the nuclear gauge?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Does contractor have the proper scarifying, grading and compacting equipment on the project?					
Is the material being used free of debris or other unsuitable material?					
Has undercut been authorized and documented?					
Has subgrade/subbase/base course been checked for stability?					
Is the Contractor manipulating the subgrade/subbase/base course to the required depth as indicated in the plans and specifications?					
Are drainage ditches and other erosion and sediment control measures being adequately maintained?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the subgrade/subbase/base course being finished to the dimensions, slope and elevation tolerances specified?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have all necessary final measurements been made?					
Have all final densities been taken for Methods B, C or D?					
Has contractor placed topsoil and permanent erosion control measures?					
If required, has prime coat been applied properly?					
Is contractor protecting the base adequately prior to placement of next course?					
Have all necessary measurements for length and width been taken and properly documented?					

SECTION 317 - CEMENT TREATED BASE

317.01 GENERAL

This work consists of constructing a cement-treated base (CTB) using a soil, aggregate, and cement mixture.

317.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following during the Preconstruction Meeting:

- Proposed source of material and material requirements
- Mix design and verify that the concrete plant has a current certification
- Acceptable tolerances for elevation, smoothness, width and thickness
- Methods to be used to obtain acceptable grade and thickness - GPS alone is not adequate
- Methods to be used to minimize disturbance or damage to the previous layers
- Subgrade requirements prior to and during construction
- Contractor's schedule/plan for the work
- Contract requirements for cement treated base including limitations on construction traffic on CTB (no traffic until reaches compressive strength requirement and no traffic after second application of curing agent
- Requirements for separator fabric to be used, method of placement and method to secure to CTB
- Weather limitations

B. Acceptance of Materials

1. Mix Design

For cement treated base, the Contractor must submit their proposed mix design. The Resident Engineer will approve the mix design in accordance with OHD L-53 and Section 317.04.A of the Standard Specifications. Confirm the Contractor's proposed material sources are listed on the Approved Products List (APL). As soon as practical, the Residency will obtain sufficient samples of aggregates to be utilized and perform applicable tests on these materials.

2. Concrete Plants

The Resident Engineer will inspect and certify the proposed concrete plant in accordance with Section 414.03.A of the Standard Specifications and will submit this information to the Materials Division. If a portable plant is mobilized to the

Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
200 N. E. 21st Street
Oklahoma City, OK 73105
Phone: (405) 521-2677
Fax: (405) 522-0552

In the notice, list the project number and the location and type of plant (concrete).

3. Sources of Materials

The Contractor will submit their proposed sources of materials. The Residency will verify that the proposed sources of materials are on the Approved Products List (APL). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. Verify the APL for the following:

- Cement Treated Base
    - Portland cement (specify type) (APL – Hydraulic Cements)
    - Supplementary Cementitious Materials (specify type) (APL – Fly Ash, Silica Fume, Slag Cement)
    - Option One (Section 703.02 of the Standard Specifications)
        - Coarse aggregate (APL - Aggregates).
        - Fine aggregate (APL - Aggregates).
    - Option Two – Combined Aggregate (Section 703.02 of the Standard Specifications)
        - If this material is recycled concrete pavement, it would not appear on the APL and must be submitted to Materials Division for testing and approval before using on the project. Avoid

deleterious materials (bricks, clay lumps, dirt, etc.). The Contractor may submit the necessary test results on the combined aggregate source along with their mix design. The testing must be performed by an accredited AASHTO re:source and/or CCRL certified (whichever is applicable) laboratory and sent to the Materials Division for review.

- Curing Materials (APL – HC Concrete Curing Agents)
- Separator Fabric (APL – Construction Fabrics)

The contractor must provide a separator fabric in accordance with Section 712.10 of the Standard Specifications. The fabric must meet the requirements of AASHTO M288, Class 1 Degree of Survivability and must weigh at least 15 oz/yd^2. If the fabric is not on the APL, a sample of the proposed fabric and the manufacturer's AASHTO NTPEP test data must be obtained and submitted to Materials Division for testing and approval as soon as possible.

The Residency will verify that the proposed water source is from an approved ODEQ public water source. If not, the Contractor must provide verification that the water source complies with the requirements of Section 701.04 of the Standard Specifications.

C. Preparatory Work and Contractor Work Plans

1. Contract Plans and Specifications

Review the Plan typical sections, specifically noting the allowable lift thickness, total required depth, and cross slope required.

Review the Standard Specifications, Special Provisions and Plan Notes.

2. Material Requirements

Review the requirements of the material being used and the related tests and acceptance criteria. Ensure that material source is approved and that other material requirements are met.

3. Equipment

Gather the necessary inspection and sampling equipment. Verify the nuclear density gauge has a current calibration and is operating properly. Be prepared to check density, lift thickness, total depth, and surface tolerance.

4. Subgrade Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the

subgrade for soft spots, ruts, and grade deficiencies. Unstable subgrade can be detected by proof rolling with typical construction equipment (motor grader, loaded dump truck, water truck, etc.) that provides sufficient wheel load to the subgrade. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of base course material.

Prior to placement of the cement treated base, ensure that the subgrade is not frozen, in accordance with Section 202.04.A(5)(b) of the Standard Specifications.

5. Staking

Spot check and verify that width and thickness have been properly staked. Ensure that the contractor has not used GPS for establishing vertical control. The vertical accuracy provided by GPS is insufficient for this type of work.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

317.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

1. Mix Design

Ensure that the Resident Engineer has approved the mix design in accordance with OHD L-53 and Section 317.04.A of the Standard Specifications. Any changes to the approved mix design, including substitution of material sources, must be approved by the Resident Engineer.

2. Concrete Plants

Ensure that the concrete plant has been certified in accordance with Section 414.03.A of the Standard Specifications.

3. Materials

Ensure that the Contractor has submitted its proposed sources of materials. The Residency will verify that no changes were made from the proposed sources of

materials and that they are still on the APL. If a proposed source is not on the APL, the Resident must contact Materials Division immediately.

Document or perform applicable tests as follows:

- Cement Treated Base:
    - Portland cement (specify type) (APL – Hydraulic Cements) [Document in Template AM5001].
    - Supplementary Cementitious Materials (specify type) (APL – Fly Ash, Silica Fume, Slag Cement) [Document in Template AM5001].
    - Aggregates – sample and test sand equivalent AASHTO T176 [Document in Template C93004]
    - Option One (Section 703.02 of the Standard Specifications)
        - Coarse aggregate (APL - Aggregates) – sample and test for appropriate gradation AASHTO T11 and T27 [Document in Template T27].
        - Fine aggregate (APL - Aggregates) – AASHTO T11 and T27 [Document in Template T27].
    - Option Two (Section 703.02 of the Standard Specifications)
        - Combined aggregate (this material may be a recycled concrete pavement) – sample and test for appropriate gradation AASHTO T11 and T27 [Document in Template T27]. Ensure there are no deleterious materials (bricks, clay lumps, dirt, etc.)
- Curing Materials (APL – HC Concrete Curing Agents) [Document in Template AM5001].
- Separator Fabric (APL – Construction Fabrics) [Document in Template AM5001].

The Residency will verify that the proposed water source is from an approved ODEQ public water source. If not, the Contractor must provide verification that the water source complies with the requirements of Section 701.04 of the Standard Specifications.

The Residency will sample and test fresh cement treated base for the following:

- Maximum density and optimum moisture – OHD L-54 [Document in Template C95001]
- Compaction of base - AASHTO T 310 and OHD L-54. [Document in Template C95001]
- Compressive strength – OHD L-54 [Document in Template C94014]

The Residency will conduct the sampling and testing described above in accordance with the frequency guidelines defined in the Project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or visual appearance (yellow concrete, segregation, etc.).

B. Equipment and Methods

The Contractor's equipment operations must not cause undue segregation of the CTB material, and the compacted material must meet the requirements of the contract specifications. Inform the Resident Engineer and notify the Contractor if segregation is suspected. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the Contractor to take corrective action. Notify the Contractor of any equipment or operation that is an apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

1. Concrete Plants

Ensure CTB material is uniformly mixed and free of any segregation. This must be achieved by use of a stationary plant only, traveling plants will not be allowed. The intent of using a mixing plant is to ensure the uniformity of the mix and to aid in compaction.

2. Spreaders

During the spreading operation ensure the mixed CTB materials are transported to the roadbed and placed using equipment that combines placement to the required line and grade and initial compaction, such as an asphalt lay-down machine.

3. Compactors

If the specified density is not achieved during the placement operation, the required compaction may be achieved by use of a self-propelled non-vibratory steel-wheeled roller. Any other equipment used for compaction (i.e. vibratory compactor, pneumatic tired roller, etc.) may be used if the contractor can illustrate that it can be used successfully without damaging the CTB.

C. Construction Operations

1. Placement

Prior to placement of the mixed CTB material, the subgrade upon which the CTB is to be constructed must be thoroughly compacted and shall conform to the required cross-section and grade. Ensure that the subgrade is in compliance with Section 307, 310 or 311 of the Standard Specifications as required by the contract.

The compacted subgrade must be moistened before placing the CTB unless the subgrade has been primed.

The CTB may only be mixed when the aggregate and subgrade are not frozen, and when the ambient air temperature in the shade is at least 40 °F and rising. Ensure the contractor is prepared to protect the CTB from freezing for 7 days after placement.

Ensure suitable haul vehicles are provided to make certain that the mixture arrives at the point of deposit without excessive moisture loss or segregation. Covers shall be provided when deemed necessary by the Resident Engineer. The spreading equipment should be ready to receive and lay the mixture as rapidly as possible.

Ensure the contractor places the CTB to the required elevation and thickness. It is not permissible to raise the CTB by placing another layer of mixture on previously compacted CTB, because additional layers will not adhere and will form planes of weakness. If the compacted surface requires trimming, the trimmed surface must be sealed with an approved mortar slurry mixture.

2. Spreading

During the spreading operation ensure the following:

- The mixed CTB materials are transported to the roadbed and placed using equipment that combines placement to the required line and grade and initial compaction, such as an asphalt lay-down machine.
- The CTB material is placed in a single layer of compacted thickness.
- The compacted layer is finished to the grades, elevations, and thicknesses shown on the Plans.
- Any segregated areas are corrected at no additional cost to the Department.
- Longitudinal joints shall be butt or sawed and must match the longitudinal joint between the driving lanes of the overlying pavement. Any other longitudinal joints must be within 3 ft of the longitudinal joint of the overlying pavement.
- Transverse construction joints must be butt joints.
- Placement procedures or equipment are adjusted to ensure compliance with the Contract requirements.

3. Compaction

Ensure the CTB is compacted within 2 hours of adding water to the aggregate and cement. The CTB must be compacted to at least 95 percent of the maximum density as determined in accordance with OHD L-54.

The initial compaction achieved during the spreading of the CTB is critical to achieving the required density. The use of an asphalt paving machine equipped with a vibratory screed has proven to be the most effective equipment for this

operation. Limited success has been achieved using conventional concrete paving equipment and self-propelled non-vibratory steel-wheeled rollers.

The most positive means of determining the adequacy of the compactive effort is by taking nuclear density tests. More frequent testing at the beginning of the work will usually pay off by preventing under-rolling and by providing the Contractor and Inspector with a "feel" for the material.

4. Finishing and Tolerances

The surface of the CTB must be kept moist during finishing operations and until the application of the curing agent.

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the CTB is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer should contact the Pavement Design Engineer.

Ensure the contractor places the CTB to the required elevation and thickness. It is not permissible to raise the CTB by placing another layer of mixture on previously compacted CTB, because additional layers will not

adhere and will form planes of weakness. If the compacted surface requires trimming, the trimmed surface must be sealed with an approved mortar slurry mixture.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base in conjunction with survey checks before/after the base is placed. The subgrade and the finished elevation of the base should be within tolerance as specified in 301.04.A. (If the base elevation is low, then the difference will likely be made up with a thicker concrete pavement on top of it. And if the base elevation is high and the resulting concrete pavement Is thin, the pay deduction would result.) If there is reason to believe there might be a problem with the thickness of the base, a test pit requiring excavation of the plastic material by use of auger, pick, chisel and/or shovel may be used for confirmation of the thickness.

Survey checks before/after the base is placed or thickness measurements shall be made and recorded following final compaction, trimming (if required) and prior to placing any succeeding courses.

5. Curing and Bond Breaker

Ensure the contractor keeps the CTB surface moist during finishing operations and until the application of the curing agent (liquid membrane curing compound in accordance with Section 701.07.C of the Standard Specifications). A curing agent must be applied on the finished CTB surface at the rate of at least 1 gal per 150 ft^2. If for any reason the curing agent cannot be applied immediately, the surface must be kept damp by frequent applications of a fine spray of water until the curing agent is applied. A damp surface, but without any free standing water, is desirable at the time of applying the curing agent. Ensure the contractor protects the CTB from freezing for 7 days after placement.

Before placing the overlying pavement, ensure the contractor sweeps the CTB surface. A 15 oz/yd^2 separator fabric will be installed on top of the completed CTB to act as a bond breaker between the CTB and the overlying pavement. A properly installed bond breaker will reduce stresses and cracking in the pavement. Ensure the contractor places and secures the separator fabric onto the surface of the CTB in such a manner that the fabric remains free of wrinkles and cracks. The fabric must be overlapped at least 8 inches both longitudinally and transversely. The fabric is typically secured by nailing into the CTB, but the contractor may choose to use asphalt cement (bituminous binder).

Limit construction traffic on the CTB to that necessary to apply separator fabric and overlying pavement. Do not allow the CTB layer to be used as a haul road. Allow only concrete delivery trucks necessary to deposit fresh concrete directly in front of the paver. The overlying pavement may not be placed on the CTB until after compressive strengths reach at least 600 psi in accordance with OHD L-53. Any damage to the CTB must be repaired at no additional cost to the Department.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, ensure the Contractor has prepared any necessary environmental statements for the plant site and any haul roads. Ensure the contractor properly disposes of waste materials. Do not allow the Contractor to place CTB or other materials in streams or waterways.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of area of completed cement treated base
- Final base course thickness

2. Measurement and Payment

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Cement Treated Base (CTB) pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

If out of tolerance compressive strength for cement treated base is produced and identified by the Residency, payment will be made under the original contract item, and a deduction will be applied in accordance with Section 317.06 of the Standard Specifications. These deductions will be documented in SiteManager by Line Item Adjustment or by change order. The calculations for these deductions will be

placed in a Book, Folder or Envelope, and as an attachment to the Line Item Adjustment or change order.

317.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Ensure that the "final" density and compressive strength requirements have been satisfied.

Perform applicable tests on these materials to determine:

- Compaction of base: AASHTO T 310 and OHD L-54. [Document in Template C95001].
- Compressive strength – OHD L-54 [Document in Template C94014]

Ensure that the separator fabric has been properly applied.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

If deductions have been made for out of tolerance compressive strength, ensure that the associated Line Item Adjustment in SiteManager or change order has been properly calculated, documented and assessed.

C. Protection of the Work

Limit construction traffic on the CTB to that necessary to apply separator fabric and overlying pavement. Do not allow the CTB layer to be used as a haul road. Allow only concrete delivery trucks necessary to deposit fresh concrete directly in front of the paver. The overlying pavement may not be placed on the CTB until after compressive strengths reach at least 600 psi in accordance with OHD L-53. Any damage to the CTB must be repaired at no additional cost to the Department.

The strength of CTB should be kept within designated strength limits. CTB with strengths higher than specified develop wider shrinkage cracks, and the cracks are usually reflected through any pavement that is placed immediately over it. If higher strengths are being observed, inspect the CTB surface for areas with excessive shrinkage cracks. These extents should be corrected before placing any overlying pavement. CTB that is too weak may not have the necessary load carrying ability.

317 CHECKLIST - CEMENT TREATED BASE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted mix design and sources of materials?					
The Resident Engineer has inspected and certified the Contractor's proposed concrete plant.					
Portable plants have been properly permitted and inspected, as applicable.					
If material is from an approved quarry, have samples been taken and appropriate tests performed?					
If material is from other than an approved quarry, have samples been taken and submitted to Materials Division?					
Discussed placement procedures with contractor?					
Inspection and sampling equipment gathered? Appropriate proctor entered in the nuclear gauge?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is ambient temperature 40 degrees F and rising?					
Is the contractor achieving proper mixture of the CTB material?					
Does contractor have the proper spreading and compacting equipment on the project?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is CTB being placed uniformly and without segregation?					
Have the proper number of quality assurance samples and tests been performed?					
Is the required compaction being achieved?					
Is the CTB being finished to the dimensions, slope and elevation tolerances specified?					
Is the curing agent being applied at the proper rate before the CTB is allowed to "dry" out?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has CTB been used as a haul road?					
Has separator fabric been applied and secured properly? (No wrinkles or gaps)					
Have all final densities been taken and properly documented?					
Have all necessary measurements for length, width and thickness been taken and properly documented?					
Is contractor protecting the CTB adequately prior to placement of the overlying pavement?					
Compressive strength meets specified requirements?					
Have pay adjustments been applied for compressive strengths outside the 600 to 2,000 psi range in accordance with Section 317.06 of the Standard Specifications?					

SECTION 318 - ECONOCRETE BASE

318.01 GENERAL

This work consists of the construction of an econocrete base.

318.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

The Preconstruction Meeting agenda should include the following topics for econocrete base:

- Subgrade requirements prior to and during construction
- Proposed sources of material and material requirements
- Mix design (refer to Section 318.04 of the Standard Specifications) and verify that the concrete plant has a current certification.
- Agree on weather parameters that will be used for "go" or "no-go" decisions both prior to and during the placement activity. The Inspector must be present for all econocrete pours.
- Method and frequency of acceptance testing during any placement. Inform the Contractor what is expected if non-acceptable material is found during placement.
- Placement method and any adjustments that may be required.
- The double application of the curing agent, application rates, curing time, and the determination of "curing days" during cold weather construction.
- Acceptable tolerances for elevation, smoothness, width and thickness.
- Methods to be used to obtain acceptable grade and thickness - GPS alone is not adequate
- Methods to be used to minimize disturbance or damage to the previous layers
- Contractor's schedule/plan for the work
- Contract requirements for econocrete base including limitations on construction traffic on econocrete base (no traffic until reaches compressive strength requirement and no traffic after second application of curing agent.

B. Acceptance of Materials

1. Mix Design

For econocrete base, the Contractor must submit their proposed mix design at least 40 days before placement. The Resident Engineer will approve the mix design in accordance with Section 318.04 of the Standard Specifications. As soon as practical, the Residency will obtain sufficient samples of aggregates to be utilized and perform applicable tests on these materials.

2. Concrete Plants

The Resident Engineer will inspect and certify the proposed concrete plant in accordance with Section 414.03.A of the Standard Specifications and will submit this information to the Materials Division. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
200 N. E. 21st Street
Oklahoma City, OK 73105
Phone: (405) 521-2677
Fax: (405) 522-0552

In the notice, list the project number and the location and type of plant (concrete).

3. Sources of Materials

The Contractor will submit the proposed sources of materials. The Residency will verify that the proposed sources of materials are on the Approved Products List (APL). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. Verify the APL for the following:

- Econocrete
    - Portland cement (specify type) (APL – Hydraulic Cements)
    - Supplementary Cementitious Materials (specify type) (APL – Fly Ash, Silica Fume, Slag Cement)
    - Option One (Section 703.02 of the Standard Specifications)
        - Coarse aggregate (APL - Aggregates).
        - Fine aggregate (APL - Aggregates).

- Option Two (Section 703.02 of the Standard Specifications)
  - Combined aggregate – if this material is recycled concrete pavement, it would not appear on the APL and must be submitted to Materials Division for testing and approval before using on the project. Avoid deleterious materials (bricks, clay lumps, dirt, etc.)
- Admixtures (specify type) (APL – HC Concrete Admixtures, Liquid)

- Curing Materials (APL – HC Concrete Curing Agents)

The Residency will verify that the proposed water source is from an approved ODEQ public water source. If not, the Contractor must provide verification that the water source complies with the requirements of Section 701.04 of the Standard Specifications.

C. Preparatory Work and Contractor Work Plans

1. Contract Plans and Specifications

Review the Plan typical sections, specifically noting the allowable lift thickness, total required depth, and cross slope required. Review the Standard Specifications, Special Provisions and Plan Notes.

2. Mix Design

Review the mix design submitted by the Contractor to ensure conformance with the Contract. Ensure that the Contractor has obtained an approved mix design. Be aware of the requirements for slump, air, and admixtures, including type and quantity. Mix designs must comply with Section 318.04 of the Standard Specifications. Ensure that fly ash is not used in the mix design when placing econocrete from November 1 to April 1.

3. Material Requirements

Review the requirements of the material being used and the related tests and acceptance criteria. Ensure that material source is approved and that other material requirements are met.

4. Equipment

Gather the necessary inspection and sampling equipment. Be prepared to make cylinders, check lift thickness, total depth, and surface tolerance.

5. Weather Considerations

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

Contractor is adequately prepared to protect fresh econocrete from damage due to inclement weather (e.g., rain storms, freezing).

6. Subgrade Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade is prepared within allowable tolerance to properly receive the required thickness of base course material.

Prior to placement of the cement treated base, ensure that the subgrade is not frozen, in accordance with Section 202.04.A(5)(b) of the Standard Specifications.

7. Staking

Spot check and verify that width and thickness have been properly staked. Ensure that the contractor has not used GPS for establishing vertical control. The vertical accuracy provided by GPS is insufficient for this type of work.

D. Safety and Environmental Issues

Discuss with the Contractor their plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction
- Providing skin and eye protection for workers
- Properly disposing of waste econocrete or materials. (Do not allow the Contractor to place econocrete or other materials in proximity of streams or waterways.)

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads.

318.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

1. Mix Design

Ensure that the Resident Engineer has approved the econocrete mix design in accordance with Section 318.04 of the Standard Specifications. Any changes to the approved mix design, including substitution of material sources, must be approved by the Resident Engineer.

2. Concrete Plants

Ensure that the concrete plant has been certified in accordance with Section 414.03.A of the Standard Specifications.

3. Materials

Ensure that the Contractor has submitted the proposed sources of materials. The Residency will verify that no changes were made from the proposed sources of materials and that they are still on the Approved Products List (APL). If a proposed source is not on the APL, the Resident must contact Materials Division immediately.

Document or perform applicable tests as follows:

- Econocrete:
    - Portland cement (specify type) (APL – Hydraulic Cements) [Document in Template AM5001].
    - Supplementary Cementitious Materials (specify type) (APL – Fly Ash, Silica Fume, Slag Cement) [Document in Template AM5001].
    - Admixtures (specify type) (APL – HC Concrete Admixtures, Liquid) [Document in Template AM5001].
    - Aggregates – sample and test sand equivalent AASHTO T176 [Document in Template C93004]
    - Option One (Section 703.02 of the Standard Specifications)
        - Coarse aggregate (APL - Aggregates) – sample and test for appropriate gradation AASHTO T11 and T27 [Document in Template T27].
        - Fine aggregate (APL - Aggregates) – AASHTO T11 and T27 [Document in Template T27].
    - Option Two (Section 703.02 of the Standard Specifications)
        - Combined aggregate (this material may be a recycled concrete pavement) – sample and test for appropriate gradation AASHTO T11 and T27 [Document in Template T27]. Ensure there are no deleterious materials (bricks, clay lumps, dirt, etc.)
    - Curing Materials (APL – HC Concrete Curing Agents) [Document in Template AM5001].

The Residency will verify that the proposed water source is from an approved ODEQ public water source. If not, the Contractor must provide verification that the water source complies with the requirements of Section 701.04 of the Standard Specifications.

The Residency will sample and test fresh econocrete for the following:

- Slump: AASHTO T119 [Document in Template C94025]
- Temperature : AASHTO T309 [Document in Template C94025]
- Air Content: AASHTO T152 or T196 [Document in Template C94025]
- Compressive strength: AASHTO T22 and T231 [Document in Template C94014]

The Residency will conduct the sampling and testing described above in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or visual appearance (yellow concrete, segregation, etc.).

B. Equipment and Methods

1. Plants and Equipment

Ensure the batching plant includes bins, weighing hoppers, and scales for each size of fine and coarse aggregate. If the contractor is using cement in bulk, ensure that the plant includes a bin, hopper, and separate scale for the cement. Ensure that all gauges and dials function properly. The contractor must provide the Department documented evidence that the batching plant produces quality econocrete or concrete. Ensure the mixing plant meets the requirements of AASHTO M 157, "Concrete Uniformity Requirements." It is the Residency's responsibility to inspect the plants every six months or after every move. Inspection of the plant by another Residency is acceptable if less than six months old. The contractor must provide the Residency with certification of the plant's scales every six months or after every move.

2. Placing and Finishing Equipment

Ensure the contractor provides a slip form paver or fixed form method to spread, strike-off, and finish econocrete.

(a) Slip Form Paver

If the contractor provides a slip form paver, it must be able to spread, consolidate, screed, and float-finish the econocrete in one pass of the machine, to minimize hand-finishing. The paver must be equipped with vibrating tubes or arms working in the econocrete, or with a vibrating screed or pan operating on the surface. Ensure the machine vibrates for the full width and depth of the econocrete. The minimum frequency ratings for different types of vibrators may be found in Table 414:1 of the Standard Specifications. If the contractor uses spud vibrators, ensure that they do not come into contact with the subgrade or side forms.

(b) Fixed Form Method

- **Finishing Machine**

If the contractor chooses to use the fixed form method, ensure that the finishing machine is equipped with at least two oscillating-type transverse screeds for finishing the surface of the econocrete to the tolerances required by Section 301.04.A of the Standard Specifications. Ensure the econocrete is properly vibrated for the full width and depth prior to finishing. The minimum frequency ratings for different types of vibrators may be found in Table 414:1 of the Standard Specifications. If the contractor uses spud vibrators, ensure that they do not come into contact with the subgrade or side forms.

- **Vibrating or Rotary Strike-Off Screeds**

The contractor may use vibrating or rotary strike-off screeds to construct radii, inlet basins, gore areas, lane tapers, intersection quadrants, and areas inaccessible to mainline paving equipment. The Resident Engineer will not allow segregation or grout buildup. To achieve thorough consolidation and uniformity of the pavement, ensure the spud-type hand operated vibrators have a frequency rating of at least 3,500 impulses per minute.

- **Forms**

The contractor must provide metal straight-side forms with thicknesses of at least 7/32 inch and lengths of at least 10 feet. Forms must be equal to the thickness of the econocrete shown on the plans and capable of supporting equipment operating on the forms. For curves with a radius of 100 feet or less, the contractor should use flexible or curved forms with devices (pins) for secure settings capable of withstanding equipment impact and vibration.

(c) Floats

Ensure the contractor provides a mechanical or hand operated float to smooth the econocrete after strike-off and consolidation. The trowel blade of hand-operated floats must be rigid, straightedged, from 12 to 18 feet long, and 8 to 12 inches wide. Ensure the float is capable of working longitudinally or transversely. The contractor may use a finishing machine with the float pan type finisher in place of a mechanical or hand-operated float if this method obtains the surface tolerances required by the Contract.

(d) Hand Tools

Ensure the contractor provides work bridges, 10 foot straightedges, and other hand tools to complete the pavement as required by the contract. Warped floats or straightedges and defective finishing tools should be replaced.

(e) Spraying Equipment

The contractor must provide fully atomizing equipment to apply the white-pigmented curing membrane. Ensure it is equipped with a tank agitator that will keep the compound mixed. The inspector must be able to verify the application rate based on tank capacity. Pressurized tank hand sprayers should be used to apply the curing membrane to vertical surfaces, irregular areas, or edges after form removal.

C. Construction Operations

1. Placement

Prior to placement of the mixed econocrete material, the subgrade upon which the econocrete is to be constructed must be thoroughly compacted and shall conform to the required cross-section and grade. Ensure that the subgrade is in compliance with Section 307, 310 or 311 of the Standard Specifications as required by the contract. The compacted subgrade must be moistened before placing the econocrete unless the subgrade has been primed.

Ensure the temperature of the mixed econocrete is from 50 °F to 90 °F during mixing, delivery, and placement. The contractor must protect the econocrete quality through all weather conditions. The econocrete may only be mixed when the aggregate and subgrade are not frozen.

Ensure the contractor places the econocrete to the required elevation and thickness. It is not permissible to raise the econocrete by placing another layer of mixture on previously placed econocrete, because additional layers will not adhere and will form planes of weakness. If the surface requires trimming, the trimmed surface must be sealed with an approved mortar slurry mixture.

When placing econocrete on the grade, ensure the contractor minimizes rehandling. If the contractor uses a spreading device, the econocrete should be discharged into a spreading device and mechanically spread onto the grade to prevent segregation. The contractor should use truck mixers, truck agitators, or non-agitating hauling equipment capable of discharging econocrete without segregation. The econocrete must be spread with appropriate tools; do not allow the use of handheld vibrators to spread econocrete. If the contractor is using a slip-form paver, ensure continuous forward movement. The contractor must coordinate mixing, delivering, and spreading operations to provide uniform progress, while minimizing stopping and starting. Ensure that vibratory and tamping elements are stopped if the forward

movement of the paver stops. The econocrete must be consolidated against the grade and face of the forms. The contractor should minimize the operation of vibrators in a single location to that required for consolidation. The contractor may not place econocrete without an inspector present, unless otherwise approved by the Resident Engineer.

Do not allow the contractor to place longitudinal or transverse joints in the econocrete base except for butt joints used for construction joints.

Any segregated areas will be corrected at no additional cost to the Department.

2. Finishing and Tolerances

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance. It is critical that the surface of the econocrete is smooth to prevent interlock and bonding with the overlying concrete pavement.

Ensure that the econocrete is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.

- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer should contact the Pavement Design Engineer.

Ensure the contractor places the econocrete to the required elevation and thickness. It is not permissible to raise the econocrete by placing another layer of mixture on previously placed econocrete, because additional layers will not adhere and will form planes of weakness. If the surface requires trimming, the trimmed surface must be sealed with an approved mortar slurry mixture.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base in conjunction with survey checks before/after the base is placed. The subgrade and the finished elevation of the base should be within tolerance as specified in 301.04.A. (If the base elevation is low, then the difference will likely be made up with a thicker concrete pavement on top of it. And if the base elevation is high and the resulting concrete pavement Is thin, the pay deduction would result.) If there is reason to believe there might be a problem with the thickness of the base, a test pit requiring excavation of the plastic material by use of auger, pick, chisel and/or shovel may be used for confirmation of the thickness.

Survey checks before/after the base is placed or thickness measurements shall be made and recorded following final compaction, trimming (if required) and prior to placing any succeeding courses.

3. Curing and Bond Breaker

Ensure the contractor keeps the econocrete surface moist during finishing operations and until the application of the curing agent (liquid membrane curing compound in accordance with Section 701.07.C of the Standard Specifications). A curing agent must be applied on the finished econocrete surface at the rate of at least 1 gallon per 150 ft^2, and allow it to cure for 7 days. A curing day is a period of 24 hours during which the ambient air temperature remains at least 40 °F. The curing time count begins when the econocrete base construction is complete for the day and after the curing agent is applied. If for any reason the curing agent cannot be applied immediately, the surface must be kept damp by frequent applications of a fine spray of water until the curing agent is applied. A damp surface, but without any free standing water, is desirable at the time of applying the curing agent.

Ensure the contractor maintains the quality and strength of the econocrete during cold weather. The contractor must replace any frost-damaged econocrete at no additional cost to the Department.

Construction traffic or the placement of overlying pavements will not be allowed on the econocrete base until the compressive strengths of test cylinders made during the base placement reach at least 500 psi. Construction traffic on the base should be limited and do not allow the base to be used as a haul road. Any damage to the econocrete base will be repaired by the contractor at no additional cost to the Department.

From 12 to 48 hours before placing reinforcing steel or dowel baskets for the overlying pavement, the contractor must sweep the econocrete base and make a second application of curing agent at a rate of at least 1 gallon per 100 ft^2. The purpose of this second application is to create a slip plane between the econocrete and the overlying pavement, and will reduce stresses and cracking in the pavement. So it is critical that the second application of curing compound is not placed more than 48 hours in advance of the paving operation, it is applied at least at the minimum rate and traffic is not allowed on the econocrete base after its application.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, ensure the Contractor has prepared any necessary environmental statements for the plant site and any haul roads. Ensure the contractor properly disposes of waste materials. Do not allow the Contractor to place econocrete or other materials in streams or waterways.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of area of completed econocrete base
- Application of curing agent
- Weather conditions

2. Measurement and Payment

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Econocrete Base pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the ‘New’ button to create a new row for the selected pay item.

318.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

Ensure that the specified 28-day compressive strength and proper thickness has been achieved.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Do not allow any construction traffic or placement of the overlying pavement on the econocrete base until the compressive strengths of test cylinders made during the base placement reach at least 500 psi. Do not allow the econocrete base layer to be used as a haul road. Any damage to the econocrete base must be repaired at no additional cost to the Department.

From 12 to 48 hours before placing reinforcing steel or dowel baskets for the overlying pavement, the contractor must sweep the econocrete base and make a second application of curing agent at a rate of at least 1 gallon per 100 ft^2. The purpose of this second application is to create a slip plane between the econocrete and the overlying pavement, and will reduce stresses and cracking in the pavement. So it is critical that the second application of curing compound is not placed more than 48 hours in advance of the paving operation, it is applied at least at the minimum rate and traffic is not allowed on the econocrete base after its application.

318 CHECKLIST - ECONOCRETE BASE

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted mix design and sources of materials?					
The Resident Engineer has inspected and certified the Contractor's proposed concrete plant.					
Portable plants have been properly permitted and inspected, as applicable.					
If material is from an approved quarry, have samples been taken and appropriate tests performed?					
If material is from other than an approved quarry, have samples been taken and submitted to Materials Division?					
Have placement procedures been discussed with contractor?					
Has the proper inspection and sampling equipment been gathered?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the temperature of the econocrete mix between 50 and 90 degrees F?					
Does contractor have the proper placing and paving equipment on the project?					
Is the econocrete base being placed uniformly and without segregation?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Have the proper number of quality assurance samples and tests been performed?					
Is the econocrete being finished to the dimensions, slope and elevation tolerances specified?					
Is the curing agent being applied at the proper rate before the econocrete is allowed to "dry" out?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Was the econocrete allowed to cure seven days and reach 500 psi prior to allowing construction traffic or beginning paving?					
Has the second application of curing compound been applied properly within 12 to 48 hours prior to paving?					
Is contractor protecting the econocrete base adequately prior to placement of the overlying pavement?					
Has the econocrete base been used as a haul road?					
Have all necessary measurements for length, width and thickness been taken and properly documented?					
Compressive strength meets specified requirements?					

SECTION 319 - OPEN-GRADED BASES

319.01 GENERAL

This work consists of constructing a permeable base course consisting of either Open-Graded Bituminous Base (OGBB) or Open-Graded Portland Cement Concrete Base (OGPCCB), and includes the following:

- Mixing aggregate and bituminous material or aggregate, portland cement, and water in a central plant, and
- Spreading and compacting the mixture on a prepared surface.

319.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

The Preconstruction Meeting agenda should include the following topics for open graded bases (OGB):

- Subgrade requirements prior to and during construction
- Proposed sources of material and material requirements
- Mix design (refer to Sections 708.04 or 319.04.C of the Standard Specifications) and verify that the asphalt or concrete plant has a current certification.
- Agree on weather parameters that will be used for "go" or "no-go" decisions both prior to and during the placement activity. The Inspector must be present for all OGB placements.
- Method and frequency of acceptance testing during any placement. Inform the Contractor what is expected if non-acceptable material is found during placement.
- Placement method and any adjustments that may be required.
- Acceptable tolerances for elevation, smoothness, width and thickness.
- Methods to be used to obtain acceptable grade and thickness - GPS alone is not adequate
- Methods to be used to minimize disturbance or damage to the previous layers
- Contractor's schedule/plan for the work
- Contract requirements for OGB including acceptable hydraulic efficiency
- Requirements for separator fabric to be used and method of placement
- Traffic restrictions on the completed OGB

B. Acceptance of Materials

1. Mix Designs

- OGBB

The Contractor must submit their proposed mix design before placement. The Materials Engineer will approve the mix design in accordance with Section 708.04.A of the Standard Specifications. As soon as practical, the Residency will obtain sufficient samples of aggregates to be utilized and perform applicable tests on these materials.

- OGPCCB

The Contractor must submit their proposed mix design before placement. The Resident Engineer will approve the mix design in accordance with Section 319.04.C of the Standard Specifications. As soon as practical, the Residency will obtain sufficient samples of aggregates to be utilized and perform applicable tests on these materials.

2. Batch Plants

The Resident Engineer will inspect and certify the proposed asphalt or concrete plant in accordance with Section 411.03.A or 414.03.A, respectively, of the Standard Specifications and will submit this information to the Materials Division. If a portable plant is mobilized to the Project, the Resident Engineer must notify the Oklahoma Department of Environmental Quality (ODEQ) and the Materials Division. The purpose of such notice is to ensure that the plant(s) are properly permitted and inspected for emissions by ODEQ, and that they are accurately tracked within ODOT's databases. When a plant is being installed to produce for a Project in your Residency notify:

Oklahoma Department of Environmental Quality
Air Quality Division
P.O. Box 1677
Oklahoma City, OK 73101-1677
Phone: (405) 702-4100
Fax: (405) 702-4101

and

Oklahoma Department of Transportation
Materials Division
Independent Assurance Branch
200 N. E. 21st Street
Oklahoma City, OK 73105
Phone: (405) 521-2677
Fax: (405) 522-0552

In the notice, list the project number and the location and type of plant (asphalt or concrete).

3. Sources of Materials

The Contractor will submit the proposed sources of materials. The Residency will verify that the proposed sources of materials are on the Approved Products List (APL). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. Verify the APL for the following:

- OGBB
    - Asphalt cement (specify type) (APL – Bituminous Materials)
    - Aggregates (Section 708.02 of the Standard Specifications) (APL - Aggregates)
- OGPCCB
    - Portland cement (specify type) (APL – Hydraulic Cements)
    - Supplementary Cementitious Materials (specify type) (APL – Fly Ash, Silica Fume, Slag Cement)
    - Aggregates (Section 703.03 of the Standard Specifications) (APL - Aggregates)
    - The Residency will verify that the proposed water source is from an approved ODEQ public water source. If not, the Contractor must provide verification that the water source complies with the requirements of Section 701.04 of the Standard Specifications.

C. Preparatory Work and Contractor Work Plans

1. Contract Plans and Specifications

Review the Plan typical sections, specifically noting the allowable lift thickness, total required depth, and cross slope required.

Review the Standard Specifications, Special Provisions and Plan Notes.

2. Material Requirements

Review the requirements of the material being used and the related tests and acceptance criteria. Ensure that material source is approved and that other material requirements are met.

3. Equipment

Gather the necessary inspection and sampling equipment.

- OGBB

Gather the necessary inspection and sampling equipment. Be prepared to sample OGBB material, check lift thickness, total depth, and surface tolerance.

- OGPCCB

Gather the necessary inspection and sampling equipment. Verify the nuclear density gauge has a current calibration and is operating properly. Be prepared to check density, lift thickness, total depth, and surface tolerance.

4. Subgrade / Subbase Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade/subbase is processed and compacted in accordance with the appropriate Section of the Standard Specifications. Visually inspect the subgrade for soft spots, ruts, and grade deficiencies. Ensure that the subgrade/subbase is prepared within allowable tolerance to properly receive the required thickness of base course material.

Prior to placement of the open-graded base, ensure that the subgrade/subbase is not frozen, in accordance with Section 411.04.H or 319.04.C(2) of the Standard Specifications.

Check the typical section in the plans to determine whether or not there should be an underlying construction fabric, and ensure that it is installed in accordance with the appropriate Section of the Standard Specifications.

5. Staking

Spot check and verify that width and thickness have been properly staked. Ensure that the contractor has not used GPS for establishing vertical control. The vertical accuracy provided by GPS is insufficient for this type of work.

D. Safety and Environmental Issues

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, the Contractor may be required to prepare an environmental statement for the plant site and any haul roads.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

319.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

1. Mix Designs

- OGBB

Ensure that the Materials Engineer has approved the mix design in accordance with Section 708.04.A of the Standard Specifications. Any changes to the approved mix design, including substitution of material sources, must be approved by the Materials Engineer.

- OGPCCB

Ensure that the Resident Engineer has approved the mix design in accordance with Section 319.04.C of the Standard Specifications. Any changes to the approved mix design, including substitution of material sources, must be approved by the Resident Engineer.

2. Batch Plants

Ensure that the batch plant has been certified in accordance with Section 411.03.A or 414.03.A, respectively, of the Standard Specifications.

3. Sources of Materials

Ensure that the Contractor has submitted the proposed sources of materials. The Residency will verify that no changes were made from the proposed sources of materials and that they are still on the Approved Products List (APL). If a proposed source is not on the APL, the Resident must contact Materials Division immediately.

The Residency will conduct the sampling and testing described below in accordance with the frequency guidelines defined in the FAST Guide project's Sampling and Testing Checklist generated by SiteManager for the appropriate items. The frequencies may be modified by the Residency personnel. Typical reasons for revising the frequencies would be consistency or inconsistency of the material being produced, size and frequency of placements, or visual appearance.

Document or perform applicable tests as follows:

- OGBB
    - Asphalt cement (specify type) (APL – Bituminous Materials) [Document in Template AM5001].

- Aggregates (Section 708.02 of the Standard Specifications) (APL - Aggregates) – sample and test for appropriate gradation AASHTO T11 and T27 [Document in Template T27].

- OGPCCB

  - Portland cement (specify type) (APL – Hydraulic Cements) [Document in Template AM5001].
  - Supplementary Cementitious Materials (specify type) (APL – Fly Ash, Silica Fume, Slag Cement) [Document in Template AM5001].
  - Aggregate (Section 703.03 of the Standard Specifications) (APL - Aggregates) – sample and test for appropriate gradation AASHTO T11 and T27 [Document in Template T27].
  - The Residency will verify that the proposed water source is from an approved ODEQ public water source. If not, the Contractor must provide verification that the water source complies with the requirements of Section 701.04 of the Standard Specifications.
  - The Residency will sample and test fresh OGPCCB for the following:
    - Density (unit weight) – AASHTO T 121
    - Compaction of base - AASHTO T 310. [Document in Template C95001]

B. Equipment and Methods

The contractor's equipment and operations must produce an open-graded base material which meets the requirements of the contract specifications. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the contractor to take corrective action. Notify the contractor of any equipment or operation that is an apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

Ensure the batching plant includes bins, weighing hoppers, and scales for each size of aggregate. Ensure that all gauges and dials function properly. The contractor must provide the Department documented evidence that the batch plant produces a quality open-graded base. It is the Residency's responsibility to inspect the plants every six months or after every move. Inspection of the plant by another Residency is acceptable if less than six months old. The contractor must provide the Residency with certification of the plant's scales every six months or after every move.

1. OGBB

Typically, all of the equipment and methods used for production and placement of the OGBB will be the same as is used for hot mix asphalt pavement. Ensure the contractor uses equipment for producing, heating, mixing, hauling, spreading,

compacting, and finishing the OGBB in accordance with Section 411.03 of the Standard Specifications.

The compaction of the OGBB is to be accomplished in accordance with Section 406.04.I of the Standard Specifications, which states that immediately after placement, roll the surface with two or three passes with a non-vibratory, steel-wheeled, self-propelled roller.

2. OGPCCB

Typically, all of the equipment and methods used for production and placement of the OGPCB will be the same as is used for portland cement concrete pavement. Ensure the contractor uses equipment for producing, mixing, hauling, spreading, compacting, and finishing the OGPCCB in accordance with Section 301.03 and Section 414.03 of the Standard Specifications.

The compaction of the OGPCCB is to be accomplished in accordance with Section 319.04.C(4) of the Standard Specifications, which states that the contractor is to consolidate the mixture using vibratory equipment during lay-down operations.

C. Construction Operations

1. Placement

Typically, the OGB material is placed on top of a separator fabric to reduce the potential of "fines" from the underlying subgrade from clogging the OGB and reducing its hydraulic efficiency. Prior to placement of the separator fabric, the subgrade must be thoroughly compacted and shall conform to the required cross-section and grade. Ensure that the subgrade is in compliance with Section 307, 310 or 311 of the Standard Specifications as required by the contract. Ensure the separator fabric has been installed in accordance with Section 325 of the Standard Specifications.

The OGBB may only be placed when the surface temperature of the underlying fabric is at least 40 °F, in accordance with Section 411.04.H of the Standard Specifications. The OGPCCB may only be mixed when the aggregate and subgrade are not frozen, and when the ambient air temperature is at least 40 °F and rising.

Ensure suitable haul vehicles are provided to make certain that the mixture arrives at the point of deposit without segregation of the material, and without excessive temperature loss for OGBB or excessive moisture loss for OGPCCB. Covers shall be provided when deemed necessary by the Resident Engineer. The spreading equipment should be ready to receive and lay the mixture as rapidly as possible.

2. Spreading

During the spreading operation ensure the following:

- The mixed OGB materials are transported to the roadbed and placed using equipment that combines placement and initial compaction, such as an asphalt lay-down machine for OGBB or a P.C. concrete paver for OGPCCB.
- The OGB material is placed in a single layer as defined in the typical section of the plans.
- The compacted layer is finished to the grades, elevations, and thicknesses shown on the Plans.
- Any segregated areas are corrected at no additional cost to the Department.
- Longitudinal joints shall be butt or sawed and must match the longitudinal joint between the driving lanes of the overlying pavement.
- Placement procedures or equipment are adjusted to ensure compliance with the Contract requirements.

3. Compaction and Hydraulic Efficiency

The compaction of the OGBB is to be accomplished in accordance with Section 406.04.I of the Standard Specifications, which states that immediately after placement roll the surface with two or three passes with a non-vibratory, steel-wheeled, self-propelled roller. There is no minimum percent of compaction required for the OGBB.

The compaction of the OGPCCB is to be accomplished in accordance with Section 319.04.C(4) of the Standard Specifications, which states that the contractor is to consolidate the mixture using vibratory equipment during lay-down operations to achieve at least 95 percent of density (unit weight) as determined in accordance with AASHTO T 121. Measure the consolidation of the finished OGPCCB from 15 to 30 minutes after placement and consolidation using a nuclear density gauge in accordance with AASHTO T 310.

Perform hydraulic efficiency tests to verify the material, placement and compaction methods will obtain acceptable results. The hydraulic efficiency is defined in Section 319.04.A(3) of the Standard Specifications as 1 quart of water being absorbed into the base surface with no remaining standing water 15 seconds after pouring. Do not place the overlying pavement until achieving acceptable hydraulic efficiency within 24 hours of placing the overlying pavement. The contractor must remove and replace OGB that fails to achieve acceptable hydraulic efficiency as directed by the Resident Engineer, at no additional cost to the Department.

4. Finishing and Tolerances

To a great extent the riding surface of the completed pavement is dependent on the base surface upon which it is laid. Since smoothness of the pavement is one of the qualities most desired by the road users, the Resident Engineer should be satisfied that every means possible has been expended to obtain a finished base course having a cross-section true to line and grade within the specified tolerance.

Ensure that the OGB is finished to the tolerances indicated in Section 301.04.A of the Standard Specifications:

(a) Surface Elevation and Smoothness

- Elevations are within ½ in of the elevations shown on the Plans.
- Smoothness is within ½ inch in 10 ft. Test for surface smoothness by placing a 10 ft straightedge between any two contacts on the finished surface and measuring the distance from the surface to the straightedge. Any visible areas of concern (such as transverse butt joints) should be checked with the straightedge in addition to random spot-checking for conformance.

(b) Width and Thickness

- Width must meet the minimum width shown on the Plans or as directed by the Resident Engineer.
- Average job thickness is within ¼ in of the thickness shown on the Plans. The Resident Engineer will determine the average job thickness by measuring the completed thickness at intervals of no more than 1,000 ft in each driving lane. For individual measurements that exceed the plan thickness by more than ½ in, the Resident Engineer will use the Plan thickness plus ½ in. For individual measurements of thickness that measure less than the Plan thickness by more than ½ in, the Resident Engineer should contact the Pavement Design Engineer.

Ensure the contractor places the OGB to the required elevation and thickness. It is not permissible to raise the OGB by placing another layer of mixture on previously compacted OGB, because additional layers will not adhere and will form planes of weakness. Trimming of the OGB is highly discouraged due to the potential for "fines" from the trimming operation clogging the OGB and reducing its hydraulic efficiency. Prior to allowing any trimming, contact the Pavement Design Engineer to discuss alternatives.

A string line is an effective tool to use in checking the grade and cross-section of the compacted base in conjunction with survey checks before/after the base is placed. The subgrade and the finished elevation of the base should be within tolerance as specified in 301.04.A. (If the base elevation is low, then the difference will likely be made up with a thicker concrete pavement on top of it. And if the base elevation is high and the resulting concrete pavement Is thin, the pay deduction would result.) If there is reason to believe there might be a problem with the thickness of the base, a test pit requiring excavation of the plastic material by use of auger, pick, chisel and/or shovel may be used for confirmation of the thickness.

Survey checks before/after the base is placed or thickness measurements shall be made and recorded following final compaction, trimming (if required) and prior to placing any succeeding courses.

5. Curing Period and Traffic Restrictions

Limit construction traffic on the OGB to that necessary to apply separator fabric (when required) and overlying pavement. Do not allow the OGB layer to be used as a haul road. The overlying pavement may not be placed on the OGB until after the applicable curing requirements are met. Any damage to the OGB must be repaired at no additional cost to the Department.

- OGBB

  Do not allow construction traffic on the OGBB until the OGBB has cooled overnight and do not allow placement of the overlying pavement on the OGBB until the curing period is complete. Although the curing period is not clearly defined, Section 411.04.M of the Standard Specifications states *" Do not allow traffic on the pavement until after final rolling and the pavement has cooled sufficiently to ensure traffic will not damage the pavement surface. Use water or other artificial means to assist in cooling, as approved by the Resident Engineer."* When placing the overlying pavement, ensure the contractor's trucks do not damage the OGBB, and that no soil, mud or other materials are tracked that would compromise its hydraulic efficiency.

- OGPCCB

  Ensure the completed OGPCCB is cured by directing a fine spray of water onto the surface every 2 hours, for a period of 16 hours. The curing must begin immediately after its initial set, when water no longer removes cement paste.

  Do not allow construction traffic on the OGPCCB, except for the paver. Ensure the 3-day curing period is complete before placing pavement layers on top of the OGPCCB. Place material for succeeding layers using the side discharge method. When placing the overlying pavement, ensure the contractor's paver does not damage the OGPCCB, and that no soil, mud or other materials are tracked that would compromise its hydraulic efficiency.

D. Safety and Environmental Considerations

If the Contractor stockpiles aggregate or operates a crusher or mixer, either on or off site, ensure the Contractor has prepared any necessary environmental statements for the plant site and any haul roads. Ensure the contractor properly disposes of waste materials. Do not allow the Contractor to place CTB or other materials in streams or waterways.

The Standard Specifications require measurement of in-place field density and moisture using a nuclear density gauge according to AASHTO T 310. Because nuclear density gauges contain radioactive material, they are subject to the control and regulation of the

Nuclear Regulatory Commission (NRC). Ensure that nuclear gauge operators are NRC-certified and follow safety procedures regarding handling, storage, and use of the device.

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Area of completed open-graded base course
- Compaction densities

2. Measurement and Payment

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

319.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

1. OGBB

None required.

2. OGPCCB

Ensure that the "final" density requirement for the OGPCCB has been satisfied.

Perform applicable tests on this material to determine:

- Compaction of base: AASHTO T 310. [Document in Template C95001].

Ensure that the separator fabric has been properly applied.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Limit construction traffic on the OGB to that necessary to apply separator fabric (when required) and overlying pavement. Do not allow the OGB layer to be used as a haul road. The overlying pavement may not be placed on the OGB until after the applicable curing requirements are met. Any damage to the OGB must be repaired at no additional cost to the Department.

Perform a hydraulic efficiency test 24 hours before placing the overlying pavement. Do not place the overlying pavement until achieving acceptable hydraulic efficiency. This is defined as 1 quart of water being absorbed into the base surface with no remaining standing water 15 seconds after pouring. The contractor must remove and replace OGB that fails to achieve acceptable hydraulic efficiency as directed by the Resident Engineer, at no additional cost to the Department.

319 CHECKLIST - OPEN GRADED BASES

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted mix design and sources of materials?					
The Resident Engineer has inspected and certified the Contractor's proposed concrete plant.					
Portable plants have been properly permitted and inspected, as applicable.					
If material is from an approved quarry, have samples been taken and appropriate tests performed?					
If material is from other than an approved quarry, have samples been taken and submitted to Materials Division?					
Have placement procedures been discussed with contractor?					
Has the proper inspection and sampling equipment been gathered?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
OGBB - Is the surface temperature of the separator fabric at least 40 degrees F? OGPCCB – Is the ambient temperature at least 40 degrees F and rising?					
Does contractor have the proper placing and paving equipment on the project?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the OGB being placed uniformly and without segregation?					
Is subgrade and/or separator fabric integrity being maintained?					
Have the proper number of quality assurance samples and tests been performed?					
Is the OGB being finished to the dimensions, slope and elevation tolerances specified?					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
OGBB – was OGBB allowed to cool overnight prior to allowing construction traffic or beginning paving? OGPCCB – was the OGPCCB allowed to cure 3 days prior to paving?					
OGPCCB - Was the water cure by a fine spray applied to the surface every 2 hours for the first 16 hours?					
Is contractor protecting the OGB from soil, mud or other materials prior to placement of the overlying pavement?					
Has the OGB been used as a haul road?					
Have all necessary measurements for length, width and thickness been taken and properly documented?					
OGPCCB – Have all final densities been taken?					
Has the hydraulic efficiency tests been performed?					

SECTION 325 - SEPARATOR FABRIC FOR BASES

325.01 GENERAL

This work consists of installing a separator fabric for bases.

325.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed source of material and material requirements
- Subgrade requirements prior to and during construction
- Contractor's schedule/plan for the work
- Contract requirements for separator fabric
- Weather limitations (wind)
- Proper geotextile storage requirements
- Required overlaps

B. Acceptance of Materials

The Contractor will submit their proposed source of materials. The Residency will verify that the proposed fabric is on the Approved Products List (APL). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. Verify the APL for the following:

- Separator Fabric (APL – Construction Fabrics)

The contractor must provide a separator fabric in accordance with Section 712.05 of the Standard Specifications. The fabric must meet the requirements of AASHTO M288 with a Class 2 Degree of Survivability. If the fabric is not on the APL, a sample of the proposed fabric and the manufacturer's AASHTO NTPEP test data must be obtained and submitted to Materials Division for testing and approval as soon as possible.

C. Preparatory Work and Contractor Work Plans

1. Shipping and Storage Requirements

Geotextiles are delivered in rolls covered with a protective wrapping. Labels on the outside of the wrapping of each roll identify the manufacturer, style name, roll number, lot or batch number, and the roll dimensions. For the material delivered to and used on the project, verify no changes were made from the proposed sources and that the fabric is still on the APL. Make sure that the Contractor maintains the protective wrapping during shipment and storage, and elevates the geotextile off of the ground during storage to protect from:

- site construction damage;
- precipitation;
- immersion in standing water;
- ultraviolet radiation, including sunlight;
- chemicals, especially strong acids or bases;
- flames, including welding sparks;
- temperatures in excess of 160 °F; and
- any environmental condition that may damage the physical properties of the geotextile.

2. Subgrade Inspection

Ensure that the cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the subgrade for soft spots, ruts, grade deficiencies or obstructions that could damage the fabric.

D. Safety and Environmental Issues

Discuss with the Contractor their plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction
- Properly disposing of waste fabric and wrapping

325.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Ensure the Contractor has submitted their proposed source of materials. As the material is delivered to the project inspect the rolls, labels and shipping record to ensure that the material being used is the same as the contractor proposed and is still on the Approved Products List (APL). If the material being delivered is not on the APL, the Resident Engineer must contact Materials Division immediately.

Document or perform applicable tests as follows:

- Separator Fabric (APL – Construction Fabrics) [Document in Template AM5001].

B. Equipment and Methods

The Contractor must provide equipment which is capable of placing the fabric smooth, straight, and free of wrinkles at the locations shown on the plans. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the Contractor to take corrective action. Notify the Contractor of any equipment or operation that is an

apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

C. Construction Operations

1. Storage

The protective wrapping must not be removed from the geotextile roll prior to placement. If the Contractor intends to leave geotextiles unrolled without their protective covering for more than 14 days, then direct the Contractor to take measures to ensure no damage or degradation occurs to the material.

2. Installation

Ensure that the fabric is placed smooth, straight, and free of wrinkles at the locations shown on the plans, and there are no voids between the fabric and the subgrade. Verify that the contractor overlaps each transverse and longitudinal joint of the fabric at least 17 inches, and that the fabric is placed so that the preceding roll overlaps the following roll in the direction the base material is being spread.

To accommodate curves in the roadway alignment, the fabric should be cut and overlapped diagonally to prevent excessive wrinkling. Verify the overlaps are in accordance with the requirements below

The fabric must be covered with the required base material on the same day it is placed. At least 4 inches of the base material must be placed over the fabric by end dumping, and all ruts in the base material must be filled and compacted. Construction vehicles will not be allowed directly on the geotextile.

Any damaged fabric must be repaired at no additional cost to the Department. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area.

3. Weather Limitations

If windy conditions disturb the fabric, ensure the contractor secures it with large nails and washers, or with base material. Ensure that stakes or anchors do not restrict the movement of the fabric during the placement of the base material.

D. Safety and Environmental Considerations

Ensure the Contractor protects workers and traffic during construction. At a minimum, the Contractor should be:

- Providing traffic control during construction
- Properly disposing of waste fabric and wrapping

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of area of separator fabric installed
- Receipt of material certificates

2. Measurement and Payment

The final quantity for the Separator Fabric pay item will be determined by the method defined in Section 325.05 of the Standard Specifications. The area of the fabric will be measured upon placement as depicted on the typical section shown on the Plans. The overlaps required for the proper placement of the fabric will not be measured for payment and are incidental to the work.

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the Separator Fabric pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

325.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

None required.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted

and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Ensure that the Contractor takes care to prevent damage to the geotextile before the base material is placed. Prior to covering, the geotextile shall be inspected to ensure that the geotextile has not been damaged (i.e., holes, tears, rips) during installation. Any damaged fabric must be repaired at no additional cost to the Department. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area.

The fabric must be covered with the required base material on the same day it is placed. At least 4 inches of the base material must be placed over the fabric by end dumping, and all ruts in the base material must be filled and compacted. Construction vehicles will not be allowed directly on the geotextile.

325 CHECKLIST - SEPARATOR FABRIC FOR BASES

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade been completed to required specifications and inspected for deficiencies?					
Has contractor submitted source of materials?					
Is the separator fabric on the APL?					
If separator fabric is not on the APL, have samples been taken and submitted to Materials Division?					
Discussed storage requirements?					
Discussed placement procedures with contractor?					
Inspection and sampling equipment gathered?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the separator fabric delivered to and used on the project the same as was approved?					
Is the protective wrapping being maintained, and are the rolls being stored properly?					
Is the subgrade ready for placement of the fabric?					
Does contractor have the proper equipment on the project?					
Is separator fabric being placed smooth, straight, free of wrinkles and in direct contact with the subgrade?					
Is the contractor maintaining the proper overlap?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is subgrade and separator fabric integrity being maintained? No construction vehicles are allowed on the fabric.					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the mat in complete contact with the underlying subgrade?					
Have any damaged areas been properly patched?					
Is the contractor end dumping at least 4 inches of base material on the fabric the same day it is placed?					
Are stakes/anchors restricting the movement of the fabric during the placement of the base material?					
Are all ruts being filled and the required compaction being achieved on the base material?					
Have all necessary measurements for length and width been taken and properly documented?					

SECTION 326 - GEOSYNTHETIC REINFORCEMENT

326.01 GENERAL

This work consists of installing geosynthetic reinforcement material beneath the aggregate base layer in the pavement structure, or beneath the roadway embankment. This includes the use of geogrids and geotextiles.

326.02 PRECONSTRUCTION CONSIDERATIONS

A. Preconstruction Meeting

Discuss the following at the Preconstruction Meeting:

- Proposed source of material and material requirements
- Application for geosynthetic use (support of the embankment or the pavement structure) and preparatory requirements prior to and during construction
- Contractor's schedule/plan for the work
- Contract requirements for geosynthetic material
- Weather limitations (wind)
- Proper geosynthetic material storage requirements
- Required overlaps

B. Acceptance of Materials

The Contractor will submit their proposed source of materials. The Residency will verify that the proposed geosynthetic material is on the Approved Products List (APL). If a proposed source is not on the APL, the Resident Engineer must contact Materials Division immediately. Verify the APL for the following:

- Geogrid Products (APL – Construction Fabrics)

  Provide a geogrid subgrade reinforcement in accordance with Section 712.07 of the Standard Specifications. The material must meet the requirements of Table 712:1 or Table 712:2 in this section.

  Geogrid is a continuous sheet of net-shaped synthetic material formed by tensile elements that reinforce soil and rock by interlocking.

- Geotextile Fabric (APL – Construction Fabrics)

  Provide geotextiles in accordance with Section 712.04 of the Standard Specifications.

  Geotextile is made of synthetic fibers manufactured in a woven or loose nonwoven manner to form a blanket-like product used to reinforce soil and rock.

C. Preparatory Work and Contractor Work Plans

1. Shipping and Storage Requirements

Geosynthetic materials are delivered in rolls covered with a protective wrapping. Labels on the outside of the wrapping of each roll identify the manufacturer, style name, roll number, lot or batch number, and the roll dimensions. For the material delivered to and used on the project, verify no changes were made from the proposed sources and that the fabric is still on the APL. Make sure that the Contractor maintains the protective wrapping during shipment and storage, and elevates the geosynthetic off of the ground during storage to protect from:

- site construction damage;
- precipitation;
- immersion in standing water;
- ultraviolet radiation, including sunlight;
- chemicals, especially strong acids or bases;
- flames, including welding sparks;
- temperatures in excess of 160 °F; and
- any environmental condition that may damage the physical properties of the geosynthetic.

2. Inspection Prior to Placing Geosynthetic

Geosynthetic reinforcement material may be placed beneath the aggregate base layer in the pavement structure, or beneath the roadway embankment.

For use in the pavement structure, ensure that the subgrade cross slope, elevation, and alignment are correct and the subgrade is processed and compacted in accordance with Section 310 of the Standard Specifications, unless otherwise specified in the contract. Visually inspect the subgrade for soft spots, ruts, grade deficiencies or obstructions that could damage the fabric.

For use beneath the roadway embankment, ensure the contractor has cleared the site of topsoil, trees, stumps, rocks, and large debris in accordance with Section 201 of the Standard Specifications. While the site conditions may not allow the contractor to clear the ground completely (i.e. swampy or unstable), it is important to make every effort to at least provide a relatively smooth surface.

D. Safety and Environmental Issues

Discuss with the Contractor their plan to protect workers and traffic during construction. At a minimum, the Contractor's plan should address the following:

- Providing traffic control during construction
- Properly disposing of waste geosynthetic and wrapping

326.03 INSPECTION GUIDELINES DURING CONSTRUCTION

A. Acceptance of Materials

Ensure the Contractor has submitted their proposed source of materials. As the material is delivered to the project inspect the rolls, labels and shipping record to ensure that the material being used is the same as the contractor proposed and is still on the APL. If the material being delivered is not on the APL, the Resident Engineer must contact Materials Division immediately.

Document or perform applicable tests as follows:

- Geogrid Products (APL – Construction Fabrics) [Document in Template AM5001].
- Geotextile Fabric (APL – Construction Fabrics) [Document in Template AM5001].

B. Equipment and Methods

The Contractor must provide equipment which is capable of placing the geosynthetic at the locations shown on the plans in a manner which is smooth, straight, and free of wrinkles. Visually inspect any equipment that does not appear to be performing satisfactorily and inform the Contractor to take corrective action. Notify the Contractor of any equipment or operation that is an apparent or obvious safety violation. Do not prohibit a method of operation as long as it is reasonable and consistent with good construction practices and does not violate the specifications.

C. Construction Operations

1. Storage

The protective wrapping must not be removed from the geosynthetic roll prior to placement. If the Contractor intends to leave geosynthetics unrolled without their protective covering for more than 14 days, then direct the Contractor to take measures to ensure no damage or degradation occurs to the material.

2. Installation

(a) General

On the first full day of geosynthetic installation, ensure the geosynthetic manufacturer or a representative is present to observe and advise the contractor on proper handling and installation.

Ensure the contractor performs the following:

- Place the geosynthetic in the direction of the construction traffic. This will allow for the proper placement of the overlying embankment and will minimize separation of the laps.

- Tension the geosynthetic by hand and secure to the ground as directed by the Resident Engineer. Typically this will be along the edges and in the center of the roll at a maximum of 30 feet intervals. Ensure that stakes or anchors do not restrict the movement of the fabric during the placement of the base material.
- The geosynthetic is placed smooth, straight, and free of wrinkles at the locations shown on the plans, and there are no voids between the geosynthetic and the subgrade.
- The overlapping sections of the geosynthetic do not separate during the placement of fill.
- To accommodate curves in the roadway alignment, the geosynthetic may be cut and overlapped diagonally to prevent excessive wrinkling. Verify the overlaps are in accordance with the requirements below.
- Secure overlap areas with small piles of fill material, pins with washers, or large, heavy-gauge staples driven securely into the subgrade.
- Do not operate tracked construction equipment directly on the geosynthetic.
- Any damaged fabric must be repaired at no additional cost to the Department. Cover the damaged area with a geosynthetic patch that extends an amount equal to the required overlap beyond the damaged area.
- If it is necessary to drive on the geosynthetic, only allow rubber-tired equipment operating at speeds no greater than 5 mph, if the underlying subgrade can support the loads without rutting and the tires do not damage or wrinkle the geosynthetic.
- Place a layer of fill material with a thickness of at least 8 inches over the geosynthetic before operating tracked vehicles on the geosynthetic. To avoid excessive "point" loading which could deform the underlying subgrade and damage the geosynthetic, the fill material should be spread with a tracked vehicle, such as a dozer.
- Avoid sudden braking or sharp turning when operating equipment on the geosynthetic.

(b) Placement in the Pavement Section

Ensure the geosynthetic is placed at the elevation and alignment shown on the Plans and parallel to the centerline of the roadway. The geosynthetic should be unrolled in the direction of the fill operation. Do not allow the geosynthetic to be placed more than 500 feet ahead of the aggregate base placement.

The aggregate base material must be end-dumped directly onto the geosynthetic or on the previously placed aggregate base and bladed onto the

geosynthetic so that the aggregate base rolls onto the material ahead (e.g. by gradually raising a dozer blade while moving forward).

Ensure that the contractor fills ruts in the aggregate base with additional aggregate base material; do not blade adjacent material to fill ruts.

Verify that at least 8 inches of aggregate base material has been placed over the geosynthetic.

(c) Placement under Roadway Embankment

Ensure the geosynthetic is placed at the location shown on the Plans and perpendicular to the centerline of the roadway

The contractor must end dump fill material onto the geosynthetic or on the previously placed fill. The fill material must be placed on the geosynthetic so that the fill rolls onto the material ahead (e.g. by gradually raising a dozer blade while moving forward).

Verify that at least 8 inches of fill material has been placed over the geosynthetic.

(d) Geotextile

Ensure that the fabric is placed such that there are no voids between the fabric and the underlying material. Verify that the fabric is placed so that the preceding roll overlaps the following roll in the direction the fill material is being spread.

Verify that the contractor overlaps the roll ends at least 3 feet. The overlap of longitudinal joints of adjacent rolls will vary, depending upon the stability of the material it is being placed on. The minimum overlap of longitudinal joints will be at least 17 inches for a material that is stable. For instances where the material is unstable, the overlap will be as much as 3 feet or sewn. The following table is from the geosynthetic industry and can be used to estimate California Bearing Ratio (CBR) values for determining minimum overlaps as required by AASHTO M 288:

Overlap Requirements		
CBR	Visual Observation	Minimum Overlap
Greater than 3	Loaded dump truck ruts less than 3 inches	17 inches
1 to 3	Pickup truck ruts less than 1 inch	2 to 3 feet
0.5 to 1	Man walking sinks less than 3 inches	3 feet or sewn
Less than 0.5	Man walking sinks more than 3 inches	Sewn

The fabric must be covered with the required base material on the same day it is placed. At least 8 inches of the base material must be placed over the fabric by end dumping, and all ruts in the base material must be filled and compacted. Construction vehicles will not be allowed directly on the geotextile.

Any damaged fabric must be repaired at no additional cost to the Department. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area.

(e) Geogrid

Ensure that the geogrid is placed such that there are no voids between the geogrid and the underlying material. Verify that the geogrid is placed so that the preceding roll overlaps the following roll in the direction the fill material is being spread.

Ensure that the geogrid is kept smooth and taut while placing the cover material and that the stakes or anchors do not restrict the movement of the geogrid. To overly restrict the longitudinal movement of the geogrid will result in excessive wrinkles and voids between the geogrid and the underlying material.

Ensure the geogrid sections do not separate at overlaps during placement of cover material. To accommodate curves in the roadway alignment, the geogrid may be cut and overlapped diagonally to prevent excessive wrinkling. Verify the overlaps are in accordance with the requirements below.

Verify the contractor overlaps adjacent rolls of geogrid 3 feet in each direction (longitudinal and transverse) and ties adjacent rolls with hog rings

or cable ties at intervals of 5 feet or less. The geogrid corners must be secured with fill material.

Do not allow the contractor to operate equipment directly on geogrid placed on soft ground. For normal soil conditions, the fill material may be dumped directly onto the geogrid. For softer soil conditions, the fill material should be dumped on previously placed fill that will bear the weight of the fill material and push the fill over the geogrid.

When placing fill on the subgrade, the contractor should work from areas of stronger soil conditions to areas of weaker soil conditions. For very soft soil conditions, a lightweight, low ground-pressure dozer should be used to place fill as directed by the Resident Engineer.

For most soil conditions, the fill material should be compacted with a light roller and at the proper moisture content. For very soft soil conditions, the contractor should use static rather than vibratory compaction. If rutting or severe pumping occurs under equipment, add fill to strengthen or bridge the section.

3. Weather Limitations

If windy conditions disturb the geosynthetic, ensure the contractor secures it with large nails and washers, or with fill / base material.

D. Safety and Environmental Considerations

Ensure the Contractor protects workers and traffic during construction. At a minimum, the Contractor should be:

- Providing traffic control during construction
- Properly disposing of waste geosynthetic and wrapping

E. Documentation

1. Daily Work Report

Record the following information, as appropriate:

- Length (station extents) and width of area of geosynthetic reinforcement installed
- Receipt of material certificates

2. Measurement and Payment

The final quantity for this pay item will be determined by the method defined in Section 326.05 of the Standard Specifications. The area of the geosynthetic reinforcement will be measured upon placement as depicted on the typical section

shown on the Plans. The overlaps required for the proper placement of the geosynthetic will not be measured for payment and are incidental to the work.

Document these items within the SiteManager / Daily Work Reports / Work Items tab in accordance with the steps listed below.

a. Select the appropriate pay item from the list of contract pay items.

b. In the appropriate fields, enter both a descriptive location and the station-to-station extents.

c. In the Placed Quantity field, enter the calculated quantity (SY) of the item completed.

d. In the Remarks bubble, document the option used for calculating the quantity for each item and provide the physical location (Folder #, Envelope #, File, etc.) of the supporting documentation for the quantities shown.

e. For additional areas or additional locations with different dimensions, select the 'New' button to create a new row for the selected pay item.

326.04 POST-CONSTRUCTION CONSIDERATIONS

A. Acceptance of Materials

None required.

B. Audit Requirements

When pay items are Pay Plan Quantity, no calculations will be required. Authorized deviations from plan quantity must be documented by a change order.

Utilize the Contract Item Work Report within SiteManager to verify that correct quantities have been placed and paid. Compare the Contract Item Work Report with the documentation provided for each pay item to verify the accuracy of the quantities submitted and to ensure that no features or gaps in the extents of the work were omitted or duplicated. If the basis of payment is Plan Quantity, ensure that the total quantities paid equals the plan quantity.

C. Protection of the Work

Ensure that the Contractor takes care to prevent damage to the geosynthetic before the fill material is placed. Prior to covering, the geosynthetic shall be inspected to ensure that the geosynthetic has not been damaged (i.e., holes, tears, rips) during installation. Any damaged geosynthetic must be repaired at no additional cost to the Department. Cover the damaged area with a geosynthetic patch that extends an amount equal to the required overlap beyond the damaged area.

The geosynthetic must be covered with the required fill material on the same day it is placed. At least 8 inches of the fill material must be placed over the fabric by end dumping, and all ruts in the fill material must be filled and compacted. Construction vehicles will not be allowed directly on the geosynthetic.

326 CHECKLIST - GEOSYNTHETIC SUBGRADE REINFORCEMENT

Part 1: Preconstruction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Has the subgrade / site been completed to required specifications and inspected for deficiencies?					
Has contractor submitted source of materials?					
Is the geosynthetic on the APL?					
If geosynthetic is not on the APL, have samples been taken and submitted to Materials Division?					
Discussed storage requirements?					
Discussed placement procedures with contractor?					
Inspection and sampling equipment gathered?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the geosynthetic delivered to and used on the project the same as was approved?					
Is the protective wrapping being maintained, and are the rolls being stored properly?					
Is the subgrade / site ready for placement of the geosynthetic?					
Does contractor have the proper equipment on the project?					
Is geosynthetic being placed smooth, straight, free of wrinkles and in direct contact with the underlying material?					
Is the contractor maintaining the proper overlap?					

Part 2: During Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is subgrade / site and geosynthetic integrity being maintained? No construction vehicles are allowed on the geosynthetic.					

Part 3: Post-Construction					
Issue	**Yes**	**No**	**N/A**	**Comments**	**Initials**
Is the geosynthetic in complete contact with the underlying subgrade?					
Have any damaged areas been properly patched?					
Is the contractor end dumping at least 8 inches of fill material on the geosynthetic the same day it is placed?					
Are stakes/anchors restricting the movement of the fabric during the placement of the base material?					
Are all ruts being filled and the required compaction being achieved on the fill material?					
Have all necessary measurements for length and width been taken and properly documented?					